



EXTENT OF SHALLOW WORKING HAS BEEN ESTIMATED BASED ON THE AREA BETWEEN BOREHOLES WHERE BROKEN GROUND OR VOIDS WERE ENCOUNTERED, AND THE NEAREST BOREHOLE WHERE THE SEAM WAS FOUND TO BE INTACT. DRILLING AND GROUTING BENEATH PLOTS, ROADS AND ADOPTED STORAGE PONDS REQUIRED IN THESE AREAS.

**KEY**

- ESTIMATED EXTENT OF SHALLOW WORKINGS WITHIN ABDY SEAM (north) & LOW BEAMSHAW SEAM (south) REQUIRING DRILLING AND GROUTING TO ~16m BENEATH PROPOSED PLOTS AND ADOPTABLE ROADS, AND ADOPTED STORAGE PONDS.
- ALTERNATIVE STRATEGY IS TO DRILL AND GROUT ENTIRE HATCH AREA TO ALLOW ANY PROPOSED LAYOUT
- GROUTING TO BE UNDERTAKEN ON 6m GRID INITIALLY AND CLOSED TO 3m WHERE VOIDS OR BROKEN GROUND FOUND IF GROUT TAKES ARE LOW. GROUTING MAY BE REQUIRED ON 3m GRID BENEATH ROADS SUBJECT TO HIGHWAY REQUIREMENTS.
- MASTERPLAN LAYOUT FOR INFORMATION - ACTUAL LAYOUT MAY CHANGE.
- POSSIBLE ADDITIONAL ZONE OF DRILLING AND GROUTING BASED ON WEATHERD COAL WITH POOR FLUSH AT 16m REPORTED IN BH R119. REQUIREMENT SUBJECT TO DISCUSSIONS WITH THE COAL AUTHORITY AND POSSIBLE FURTHER INVESTIGATION / REVIEW OF DRILLING AND GROUTING PROGRESS FROM THE WEST.
- RODGERS LEASK OPEN HOLE BH 2021
- SIRIUS WATER FLUSH BOREHOLE 2021
- SIRIUS AIR MIST FLUSH BOREHOLE 2021

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Client  
**HARWORTH ESTATES**

Project  
**ATHERSLEY**

Drawing Title  
**PROPOSED DRILLING & GROUTING PLAN**

Status

**INFORMATION**

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**APPENDIX B**  
**LITHOS TIER 1 SCREENING VALUES**

### Soil screening values used by Lithos

In March 2002 DEFRA and the Environment Agency published a series of technical papers (R&D Publications CLR 7, 8, 9 and 10) outlining the UK approach to the assessment of risk to human health from land contamination. In 2008 CLR 7, 9 and 10 and all corresponding SGV and Tox reports were withdrawn and superseded by new guidance including:

- Guidance on Comparing Soil Contamination Data with a Critical Concentration - CL:AIRE and CIEH, May 2008
- Evaluation of models for predicting plant uptake of chemicals from soil - Science Report – SC050021/SR
- Human health toxicological assessment of contaminants in soil - Science Report: SC050021/SR2
- Updated technical background to the CLEA model - Science Report: SC050021/SR3
- CLEA Software Handbook, Science report: SC050021/SR4
- Compilation of data for priority organic pollutants for derivation of Soil Guideline Values - Science Report: SC050021/SR7

In December 2013 Defra published the results of research project SP1010 – Development of Category 4 Screening Levels (C4SLs) for Assessment of Land Affected by Contamination. The objective of this project was to provide technical guidance in support of Defra's revised Statutory Guidance for Part 2 A of the Environmental Protection Act 1990 (Part 2A). The revised Statutory Guidance, published in April 2012, introduced a new four-category system for classifying land under Part 2A where Category 1 includes land where the level of risk is clearly unacceptable, and Category 4 includes land where the level of risk posed is acceptably low. Project SP1010 aimed to deliver:

- A methodology for deriving C4SLs for four generic land-uses comprising residential, commercial, allotments and public open space; and
- Demonstration of the methodology, via derivation of C4SLs for 6 substances – arsenic, cadmium, chromium IV, lead, benzene & benzo(a)pyrene.

