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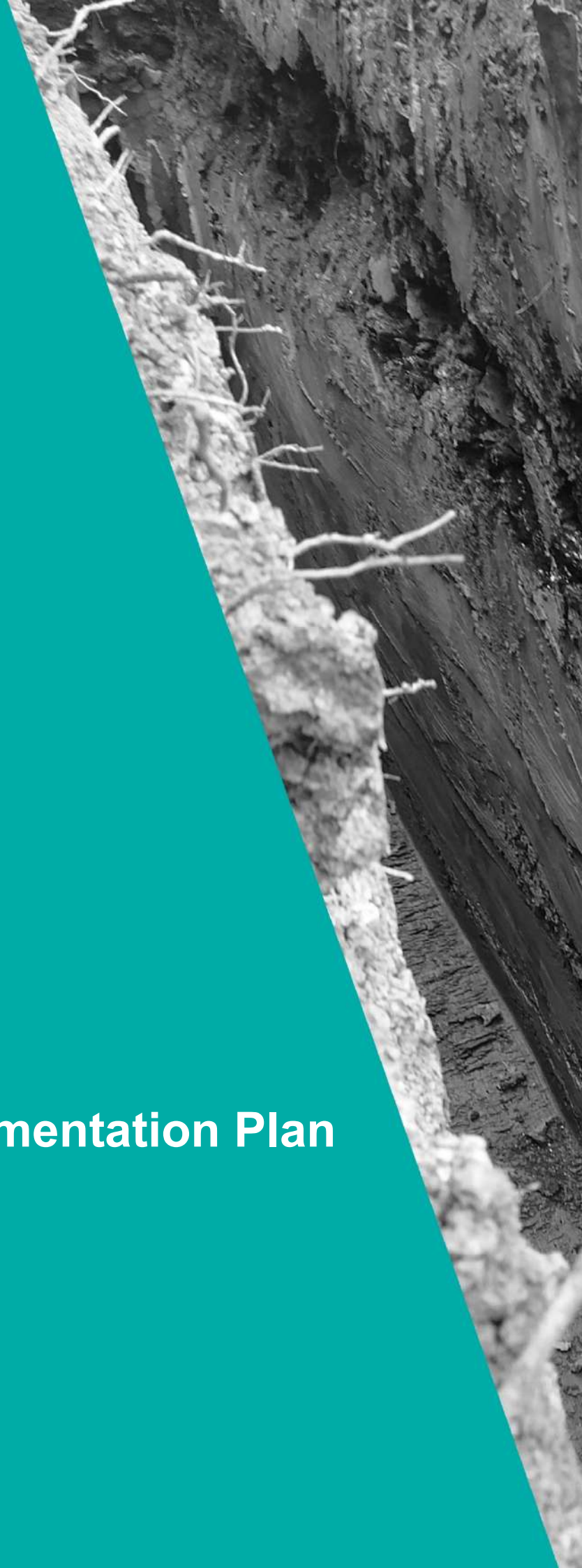

Remediation Implementation Plan

SHEFFIELD ROAD, PENISTONE

JAGUAR ESTATES

3 JANUARY 2024

Eastwood
CONSULTING ENGINEERS

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REMEDIATION IMPLEMENTATION PLAN

SHEFFIELD ROAD
PENISTONE

FOR

JAGUAR ESTATES

38586-006 **3 January 2024**

REMEDIATION IMPLEMENTATION PLAN

SHEFFIELD ROAD
PENISTONE

FOR

JAGUAR ESTATES

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1.0 INTRODUCTION

This Implementation Plan has been produced by Eastwood Consulting Engineers Limited, on behalf of Jaguar Estates, for the site at Sheffield Road, Penistone. The purpose of this document is to detail the procedure for the implementation and subsequent verification of remedial works to deal with contamination found within the ground at the site.

This is to ensure that upon completion of the proposed residential development, the site can be shown to be suitable for its intended use and that it will not pose unacceptable risks to future receptors. This therefore covers the protective measures to be installed during the construction phases of the redevelopment for a residential end use.

This document is a working publication and may need to be updated, in agreement with the relevant regulatory bodies, at any stage during development dependent on what is encountered. This document is also subject to the approval of the regulatory parties; the Local Authority and your warranty provider. This version constitutes Issue 1. Please contact Eastwood Consulting Engineers if you are unsure of the current issue.

2.0 RATIONALE FOR REMEDIAL WORKS

Eastwood Consulting Engineers (then Eastwood & Partners) previously produced a phase 2 'Geotechnical and Geo-environmental Site Investigation Report', reference CAT/RAN/KLG/38586-001 dated 24 July 2015. This investigation comprised;

- Eleven trial pits to between 1 and 2.65 m below ground level (bgl)
- Four infiltration tests

WSP Environmental Ltd also previously produced a 'Phase 1 Environmental Audit' reference 201101m/3185(1), dated December 2000.

These reports are therefore to be read in conjunction with this Implementation Plan.

The Site

The approximately one-hectare site is located to the rear of the properties on the north east of Sheffield Road, in Penistone, around 20 km north west of Sheffield, and is centred around grid reference 425480, 403280.

The site slopes down to the north east with the south western boundary at around 200 m AOD and the north eastern boundary at around 190 m AOD.

At the time of the previous site investigation the site comprised predominantly open land containing rough vegetation and scattered small trees. Two commercial buildings were present in the southern corner, with associated hardstanding however we understand these have been demolished. Macadam hardstanding used as a parking area by local residents was located in the south west of the site. The north western corner of the site was grass-covered but understood to be utilised by the Cricket Club for parking.

The site is bounded by a track to the north west; the River Don to the north; woodland with a stream and industrial buildings beyond to the majority of the eastern boundary and a track to the southern part of the eastern boundary; with housing with associated gardens to the south west. The boundaries are marked by fences, hedges or mature trees.

A culvert, orientated approximately north east to south west, crosses the south of the site around 30 m west of the southern corner. Services are also present crossing the site from the road to the building in the southern corner of the site.

It is proposed that the site will be developed with residential properties of conventional construction. It is assumed that existing ground levels will not alter significantly.

Ground Conditions

The majority of the site was recorded to be surfaced with grass over topsoil to 0.3 to 0.35 m bgl. A macadam surface covering was present in the southeast of the site surrounding the buildings and in the southwest of the site providing a residential parking area.

In the southern corner of the site made ground, comprising light grey or brown clayey gravelly sand, grey sand or black very slightly clayey sand, was encountered to depths of up to 1.3 m to the north west of the buildings and to at least 2.2 m bgl to the south of the buildings.

Any surface covering was underlain by natural ground generally comprising firm, often sandy and/or gravelly clay. Weathered sandstone, generally recovered as gravel and cobbles, was encountered from 0.45 to 2.5 m.

Groundwater seepages or inflows were not encountered in any of the exploratory holes.

No visual or olfactory evidence of contamination was noted during the investigation.

Chemical Testing Assessment

Following the site works completed by ECE in 2015 a total of four samples of topsoil, four samples of made ground and four samples of natural ground were dispatched for chemical testing. The results were then compared to the assessment criteria relating to a residential with home-grown produce end use.

Topsoil

Of the four samples of topsoil tested two samples recorded elevated concentrations of both Lead and Arsenic when compared to the residential with homegrown produce assessment values.

Following suitable risk assessment, it was determined that due to the modified mean for Lead only being slightly elevated above the assessment value and the arsenic bioavailable fraction generally being lower than the bio accessible fraction the elevated concentrations were not expected to pose significant risks to human health. The topsoil was therefore considered to be suitable for reuse on site.

Copper was found to marginally exceed its pH dependent phytotoxic assessment concentration in one sample of topsoil, however this was not considered to pose a significant risk to plant growth.

Made Ground

A number of samples of made ground recorded elevated concentrations of numerous heavy metals/metalloids and several polycyclic hydrocarbon (PAH) compounds.

Slightly elevated concentrations of petroleum hydrocarbons were also recorded within one sample of the made ground in the south of the site.

The made ground was not considered suitable for re-use within 600 mm of the surface in gardens and landscaped areas. Therefore, where made ground is present in garden and landscaped areas it should be capped with a minimum of 600 mm of clean, inert soil, including at least 150 mm of topsoil. Alternatively, the made ground can be placed below areas of hardstanding. The identified made ground is currently indicated to affect plots 1 to 4.

Natural Ground

None of the samples of natural ground tested recorded any elevated concentrations of determinants when compared to the residential with homegrown produce assessment values.

The natural ground was therefore considered suitable for reuse on site.

