Frequently Asked Questions

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Further details on the LQM/CIEH Suitable 4 Use Levels (S4ULs) for Human Health Risk Assessment can be found at: http://www.lqm.co.uk/publications/

No.	Question	Response
24.	**I am struggling to replicate the S4UL's in the latest version of the CLEA model (CLEA v1.071), especially for the 'Residential with homegrown produce' and 'Alltoment' landuse scenarios?**	You can replicate the S4UL's using CLEA v1.071 providing you use the relevant receptor, exposure and land use parameter inputs as described Chapter 1 of the publication. The current version of the CLEA (v1.071) contains two sets of pre-defined land uses and receptors; those compliant with SR3 (Environment Agency, 2009a) and those incorporating the changes as implemented in deriving the C4SLs (Defra, 2014a). The S4UL's were derived by implementing the exposure, receptor and land use parameter changes described by Defra (2014a), with the exception of the '*Top Two Approach*' for the vegetable consumption pathway (see also FAQ entry 15) below. Therefore, to replicate the S4UL's which include exposure via homegrown produce the risk assessor will need to: - Select the appropriate 'C4SL compliant' Land Use; - Select the appropriate 'C4SL compliant' Receptor; - Ensure the '*Apply Top 2*' check box within the '*Homegrown Produce Data*' (Advanced Settings, Step 4) is unchecked; and - Ensure that within the '*User Chemicals*' worksheet the entries for each produce group in the '*Apply Top 2 Method to Produce Groups*' columns (BK3:BP3) are set to Yes for each contaminant.
23.	**What is the origin of the adult oral MDI estimates for mercury presented in paragraph 36 (Section 8.3.5)?**	A cautious approach has been taken to estimating MDI_{oral} estimates based on the most recent information known to us at the time of writing. The previous Environment Agency TOX report (Environment Agency, 2009b) reported that "*adult oral mean daily intake (MDI_{oral}) for mercury from food and*

	water is estimated to be 1.5 µg day^{-1}, of which about 1 µg day^{-1} is inorganic mercury and about 0.5 µg day^{-1} is methylmercury". However, the FSA subsequently published the 2006 Total Diet Survey (FSA, 2009) which concluded that "*The population exposure to mercury is 0.001 - 0.003 milligrams per day. The mean adult daily dietary exposure to mercury is 0.05 micrograms per kilogram body weight*". Correcting this mean value based on a 70kg body weight gives a MDI for total mercury of 3.5µg day^{-1}. Section 8.3.2 discusses the fact that the contribution via drinking water is negligible in comparison to this dietary exposure. Previously, the Environment Agency (2002; 2009b) had used the assumption that all "*that all this fish mercury is in the organic form, and that fish is the main source of methylmercury in the diet*" to estimate the MDI for organic mercury from that of total mercury. We have adopted the same assumptions, but used the more recent estimate by the FSA (2009) that fish contributes 25% to dietary exposure. Thus, of the 3.5µg day^{-1} of total mercury it is estimated that around ~0.9µg day^{-1} will be organic mercury/methylmercury and the remaining 2.6µg day^{-1} inorganic mercury. These higher estimates have been used in preference to those recommended by the Environment Agency (2009b). It should also be noted that the values adopted are very similar to those originally recommended by the Environment Agency (2002) in the original TOX 7 report, which concluded that "*The mean daily intake of total mercury assumed for an adult from food sources is therefore 3.5µg day^{-1}, of which approximately 1µg day^{-1} is organic mercury and approximately 2.5µg day^{-1} is inorganic mercury*".
22. The Environment Agency have withdrawn their 2009 SGV for Nickel, in response to the EFSA scientific opinion (published February 2015) on the public health risk from the presence of nickel in food and drinking water. Does this affect the published LQM/CIEH S4ULs?	In February 2015, the European Food Safety Authority (EFSA, 2015) published a scientific opinion on the public health risk from the presence of nickel in food and drinking water. EFSA (2015) recommended an oral TDI of 2.8 µg kg^{-1} BW day^{-1} for Nickel for the assessment of chronic effects. This is considerably lower than the oral HCV used in the derivation of the 2009 Environment Agency SGV (i.e. TDI_{oral} of 12 µg kg^{-1} BW day^{-1}), which was also used in deriving the LQM/CIEH S4UL's published in January 2015.