The methodology for deriving both the previous Soil Guideline Values and the Category 4 Screening Levels is based on the Environment Agency's Contaminated Land Exposure Assessment (CLEA) methodology. Development of C4SLs has been achieved by modifying the toxicological and/or exposure parameters used within CLEA (while maintaining current exposure parameters).

The Part 2A Statutory Guidance was developed on the basis that C4SLs could be used under the planning regime. Defra anticipate that, where they exist, C4SLs will be used as generic screening criteria, and Lithos consider C4SLs to be suitable for use as Tier 1 Screening Values. Lithos have discussed this matter with both NHBC and YALPAG (collection of Yorkshire & Lincolnshire local authorities) and received confirmation that they are satisfied with this approach.

The CLEA conceptual site model assumes a source located in a sandy loam, with 6% soil organic matter (SOM) - equivalent to 3.5% total organic carbon (TOC). However, many organic contaminants are more mobile when the SOM is lower, and consequently comparison of soil results with revised, lower screening values may be required. Other CLEA default characteristics adopted by Lithos are:

Sandy Loam characteristics (source)	Default values adopted
Total porosity (fraction)	0.53
Water filled porosity (fraction)	0.33
Air filled porosity (fraction)	0.2

Lithos have derived Screening Values for five different CSMs (scenarios); these are:

- A - Residential with gardens, but no cover (or only up to 300mm)
- B - Residential with gardens and 600mm 'clean' cover
- C - Residential apartments with landscaping (i.e. no home grown produce)
- D - Commercial/industrial with landscaping
- E - Importation of soil cover

The **exposure** pathways considered for each scenario are detailed in the table below.

Scenario	Land use	Pathways	Justification
A	Residential with garden, but no cover (or only up to 300mm)	<ul style="list-style-type: none"> <li>• Direct ingestion of soil</li> <li>• Dermal contact</li> <li>• Consumption of vegetables &amp; soil attached to vegetables</li> <li>• Inhalation of indoor vapours and dust</li> <li>• Inhalation of outdoor vapours and dust</li> </ul>	Minimal cover – insufficient to break any pathways therefore all exposure pathways are relevant.
B	Residential with garden minimum 600mm cover	<ul style="list-style-type: none"> <li>• Inhalation of indoor vapours</li> <li>• Inhalation of outdoor vapours</li> </ul>	The 600mm cover removes the risk from all pathways other than inhalation.
C	Residential apartments with landscaped areas and minimum 300mm cover	<ul style="list-style-type: none"> <li>• Direct ingestion of soil</li> <li>• Dermal contact</li> <li>• Inhalation of indoor vapours and dust</li> <li>• Inhalation of outdoor vapours and dust</li> </ul>	All pathways applicable due to possible exposure from landscaped areas. However consumption of home grown produce not included as unlikely to be grown in landscaped areas. Where vegetables are to be grown site specific QRA may be required.
D	Commercial/ industrial with landscaped areas no cover	<ul style="list-style-type: none"> <li>• Direct ingestion of soil</li> <li>• Dermal contact</li> <li>• Inhalation of indoor vapours and dust</li> <li>• Inhalation of outdoor vapours and dust</li> </ul>	All pathways applicable due to possible exposure from landscaped areas. Assumed the commercial development consists of offices to provide a conservative assessment.
E	Importation of soil for cover in garden and landscaped areas	<ul style="list-style-type: none"> <li>• Direct ingestion of soil</li> <li>• Dermal contact</li> <li>• Consumption of vegetables &amp; soil attached to vegetables</li> <li>• Inhalation of outdoor vapours and dust</li> </ul>	Material used as cover to break existing pathways therefore all direct and indirect pathways relevant; however cover is <b>not</b> placed below plots therefore indoor inhalation is not relevant.

