06/3908/9

REPORT ON GROUND INVESTIGATION AT FOULSTONE & WOMBWELL SCHOOL

FOR

BARNSLEY METROPOLITAN BOROUGH COUNCIL

SEPTEMBER 2006

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1.0 INTRODUCTION

CC GEOTECHNICAL LTD was commissioned by ***BARNSLEY MBC*** to provide site investigation services in connection with the proposed construction of new educational facilities at the proposed site of ***Foulstone & Wombwell Schools***.

The specific services required of ***CC GEOTECHNICAL LTD*** included:

- The review of desk study documentation provided by Barnsley MBC
- The planning and undertaking of intrusive ground investigations to include inter alia - cable percussion boreholes, rotary boreholes, trial pits, insitu CBR testing, insitu soakaway testing
- The performance of appropriate soil laboratory engineering classification testing
- The procurement of soil and groundwater contamination analyses via an accredited laboratory
- The preparation of a Building Durability Risk Assessment based on soil and groundwater contamination data, together with appropriate protective recommendations
- The preparation of a Human Health Risk Assessment based on soil and groundwater contamination data, together with appropriate remedial recommendations
- The provision of recommendations for the stabilisation of shallow mineworkings, where such workings have been demonstrated to be present
- The provision of recommendations on the selection and design of foundations and floor slabs
- The provision of recommendations on pavement design
- The provision of recommendations on adoption of soakaway drainage

This report is presented in combined factual / interpretative form, and must be read in conjunction with the Notes on Limitations given in Appendix L.

2.0 SITE DATA

2.1 Introduction

For a comprehensive review of the historical and current context setting of the site, reference should be made to Soil Mechanics Desk Study Report A6022, published April 2006, as furnished to ***CC GEOTECHNICAL LTD*** by ***Barnsley MBC.***

2.2 Site Description

The site is located to the north and south of Pitt Street, in the Wombwell area of Barnsley, about 7.5km south east of Barnsley town centre as shown on Drawing 3908/9/1. The National Grid reference for the approximate site centre is E440290 N403880.

The site comprises two roughly rectangular plots of land of approximately equal area, located to the north and south of Pitt Street, which runs on an east-west axis at this location.

The area to the south of Pitt Street comprises of dense woodland on its western half, and open grassed fields on its eastern half. The River Dove defines the southern boundary of this area.

The site is bound by Pitt Street to the north, neighbouring residential housing and commercial properties to the east, contiguous parkland to the west and the River Dove to the south of the site.

2.3 Proposed Development

The proposed development layout is illustrated on Drawing 3908/4/2. It can be seen that the proposed development includes new 2 storey ALC blocks, car parking areas, and bus drop off facilities.

2.4 Published Geology

The documented geology of the site is summarised on British Geological Survey Sheets, principally:-

Table 1
Sheet 87 – BARNSLEY – Solid and Drift Edition, Scale 1:50000

Drift Geology	*Aluvium of Recent Origins*
Solid Geology	*Middle Coal Measures of Upper Carboniferous Origins*

The Middle Coal Measures strata underlying the site contain workable coal seams. The 1:50000 map indicates the Mansfield Marine Band outcropping to the south of the site and dipping to the north at an angle of about 1 in 16. The nearest point of outcropping is in the order of 200m south of the site, indicating a potential for the seam to be encountered at around 13m below rockhead.

2.5 Hydrology

The nearest surface watercourse is the River Dove, which flows on a roughly east-west alignment and forms the southern boundary of the site.

2.6 Hydrogeology

The documented lithology underlying the site may be represented as a series of discrete units as shown hereunder:

UNIT	COMMENT
Made ground	Probable permeable strata – may store perched groundwater
Alluvium	Semi -permeable strata – may store and transmit limited amounts of groundwater
Coal Measures	Minor aquifer – minor aquifers seldom produce viable quantities of water for abstraction, although they may be important in providing base flow to rivers

3.0 FIELDWORK

3.1 Introduction

The fieldwork was undertaken during August 2006 and comprised the drilling of six boreholes, and the excavation of seven trial pits. The positions of the boreholes and trial pits are as shown on Drawing 3908/9/2. The fieldwork was

planned in accordance with BS10175: 2001, and carried out in accordance with BS10175: 2001 and BS5930: 1999, insofar as they related to the scope of the investigation.