		Based on the findings of EFSA (2015), the Environment Agency have decided to withdraw the 2009 SGV[1] and associated reports (7th August 2015), although the SGV Report, the TOX Report, and the Supporting Information Document for Nickel will remain available for historical reference on the Environment Agency archives[2]. However, the Environment Agency no longer undertakes work to derive new SGV or TOX reports and so will not be updating them. *****UPDATED Nickel S4ULs ***** Therefore, following the EFSA (2015) opinion and Environment Agency statement, LQM have decided to revise the published S4UL's in light of these recent developments. The EFSA (2015) recommended oral TDI of 2.8 µg kg^{-1} BW day^{-1} for Nickel has been used for the assessment of chronic effects via the oral routes of exposure. This has resulted in a decrease in those S4UL's in which the oral exposure pathway dominates. The updated S4UL's and additional explanation are available for download from: http://www.lqm.co.uk/uploads/documents/Nickel_S4UL_Update_Aug_2015_Final.pdf We would recommend you print off the downloadable update and keep with your original document for future reference.
21.	**How have the oral pathways for Elemental Mercury been modelled?**	Table 8-2 states that "*Oral+dermal+inhalation*" intakes have been compared with the TDI_{inhal} and this is correct. However, this appears to be contradicted by the footnote to Table 8-5 stating "… *oral pathways [are] not considered for elemental mercury*". This footnote should more accurately state that the "*uptake by homegrown produce is not considered for elemental mercury*", hence no soil to plant concentration factors are presented in Table 8-5. Consequently, the pathway contributions for the '*Consumption of homegrown produce and attached soil*' presented for relevant landuses in Table 8-7, relate solely to the ingestion **soil attached** to homegrown produce.
20.	**Is there a unit error in the 3rd sentence of paragraph 39 of Section 6.4.1.4, for the Chromium III inhalation TDI?**	*****ERRATUM***** Yes, the publication states "*An inhalation TDI of 0.03 mg chromium III* m^{-3} *was selected …*". It should state that "*An inhalation TDI of 0.03 µg* kg^{-1} *BW* day^{-1} *was selected …*", the value that is presented in Table 6-3 and

[1] https://www.gov.uk/government/publications/land-contamination-soil-guideline-values-sgvs, accessed 18/08/15

[2] http://webarchive.nationalarchives.gov.uk/20131108051347/http:/www.environment-agency.gov.uk/research/planning/33714.aspx, accessed 11 August 2015

	Does this impact the S4ULs published for Chromium III?	used to derive the S4ULs. No the S4ULs have been derived using the value for the inhalation TDI of 0.03 µg kg^{-1} BW day^{-1}, as presented in Table 6-3.
19.	**Are the S4ULs for Elemental and Methlymercury sensitive to SOM?**	Yes. For consistency of approach within the individual 'Metals' group chapters we have followed the LQM/CIEH 2nd Edition GAC and SGV approach of presenting S4ULs at a single Soil Organic Matter (SOM) value. Therefore, S4ULs for the forms of Mercury exhibiting volatility (Elemental and Methylmercury) have only been derived at 6% SOM, as noted in footnote 'a' of Table 8-6 (S4ULs for Mercury). It is accepted that given the physical-chemical properties of Elemental and Methylmercury we would see sensitivity in S4ULs derived using the CLEA model according to SOM.
18.	**I cannot replicate the S4ULs for elemental mercury.**	The S4ULs for elemental mercury have been derived using the inhalation Health Criteria Value (HCV) presented in the 2009 Environment Agency Mercury Tox report (Environment Agency, 2009c). The paucity of data does not allow the derivation of an oral HCV. In generating the S4ULs exposure via all routes of entry into the body (i.e. oral, inhalation and dermal) has been compared with the inhalation HCV (as detailed in Table 8-2 of the S4UL publication). Whereas in deriving the Soil Guideline Values for elemental mercury (Environment Agency, 2009d) only the inhalation exposure was compared with the inhalation HCV as absorption following oral ingestion was considered by the Environment Agency to be limited and was therefore ignored in deriving the SGV. Hence when running the CLEA v1.06 software if you are selecting the default mercury contained in the software the inputs in the contaminant database relating to the comparison of exposures with the relevant HCVs will be different.
17.	**For Naphthalene should the S4UL value at 6% SOM for POS_{park} (Table 18-59) have a superscript f, as per the S4ULs at 1% and 2.5% SOM%?**	Yes that is correct, all of the S4ULs for Naphthalene for each landuse should have the superscript f, with the explanation provided as a footnote in each relevant table (18-54 to 18-59).
16.	**I can't replicate the S4ULs for Phenol using the data in the S4UL report and the revised exposure scenarios.**	It is important that all user-entered contaminants added to Chemicals Database within the CLEA software are given a unique chemical name. Unfortunately, the revised parameters intended for the phenol S4UL were entered with the name "*Phenol*", but the CLEA v1.06 software already contains a hardcoded entry with the same name with the parameter dataset used for the 2009 SGV (Environment Agency, 2009e). Due to the coding used within the CLEA software, which also