Lithos have assumed the source of contamination is directly below the building foundations; i.e. a depth to source of 0.15m as opposed to the CLEA default of 0.65m. This assumption provides for a more conservative approach than the UK default.

Lithos have derived Tier 1 values for a number of inorganic and organic determinands in the context of the five Scenarios A to E. The Tier 1 values are **not** intended to be used when considering potential risks associated with:

- Existing land uses in the context of Part 2A of the Environment Protection Act 1990;
- End uses such as allotments, sports fields, children's playgrounds, care homes, hospitals etc; and
- Controlled waters

Inorganic Tier 1 values for scenarios A to E

Inorganic contaminant	Tier 1 assessment criteria (mg/kg) for Scenarios A to E							Comments/notes
	SGV*	C4SL*	A	B	C	D	E	
As	32	37	37	Use (A) in SI Report for initial "screen"  If >5 x A, then consider increase of cover to 1,000mm	40	640	37	C4SL adopted
Cd	10	26	26		149	410	26	C4SL adopted
Cr			4,000		4,000	28,767	4,000	Assumes Cr is CrIII
Pb	450	200	200		314	2,330	200	C4SL adopted
Ni	130		109		123	892	109	Assessment of health risk only
Se	350		434		596	13,018	434	
Hg	170		199		244	3,603	199	Assumes in an inorganic compound
Vn			584		586	4,994	584	
B			5		5	5	5	
Cu			100		100	100	100	Based on phytotoxic risks as plants are the more sensitive receptor (Cu is pH dependant)
Zn			200		200	200	200	

Organic Tier 1 values for scenarios A to E

Organic contaminant (all sourced via CLEA)	Tier 1 assessment criteria (mg/kg) for Scenarios A to E							Comments/notes
	SGV*	C4SL*	A	B	C	D	E	
Benzene	0.33	0.87	0.7	<1^	<1^	63	<1	<1 based on professional judgement and lower than calculated value.
Toluene	610		836	2,048	1,912	5,000	<1	Scenario D based on professional judgement and lower than calculated value.
Ethyl Benzene	350		379	592	566	5,000	<10	Scenario E based on professional judgement and lower than calculated value.
Xylenes	240		535	590	585	5,000	<10	
Phenol	420		1,434	3,360	2,264	5,000	<10	
PCBs			2	8	2	38	N/A	Based on toxicity of EC7
Benzo(a)pyrene		5	5	25	5	76	5	C4SL adopted. Scenario B 5 times scenario A
Naphthalene			6	6	6	619	<10	Scenario E based on professional judgement and lower than calculated value
Gasoline Range Organics			22	23	23	2,178	626	See 3-step assessment of TPH below ^Based on professional judgement and lower than calculated value
Diesel Range Organics			215	218	215	^5,000	1429	
Lubricating Range Org			3,299	5,000	3,829	^5,000	3,299	

\* For a residential end use

The significance of PAHs can be determined by considering indicator compounds. In most cases benzo(a)pyrene (BaP) is adopted as an indicator due to the amount of toxicological data available and has been used by various authoritative bodies to assess the carcinogenic risk of PAHs in food. A surrogate marker approach can be used to estimate the toxicity of a mixture of PAHs in soil using toxicity data for individual indicator compounds within that mixture. Exposure to the surrogate marker is assumed to represent exposure to all PAHs in that matrix. The surrogate marker approach relies on a number of assumptions:

- Surrogate marker (BaP) must be present in all soil samples
- Profile of the different PAH relative to BaP should be similar in all samples
- PAH profile in the soil samples should be similar to that used in the pivotal toxicity study<sup>1</sup>

To assess the PAH profile in a soil sample, the ratio of the seven genotoxic PAHs (benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, chrysene, dibenz[a,h]anthracene and indeno[1,2,3-c,d]pyrene), relative to BaP, should be calculated. The ratio relative to BaP should lie within an order of magnitude above and below the mean ratio to BaP.