3.2 Boreholes

All boring tools were decontaminated prior to commencement, and between borehole moves.

The cable percussion boreholes were drilled by Dando 150 light cable percussion boring rigs, to rockhead. Standard Penetration Tests were carried out at regular intervals in granular strata. Bulk disturbed samples and jar samples were recovered at incremental depths in the boreholes.

Each borehole was advanced below rockhead by rotary open hole drilling methods, using 76mm diameter equipment with air/mist flush, to depths of about 30mbgl. The logs of the boreholes, annotated with sampling details, N values, and observations made during the rotary drilling are given in Appendix B.

On completion, each borehole was grouted to rockhead, and further backfilled using borehole arisings.

Monitoring wells comprising of a 1.0m upper section of 50mm diameter HDPE plain pipe surrounded by a bentonite/grout seal, atop a 50mm diameter HDPE slotted pipe section in a pea gravel surround, were installed in four of the six boreholes. The installations were fitted with gas valves and protected by flush covers set in concrete, and were periodically monitored for flow rate and composition of ground gas using a Gas Data LMSxi Type G4.18 infrared gas analyser and Gas Data GFM60 flowmeter. The installations were also monitored for standing groundwater levels.

The results of the gas monitoring and the instrument calibration certificate are given in Appendix D.

Water monitoring observations are annotated on the Borehole Section Sheets in Appendix B.

3.3 Trial Pits

Trial pits were excavated to obtain a broad assessment of the near surface geology, to facilitate sampling for classification and contamination testing, and to enable a preliminary assessment of the likely drainage characteristics of the soils.

The excavations were undertaken by mechanical digger to depths of up to 3.0mbgl. The exposures within each excavation were carefully logged, and Mexicone CBR tests were carried out in the trial pit walls and floor. The arisings were then returned in the reverse sequence of their excavation, to preserve, insofar as was practical, the original lithology

The Trial Pit Section sheets annotated with sampling and testing data are given in Appendix C.

4.0 LABORATORY TESTING

A programme of soil engineering testing was undertaken, which comprised the following:

- Determination of soil moisture content in accordance with BS1377: Part 2: 1990
- Determination of Atterberg Limits in accordance with BS 1377: Part 2: 1990
- Determination of Particle Size Distribution in accordance with BS 1377: Part 2: 1990

The Soil Engineering Test Results are presented in Appendix E.

A laboratory chemical analysis programme was undertaken at a UKAS/MCERTS accredited laboratory, and comprised the analysis of six soil

samples to a broad-spectrum contamination suite, of which three were analysed for TPHCWG.

PID headspace analyses were carried out on counterparts of all samples sent for analysis.

The results of the soil chemical analyses are presented in Appendix F.

The results of the PID headspace analyses are given on the respective trial pit / borehole logs.

5.0 OBSERVED STRATIGRAPHY

The boreholes and trial pits generally confirmed the documented geology.

The succession generally commences with a depth of topsoil overlying significant depths of made ground, observed extending to depths of up to 10.3mbgl. The made ground generally comprises brick, ash, timber, coal, concrete, clay, gravel and sand. Large metal obstructions, approximately 0.1m thick, were encountered in TP9 at a depth of about 0.6mbgl. The made ground was occasionally interbedded with coal and mudstone gravel deposits, probably resulting from the extensive mining undertaken in the area. The made ground is underlain by weathered mudstone, which was weathered to silty sandy gravelly clay at the surface becoming fresh with depth.

Groundwater was not encountered during the initial fieldwork, or during standpipe monitoring visits.

6.0 RISKS TO FABRIC OF BUILDINGS

6.1 Water Supply Mains

Based on the criteria specified in Paper 9-04-03: Oct 2002 published by the Water Regulations Advisory Scheme (Ref 1) for pipe materials selection, the chemical analyses indicate that water supply mains must be laid in a remediated alignment, due to the concentration of arsenic and TPH's **in the soils – see**

Appendix G.

In this circumstance, the WRAS guidance states that PE/Al/PE mains should be laid in a sterile trench of width 1m + pipe diameter, and extending 300mm below the pipe.