		does not highlight dual entries, the parameters for this hardcoded entry were inadvertently used in deriving the originally published S4ULs for Phenol, which are higher than they ought to have been when derived using the toxicological (Table 40-2) and physical-chemical input parameters (Table 40-3). Note that the remaining S4UL contaminants were all given unique chemical names thereby avoiding confusion with pre-existing SGV contaminants and so are not affected by this issue. *****ERRATUM***** An errata containing the corrected S4UL values and ADE/HCV ratios and pathway contribution data for Phenol is available for download from: http://www.lqm.co.uk/uploads/documents/Errata_S4UL_version1.1.pdf
15.	**It's not clear in the S4UL document if LQM applied the 90th percentile values for the vegetable consumption rates supplied as Table 3.4 in the SP1010 (C4SL) Project Main Report (Defra, 2014b) or used the default 90th percentile values supplied within the current CLEA model (v1.06) as defined in SR3 (Environment Agency, 2009a).**	As outlined and explained within Section 1.4.4. of the S4UL publication (Nathanail et al., 2015) the "*top two*" produce approach has not been implemented in deriving the S4UL. In deriving the residential with home grown produce S4ULs, the default 90th percentile vegetable consumption rates that are included within the CLEA v1.06 model as presented within SR3 (Environment Agency, 2009a) have been relied upon.
14.	**In the derivation of the LQM/CIEH S4UL value for dibenz[ah]anthracene, the S4UL level is based on a 2010 US EPA publication that clearly states "DO NOT CITE". If you are using the S4UL, and you have a site where this is exceeded, how would you defend it?**	Exceedance of a generic assessment criterion should trigger either a detailed quantitative risk assessment or if the exceedance is deemed substantial then remediation – to a site specific remediation target - may be justified. As stated in Chapter 1 of the S4UL report (Nathanail et al., 2015), S4ULs are intended to be screening values and as such "*exceedance of a relevant LQM/CIEH S4UL* ***does not constitute*** prima facie *evidence of either a 'significant possibility of significant harm' or of the need for remediation under the UK's planning regimes. Rather such exceedance should usually trigger a further detailed quantitative risk assessment, where site-specific parameters are used to derive site-specific assessment criteria*". As clearly acknowledged in Section 18.3.1 of the S4UL report (Nathanail et al., 2015), the USEPA document is labelled as "*DRAFT - DO NOT CITE OR QUOTE*" but in our opinion represents "the *most comprehensive and up-to-date estimates available*". Furthermore, it is USEPA normal practice to consult widely on a