Tanks

Underground tank(s) are thought to be present in the southern corner of the site, relating to the former garage located in this area. These should be decommissioned and removed along with any impacted ground (and groundwater if affected) and this will need to be verified, with sampling and testing by a geo-environmental engineer.

In addition, slightly elevated concentrations of petroleum hydrocarbons were recorded within one sample of the made ground in the vicinity of the tank(s). The risks from direct contact with this material are considered to be mitigated through the use of the capping layer described above. Risks from inhalation of vapours associate with the elevated levels of petroleum hydrocarbons should be mitigated through the installation of a hydrocarbon-resistant gas membrane in the ground floor construction of plots in the vicinity of the tank(s). This is considered to affect plots 1 to 4.

Construction Materials Assessment

Based upon the results of the pH and sulphate testing undertaken a design sulphate class of DS-3 and ACEC class AC-3 are considered appropriate where concrete is in contact with the made ground. Where concrete will be contact with the natural ground only DS-1 AC-4z concrete can be utilised.

The results of the chemical testing will need to be forwarded to the water company so that appropriate water supply pipes can be selected.

Radon and Ground Gas

According to UKRadon the site is in a lower probability Radon area where less than 1% of homes are at or above the action level. Radon precautions are therefore not required.

In addition to the risk of hydrocarbon vapour discussed above, ground gas precautions are required where the depth of made ground exceeds 2 m. These will require a pre-cast concrete floor with a ventilated void below and fully lapped and sealed membrane system. The membrane should be suitably resistant to methane, carbon dioxide and hydrocarbon vapours and the installations will require independent certification. This applies to plots 1 to 4. Pre-cast concrete floors with a ventilated void beneath are also recommended for the remainder of the site as some areas of made ground may be present off site.

3.0 REMEDIATION OBJECTIVES

The remedial objectives for this site are therefore:

1. To ensure that a minimum 600 mm thickness of clean, inert, physically suitable material, including 150 mm of topsoil, is present within gardens and areas of soft landscaping where made ground remains (Plots 1 to 4);

2. To install Amber 1 gas precautions in all plots where the depth of made ground exceeds 2 m (Plots 1 to 4). Pre-cast concrete floors with a ventilated void beneath should also be utilised for the remainder of the site.

3. To ensure that appropriate sulphate precautions and water supply pipes are installed*;

4. Underground tank(s) in the southern corner of the site should be decommissioned and removed along with any impacted ground (and groundwater if affected). This should be verified, with sampling and testing by a geo-environmental engineer.

5. A hydrocarbon vapour resistant membrane should be installed in the ground floor construction of plots in the vicinity of the tanks (Plots 1 to 4).

6. Upon identification of any additional or unexpected contamination, a suitable strategy to determine any remedial action is to be in place; and

7. To reduce the risks to construction workers, they should be made aware of the presence of elevated levels of contaminants within the materials to be excavated and ensure that the requisite working practices are adhered to*.

*No further guidance with regards to this is considered necessary as part of this document.

4.0 WORKING METHOD

During the works, procedures to protect site neighbours, the environment and amenity, and to control dust, noise and odours should be put in place by the contractor, in addition to the required site health and safety procedures that apply. Control of surface runoff over areas of potentially contaminated ground should also be taken into consideration.

The procedures for implementation of the mitigation measures identified in Section 2, to ensure that the objectives detailed in Section 3 are met, are outlined in Sections 5 to 8. All remediation works are to be overseen by suitably experienced site staff. Periodic visits will be made by a suitably qualified independent consulting Engineer, to undertake the necessary verification works detailed.

5.0 CAPPING MATERIALS

5.1 Sourcing of Material

The site won topsoil and natural ground are considered suitable for re-use in the development. However, if additional material is required, this will need to be imported.

Any topsoil and subsoil considered for importation should be from a source not expected to be contaminated and meet both physical and chemical criteria as detailed in the Sections 5.2 and 5.3. Testing will need to be carried out in accordance with the guidance given in the Yorkshire and Lincolnshire Pollution Advisory Group (YALPAG) document 'Verification Requirements for Cover Systems: Technical Guidance for Developers, Landowners and Consultants'. A copy is attached in the Appendix.

Prior to importation, certification should be obtained from the supplier detailing the source site, its previous and current land use and relevant test results. A copy of this information should also be forwarded to the Engineer.

For imported materials, copies of the carrier's consignment notes should be retained with the documentation detailed in Section 5.4 and a copy forwarded to the Engineer. The soil should be stockpiled separately and away from areas designated for storing other materials or potential sources of contamination. Separate stockpiles should also be created for each different source. All stockpiles should be suitably quarantined and identified as such until deemed suitable for use.

The following soil handling procedures should also be adhered to:

- Topsoil and subsoil should not become mixed;
- Capping should not be laid during or immediately following heavy rain;
- Double handling of material should be avoided;
- Stockpiles of topsoil should be shaped to shed water;
- Topsoil stockpiles should be low and narrow to ensure that the core is within 1 m of the surface; and

- Over tracking by machinery used to place soils should be avoided.

Imported and site won stockpiles should not be mixed. Site won stockpiles considered as suitable for reuse in gardens and site won stockpiles considered to be impacted with contaminants must not be mixed.

5.2 Physical Requirements

Topsoil and subsoil should comprise clay or sand. Topsoil should have a maximum of 30% of fragments in excess of 2 mm, a maximum of 10% in excess of 20 mm and nothing greater than 50 mm. Subsoil should comprise clay or sand and should have a maximum of 65% of fragments in excess of 2 mm, a maximum of 60% in excess of 20 mm, a maximum of 40% in excess of 50 mm and only occasional pieces in excess of 100 mm.

Material should be free of fragments of glass and wire or other potentially hazardous foreign material which could cause traumatic injury. Significant quantities of extraneous material such as brick and concrete should also not be present within the topsoil. Reasonable judgement should be taken with respect to their presence in subsoil. In addition, all materials should be free from propagules of aggressive weeds and bulk vegetative growth, in order to ensure negligible risk of subsequent weed problems.

5.3 Chemical Requirements

Testing should be carried out for the following general suite of contaminants:

Type of Material	Frequency of Testing	Testing Schedule
Greenfield / Manufactured Soils	Minimum 3 Dependent on source and receptor between 1 per 50 m^3 and 1 per 250 m^3	Standard metals/metalloids PAHs (16 USEPA speciation) Asbestos pH Soil organic matter/Total organic carbon
Brownfield Soils / Screened Soils	Minimum 6 Dependent on source and receptor between 1 per 50 m^3 and 1 per 100 m^3	Standard metals/metalloids PAHs (16 USEPA speciation) Asbestos TPH (CWG banded) pH Soil organic matter/Total organic carbon Any additional analysis dependant on the history of the donor site.

The sampling is to be undertaken by a suitably qualified Geo-environmental Engineer and depending on the source or variability of imported material, the Engineer may, at their discretion, request additional testing to be undertaken.

A table of assessment values is included in the Appendix. If any of the assessment values are exceeded, the material shall be considered to be unsuitable unless further testing and risk assessment shows it to be satisfactory.

5.4 Documentation

Each stockpile of imported material should be given a clear reference number and designated sheet recording the following:

- Identification reference (e.g. Stockpile A, B, C etc.);
- Material type (e.g. Topsoil);
- Source site;
- The carrier's consignment note reference numbers;
- The approximate volume (or number of loads); and
- Which plots the material is to be used on and where (i.e. Plot number and landscaped area to the front or rear garden);

Each entry shall be signed and dated by the Site Manager or their assistant. These sheets should be available for inspection by the Engineer, Warranty Inspectors, Local Authority staff and others involved with this development. A copy should also be given to the Engineer when verification visits are made.

6.0 INSTALLATION AND VERIFICATION OF CAPPING

6.1 Installation

Where made ground is to remain or be placed below gardens and landscaped areas, a minimum 600 mm thick capping, including at least 150 mm of topsoil will be required. This is currently expected to apply to plots 1 to 4 only, however if made ground is encountered outside the area occupied by these plots the extent of the capping layer will need to be extended.

Where no made ground is present, a minimum 150 mm of topsoil to act as a growing medium should be placed. Verification of this is not however considered necessary.