6.2 Concrete in the Ground

The data obtained in the investigations has been assessed against the guidance given in BRE Special Digest 1: 2005, and is summarised on a site-specific basis as hereunder:

Table 2:
Design Chemical Classification

CONCRETE SPECIFICATION DATA SHEET		
Is the site brownfield or greenfield?	Brownfield	
Is the water table static or mobile?	Static	
Maximum Water Soluble Sulphate results	1976mg/l	Design Sulphate Class of DS-3 and ACEC Class of AC-3s
Lowest pH result	3.6	
Intended Service Life	100 years	Specify concrete to comply with the requirements of Design Chemical Classification of DC-3 as given in BRE Special Digest 1: 2005

6.3 Ground Gas Assessment

The gas monitoring data obtained on this site indicates that the site complies with Characteristic Situation 2 as defined in SA Wilson and GB Card document "Reliability and Risk in Gas Protection Design", and as such, the following gas protection measures are required:

- Well constructed cast in situ reinforced concrete ground slab
- All joints and penetrations sealed
- Waterproofing membrane sealed around penetrations
- Granular layer below slab passively vented to atmosphere with interleaved geocomposite strips or pipes

7.0 LEGISLATIVE BACKGROUND TO CONTAMINATED LAND ASSESSMENT

Land contamination is a material planning consideration within the planning regime. This means that a planning authority has to consider the potential implications of contamination both when it is developing strategic or local plans (or unitary development plans), and when it is considering individual applications for planning permission. Where contamination is suspected or known to exist at a site, a planning authority may require investigation before granting planning permission, or may impose conditions on the permission requiring appropriate investigation and, if necessary, remediation (Department of the Environment/Welsh Office, 1994).

Section 78A(2) of the Environmental Protection Act 1990 inserted under Section 57 of the Environment Act 1995 defines contaminated land for the purposes of Part IIA as:

"**any land which appears to the local authority** in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that

- Significant harm is being caused
- Significant possibility of significant harm being caused
- Pollution of controlled waters is being caused
- Pollution of controlled waters is likely to be caused

Under the Act, **"harm" is defined as:**

"harm to the health of living organisms or other interference with the ecological systems of which they form apart and, in the case of man, includes harm to his property"

and pollution of controlled waters is defined as:

"the entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter".

8.0 HUMAN HEALTH RISK ASSESSMENT METHODOLOGY

The risk assessment methodology employed by ***CC GEOTECHNICAL LTD*** is given in Appendix H.

9.0 SITE SPECIFIC ASSESSMENT CRITERIA

The assessment of the contamination data obtained on this site has been undertaken by comparison of the results with published SGV`s, and with derived GAC's obtained using the SNIFFER methodology, employing toxicological input data from sources generally in accordance with CLEA CLR 9.

The input data, Derivation Worksheets based on the methodology discussed in Report number LQ01 – 'Method for Deriving Site Specific Human Health Assessment Criteria in Soil', and Risk Evaluation Sheets are presented in Appendix I.

The statistical interpretations of the soil contamination data obtained in the investigations are given in Appendix J.

10.0 HUMAN HEALTH RISK ASSESSMENT

10.1 Introduction

The development will comprise the construction of education facilities with associated playing fields. Current risk assessment land classifications do not include a specific "school" classification. However a precautionary approach is recommended, and the land use has been taken to be equivalent to 'Residential Without Plant Uptake' pathways, as defined in CLEA CLR 10, and the results of soil analyses have been assessed against criteria derived for this scenario.

10.2 Maximum Value Test Analysis

A maximum value test on the contamination data is presented in Table 2 in Appendix J based on the soil contamination data in Table 1. It can be seen that 24 contaminants fail the Maximum Value Test.

The results for arsenic at TP3 has been identified as an outlier, and exceeds the SGV. Therefore, this result has been removed from the statistical analysis.

All other identified outliers are either low values, which distort the mathematical test, and are not indicative of contamination, or elevated values, which do not exceed the relevant human health criteria, and have been included in the Mean Value Test Analysis.

10.3 Mean Value Test Analysis

A mean value test analysis has been undertaken in accordance with the CLR 7 methodology, and the results presented in Table 3 in Appendix J. The 95th UCL values obtained from these analyses have been compared to their respective SGV / GAC, as shown in Table 4 of Appendix J.

The 95th UCL for arsenic exceeds the SGV.

All other 95th UCL's are all below their relevant criteria.

10.4 Asbestos Analyses

Chrysotile asbestos fibres were encountered in the sample analysed from TP10.