	contractor's draft reports prior to their final publication, such drafts are normally marked "*DRAFT - DO NOT CITE OR QUOTE*". Such documents have routinely been used as pertinent information in the derivation of UK human health generic assessment criteria, including SGVs, C4SLs and previous LQM/CIEH GACs.
13. Can you clarify why there are two approaches outlined within the S4UL publication for assessing PAHs and benzo[a]pyrene?	There are large uncertainties in the assessment of risk posed by mixtures of polycyclic aromatic hydrocarbons (PAHs), and authoritative bodies in different countries have made different assumptions and recommendations. As discussed in Chapter 18, S4ULs have been generated that allow for the use of the two most common approaches for PAH mixtures. Both methods have different strength and weaknesses and Section 18.3 states "*Risk assessors need to understand the differences between these two approaches and use the appropriate S4ULs in each case, which may differ significantly*". Consequently, two sets of S4ULs relevant to benzo[a]pyrene (BaP) are reported; one referred to as "*benzo[a]pyrene (only)*" or simply "*benzo[a]pyrene*", the other as "*Coal Tar (BaP as surrogate marker)*". These numbers are not interchangeable and are designed for use under the two different approaches. The first approach (adopted in the 2nd Edition LQM/CIEH GAC publication (Nathanail et al., 2009) is to individually assess each of the PAH congeners commonly tested for (i.e. the EPA 16). Consequently, an S4UL has been reported for each of these 16 congeners. This is how the "benzo[a]pyrene (only)" values were derived and are based on Health Criteria Values that apply to BaP itself (a single congener). When adopting this value all the other congeners within the mixture (including dibenzo[ah]anthracene) also need to be assessed against their corresponding S4ULs. Risk assessors may decide to adopt this method in a variety of situations, including where a PAH mixture is not sufficiently coal tar-like to apply the surrogate marker approach (described below). The second approach involves the use of a surrogate marker to assess the carcinogenic risks from the PAH mixture as a whole. This is the approach recommended within the Public Health England (formerly HPA) guidance "*Risk assessment approaches for polycyclic aromatic hydrocarbons (PAHs) - Version 5*" (HPA, 2010). This document describes when this approach is appropriate and the validation needed to test whether the PAH mixture at any given site can be regarded as "*coal tar*". Under this method the levels of the surrogate marker (BaP in this case) are compared to a suitable assessment criteria; this

	assessment is assumed to apply to the risks for the mixture as a whole. The benzo[a]pyrene C4SLs derived for Defra (Defra, 2014c) are intended for use in such a surrogate marker approach. The COC (2013) raised concerns about the effects of mixtures at the Low Level of Toxicological Concern (LLTC) on which C4SLs are based and reiterated their preference for a minimal level of risk basis for choosing toxicological benchmarks. The "*Coal Tar (BaP as surrogate marker)*" S4UL is intended for use as a surrogate marker. The S4UL is based on Health Criteria Values from studies involving coal tar mixtures (i.e. that of Culp et al., 1998), and the fate and transport parameters are the same as those used for BaP alone. Although the S4ULs for BaP alone are generally higher than those for "*Coal Tar (BaP as surrogate marker)*", Section 18.9 clearly states that "*the S4UL for benzo[a]pyrene (only) is not suitable for use in [a] surrogate marker approach to risk assessment*".
12. Could you please confirm that the first column heading of Table 17.14 (Petroleum Hydrocarbons) on page 17.20 should read residential land use w/o HP and not allotment land use?	***ERRATUM*** Yes you are correct the title of Table 17-14 is correct and the first column heading is incorrect. Therefore, Table 7-14 reports the S4ULs for the residential without homegrown produce for Petroleum Hydrocarbons, whilst Table 7-15 reports the S4ULs for the allotment landuse. Also note that the first column headings for Table 17-17 (POS_{resi}) and 17-18 (POS_{park}) also incorrectly state 'Commercial land use'. The table titles are correct for the S4ULs reported.
11. I think the S4UL document could cause some confusion using the 'PCA' acronym and the 'Perchloroethane' alternative name for Tetrachloroethane (CAS 79-34-5 & 630-20-6), C_2-H_2-Cl_4.	PCA and Perchloroethane are also commonly used as abbreviation/alternative name for Hexachloroethane (C_2Cl_6, CAS No. 67-72-1), which is a white crystalline solid at room temperature with a camphor-like odour[3]. However, PCA has also been widely used as an abbreviation for Tetrachloroethane isomers (e.g. Defra & Environment Agency, 2004) and so this 'convention' was re-stated in the S4UL publication and used for expediency. When reporting a substance LQM would recommend use of the full IUPAC name and CAS Number to avoid confusion and so these have also been provided in the publication. It is acknowledged that the use of the term Perchloroethane as an alternative

