APPENDIX H

HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

CONTAMINATION RISK ASSESSMENT METHODOLOGY

INTRODUCTION

CC GEOTECHNICAL utilises a range of methods to assess soil and/or groundwater contamination, as discussed below. The toxicological data collated by ***CC GEOTECHNICAL*** is presented within an appendix in the Report. The data gathered is generally in accordance with the hierarchy in Clause 3.7 of CLEA CLR 9. The hierarchy may be circumvented where more up to date authoritative data from a toxicological study has been published from sources lower down the hierarchy.

CLEA 2002

A number of SGV's have been published by DEFRA, derived using the CLEA 2002 model, and these form the baseline approach to assessment of soil contamination. The SGV's vary according to intended end use of the land under assessment. ***CC GEOTECHNICAL*** applies these SGV's in human health risk assessment

Where an SGV is not available, current Environment Agency advice is that, at present, the CLEA 2002 program should not be used to generate Site Specific Assessment Criteria (SSAC's). In accordance with this guidance ***CC GEOTECHNICAL*** does not generally use CLEA 2002 in its risk assessment for organic contaminants. SSAC's are however, derived using the CLEA 2002 software for beryllium and vanadium where appropriate. This approach will be reviewed when updated versions of CLEA are released (due to be 2005).

SNIFFER – LQ01 – "Method for Determining Site Specific Assessment Criteria"

SEPA has published a deterministic methodology for the derivation of SSAC's, which is consistent with the CLEA methodology. The method is called "SNIFFER".

The SNIFFER methodology allows the derivation of SSAC's for non-standard land use scenarios, and allows site-specific data to be used (e.g. bioavailability).

SNIFFER evaluates the exposure risk from threshold and non-threshold compounds. It cannot be used for risk assessment from groundwater contamination.

The SNIFFER models the following pathways:

TABLE 1 - PATHWAYS INCLUDED IN SNIFFER

Pathway Number	Pathway
1	Outdoor Ingestion of Dust
2	Indoor Ingestion of Dust
3	Consumption of Home-grown Vegetables
4	Ingestion of Soil Attached to Vegetables
5	Outdoor Inhalation of Fugitive Dust
6	Indoor Inhalation of Dust
7	Outdoor Inhalation of Soil Vapour
8	Indoor Inhalation of Soil Vapour

SNIFFER does not assess the risk via dermal pathways but does contain mechanisms to ascertain whether the dermal pathway should be assessed.

RISC v4.02

Where a detailed quantitative risk assessment is required for the dermal pathway RISC v4.02 will be used.

CC GEOTECHNICAL uses RISC v4.02 for human health risk assessment in scenarios where SNIFFER is unsuitable i.e. where inhalation of groundwater vapours and soil and/or groundwater dermal contact are important pathways

The treatment of threshold and non-threshold contaminants with respect to toxicity and quantification of risk, is discussed within the CLEA methodology (DEFRA & EA-CLR10, 2002). Regulatory bodies in the UK do not accept the concept of slope factors (mathematical models based on animal data) in risk assessment, therefore the application of RISCv4.02 in ***CC GEOTECHNICAL*** reports is based on the substitution of slope factors by appropriate toxicological data. The database in RISC v4.02 has been updated with the toxicological data published by the Environment Agency in the CLEA TOX reports.

In RISC v4.02, exposure risks for threshold and non-threshold compounds are evaluated using a Hazard Quotient (HQ). The hazard quotient is a ratio of exposure to toxicity(i), for an individual chemical and exposure pathway(j):

$HQ_{ij} = ADE_{ij} / TDI_{ij}$ (threshold contaminants)
$HQ_{ij} = ADE_{ij} / ID_{ij}$ (non threshold contaminants)

HQ_{ij} Hazard quotient for chemical "i" and pathway "j"

ADE_{ij} Average daily intake for chemical "i" and exposure pathway "j"

TDI_{ij} Tolerable Daily Intake for chemical "i" and exposure pathway "j"

ID_{ij} Index dose for chemical "i" and exposure pathway "j"

The acceptable hazard quotient for all human receptors is 1.0

For a specific chemical, the overall risk is assessed as the summation of each HQ arising from each applicable exposure pathway.