The capping installation should be undertaken by site staff in the following steps:

1. Establish the finished ground levels over each garden or landscaped area and from this determine the required level of the underside of the capping.
2. Where present ground levels are above the level of the underside of the capping, re-grading of the ground is to be undertaken to accommodate the capping. This excavated material may be placed in areas where ground levels are to be raised, such as beneath hard-standing or used to raise levels beneath other capped areas (see 3 below). Failing this the material can be removed from site (see 4 below).
3. Where the present ground levels are below the underside of the capping, the ground level may be made up to the underside of the capping layer using material from 2 (above) or imported material where no suitable fill exists.
4. All arisings should be regarded as contaminated until proven otherwise. If they cannot be used on site, they are to be removed to a licensed waste management facility. The waste is to be taken by a registered waste carrier in accordance with the Waste Management Duty of Care Code of Practice. Copies of all waste transfer notices are to be retained.
5. Check the level of the ground surface to ensure that it is at the correct level for the underside of the capping.
6. Install the subsoil, if required.

7. Install private services, where applicable. Where materials from above and below the capping are excavated these should be kept separate. Capping materials can be reused but the material below the cap should be placed as detailed in 3 or removed from site following the procedures set out in 4.
8. Place a minimum of 150 mm topsoil.

6.2 Verification of the Capping

Upon completion of the capping, verification pits shall be dug by an independent Engineer in order to measure the thickness of topsoil and subsoil, where present. Verification pits will be dug at a rate of 1 pit per 3 plots.

Prior to placement of the capping materials, the formation layer shall be inspected by the Site Manager and photographed. Verification pits shall be dug by an independent Engineer in order to measure the thickness of the capping.

Each verification pit shall be photographed. The photograph will include reference of depth and location of the pit.

If the capping is deemed to be insufficient, the Site Manager will be informed and advised on how much more material is needed for the capping to be adequate. Verification of capping can only be carried out on areas where the capping has been completed. All gardens and landscaped areas which have had the capping layer completed will be photographed by the Engineer.

A verification report is to be produced by the Engineer, which includes:

- The documentation detailed in Section 5.4;
- The chemical test results for imported subsoil and topsoil;
- Confirmation of the capping thicknesses, including photographs of the verification pits with a scaled marker; and
- Confirmation of the physical suitability of the material.

The submission of verification reports is covered in Section 10.

7.0 DECOMMISSIONING AND REMOVAL OF UNDERGROUND FUEL TANKS

7.1 Decommissioning of Tanks

Underground fuel storage tank(s) are suspected to be present in the south of the site, in the vicinity of the former garage. The exact nature and location of these is currently unknown, and it is also not clear whether any fuel remains within any of the tanks.

Once located, a specialist contractor will need to be appointed to confirm whether the tanks have been previously emptied of all fuel, fuel residues and gases, and complete these procedures if required. The contractor should submit their proposed method statement and risk assessment to the regulators prior to undertaking the works.

Once emptied of any remaining fuels and made safe, the tanks should be removed from the ground, and the structures removed from site. Any surrounding structure and/or concrete slabs found below the tanks, as well as any associated pipework should also be removed.

The soils surrounding the tanks, inspection pits and associated structures should be carefully inspected by a Geo-environmental Engineer to determine whether free product is present. Any impacted soils should be excavated. Arisings should be stockpiled on site, and should be placed either onto hardstanding areas, or onto an impermeable membrane to avoid any cross contamination with the underlying soils, prior to treatment or disposal.

7.2 Verification of Removal of Impacted Soils

The Engineer will determine the extents of the excavation based on visual and olfactory indications of contamination remaining. When they are happy that no significant visual or olfactory evidence of contamination remains, the base and sides of the resultant excavations will be sampled. The rate of sampling will be at the discretion of the Engineer but should comprise a minimum of one sample per side and two samples from the base of each excavation. Where pipework has been removed the length of the run will be sampled at a minimum of 3 m intervals.

If any water is present within the excavations, this should be inspected for evidence of free product. If any is observed, hydrophobic pillows or booms should be used to remove the free product from the surface. These may need to remain in place over a number of days to ensure effective removal of free product. Once saturated the pillows/booms should be removed and

disposed of accordingly. If free product then remains the process should be repeated until no more than a sheen is present. The resultant water should then be sampled and tested.

The Geo-environmental Engineer will compare the results of the testing with assessment values relating to a residential end use with home-grown produce and protective of controlled waters. If the results indicate, after risk assessment, that potentially harmful levels of hydrocarbons remain in the ground, the Geo-environmental Engineer will advise if further remedial work is required, and the sides and base of the additional excavation re-tested.

Samples will also be collected from any stockpiles of fuel-impacted soil and the Geo-environmental Engineer will advise on potential treatment methods, or likely waste classification if disposal is required.

All test results should be submitted to the regulators to confirm acceptance of the remediation. Following acceptance of the remediation works from the regulators, all excavations should be backfilled with suitable granular material, placed in engineered layers.

8.0 GAS PROTECTIVE MEASURES

Summary of Gas Measures Required

Where the depth of made ground exceeds 2 m, ground gas precautions are required. In the vicinity of the underground tank(s) this should also be suitably resistant to hydrocarbon vapours. Both the deep made ground and tank(s) are considered to affect plots 1 to 4 only. Should further deep made ground be encountered below additional plots, these will also require gas protection measures. Pre-cast concrete floors with a ventilated void are required across the rest of the site.

Appropriate gas protective measures for Amber 1 and 2 regimes comprise a beam and block floor with a minimum 150 mm ventilated void below and a suitably resistant gas membrane.

A 'Gas Details Drawing' is attached showing the positioning of the gas membrane for precast concrete floors

The gas membrane system to be installed on site is TBC, however the chosen system will need to be resistant to methane, carbon dioxide and hydrocarbon vapours.

Installation & Verification of Gas Protective Measures

This membrane system which is suitably resistant to the ingress of methane and carbon dioxide, is to be approved by the NHBC and the Local Authority. This membrane should be fully lapped and sealed across the floors and external walls. All service pipe penetrations should be sealed using a preformed gas proof top-hat, lapped beneath the membrane by a minimum of 150 mm, sealed around the top of the penetration using double sided tape and secured with a jubilee clip, in accordance with the manufacturer's instructions.

The membrane system should be installed by suitably qualified personnel.

In accordance with C735, for Situation B i.e. housing with precast beam and block floors and an underlying minimum 150 mm ventilated void, the following table (taken from C735) displays the level of verification required given the membrane's installers' qualifications:

Amber 2	
Qualified[1] and experienced installer (minimum one operative to hold qualification)	Verifier (consultant[4] or third party qualified and experienced installer[1]) to conduct thorough verification (visual) inspection of **first 5 plots** and after placement of reinforcement if no protection provided. **All joints, pipe penetrations etc air lanced to ASTM D4437.** Subsequent inspections (including air lancing) carried out at approx. frequency of **1 in 20** plots. Contractor to supply sign off sheets (verification evidence) including photographs for all other plots. Consideration given to need for/scope of **integrity testing** (e.g. initially on 10 to 25% of plots then falling to 0 to 5% if acceptable results obtained and no concerns raised by visual inspections)[3].

Notes

* Gas regime defined by characteristic situation as set out by Wilson *et al* (2007), and all other recent good practice guidance and British Standards.

** Assumes venting designed to keep steady state concentration of CH_4 below one per cent in void, sites designed with higher levels of gas in the void should adjust the frequency of inspection and testing as appropriate.

1 Relevant qualification is NVQ Level 2 in gas protection installation (see Section 3.3 of C735).

2 Before the works start the contractor should produce a detailed installation plan including method statement, CQA procedures and qualifications, on receipt of these the verification protocol could be increased or reduced.

3 Consideration should be given to carrying out integrity testing /leak detection (ie smoke, tracer gas or dielectric testing) on the above basis and/or if an unacceptable amount of damage/loss of integrity is found during visual inspections. In this instance the consultant should discuss with the relevant personnel, strategies to prevent this recurring. This could include changing material, improving subgrade preparation, putting up warning signs to reduce the amount of trafficking etc.

4 Verification consultant should be competent, experienced and suitably trained (see Section 3.2 of C735). A statement detailing their qualifications and relevant experience should be included in the verification plan.

5 Air lancing is the only integrity test that has an independently recognised international standard suitable for testing taped and welded seams and should be used at the frequency suggested in the table.

To summarise, site visits should be undertaken on two occasions:

- to inspect the ventilated void and ensure it is clear of obstructions; and
- to inspect the membrane.

When the installation of the membrane is complete, it should be protected either by the installation of insulation or by the temporary placement of protective boards.

Verification Reports

For each inspection, the attached checklist must be completed.

A Verification Report would then be compiled containing the completed checklist, plot specific photographs of the ventilated void (where applicable) and the fully sealed gas membrane, and confirmation that the membrane has been installed in accordance with manufacturer's guidelines, this Implementation Plan and relevant industry standards.