Naphthalene should also be considered separately against its generic screen. Whilst classed as a PAH, naphthalene is more volatile and mobile in the environment than most other PAHs. As such the significance of naphthalene cannot be considered within the surrogate marker approach.

Similarly, TPH cannot be assessed as a single "total" value, and reference has been made to the Environment Agency's document P5-080/TR3, "The UK approach for evaluating human health risks from petroleum hydrocarbons in soils". This document supports the assumptions and recommendations made by the US Total Petroleum Hydrocarbons Criteria Working Group (TPHCWG). The TPHCWG have broken down "TPH" into representative constituent fractions or "EC Bandings". The TPHCWG have derived a series of physiochemical and toxicological parameters for each of the bandings.

<sup>1</sup> SP1010 Appendix E, Provisional C4SLs for benzo(a)pyrene as a surrogate marker for PAHs, CL:AIRE 2013

The significance of speciated TPH results can be assessed by following the 3 steps outlined in the tables below.

Step	Result	Action
1. Consider indicator compounds: Are BTEX, naphthalene, benzo(a)pyrene above their respective Tier 1 values?	Yes	Remediation or dQRA required
	No	Proceed to Step 2
2. Consider individual TPH fractions: are they above respective screening values?	Yes	Remediation or dQRA required
	No	Proceed to Step 3
3. Assess Cumulative effects: Is the calculated Hazard Index for each source >1	Yes	Remediation or dQRA required
	No	TPH compounds pose no significant risk

The equation used to assess cumulative effects in step 3 is shown below.

$$HI = \sum_{F_i=1}^{16} HQ F_i = \frac{\text{Measured concentration } F_i \text{ (mg kg}^{-1}\text{)}}{SGV F_i \text{ (mg kg}^{-1}\text{)}}$$

where  $HI$  = Hazard Index  
 $HQ$  = Hazard Quotient  
 $F_i$  = Fraction  $i$   
 $SGV$  = Soil Guideline Value

### Statistical Assessment

Current UK guidance is provided by CL:AIRE<sup>2</sup>, and uses two-way confidence intervals and graphical summaries, to assist assessors when determining whether or not a dataset is adequate to answer the question posed; e.g. "is existing site topsoil suitable for retention & re-use?". To answer such a question, it is necessary to recover and test a large number of samples (a minimum of 10; ideally 20+) in order to undertake meaningful statistical analysis.

However, in the context of site investigation to assess the significance of contamination on brownfield sites which are typically underlain by **heterogenous made ground**, some remediation is almost always required (placement of soil cover, excavation of gross contamination etc). Consequently, in such circumstances, it is not necessary to demonstrate that made ground soils are "clean" and therefore there is no need to test large numbers of samples and undertake statistical analysis. Sample results can simply be compared directly with appropriate screening values (e.g. Lithos Tier 1 values).

The CL:AIRE (2020) guidance replaces the withdrawn "Guidance on Comparing Soil Contamination Data with a Critical Concentration" (2008).

The old approach to statistical analysis was based on a definitive yes/no answer which required limited consideration of the dataset and Conceptual Site Model, it was widely accepted that this did not allow sites or risk to be adequately assessed. The updated approach requires a comprehensive understanding of the datasets within the context of the Conceptual Site Model.

The current guidance requires that:

- A robust CSM is in place which identifies source areas, averaging areas and averaging zones
- Sampling locations are relatively evenly spread across the site and were selected using simple or stratified random sampling with no targeting being undertaken
- The field data and CSM do not suggest the presence of a hotspot of contamination which should be treated as a separate zone
- The samples are all taken from a similar same depth and within the same material type across the zone being assessed
- A minimum of 10 samples have been taken. It should be appreciated that confidence in a dataset increases as the number of samples obtained and tested from a zone increases.

The statistical analysis assumes a homogenous distribution of strata and contamination and therefore the dataset will be normally distributed (symmetric, log symmetric or fat tailed).