Asbestos fibres were not detected in any other sample analysed.

10.5 Assessment of Individual Results

An assessment of the individual results from the dataset show the following:

- The concentration of arsenic in TP3, TP4, TP8, TP9, TP11 and TP12 exceeds the SGV of 20mg/kg.

11.0 SUMMARY CONCEPTUAL MODEL

Based on the foregoing assessment, a conceptual model of the site may be constructed, demonstrating pollution linkages, as presented below:

Table 3 – Conceptual Model and Mitigation Measures

SOURCE	PATHWAY	TARGET	MITIGATION MEASURE
Arsenic in site soils	Accidental ingestion of soil Dermal contact with soil Dermal contact with dust Ingestion of dust	Pupils and staff	Investigation has shown superficial soils on playing fields to be significantly contaminated by arsenic – reassess by DQRA – see 11.2 hereunder
Asbestos fibres at TP10	Inhalation / ingestion of fibres	Installation and maintenance workers Human pupils and staff	Provide 300mm clean topsoil cover over all landscaped areas
Arsenic and TPH's in water main alignment	Direct attack on plastic mains – permeation through walls of mains	Installation and maintenance workers Human occupants	Use PE/Al/PE mains laid in a sterile trench alignment

11.2 Further Assessment of Arsenic

The foregoing assessment has been based on a conservative conceptual model (residential without plant uptake). However, the exposure parameters for the critical receptor on this site are significantly different than those adopted in the derivation of GAC`s for the "residential without plant uptake" conceptual model.

To obtain true site specific assessment criteria (SSAC`s), the following input parameters may be adopted:

Table 4: Site Specific Exposure Parameters

Parameter	Value	Justification
Exposure Duration	11-18 years (7 years)	Taken from BBC website
Time Averaged Body Weight	34.14kg	Based on data from LQ01 and ED
Time Averaged Body Height	1.57m	Based on data from LQ01 and ED
Childhood Ingestion Factor	0.868	Based on data from LQ01 and ED
Averaging Time	2555	Based on ED
Exposure Frequency	208 days	Based on term times

As exposure for arsenic is via the soil ingestion pathway, SSAC's for these contaminants may be derived using the algorithms given in LQ01 "Method for deriving site specific human health assessment criteria for contaminants in soil" (SNIFFER).

$$SSAC_{ingestion} = \frac{RI_{ingestion}}{SEI_{ingestion}} = \frac{RI_{ingestion}}{\frac{TADSR \times ED \times EF}{TABW \times AT}} = \frac{RI_{ingestion} \times TABW \times AT}{TASDR \times ED \times EF}$$

$$SSAC_{ingestion(arsenic)} = \frac{3 \times 10^{-4} mgkg^{-1} day^{-1} \times 34.14kg \times 2555days}{6.1260 \times 10^{-5} kgday^{-1} \times 7 \times 208days} = \frac{26.16831}{0.08919456} = 293mg/kgbw/day$$

On the basis of this SSAC, it may be concluded that the observed levels of contamination are probably not harmful, and the site does not require remediation.

12.0 OFFSITE DISPOSAL OF SURPLUS SPOIL

In July 2004, the Landfill Directive 1999/31/EC was invoked, and from this date, spoil arising from site construction must be assessed in accordance with Waste Acceptance Criteria (WAC) and EA Document RGN18 Waste Acceptance Criteria for Landfills for Non Hazardous Waste.

Based on the methodology discussed Environment Agency publications "Framework for the Classification of Contaminated Soils as Hazardous Waste" the soil contamination data has been analysed and any spoil from the site may be classified as "Non-Hazardous" waste. The calculations are given in Appendix K.

13.0 MINING ASSESSMENT

Shallow mineworkings can lead to crownhole development or subsidence at the ground surface. Carter & Symons (Site Investigations and Foundations Explained: 1989) propose the widely held view, that in areas where the thickness of competent rock cover is less than six times the worked seam thickness, it is unsafe to build, due to the risk of surface movements. They

propose that between six and ten times the worked seam thickness is unlikely to be affected by void migration or subsidence effects, and is safe to build on if rigid or raft foundations are employed. Where the rock cover is in excess of ten times the worked seam thickness, the zone is regarded as safe. Atkinson (Structural Foundations Manual: 1993) also proposes the so called ***"ten times seam thickness rule"***, without referring to the other classifications of "less than six", and "six to ten" times the seam thickness. This single 10:1 classification is also proposed in CIRIA Technical Guide 34: Construction Over Abandoned Mineworkings.