9.0 UNEXPECTED CONTAMINATION

There is the potential for areas of unexpected contamination, as is the case with any 'Brownfield' site. Any unusual, brightly coloured, oily or odorous material should be considered in this category. Significant amounts of material suspected of containing asbestos or potential tanks should also be included.

If unexpected contamination is found the following procedures should be adhered to:

1. All site works at the position of the suspected contamination should stop, and visual and olfactory observations of the condition of the ground and the extent of contamination should be made. Notification shall be given to an independent consultant and the Local Authority not later than 24 hours after discovery. Should the contamination be likely to affect controlled waters the Environment Agency should also be informed.
2. During the presence of a suitably qualified Engineer, investigation works shall commence to recover samples for testing and, using visual and olfactory observations of the condition of the ground, accurately delineate the area over which contaminated materials are present.
3. Should the Consultant deem it appropriate, the affected material may be excavated and placed in a stockpile on a suitable impermeable surface. This should be suitably quarantined with no addition to or removal of the stockpile while chemical analysis is being undertaken. Alternatively, the material should remain in-situ until laboratory test results have been obtained.
4. The testing suite will be determined by the Consultant on the basis of visual and olfactory observations.
5. Test results will be compared against current assessment criteria suitable for the future use of the area of the site affected.
6. If after testing the ground is found to be contaminated, the Local Authority shall be informed. After consultation with the Local Authority, and if necessary, the Environment Agency, materials should either be removed for disposal to a licensed waste management facility or remediated to agreed clean-up criteria.

A report will be prepared by the Engineer and submitted to the Local Authority and where groundwater may potentially have been impacted, the Environment Agency.

10.0 COMPLETION DOCUMENTATION

On completion of the verification works the appropriate verification documentation, detailing the works that have been completed in accordance with the agreed Implementation Plan, will be forwarded to the Local Authority and warranty provider. Should any remediation affecting controlled waters have been required and consequently undertaken, verification documentation will also need to be issued to the Environment Agency for their approval.

The verification report for the capping will include photographs of the capping materials within validation pits and of the garden and landscaped areas, as well as the pertinent chemical test results.

The verification report for the gas measures will contain the completed checklist, plot specific photographs of the ventilated void and the fully sealed gas membrane, and confirmation that the membrane has been installed in accordance with manufacturer's guidelines, this Implementation Plan and relevant industry standards.

Necessary changes to the agreed Implementation Plan, arising during the course of the works, are to be agreed in writing with the Local Authority and warranty provider prior to being undertaken on site.

APPENDIX

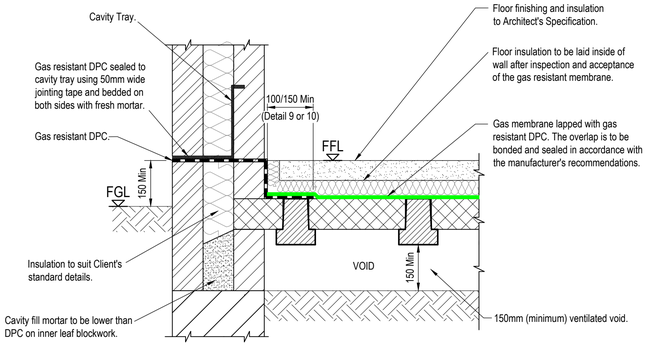
Gas Details – Drawing 38586/086

Gas Membrane Specification – TBC

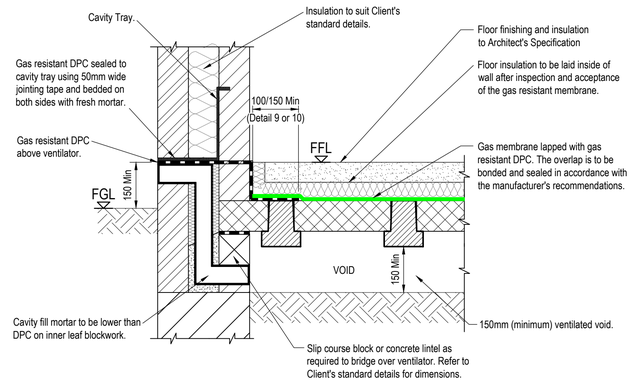
Gas Membrane Checklist

YALPAG – 'Verification Requirements for Cover Systems: Technical Guidance for Developers, Landowners and Consultants'

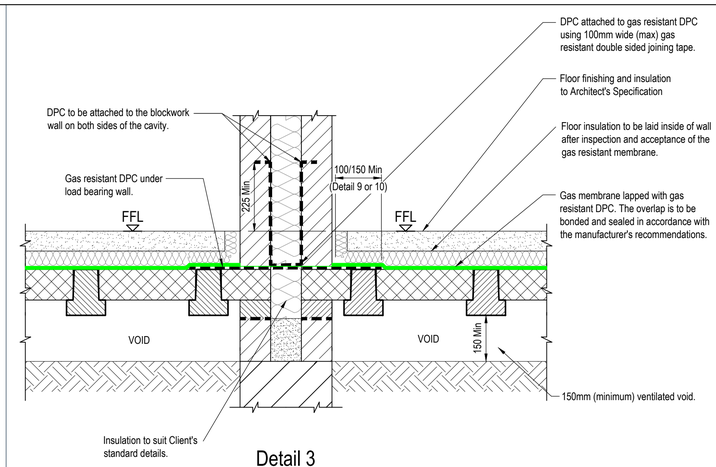
Soil Assessment Values – Residential with Homegrown Produce



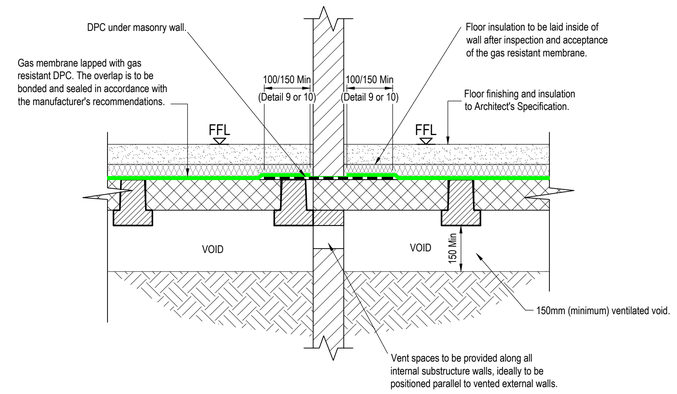
Detail 1
External Wall Detail Where DPC Is At FFL (Away From Ventilator Position)
(Scale 1:10)



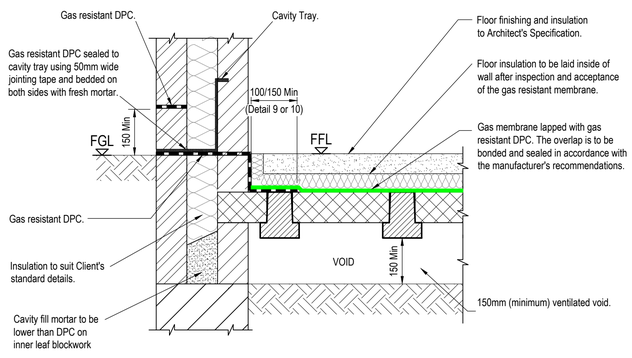
Detail 2
Typical Perimeter Detail Where D.P.C. Is At Finished Floor Level (With Ventilator)
(Scale 1:10)



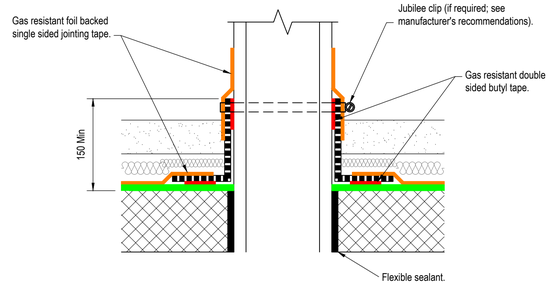
Detail 3
Party Wall Detail
(Scale 1:10)