The normally distributed dataset is assessed using a number of statistical tools to generate a Dot and Box Plot which includes summary statistics and confidence intervals. The review of statistical data enables the assessor to make a decision, with an associated level of confidence, where the true mean of the sample population lies in relation to the critical concentration.

It is essential when using statistics to assess sample data that all decisions relate back to the conceptual site model. Statistics cannot indicate if contamination on a site is likely to present a risk to the end user, this is the role of the 'competent person' i.e. Lithos.

However, broadly speaking the following applies:

- Mean and UCL below the critical concentration – no further assessment required.
- Mean below the critical concentration, but UCL above – consider the CSM and likely sources.
- Mean and UCL above the critical concentration – further assessment required, remediation likely depending on the CSM.
- LCL, Mean & UCL above the critical concentration – further assessment required, remediation likely.

<sup>2</sup> CL:AIRE, 2020. Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration.

### Other screening values used by Lithos

Tier 1 risk assessment of **hazardous gas** is undertaken through reference to the following documents (and further information is presented in Generic Note No. 5 – Hazardous Gas):

- Approved Document C, Building Regulations 2000
- Boyle & Witherington (2007) – Guidance on evaluation on development proposals on sites where methane and carbon dioxide are present, incorporating “traffic lights”. Report Ref. 10627-R01-(02), for NHBC
- CIRIA C665 (2007) – Assessing risks posed by hazardous ground gases to buildings
- BS 8485:2015 – Code of Practice for the characterisation & remediation from ground gas in affected developments

With respect to the assessment of potential **phytotoxic effects** of contaminants, Lithos refer to The Sewage Sludge in Agriculture: Code of Practice 2018 for copper and zinc (at pH 5.5 to 6.0). The CLEA derived Tier 1 value is adopted for nickel due to its human health effects.

The potential risk to **building materials** is considered through reference to relevant BRE Digests, with particular emphasis on BRE Special Digest 1, ‘Concrete in aggressive ground’, 2005.

With respect to the interpretation of the **calorific values**, at present there are no accepted methods to assess whether a sample is combustible and under what circumstances it might smoulder. Some guidance is given in ICRCCL Note 61/84 “Notes on the fire hazards of contaminated land” which states that: “*In general ... it seems likely that materials whose CV’s exceed 10MJ/kg are almost certainly combustible, while those with values below 2MJ/kg are unlikely to burn*”.

Tier 1 **groundwater risk assessments** are always site specific and compare leachate or groundwater concentrations with the appropriate water quality standard based on the CSM and consideration of relevant water quality impacts and assessments.

### Waste classification & WAC

In the context of waste soils generated by remediation and/or groundworks activities on brownfield sites, the following definitions (from the Landfill Regulations 2002) apply:

- Inert (e.g. uncontaminated ‘natural’ soil, bricks, concrete, tiles & ceramics)
- Non-Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances, but at concentrations below prescribed thresholds)
- Hazardous (e.g. soil excavated from a contaminated site which contains dangerous substances at concentrations above prescribed thresholds)

Dangerous substances include compounds containing a variety of determinants commonly found in contaminated soils on brownfield sites, for example arsenic, lead, chromium, benzene etc.

Landfill operators require Waste Acceptance Criteria (WAC) laboratory data, if soil waste is classified as **hazardous**. However, subject to WAC testing it may be possible to classify it as stable, non-reactive hazardous waste, which can be placed within a dedicated cell within the non-hazardous landfill.

Lithos typically only include WAC analysis in site investigation proposals and reports, if significant off-site disposal (of soil classified as hazardous waste) is anticipated, for example where redevelopment proposals include basement construction etc. If off-site disposal of soils classified as hazardous waste during redevelopment is anticipated, then WAC analysis should be scheduled at an early stage in the remediation programme. However, organic compounds (BTEX, TPH, PAH etc) are the most common contaminants that result in soils being classed as hazardous, and these contaminants can often be dealt with by alternative technologies (e.g. by bioremediation or stabilisation) and consequently retention on site is often possible.