[3] http://www.rsc.org/learn-chemistry/resource/rws00005979/hexachloroethane, accessed 15 January 2015

		name for Tetrachloroethane is not strictly correct, but it has been used in some literature historically and so the reader should be aware of the possibility for confusion when using non IUPAC terminology. Such practices were widespread and are important to resolve during the desk study phase when trying to compile an inventory of potential contaminants.
10.	**Do the "Exposure Frequency" values in Table 1-1 & 1-2 of the S4UL publication apply to all the POS 1/2 pathways (i.e. POS_{resi} and POS_{park})?**	Yes the stated exposure frequencies within Table 1-1 and 1-2 have been applied to all of the active exposure pathways for each public open space scenario. The approach taken by LQM is consistent with the stated approach published on behalf of Defra (Table 3.5, Defra, 2014b).
9.	**Have SR3** (Environment Agency, 2009a) **Residential Outdoor Inhalation (dust & vapour) also been reduced to 170 days from 365 days? (in line with dermal & POS-1/2 as indicated by "Exposure Frequency" in Table 1-1 & 1-2 of the S4UL publication). Table 1.3 (S4UL publication) only states that Dermal reduced. [Note: POS1 ≡ POS_{resi}; POS2 ≡ POS_{park}; POS1 and POS2 were terms used to represent the two public open space scenarios during the stakeholder engagement period of the SP1010 Defra project]**	No the residential outdoor inhalation (dust and vapour pathways) exposure frequency has not been reduced to 170 from the SR3 default of 365 days per year. Therefore, the exposure frequency is not consistent with the outdoor dermal exposure frequency discussed under Query 8 below or that outlined for POS_{resi} or POS_{park} (Table 1-1 or Table 1-2, of the S4UL publication, respectively). The approach taken by LQM is consistent with the stated approach published on behalf of Defra (Table 3.5, Defra, 2014b). Presumably this apparent inconsistency arises because the sensitivity analysis carried out on behalf of Defra did not highlight the outdoor inhalation of dusts or vapours to be an important pathway (i.e. significant contribution to exposure for the exposure scenarios considered) and so were not considered to be key pathways for further assessment or modification (Section 3.3, Defra, 2014b).
8.	**Table 1.3 of the S4UL publication states for Residential: "reduce exposure frequency for dermal contact outdoors for residential land use from 365 to 170 days per year (AC1 to AC18). However, SR3** (Environment Agency, 2009a) **sets default Residential Outdoor (and indoor) Dermal exposure frequency for AC-1 as 180 days, not 365 days. Has AC-1 also been reduced to 170 days, or does it remain at 180 days?**	All age classes (AC1 to AC18) for dermal contact outdoors under the residential scenarios (with and without homegrown produce, lifetime exposure and public open space) have a default exposure frequency set at 170 days per year. The approach taken by LQM is consistent with the stated approach published on behalf of Defra (Table 3.5, Defra, 2014b).

7.	**The POS_{resi} values do not have the vapour saturation limits in parenthesis, while the lower POS_{park} values do (e.g. 1,1,1-trichloroethane). Has there been a typo or am I missing something? [Note this is a similar query to the FAQ Q8 for the 2nd Edition LQM/CIEH GAC Publication, available at: http://www.lqm.co.uk/uploads/documents/FAQ_2ndEdition.pdf]**	The introductory chapter of the LQM/CIEH S4UL publication addresses the procedure that was followed in the reporting of saturation limits (Section 1.4.7. on page 1-6). Specifically, where the S4UL calculated by the CLEA model exceeds the lower saturation limit (i.e. the lower of either the aqueous or vapour based saturation limit) and is highlighted in red within the CLEA model output (i.e. where the vapour pathway is calculated by the CLEA model as being an important contributor to exposure) the lower saturation limit is also reported in brackets. It should be noted that the saturation limits are estimated within the CLEA model based upon site- and contaminant-specific user inputs, as described within Section 5.3 of SR3. The appearance of a saturation limit in any of the S4UL tables within the LQM/CIEH S4UL publication is dependent on the outcome of the '*traffic light*' approach taken within the CLEA model and also the contaminant, site specific inputs and landuse scenario selected. Further explanation of the approach taken within the CLEA model and '*traffic light system*' is provided within Section 4.12 of SR4, which also provides some points for consideration by the risk assessor when interpreting outputs from the CLEA model. The answer to Q8 and Q9 of the FAQ for the **2nd Edition LQM/CIEH GAC Publication** may also be useful for further background on this issue. The S4UL presented within the publication are taken directly from the CLEA model output to facilitate the comparison with criteria generated by the assessor themselves. However, the CLEA model does not cap media concentrations based on saturation limits or maximum values, rather the outputs are based on worst-case health criteria based assumptions. As with all assessment criteria, the risk assessor needs to exercise their judgement as to the appropriateness of the LQM/CIEH S4UL taking into consideration site-specific circumstances.
6.	**Some of the S4ULs for a Residential Open Space (POS_{resi}) seem to be an awful lot higher than the values for Park Open Space (POS_{park}) which seems counter intuitive (e.g. 1,1,1-trichloroethane).**	When comparing the values of the S4ULs for these two public open spaces it should be noted that the receptor characteristics (such as age classes and exposure frequencies) and relevant exposures pathways are different. For example the POS_{resi} critical receptor is the female child Age Class 4-9 years, whilst for the POS_{park} it is the female child Age Class 0-6 years. Therefore, the S4UL calculated using the CLEA model will vary according to the receptor characteristics, exposure pathways and physical-chemical properties of the contaminant. For organics of relatively high volatility, the contribution of the outdoor inhalation pathway to total average daily exposure will be more significant for the POS_{park} compared to the POS_{resi} exposure scenario.