Where there are two or more contaminants present that affect the same organ, then the risk of the contaminants will be summed.

SUMMARY OF RISK ASSESSMENT TOOLS
A summary of the risk assessment tools used by ***CC GEOTECHNICAL*** is given below:

TABLE 2 - SUMMARY OF RISK ASSESSMENT TOOLS

RISK ASSESSMENT METHOD	Assesses Risk From						Suitable for non-standard land uses
	Ingestion Pathways	Dermal Contact Pathways	Vegetable Pathways	Vapour Pathways	Water Pathways	Vegetable Pathways	
CLEA 2002 SGV`s	√		√	√		√	
SNIFFER	√		√	√		√	
RISC v4.02	√	√	√	√	√	√	√
CCG RISK	√		√	√		√	√

METHODOLOGY FOR PAH`s
CLEA TOX reports have been published for 2 of the EPA 16 PAH's, namely benzo(a)pyrene and naphthalene.

To assess the PAH's where toxicological data is not available, ***CC GEOTECHNICAL*** adopts published authoritative Toxicity Equivalent Factors (TEF) to assess the risk posed by these PAH's. This methodology multiplies the 95th UCL result for the PAH by the TEF to give a total TEF for the PAH, expressed as equivalent Benzo(a)pyrene, which may then compared with the criteria for Benzo(a)pyrene.

This methodology will be reviewed when the TOX reports for threshold and non-threshold PAH's are published by DEFRA / EA.

METHODOLOGY FOR TPH's

TPH (Total Petroleum Hydrocarbons) is not a single chemical, but a collection of many different molecules, with differing physical and toxicological properties.

The EA have published a document (Science Report P5-080/TR3) discussing the approach for the evaluating human health risks from TPH's in soil and the guidance has been incorporated into the methodology employed by ***CC GEOTECHNICAL*** and is as follows;

1) An initial TPH (C9-C40) screen is undertaken to assess concentrations on the site. Duplicate samples are analysed for VOC's using a PID headspace analysis. The lack of positive reading from the headspace analysis indicates that **aromatic hydrocarbons are not present**. Where positive responses are obtained, further analysis may be carried out depending on the levels recorded.
2) In Addition to the above a sufficient number of speciated TPH's will be undertake to sufficiently characterise the nature of the TPH's encountered.
3) To assess the TPH screen data, ***CC GEOTECHNICAL*** compares the data to the SSAC for the **Aliphatic** EC8-EC10 fraction
4) **Where the conceptual model indicates they chlorinated aliphatic hydrocarbons or aromatic hydrocarbons are present on the site then 50% of the samples will be analysed for VOC's and the remainding 50% will be analysed for speciated TPH's.**
5) **Where the TPH data contains an outlier then additional speciated TPH analysis will be undertaken to assess the 'hotspot'**

STATISTICAL DATA INTERPRETATION

In any site investigation only a small fraction of the soil on the site is tested. Therefore the mean derived from the contamination data for a contaminant may not be the same as the true mean for the contaminant distribution on the site.

The analysis of any data set involves three steps;

1. Determine if the data set is a normal or a skewed distribution (coefficient of variation)
2. Determine the number of samples in the analysis
3. Determination of procedure for calculation of 95th UCL

For a data set with a normal distribution where there are less than 30 samples the methodology is based on CLEA CLR 7.

$$95thUCL = \overline{x} + \frac{t.S.D}{\sqrt{n}}$$

t is dependant on value of n.

CLR 7 also allows for the assessment of the maximum value to determine whether it is an outlier and forms part of a separate population. Data sets that form more than one population should be considered as two or more sets.

Where all results for a contaminant are below the limit of detection, a statistical analyses will not be undertaken.