It should be noted that **non-hazardous** soil waste can go to a non-hazardous landfill facility; no further testing (e.g. WAC) is required.

**APPENDIX C**  
**PROTOCOL FOR IMPORTATION & USE OF SOIL COVER (CAPPING)**

## 1 INTRODUCTION

- 1.1 Isolation of made ground in garden and landscaped areas beneath a cover of "clean" subsoil, and topsoil is often recommended on new developments; most notably when the made ground contains inorganic (and non-volatile organic) contaminants at concentrations above relevant guidance threshold values. A cover solution is not appropriate for volatile or semi-volatile organic contaminants (fuels, solvents etc); removal or treatment will usually be required.
- 1.2 The thickness of cover is dependent on the end use of the development, nature and degree of contamination (and sometimes the Local Authority whose area the site lies within), Typically for a commercial development between 300mm and 1,000mm thickness is required and for a residential development between 600mm and 1,000mm thickness is required. Regardless of the type of development, where contamination is more significant a granular hard-dig layer or geotextile marker membrane may also be required at the base of the cover.
- 1.3 The "clean" soil cover blocks potential linkages between the contaminated made ground and future site users. Soil cover is not required beneath areas of hardcover including buildings, private drives, carparking and roads.
- 1.4 If the made ground is essentially "clean", but contains materials generally considered undesirable as near-surface material in garden and landscaped areas (e.g. oversize materials such as construction/demolition rubble) then placement of cover is also required. In private gardens, in accordance with NHBC Standards Chapter 10.2, a 450mm thick soil cover should be adequate. In landscaped areas a 300mm thick soil cover should be adequate. For both gardens and landscaped areas if the made ground is essentially "clean" and comprises reworked natural soil, the only cover likely to be required is 100mm topsoil.
- 1.5 The **CML initiative** came into force in April 2003 and relates specifically to residential developments. It requires housebuilders to submit to NHBC (or other warranty providers) a validation report confirming the thickness and quality (i.e. contaminant-free) of the placed soil cover. Validation reports should normally be prepared by independent geoenvironmental consultants.
- 1.6 Failure to submit cover validation reports promptly will delay issue of the cover note by the warranty provider, which will subsequently delay the release of mortgage funds and hence legal completion; i.e. the financial implications are significant. Consequently, it is essential that cover validation is requested at least 2 weeks prior to the anticipated finalling date.
- 1.7 For all land uses soil cover is usually placed many weeks after completion of the preparatory/remediation works, and issue of the associated Verification Report, typically at a relatively late stage in the construction programme.
- 1.8 Prior to placement of soil cover, the appointed remediation contractor and/or groundworker should ensure that ground levels are low enough to accommodate the required cover thickness, taking account of any boundary issues, and, where relevant, without compromising the DPC and any sub-floor ventilation.
- 1.9 Ideally soil quality should initially be determined by sampling of the source (at least 7 working days before importation to the development site) to demonstrate suitability for use. Further sampling of the material at the site may also be required to demonstrate cross contamination did not occur during the importation process. Samples could also be obtained from stockpiles of site won material on site; there may comprise surplus natural ground development arisings. Soil samples could be obtained after placement of the cover layer, but this is not recommended.