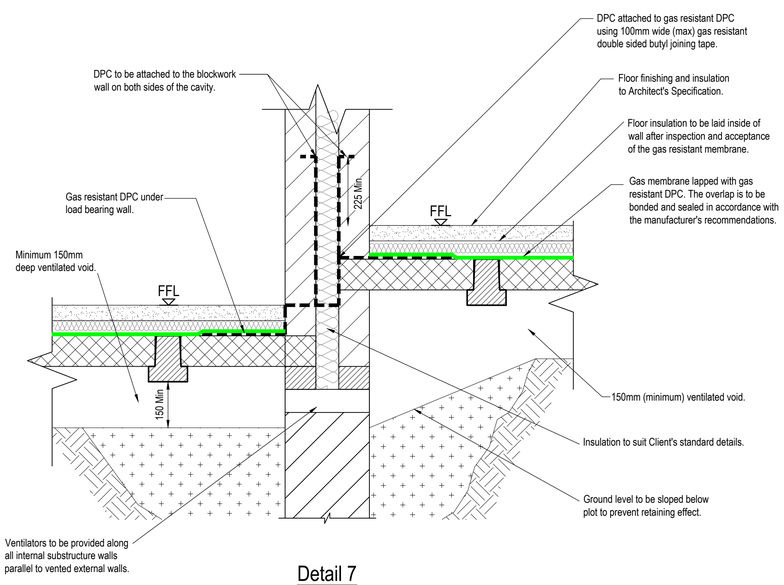
Detail 4
Details Of Gas Barrier Construction At Internal Loadbearing Wall
(Scale 1:10)



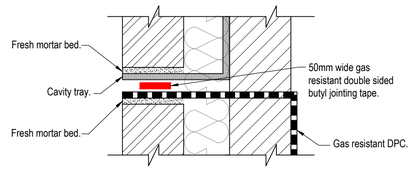
Detail 5
Detail Where Ground Level Is Locally Raised To Suit Finished Floor Level
(Scale 1:10)



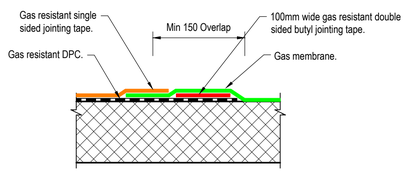
Detail 6
Top Hat Joint Detail
(Scale 1:5)



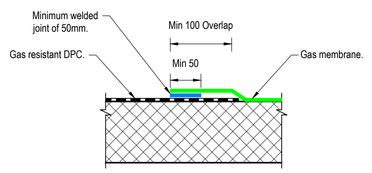
Detail 7
Typical Section Through a Stepped Party Wall
(Scale 1:10)



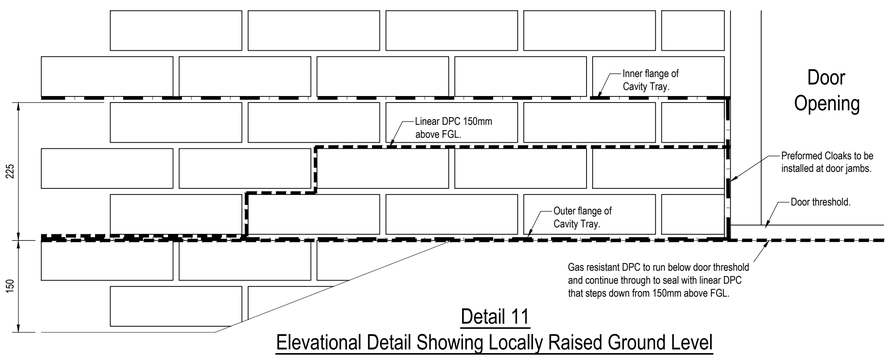
Detail 8
Detail Of Cavity Tray Sealed To DPC In External Leaf
(Scale 1:5)



Detail 9
Detail Of Overlap Between DPC And Membrane
(Scale 1:5)



Detail 10
Welded Joint Detail
(Scale 1:5)



Detail 11
Elevational Detail Showing Locally Raised Ground Level
(Scale 1:5)

INFORMATION WITHIN THIS DRAWING IS NOT NECESSARILY PRODUCED TO SCALE.
ALWAYS USE FIGURED DIMENSIONS AND CO-ORDINATES - IF IN DOUBT, ASK.

NOTES

1. The details shown on this drawing for construction of precast concrete ground floors with a ventilated void and gas membrane are to be used in conjunction with Eastwood & Partner's documents prefixed 38586.

Ventilation

2. The client is to provide mark ups of each house type showing where air bricks are to be positioned, and where vent spaces are to be positioned on internal substructure walls.
3. Through-wall ventilation to be achieved using telescopic ventilators and air bricks; their spacing should conform to relevant statutory and mandatory requirements. In accordance with NHBC Standards Chapter 5.2, void ventilation should be provided to whichever gives the greater opening area i.e. 1500mm^2/ per metre run of external wall, or 500mm^2/ per m^2/ of floor area. All internal substructure walls parallel to ventilated external walls are to be vented using cavity sleeve ventilators.
4. Sleeve ventilators must not be located directly under bearing of a precast floor beam.
5. As part of the Verification Plan, the amount of ventilation will need to be calculated and the positions of air bricks and vent spaces approved by the regulators.
6. Wall cavity to be ventilated with perpend weepholes at 900c/c above cavity trays at DPC level and all lintels, to Architect's details.
7. Void heights to be minimum 150mm and may need to be increased to suit site specific volume change potential. See Foundation Schedule for foundation sections and void heights.

Gas Membrane

8. It is recommended that all gas membranes are fitted by qualified installers.
9. All gas membranes and ancillary products must be installed in accordance with the manufacturer's recommendations and the requirements of BRE 414 Protective Measures for Housing on Gas Contaminated Land, CIRIA Documents C665 & C735, and BR8485:2015.
10. The gas membrane to be used is to be suitable for CS-2 protection requirements.
11. All overlaps in the gas membrane to be at least 150mm and bonded with gas resistant double sided butyl Tape. The joint should then be sealed with gas resistant single sided tape. Prior to sealing, all surfaces are to be cleaned to ensure a good bond. Seals can also be welded, should the membrane specification indicate welding is appropriate.
12. All horizontal DPCs must be bedded on both sides with fresh mortar and must extend the full width of the wall including any rendering and project 5mm beyond external face.
13. Preformed cloaks can be used at corners and change in levels exceeding 75mm in height to suit cavity tray profiles.
14. DPC where FGL is level with FFL must be suitable for tanking/water proofing as well as being gas proof. Tanking details to be designed by a CSSW certified specialist.

Verification

15. Verification of gas measures (ie. of ventilated void and membrane installation) should be carried out in accordance with C735.

Legend:

FGL	-	Finished Ground Level
FFL	-	Finished Floor Level
DPC	-	Damp Proof Course

REV	DESCRIPTION	SIG	CHK	DATE

JAGUAR ESTATES

SHEFFIELD ROAD, PENISTONE

GAS MEMBRANE STANDARD INSTALLATION DETAILS FOR PRECAST CONCRETE SLAB WITH VENTILATED VOID

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SCALE WHEN PLOTTED AT A1	DRAWING STATUS
As Shown	CONSTRUCTION

DRAWN	CHECKED	DATE	DRAWING NUMBER	REV
JAE	RAN	03.01.2024	38586/086	A

Eastwood
CONSULTING ENGINEERS

Gas Membrane Checklist

Site Name			
Plot			
Name of Membrane/Product Code			
Manufacturer of Membrane			
Specification of Membrane			
Name of DPC/Product Code			
Manufacturer of DPC			
Specification of DPC			
Date of Visit		**Engineer**	

	Unsatisfactory	Satisfactory	**Signed**
Correct materials used			
DPC installed			
Membrane installed			
Membrane to Membrane joints sealed			
DPC to DPC joints sealed			
Membrane to DPC joints sealed			
Service pipe joints sealed			
Membrane extends across cavities			
Membrane installed to manufacturer's specification			

Comments:

VERIFICATION REQUIREMENTS FOR COVER SYSTEMS

Technical Guidance for Developers, Landowners and Consultants

Yorkshire and Lincolnshire Pollution Advisory Group

Version 4.1 – June 2021

The purpose of this guidance is to promote consistency and good practice for development on land affected by contamination. The Local Authorities in Yorkshire, Lincolnshire, the North East of England, East Anglia, Greater Manchester and St Helens who have adopted this guidance are shown below:

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Appendix 2 – Checklist for Verification Reports *10*

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Disclaimer

This guidance is intended to serve as an informative and helpful source of advice. YALPAG will review this guidance every three years, but readers must note that legislation, guidance and practical methods are inevitably subject to change and therefore should be aware of current UK policy and best practice. This note should be read in conjunction with prevailing legislation and guidance, as amended, whether mentioned here or not. Where legislation and documents are summarised this is for general advice and convenience, and must not be relied upon as a comprehensive or authoritative interpretation. Ultimately it is the responsibility of the person/company involved in the development or assessment of land to apply up-to-date working practices to determine the contamination status of a site and the remediation and verification requirements.