Boreholes on this site were drilled to depths of 20mbgl. No voids or loss in flush were encountered during drilling, and therefore, it may be concluded that the site is not underlain by any worked coal seams within the depth of influence of the proposed development, and subsidence or settlement associated with mine workings will not affect properties on the site.

14.0 FOUNDATION RECOMMENDATIONS

14.1 Spread Foundations for ALC Building

Spread foundations are not recommended, due to the depth of made ground encountered within the boreholes.

14.2 Piled Foundations for ALC Building

Piled foundations are recommended for this development. In these ground conditions, a range of piling techniques may be considered, including precast concrete driven, or CFA piles.

Precast concrete driven piles will provide an economic and technically suitable solution. Piles are installed to a "set", a downward movement per blow corresponding to the required carrying capacity, and calculated from the mass and height of fall of the driving hammer. Piling contractors must be required to provide these calculations for control of the fieldwork.

Typical carrying capacity of single isolated precast concrete piles are shown hereunder:

Pile Section mm x mm	Carrying Capacity kN
250 x 250	700
300 x 300	1200

Piling contractors must be required to verify these capacities and/or provide estimates of the capacity of their own pile types in isolation and in groups as appropriate to the proposed layout.

14.3 Bridge Foundations

It is recommended that piled foundations be adopted for the proposed new vehicular access bridge. Precast concrete driven piles are recommended as above.

15.0 GROUND SLABS

For normal service applications, ground-bearing slabs may be deployed subject to appropriate preparation of the subgrade. This preparation must include as a minimum:

- Removal of all organic soils
- Reduction of site levels to allow placement of 2 x 150mm compacted layers of granular fill (DTp Type 1 or equivalent + dpm + slab)
- Thorough compaction at subgrade level, with additional excavation and granular fill refilling at any areas showing excessive softness / deflection

16.0 GROUNDWATER AND EXCAVATIONS

It is unlikely that management of groundwater will significantly hamper spread foundation construction, although prudent contractors would allow for some pumping to maintain dry working conditions.

It should be assumed that foundation excavations in excess of 1.5mbgl will require temporary support.

17.0 PAVEMENT DESIGN

On the basis of insitu CBR measurements made by Mexicone, it is recommended that pavements be designed on the basis of a CBR of 4%.

18.0 SOAKAWAY ASSESSMENT

Based on the trial pit observations, soakaway drainage will probably function effectively on this site.

However, based on the soil contamination analyses and the presence of an environmental receptor (River Dove) at the southern boundary, it would be prudent to undertake leachate analyses on soils within the proposed soakaway locations, to determine if there is a risk to the River Dove from contaminants leached from the site soils.

19.0 CONCLUSIONS AND RECOMMENDATIONS

The conclusions of this ground investigation may be summarised as hereunder:

- The made ground on the site is sporadically affected by asbestos contamination. Suitable remediation should comprise the placement of 300mm of clean imported topsoil over all landscaped areas
- The gas monitoring data obtained on this site, indicates that the site complies with Characteristic Situation 2 as defined in SA Wilson and GB Card document "Reliability and Risk in Gas Protection Design", and as such, gas protection measures are required.
- The presence of deep deposits of made ground renders the site suitable for use of soakaway drains. However, a programme of leachability testing should be carried out at proposed soakaway locations, to assess whether contamination of the River Dove may potentially occur