5.	**Defra have recently published an erratum to their C4SL methodology, how does this affect the S4ULs?**	The Defra erratum was issued during the course of the S4UL print-run. We subsequently checked the implication of the currently published changes to Defra's C4SL methodology (Main report, Policy Companion Document and individual substance reports)[4]. We conclude that the only impact to the published S4ULs to date is for cadmium for the POS_{park} exposure scenario, which relies on assessing lifetime exposure. The original Defra Main Report (Table 3.7 and Section 3.6.4.3), published December 2013, had incorrectly stated the soil and dust ingestion rates for **AC1-16** was 50mg day^{-1} and **AC17-18** was 20mg day^{-1}. This has now been amended to soil and dust ingestion rates for **AC1-12** as 50mg day^{-1} and **AC13-18** as 20mg day^{-1} (modifications in bold type). *****ERRATUM***** The impact on the LQM/CIEH S4UL for cadmium (POS_{park}) is relatively minor (<5% change), whereby the currently published value (532mg kg^{-1}) should be replaced on page 5-5 (Table 5-4) with the corrected value of 555mg kg^{-1} (560mg kg^{-1} to 2 significant digits).
4.	**As with DEFRA's C4SL values, what's the likelihood that EHOs won't embrace the S4ULs?**	The S4ULs are based on the same principles as the uncontroversial and uncontested Environment Agency SGVs and the previous editions of the LQM/CIEH GAC. The S4ULs have been derived for more land uses and reflect more up to date toxicology than our previous GACs but still using the health criteria values as their basis. So on this basis there is every reason for risk assessments, whether under planning or under Part 2A/IIA, based on S4ULs to be acceptable to regulators, including EHOs.
3.	**Bearing in mind the "prolonged discussion" with respect to use of CS4 (sic) for planning purposes why should the S4UL publication be exempt from any peer review and examination?**	The S4UL make no use of the C4SL Tox methodology. The publication has been both peer reviewed and subject to input from those interested in being involved. This was also the case for the 1st and 2nd editions of the LQM/CIEH GAC publications.
2.	**Is there a risk that this could, by implication, be interpreted that a substance failing these limits is NOT suitable for use?**	Exceeding generic assessment criteria based on Health Criterion Values (rather than any elevated level of risk) should trigger further consideration and not be presumed to imply remediation is needed. Sadly many have not understood that

[4] http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18341, accessed 11 December 2014

	this has been the case for the SGVs and other GACs over the years.
1. Whilst this is a catchy acronym, do any other consultants have misgivings about using the wording 'suitable for use' and the contractual implications that has?	I am glad you like the wording! Like any generic assessment criterion, establishing the relevance of a Suitable 4 Use Level to the site specific and contractual circumstances in which it is being used is up to the risk assessor using the value. Under the planning regime it is the development that has to be suitable for use and therefore the basis on which that judgment is made has to be relevant to the circumstances in question.