Acknowledgments

YALPAG would like to thank North Lincolnshire Council, Leeds City Council, City of Bradford Metropolitan District Council, Barnsley Metropolitan Borough Council, Rotherham Metropolitan Borough Council, Wakefield Council, and Tameside Metropolitan Borough Council, for producing this guidance.

YALPAG would also like to acknowledge Liverpool City Council's Contaminated Land Team, Coopers Consulting Engineers for allowing us to use their guidance document and photographs and WSP Environmental Ltd for also donating photographs.

Consultation

39 Local Authorities and 6 Environmental Consultants were consulted over a four week period in 2010 during the production of the initial guidance. At that time, consultation comments were considered by the review panel and a number of revisions were made to the guidance to reflect these comments.

49 Local Authorities and 25 Environmental Consultants were consulted in 2021, during the production of this version [4.1] of the guidance. Consultation comments were considered by the review panel and a number of revisions were made to the guidance to reflect these comments.

Introduction

This guidance has been produced to help developers ensure that they can demonstrate that material brought onto a development site for gardens or areas of soft landscaping are suitable for use and do not present harm to people, the environment and/or property. It is intended to improve the quality of reports submitted to Local Authorities on this matter and to give contractors/consultants a point of reference to obtain approval for such work from their client. This guidance does not cover the geotechnical suitability of soils or materials, chemical suitability that does not affect human health e.g. sulphates, or importing soils contaminated with invasive (or injurious) plants.

The verification of cover systems should be an integral part of the remediation project and agreed between developers and regulators at an early stage in the project.

UK guidelines for remediation verification are set out within Land Contamination Risk Management[1] (LCRM) and the document on Verification of Remediation of Land Contamination[2]. This guidance note should be considered as supplementary advice in conjunction with these documents.

This guidance relates to the remediation of land contamination by using cover systems; however, the verification of the quality of imported material is equally important in other situations, such as raising levels for flood prevention or general landscaping works. This guidance could also be used in such instances.

The Process of Verification

Implementation plans for remedial works should always be site specific. Where a cover system and potentially, excavation, is the main remedial method or a component of an overall site remediation, specific goals will need to be set that are linked directly to the risk management strategy for the site in question.

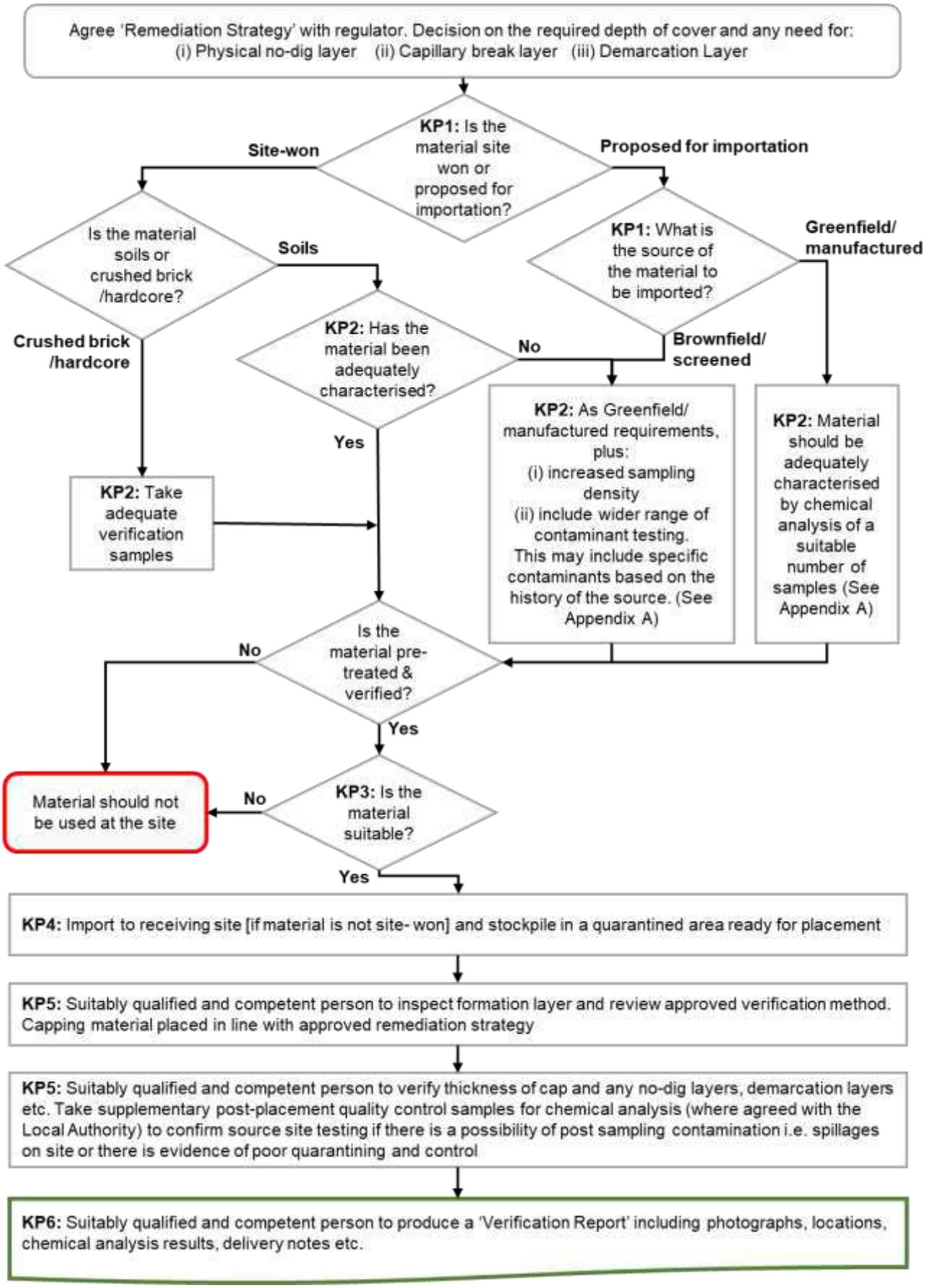
For cover and containment systems, verification will normally depend upon the provision of defensible measurements, observations and records. Critical factors to be considered are:

- What should be measured?
- When should they be measured?
- Where measurements need to be taken, what is the appropriate monitoring regime i.e. number and frequency of samples?
- Statistical constraints on sampling.

National Planning Policy Framework (NPPF) states that “planning policies and decisions should ensure that after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990”. The Verification Report is a key document to demonstrate compliance with NPPF, and the responsibility rests with the developer/applicant to submit the required Verification Report to complete the remediation and to discharge any planning conditions.

[1] Land Contamination Risk Management, Environment Agency, Oct 2020
[2] Verification of Remediation of Land Contamination. Environment Agency, Feb 2010

Overview Flowchart



Key Points

KP1: Source of Material

Material can be sourced from site won material i.e. crushed brick/hardcore or site-won soils from existing open or landscaped areas. In the interest of sustainability, Local Authorities promote the use of such site-won material providing that they are suitable for the intended end use of the site.

Alternatively, material can be sourced from other developments and commercial companies. Dependent on the source of the material it can be classified as either from a 'Greenfield/Manufactured' or 'Brownfield/Screened' source.

Broadly speaking material can be classified as follows:

Greenfield – Where documentary evidence is provided confirming that the source site has not been developed and that no past contaminative uses have occurred. Should evidence not be provided or approved by the Local Authority, please note that the source would be expected to be assessed as though it were a brownfield source.

Manufactured – from a commercial company who manufacture material by mixing or blending mineral soils (subsoil or sand) with an organic amendment (compost). If other soil component sources are used, documentary evidence should be provided confirming that the source site has not been developed and that no past contaminative uses have occurred. Should documentary evidence not be provided or approved by the Local Authority, please note that the source would be expected to be assessed as though it were a brownfield source.

Brownfield – material from a donor site that has previously been developed

Screened – material from a company who deal with skip/demolition waste which is screened for unsuitable material i.e. bricks, wood, plastic etc.

KP2: Characterisation of Material

It is essential that material is suitable for its intended use. Documentary evidence of the source of the material should be provided to the Local Authority. This may include desk study or site investigation reports. A defensible method is required to ensure the verification proposals are site specific and that the level of sampling reflects the need to ensure that imported material are suitable for their intended use.