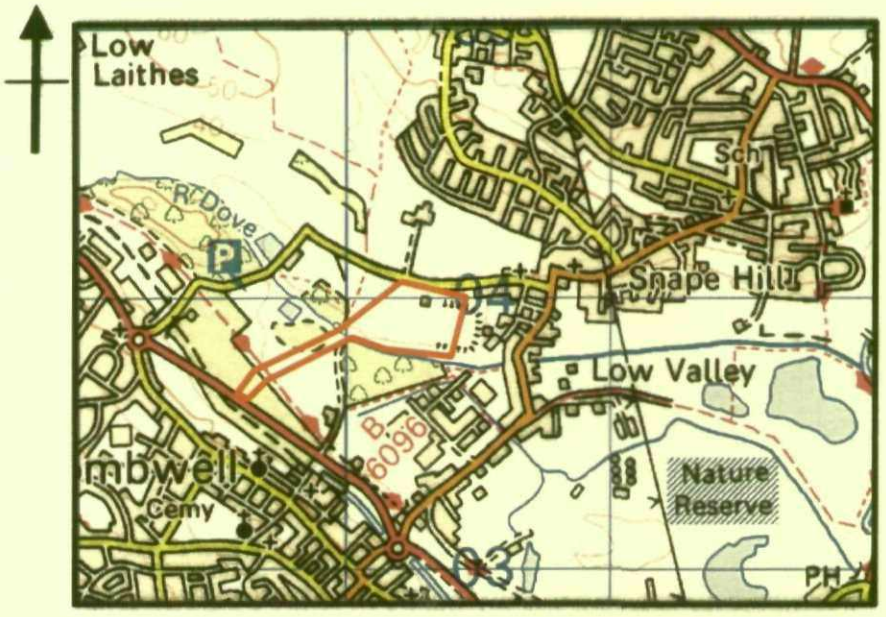
- There are no mining voids within a depth that could potentially cause movements at the ground surface
- Piled foundations are recommended for the new building
- For normal service applications, ground bearing slabs may be considered, subject to appropriate preparation of the ground
- Piled foundations are recommended for the new vehicular access bridge
- Concrete in the ground should be specified in accordance with Design Chemical Class DC-3 as defined in BRE Special Digest 1:2005
- PE/Al/PE mains should be laid in a sterile trench of width 1m + pipe diameter, and extending 300mm below the pipe.
- Spoil for disposal will classify as non hazardous waste
- Pavements should be designed on the basis of a CBR of 4%.