- 1.10 Imported topsoil should be subject to testing, unless it is being sourced from a reputable commercial supplier able to provide robust certification (certificate date less than 2 months prior to import date). In addition, some analysis in accordance with BS3882 may occasionally be appropriate.
- 1.11 Where sampling of the source has been carried out, and on receipt of the laboratory results, Lithos will issue a confirmation of soil suitability for importation to the client, who will in turn instruct his contractor to commence importation.
- 1.12 Clearly, if soil cover is imported and placed before confirmation of its suitability, no guarantee can be given that validation work will yield the desired results. It may therefore be necessary to excavate and export the placed soil cover and/or import further "clean" soil.
- 1.13 It is likely that it will be necessary to stockpile imported soil cover material at the site. Where soils have been confirmed as suitable for use and temporarily stockpiled on site, stockpiles should be fenced-off and marked as containing certified topsoil/subsoil. The soil should be inspected prior to placement to confirm that it is the same material as previously tested, and that it has not been cross-contaminated with miscellaneous arisings generated during the construction works. Where material has been stockpiled on site for an extensive period of time further sampling may be required at the development site to demonstrate cross contamination has not taken place.
- 1.14 Soil **thickness** can only be checked after placement; this should be done before turfing / landscaping, but ideally after scaffolding has been dismantled.
- 1.15 **Sampling Frequency (to check Soil Quality):** The number of samples tested will be dependent on the nature of the source, and the quantity of material to be imported. However, in accordance with current YALPAG (Yorkshire & Lincolnshire Pollution Advisory Group) guidance<sup>1</sup>, the testing frequency should be as follows:

Nature of source	Number of samples (from any single source material)	
	Up to 500m <sup>3</sup>	Per additional 500m <sup>3</sup>
Greenfield	At least 3 <sup>#</sup>	1 <sup>*</sup>
Brownfield	At least 6 <sup>#</sup>	1 <sup>*</sup>
Crushed product	At least 3	1 <sup>*</sup>

\* To be agreed with the relevant Local Authority

# But could be up to 10 samples (if 500m<sup>3</sup>), depending on the Local Authority area within which the site is located.

- 1.16 On a typical residential development where gardens comprise a total area of 100m<sup>2</sup> (front and rear), and a soil cover thickness of 600mm including 100mm topsoil, for a brownfield source this testing frequency equates to approximately one topsoil sample per ten plots and one subsoil sample per two plots. Given the requirement to test a minimum number of samples from any one source, the testing frequency effectively increases for sites with only a small number of plots.

<sup>1</sup> Verification Requirements for Cover Systems: Technical Guidance for Developers, Landowners & Consultants; Version 4.1, June 2021.

1.17 **Inspection Frequency (to check soil thickness):** The number of inspection pits excavated to check cover thickness (and collect samples, if required) should be dependent on the end use of the development.

1.18 For **residential developments** the number of plots associated with a given site will dictate the number of inspection pits. The following frequencies are recommended for residential plots.

No. plots within development	Frequency of inspection pits	Remarks
1 to 5	1 pit per plot	e.g. for 3 plots, dig 3 inspection pits
6 to 20	1 pit per 2 plots	e.g. for 9 plots, dig 5 inspection pits
21 to 30	1 pit per 3 plots	e.g. for 23 plots, dig 8 inspection pits
≥ 30	1 pit per 4 plots	e.g. for 39 plots, dig 10 inspection pits

1.19 For **areas of landscaping**, regardless of development type, a minimum of 3 pits per area of soft landscaping are recommended where the landscaped area is greater than 25m<sup>2</sup>. In individual landscaped areas smaller than 25m<sup>2</sup> inspection pits are not required.

1.20 Photographs should be taken of each inspection pit to show:

- The thickness of cover material present
- The presence of any geotextile marker or granular hard-dig layer (if required)
- The position of each inspection pit in relation to the plot/area of landscaping

1.21 **Soil Material Suitability:** Inspection pits should be excavated through the entire thickness of any proposed in-situ source material, or cover material (if inspection is post-placement). Stockpiles should be assessed from both the surface and by digging into the “core”, to ensure the material is reasonably homogenous.

1.22 The soil material should comply with the following requirements:

- Be clean and free of foreign debris, building waste materials, glass sharps, and contaminants
- Topsoil should not have a gravel content of greater than 30% by dry weight and should generally have a maximum stone size of 50mm in any one direction
- Subsoil should generally have a maximum stone size of 75mm in any one direction
- Not have been sourced from an area within 7m laterally, or 3m vertically, of Japanese Knotweed plants, and not contain any Japanese Knotweed fragments (rhizomes, leaves, stems etc)

1.23 **Laboratory Analysis:** Whether samples are taken at source, from stockpiles on site, or from gardens and landscaped areas after placement, they should be forwarded to an analytical laboratory for testing in accordance with one of the Schedules detailed in Table 1 overleaf.