Due to the diminishing supply of suitable Greenfield topsoil sources it has been found that the chemical quality of Greenfield sources is less reliable in certain areas. As a result the recommended analytical rate for the intended use of the development may vary between Local Authorities [see **Appendix 1a**].

When should this be done?

Sampling of material should be undertaken as early as possible i.e. prior to placement [for site won material] and prior to importation [for imported material]. This is to avoid the costly exercise of re-excavating unsuitable material and the possibility of cross contamination. Where the assessor has confidence that the material is of sufficient quality (i.e. tested by supplier, used previously) it is acceptable to test the material on site. Although, if it is deemed unsuitable it would have to be either removed off site or pre-treated at the cost and time of the developer. It is recommended that some verification samples are also taken once this material has been delivered to site to confirm suitability for use. Soils can become contaminated during transportation or when stockpiled on site.

What about certificates from commercial suppliers?

Where the material is provided by a commercial company, certificates or other industry Quality Protocol compliance i.e. WRAP, DoWCoP, will normally be accepted. This is on the proviso that it: (i) relates to the actual material being imported to the site and the type and amount of analysis is in line with what is prescribed in Appendix 1a; and, (ii) the certificates are less than two months old.

It is recommended that some additional verification samples are taken once this material has been delivered to site. Soils can become contaminated during transportation or when stockpiled on site.

Extreme caution should be given to importing material that has been recycled from demolition or skip waste as they could easily be contaminated e.g. asbestos containing materials. Please refer to "questions you should be asking your supplier" in **Appendix 1b** and include the responses in your report.

British Standard

Imported soils should be as specified in BS 3882:2015 for topsoil and BS8601:2013 for subsoil as 'suitable for their intended purpose'. Both British Standards relate mostly to nutrient content of topsoil and phytotoxic contamination and they do not consider contaminants that pose a risk specifically to human health. Soils should be tested for contaminants that are considered to pose a risk to human health in addition to those specified in the relevant British Standards to ensure that they are suitable for their intended use.

Initial screening

A visual / olfactory inspection of the material should be carried out by a suitably qualified and competent person to ensure that:

- It is a suitable growing medium;
- It is free from obvious contamination i.e. staining/free product etc.;
- It has not come from areas where Japanese Knotweed or other invasive or injurious plants, as specified by the Environment Agency, are suspected to have been growing;
- It is not odorous (could be considered a statutory nuisance);
- It is free from unsuitable material i.e. bricks, brick ties, timber and glass etc.); and,
- There are no visible signs of asbestos containing material (ACMs).

Testing schedule & number of samples

Chemical testing will normally be required on any materials that are to be used as cover material, even where this includes first generation quarried material. This should be carried out by a suitably qualified and competent person.

Appendix 1a explains in detail the sampling and testing requirements for a typical residential development. These are only guidelines and it may be necessary to deviate away from them depending on local and site-specific factors. It is recommended that the developer discusses any deviation with the Local Authority.

The following criteria sets out the requirements for sampling and testing:

- **Virgin Quarried Material** sampling needs to be 1 or 2 samples depending on the type of stone utilised, to confirm the inert nature of the material. Testing to include standard metals/metalloids (should include as a minimum As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn).

- **Crushed Hardcore, Stone, Brick (excluding asphalt)** a minimum of 1 sample per 500m^3. Testing to include 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** a minimum of 3 samples or, dependent on source and receptor, between 1 per 50m^3 and 1 per 250m^3. Testing to include 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** a minimum of 6 samples or dependent on source and receptor, between 1 per 50m^3 and 1 per 100m^3. Standard metals/ metalloids (as above), PAH (16 USEPA speciation), TPH (CWG banded), asbestos, pH and SOM (or calculated from TOC). Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).

The assessment criteria need to be UK based, e.g. LQM S4ULs, Defra C4SLs or other similarly derived GACs.

KP3: Suitability of Material

Based on the characterisation of material above, the material should be either deemed suitable or unsuitable. Obviously unsuitable material should not be used (unless it is treated to reduce levels of contaminants below agreed target levels i.e. bioremediation – this would have to be agreed and included within the Remediation Strategy) and an alternative source of material should be sought by the developer. If the material is considered suitable it can be imported (if not site won) and stockpiled in a suitably quarantined area [refer to **KP4**].

KP4: Stockpiling & Quarantining of Material

It is essential that the 'suitable' material is either placed in its intended area straight away i.e. soft/landscaped areas or stockpiled in a suitable quarantine area to prevent on-site contamination.

In the event that an assessor finds material has been stored in an unsuitable area, samples should be taken to confirm that no cross contamination has occurred (including a visual/olfactory check of the material). The material should then be suitably quarantined or placed at its intended location immediately.

KP5: Verification of Required Depth

In line with the agreed Remediation Strategy, it is important to establish that the required depth has been achieved and is consistent across the site. There are two main ways to achieve this:

Depth testing in situ – small trial pit excavated to allow measurement of its depth by standardised tape measure or measuring staff.

Topographical surveys – accurate survey of the base and final formation layer height to establish the depth of cover.

Specific Local Authority Policy

Please check with the local Contaminated Land Officer to establish:

- Which type of method for testing depth is accepted; and,
- The number of verification areas per property, plot, landscaped area or garden area (some Local Authorities recommend at least 2 per plot for residential developments).

Important Note: Where demarcation, physical no-dig and capillary break layers exist they should be verified for their thickness and presence during the time of their installation. Details of the demarcation layer should be agreed with the Contaminated Land Officer prior to placement. This will include the design, type and strength of the geotextile separator or visual warning membrane. The verification of depth and confirmation of such layers should be carried out by a suitably qualified and competent person.

KP6: Reporting

The purpose of verification documentation is to provide transparent reasoning why the remediation was required, a methodology about how it was to be undertaken and proof that the specified works have been undertaken and to provide confirmation that the site is "suitable for its intended use".

The document is utilised not only to satisfy conditions of planning permissions but also is to be kept on record by the Local Authority should queries be raised during the lifetime of the development and to confirm to future purchasers that the site is suitable for use.

National Planning Policy Framework (NPPF) states that "planning policies and decisions should ensure that after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990". The Verification Report is a key document to demonstrate compliance with NPPF, and the responsibility rests with the developer/applicant to submit the required Verification Report to complete the remediation and to discharge any planning conditions.

It is also essential that other supporting documentation is included within a report carried out by a suitably qualified and competent person e.g. laboratory analysis results, delivery tickets for material, certificates for imported material (or if unavailable, documented evidence of the source of the Greenfield material), trial pit logs etc. A checklist has been included in **Appendix 2** to give an idea on what information should be recorded.

Additionally, any reporting should include details of any measures required to maintain the cover system integrity in the future e.g. successive construction phases (management plans) and longer term (restrictive covenants on title deeds).

Photographic evidence for validating the depth of cover

The Local Authority ideally would recommend the following programme of photographs to be taken of the placement of inert cover:

- Photographs of any stockpiles and quarantine areas
- Proof that the depth of inert cover has been installed
- Proof of the quality of the material to be used as inert cover
- Proof there is a geotextile separator and visual warning membranes if used between the underlying material and suitable for use soils.
- Proof of the method of placement and different layers if appropriate
- Proof of the completed project
- Inclusion of background features which will aid locating the photograph
- Inclusion of site identification boards within the photos which show the date, position taken i.e. corner of plot 3 and the site name.
- Inclusion of photographs of site stockpiles and quarantine areas.

The presence of good quality photographs is essential to prove beyond doubt that the remediation has been done as specified both by method and position, and that the images have been taken from the specific area stated.

Refer to **Appendix 3** for examples of good photographic evidence.

Appendix 1a – Sampling & Testing Matrix

Type	Number of Samples	Testing Schedule	Assessment Criteria
	Please note that these guidelines apply to a typical residential development, and relaxation of the guidelines or more stringent requirements may apply dependent on local and site specific factors. Therefore, <u>all parameters need to be agreed with the Local Authority</u>.		
Virgin Quarried Material	1 or 2 depending on the type of stone utilised, to confirm the inert nature of the material.	Standard metals/metalloids (should include as a minimum As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn)	The assessment criteria need to be UK based, e.g. LQM S4ULs, 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 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 50m^3 and 1 per 250m^3	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 50m^3 and 1 per 100m^3	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).	