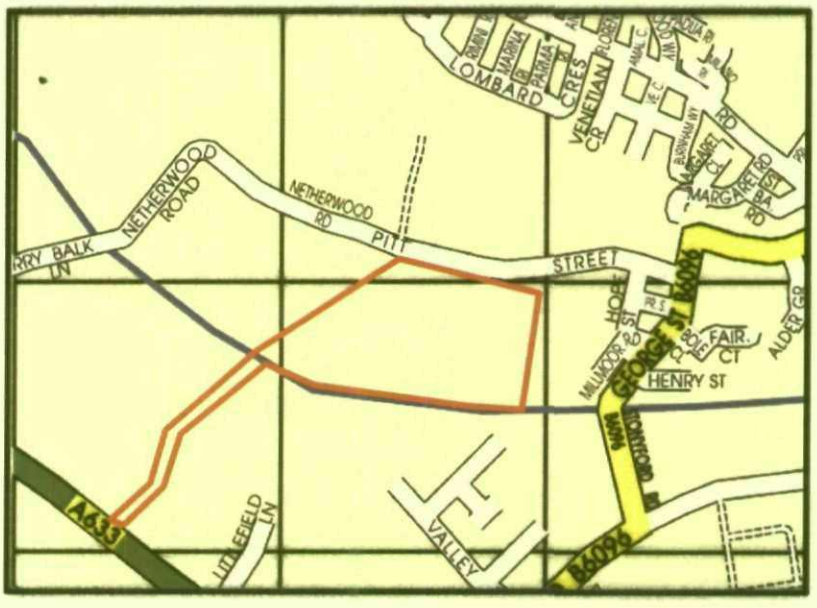
APPENDIX A

DRAWINGS

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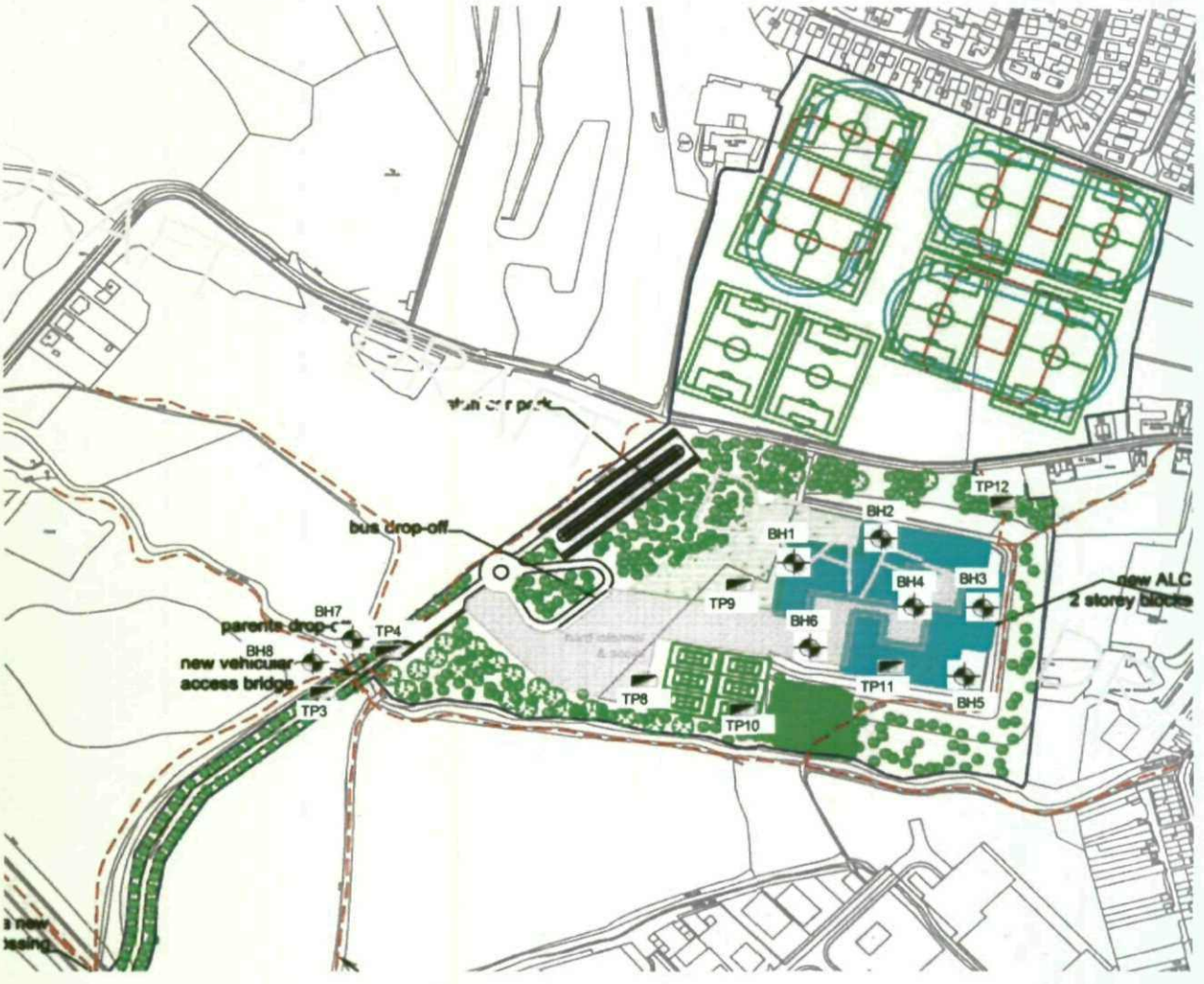
Foulstone & Wombwell Schools, Barnsley

Location Plan

3908/9/1

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	Date September 2006 **Number** 3908/9/2

APPENDIX B

BOREHOLE SECTION SHEETS

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH1 Sheet 1 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
13/09/06-20/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	TYPE	SPT N (Cu-kN/m²)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				Grassed TOPSOIL (0.30)	0.30		
0.50	BULK			Medium dense MADE GROUND comprising brick, ash, coal and gravel in sand (2.20)			
1.20 - 1.65	SPT	23					
1.50	BULK						
2.00 - 2.45	SPT	21					
2.50	BULK						
				MADE GROUND comprising coal gravel (0.20)	2.50		
					2.70		
3.00 - 3.45	SPT	19		Medium dense MADE GROUND comprising brick, coal, ash and gravel in sand (2.80)			
3.50	BULK						
4.00 - 4.45	SPT	17					
4.50	BULK						
5.00 - 5.45	SPT	17					
				MADE GROUND comprising coal gravel (0.90)	5.50		
6.00	BULK						
6.50 - 6.95	SPT	50/75MM		Dense MADE GROUND comprising ash, coal, brick and gravel in sand (0.90)	6.40		
7.50	BULK			Light grey/brown MUDSTONE weathered to firm silty sandy gravelly clay at surface becoming fresh with depth (11.20)	7.30		
8.00 - 8.45	SPT	13					
9.00	BULK						
9.50 - 9.95	SPT	27					