1.24 Additional determinands may be scheduled dependent on the history of the source site, although if this is considered necessary it may suggest the material is unlikely to be suitable for use as clean cover.

**Table 1 – Test schedule**

Source	Test schedule
Greenfield & Manufactured topsoil	pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron. TOC & speciated PAH Asbestos ID
Brownfield & Soil transfer stations	pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron. TOC, Speciated PAH & banded TPH* Asbestos ID
Crushed product	pH, total metals (Cu, Ni, Zn, Cr III, Cr VI, As, Hg, Se, Cd & Pb), water soluble boron. TOC & Speciated PAH Asbestos ID

**Note:** The schedules detailed above have been prepared in accordance with the Secondary Model Procedures and Land Contamination Risk Management, 2020. This document states that analysis should be relevant to potential sources and not merely a set list of parameters applied to each site.

\* The YALPAG guidance recommends speciated TPH (TPH CWG) analysis for brownfield sources, but this should not be necessary unless the banded TPH analysis fails the assessment criteria detailed in Table 2 below.

Where crushed product is used at least 600mm below finished garden level, only asbestos analysis will be required.

1.25 Chemical assessment (Tier 1) criteria for imported soils are provided in Table 2, these reflect exposure and toxicological amendments proposed within the C4SL report. Where no C4SL value has been published generic assessment criteria have been derived based on the C4SL assumptions using the CLEA model (version 1.701).

**Table 2 - Chemical assessment criteria for imported soils**

Contaminant	Source	Tier 1 assessment criteria (mg/kg)	Comments/notes
pH	CLEA		
As	C4SL	37	
Cd	C4SL	26	
Cr (III)	CLEA	4000	
Cr (VI)	C4SL	21	
Pb	C4SL	200	
Ni	CLEA	109	Assessment of human health risk only.
Se	CLEA	434	
Hg	CLEA	199	Assumes mercury present as an inorganic compound (cf elemental metal or within organic compound). See Science Report SC050021/Mercury SGV.
Vn	CLEA	584	
B	Lithos	5	Based on phytotoxic risks as plants are the more sensitive receptor (Cu is pH dependent).
Cu	DoE	100	
Zn	DoE	200	
Benzo(a)pyrene	C4SL	5	
Naphthalene	CLEA	6	
GRO	CLEA	22	Conservative value based on value for aromatic fraction C7 to C8 range, but assuming indoor inhalation pathway still relevant (it shouldn't be).
DRO	CLEA	215	Conservative value based on value for aliphatic fraction C10 to C12 range, but assuming indoor inhalation pathway still relevant (it shouldn't be).
LRO	CLEA	1,000	Calculated value above hazardous waste screen in WM3, therefore 1,000mg/kg adopted. This may be reviewed on a site specific basis depending on the source and nature of transfer.

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## 2 VALIDATION REPORTS

- 2.1 The analytical testing will usually be undertaken on a 3 or 5-day turnaround and the Client/Contractor will be notified of the soil's suitability (or otherwise) immediately after receipt of the results.
- 2.2 Interim plot validation certificates for residential plots should be issued to warranty providers on a plot by plot (or block by block) basis as development proceeds. Once the full development has been completed these should be pulled together into a final verification report, for submission to the Local Authority to satisfy planning conditions.
- 2.3 Interim validation certificates will be issued by Lithos for each landscaped area or set of landscaped areas once completed. After Lithos have been able to confirm placement of agreed thicknesses of suitable soil cover in all landscaped areas across the site, and where required to satisfy a Local Authority planning condition, we will prepare and submit a final validation letter report.