Appendix 1b – Questions to Ask Your Soil Supplier Relating to Soil Quality

- What is the source of the material (refer to KP1)? If the source is Greenfield, can they provide evidence of this?
- Will all of the material be coming from the same source?
- Are you satisfied that the material is a suitable growing medium for the proposed end use?
- Has the supplier used an appropriate sampling protocol to ensure a representative sample is analysed? What volume of soil is represented by the analysis and does it comply with Appendix 1a?
- Does the testing include analysis of contaminants identified in Appendix 1a?
- Does the laboratory conducting the analysis have UKAS and MCERTS accreditation for the tests they are carrying out?
- Does the material comply with relevant waste regulations?
- Can I have a copy of the whole analysts report and does it include an interpretive section?
- Will the provided certificate be dated within the last 2 months?

Appendix 2 – Checklist for Verification Reports

Example only. Not to be considered as typical minimum requirements. Additional information should be included for non-cover systems aspects of the remediation i.e. gas protection measures etc.

Site Details	
Site Name / location	
Developer name	
Development use	
Plot No / description of landscaped area (inc plan of inspection areas)	
National Grid Reference	
Inspection visit date	
Supporting Evidence	
Description of remediation (as per agreed Remediation Method Statement including depths / thickness checks, topographical readings)	
Material tracking information (including way tickets etc.)	
Name of groundwork's remediation contractor	
Name of supervising environmental consultant	
Site Specific chemical analysis results	
Verification Photographs (inc. remarks)	
Recommendations	
Pass/fail	
If material fails, how will this be managed i.e. removed, treated	
Detail any further remedial works and/or inspection	
Signed off	

Failure to provide any of the above information may prevent planning conditions from being discharged.

Appendix 3 – Examples of Good Quality Photographs

© Coopers Consulting Engineers

Photograph 1:
Depth check of inert cover within area of public open space. Physical break layer and topsoil visible.

© WSP

Photograph 2:
Depth check of inert cover with Site & Location Information Board.

© Coopers Consulting Engineers

Photograph 3:
Depth check of inert cover within areas of front gardens.

© Coopers Consulting Engineers

Photograph 4:
Depth check of inert cover within areas of front gardens.

© Coopers Consulting Engineers

Photograph 5:
Depth check of inert cover within rear gardens. Taut string line spans across excavation.

© Coopers Consulting Engineers

Photograph 6: Depth check of inert cover within rear gardens. Taut string line spans across excavation.

© Coopers Consulting Engineers

Photograph 7: Shows the spatial location of the verification pit.

© Coopers Consulting Engineers

Photograph 8: Excavation within public open space and verification pit showing the presence of a remediation break layer at the base, a crushed sandstone inert fill overlain by topsoil.

© Coopers Consulting Engineers

Photograph 9: Inert crushed sandstone being delivered. The spatial area of the remediation can be observed from these photographs (old terrace housing).

© Coopers Consulting Engineers

Photograph 10: Inert crushed sandstone being delivered with visible remediation break layer. The spatial area of the remediation can be observed from these photographs (traffic lights).

© Coopers Consulting Engineers

Photograph 11:
Shows the remediation of the rear garden, with a significant depth (1.0m) of inert cover. This photograph has been stitched to form a panoramic photograph and hence there is slight distortion

© Coopers Consulting Engineers

Photograph 12:
Shows the remediation of the rear garden, with a significant depth (1.0m) of inert cover. Remediation break layer visible at the base of the excavation.

Inorganic Compounds	Human Health - Residential with Homegrown Produce (mg/kg)
Arsenic	37
Cadmium	11
Chromium (III)	910
Chromium (VI)	6
Lead	200
Mercury	1.2
Nickel	180
Selenium	250
Copper	2400
Zinc	3700

Organic Compounds	Human Health - Residential with Homegrown Produce (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Naphthalene	2.3	5.6	13
Acenaphthene	210	510	1100
Acenaphthylene	170	420	920
Fluorene	170	400	860
Phenanthrene	95	220	440
Anthracene	2400	5400	11000
Fluoranthene	280	560	890
Pyrene	620	1200	2000
Benzo(a)anthracene	7.2	11	13
Chrysene	15	22	27
Benzo(b)fluoranthene	2.6	3.3	3.7
Benzo(k)fluoranthene	77	93	100
Benzo(a)pyrene	2.2	2.7	3.0
Dibenz(a,h)anthracene	0.24	0.28	0.3
Indeno(1,2,3-cd)pyrene	27	36	41
Benzo(g,h,i)perylene	320	340	350
Benzene	0.087	0.17	0.37
Toluene	130	290	660
Ethylbenzene	47	110	260
o-Xylene	60	140	330
m-Xylene	59	140	320
p-Xylene	56	130	310

Prepared	KB	Checked	KE	Date	03/01/2024	Job No	38586

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SHEFFIELD ROAD, PENSITONE

JAGUAR ESTATES

ASSESSMENT CRITERIA – RESIDENTIAL WITH HOMEGROWN PRODUCE

Contaminant	Phytotoxicity			
	pH 5.0 to 5.5	pH 5.5 to 6.0	pH 6.0 to 7.0	pH >7.0
Arsenic	50			
Cadmium	3			
Chromium	400			
Lead	300			
Mercury	1			
Nickel	50	60	75	110
Copper	80	100	135	200
Zinc	200	200	200	300

The assessment concentration for lead is the Category 4 Screening Level produced by Contaminated Land: Applications in Real Environments (CL:AIRE) and outlined in Appendix H of their report SP1010. The others have been taken from Nathanail, C. P., McCaffrey, C., Gillett, A., Ogden, R., and Nathanail, J., 2015, *'The LQM/CIEH S4ULs for Human Health Risk Assessment'*, Land Quality Press, Nottingham. The metals/metalloids are based on a sandy loam soil and 6% soil organic matter. The assessment values are not intended to be applied to individual sample results where materials are similar, as the levels of contaminants will have a natural variability across the site. Instead, the modified mean value should be compared with the assessment concentration.

The assessment values for phytotoxicity are the levels at which plant growth is thought to be affected. They are taken from the maximum permissible and advisable concentrations in soil after application of soil sludge given in the *'The Code of Good Agricultural Practice for the Protection of Soil*', MAFF, 1998.

The assessment of sulphate, water soluble sulphate, elemental sulphur and sulphide is to determine the aggressive nature of the ground with respect to concrete and consequently the results are compared with BRE Special Digest 1:2005 '*Concrete in Aggressive Ground*'.

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SHEFFIELD ROAD, PENSITONE

JAGUAR ESTATES

ASSESSMENT CRITERIA – RESIDENTIAL WITH HOMEGROWN PRODUCE

TPH Fraction	Intended Land Use Residential (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Aliphatic EC 5-6	42	78	160
Aliphatic EC >6-8	100	230	530
Aliphatic EC >8-10	27	65	150
Aliphatic EC >10-12	130 (48)[vap]	330 (118)[vap]	760 (283)[vap]
Aliphatic EC >12-16	1100 (24)[sol]	2400 (59)[sol]	4,300 (142)[sol]
Aliphatic EC >16-35	65,000 (8.48)[f,sol]	92,000 (21)[f,sol]	110,000[f]
Aliphatic EC >35-44	65,000 (8.48)[f, sol]	92,000 (21)[f,sol]	110,000[f]
Aromatic EC 5-7	70	140	300
Aromatic EC >7-8	130	290	660
Aromatic EC>8-10	34	83	190
Aromatic EC >10-12	74	180	380
Aromatic EC >12-16	140	330	660
Aromatic EC >16-21	260[f]	540[f]	930[f]
Aromatic EC >21-35	1,100[f]	1,500[f]	1,700[f]
Aromatic EC >35-44	1,100[f]	1,500[f]	1,700[f]

[f] oral, dermal, and inhalation exposure compared with oral HCV

[sol] S4UL presented exceeds the solubility saturation limit, which is presented in brackets

[vap] S4UL presented exceed the vapour saturation limit, which is presented in brackets

The assessment criteria for each of the petroleum hydrocarbon fractions have been taken from Nathanail, C. P., McCaffrey, C., Gillett, A., Ogden, R., and Nathanail, J., 2015, *'The LQM/CIEH S4ULs for Human Health Risk Assessment'*, Land Quality Press, Nottingham. These are also all based on a sandy loam soil.

Within the Environment Agency Science Report P5-080/TR3, Askari, K. & Pollard, S., 2005 *'The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils'* it is stated that the assessment values should not be considered individually; instead the potential additive effects should be calculated. This is achieved by calculating an individual Hazard Quotient (HQ) for each fraction. The HQ is the proportion of the assessment concentration represented by the recorded concentration. The HQs are then added together to form a Hazard Index (HI) and where this exceeds unity a potential significant risk to human health may exist.

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