References

COC. (**2013**). Minutes of the meeting held at 10.30am on Thursday 19th September 2013. Item 4: The development of new screening levels for contaminants in soil (CC/2013/7) (No. CC/MIN/2013/2). Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment (London, UK). Accessed from http://webarchive.nationalarchives.gov.uk/20140722183324/https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/315925/19_September_2013_minutes_and_discussion_papers.zip

Culp S, Gaylor D, Sheldon W, Goldstein L, & Beland F. (**1998**). A comparison of the tumors induced by coal tar and benzo[a]pyrene in a 2-year bioassay. Carcinogenesis, 19(1), 117–124.

Defra. (**2014a**). SP1010 - Development of Category 4 Screening Levels for assessment of land affected by contamination. Final Project Report (Revision 2). Accessed from http://randd.defra.gov.uk/Default.aspx?MenuMenu&ModuleMore&LocationNone&Completed0&ProjectID18341

Defra. (**2014b**). SP1010 - Development of Category 4 Screening Levels for assessment of land affected by contamination. Final Project Report (Revision 2). 24th September 2014. Accessed from http://randd.defra.gov.uk/Default.aspx?MenuMenu&ModuleMore&LocationNone&Completed0&ProjectID18341

Defra. (**2014c**). SP1010: Appendix E Provisional C4SLs for Benzo(a)pyrene as a surrogate marker for PAHS. Department for Environment Food and Rural Affairs (London, UK). Accessed from http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=18341

Defra, & Environment Agency. (**2002**). Contaminants in soil: Collation of toxicological data and intake values for humans. Mercury (No. 1 857 05746 5). Environment Agency (Bristol, UK).

Defra, & Environment Agency. (**2004**). Contaminants in soil: Collation of toxicological data and intake values for humans. 1,1,2,2-Tetrachloroethane and 1,1,1,2-Tetrachloroethane. Environment Agency: Bristol, UK.

EFSA. (**2015**). EFSA CONTAM Panel (EFSA Panel on Contaminants in the Food Chain), 2015. Scientific Opinion on the risks to public health related to the presence of nickel in food and drinking water. EFSA Journal 2015, 13(2), 4002, 202. doi:doi:10.2903/j.efsa.2015.4002

Environment Agency. (**2009a**). Updated Technical Background to the CLEA Model. Environment Agency: Bristol, UK. Accessed from http://www.environment-agency.gov.uk/static/documents/Research/CLEA_Report_-_final.pdf

Environment Agency. (**2009b**). Contaminants in soil: Updated collation of toxicological data and intake values for humans. Mercury (No. 978-1-84911-021-1). Environment Agency (Bristol, UK).

Environment Agency. (**2009c**). Contaminants in soil: Updated collation of toxicological data and intake values for humans. Mercury. Environment Agency: Bristol, UK.

Environment Agency. (**2009d**). Soil Guideline Values for mercury in soil (Science Report No. SC050021 / Mercury SGV). Environment Agency (Bristol, UK). Accessed from http://www.environment-agency.gov.uk/static/documents/Research/SCHO0309BPQG-e-e.pdf

Environment Agency. (**2009e**). Soil Guideline Values for phenol in soil (Science Report No. SC050021/ Phenol SGV). Environment Agency (Bristol, UK). Accessed from http://www.environment-agency.gov.uk/static/documents/Research/SCHO0709BQRN-e-e.pdf

FSA. (**2009**). Measurement of the concentrations of metals and other elements from the 2006 UK Total Diet Study. Food Survey Information Sheet 01/09. Food Standards Agency (London, UK).

HPA. (**2010**). Risk assessment approaches for polycyclic aromatic hydrocarbons (PAHs) - Version 5. Health Protection Agency (Didcot, UK). Accessed from http://webarchive.nationalarchives.gov.uk/20140714084352/http://www.hpa.org.uk/webc/hpawebfile/hpaweb_c/1287147342113

Nathanail CP, McCaffrey C, Ashmore MH, Cheng YY, Gillett AG, Ogden R, & Scott D. (**2009**). The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd Edition). Land Quality Press: Nottingham, UK.

Nathanail CP, McCaffrey C, Gillett AG, Ogden RC, & Nathanail JF. (**2015**). The LQM/CIEH S4ULs for Human Health Risk Assessment. Land Quality Press, a Division of Land Quality Management Ltd: Nottinghamshire, UK.