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
15.00					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1/2HR CHISELLING ON COBBLE AT 6.5MBGL
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH1 Sheet 2 of 4
CLIENT BARNSLEY MBC		SITE FOULSTONE & WOMBWELL SCHOOL, BARNSLEY	

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
13/09/06-20/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				(Continued boring in same stratum)			
10.50	BULK						
11.00-11.45	SPT	37					
12.00	BULK						
12.50-12.95	SPT	117					
				Blue/grey SILTSTONE (2.50)	18.50		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
15.00					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1/2HR CHISELLING ON COBBLE AT 6.5MBGL
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical
Tel: 0151-523-0202
Fax: 0151-523-0252

BOREHOLE LOG

HOLE NO. BH1
Sheet 3 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
13/09/06-20/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				(Continued boring in same stratum)			
				Grey MUDSTONE	21.00		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
15.00					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1/2HR CHISELLING ON COBBLE AT 6.5MBGL
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH1 Sheet 4 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
13/09/06-20/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	SAMPLE RECORD TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				(Continued boring in same stratum)			
				BOREHOLE TERMINATED - NO VOIDS OR LOSS IN FLUSH ENCOUNTERED	35.00		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
15.00					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1/2HR CHISELLING ON COBBLE AT 6.5MBGL
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH2 Sheet 1 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
14/09/06-20/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				Grassed TOPSOIL (0.20)	0.20		
0.50	BULK			Medium dense MADE GROUND comprising brick, ash, coal and gravel in sand (2.70)			
1.20 - 1.65	SPT	10					
1.50	BULK						
2.00 - 2.45	SPT	14					
2.50	BULK						
3.00 - 3.45	SPT	3		MADE GROUND comprising soft dark grey clayey SILT (2.00)	2.90		
3.50	BULK						
4.00 - 4.45	SPT	5					
4.50	BULK						
5.00 - 5.45	SPT	17		Medium dense MADE GROUND comprising brick, ash, coal and gravel in sand (2.00)	4.90		
6.00	BULK						
6.50 - 6.95	SPT	14					
				Grey MUDSTONE weathered to silty sandy gravelly clay at surface becoming fresh with depth (3.80)	6.90		
7.50	BULK						
8.00 - 8.45	SPT	28					
9.00	BULK						
9.50 - 9.95	SPT	75/150MM					

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
14.80					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH2 Sheet 2 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
14/09/06-20/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	SAMPLE RECORD TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				(Continued boring in same stratum)			
				Grey MUDSTONE (2.30)	10.70		
				Grey MUDSTONE (14.00)	13.00		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
14.80					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH2 Sheet 3 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
14/09/06-20/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	SAMPLE RECORD TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				(Continued boring in same stratum)			
				Grey/blue SILTSTONE (2.30)	27.00		
				Grey MUDSTONE	29.30		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
14.80					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical
Tel: 0151-523-0202
Fax: 0151-523-0252

BOREHOLE LOG

HOLE NO. BH2
Sheet 4 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
14/09/06-20/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	SAMPLE RECORD TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				(Continued boring in same stratum)			
				BOREHOLE TERMINATED - NO VOIDS OR LOSS IN FLUSH ENCOUNTERED	35.00		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
14.80					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH3 Sheet 1 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
20/09/06-21/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				Grassed TOPSOIL (0.30)			
0.50	BULK			Medium dense MADE GROUND comprising brick, ash, coal and gravel in sand (6.10)	0.30		
1.20 - 1.65	SPT	11					
1.50	BULK						
2.00 - 2.45	SPT	17					
2.50	BULK						
3.00 - 3.45	SPT	19					
3.50	BULK						
4.00 - 4.45	SPT	14					
4.50	BULK						
5.00 - 5.45	SPT	15					
6.00	BULK						
6.50 - 6.95	SPT	7		MADE GROUND comprising loose/soft dark grey sandy SILT (0.70)	6.40		
7.00	BULK						
				Medium dense MADE GROUND comprising brick, ash, coal and gravel in sand (3.20)	7.10		
8.00 - 8.45	SPT	13					
8.50	BULK						
9.50 - 9.95	SPT	15					

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
17.00					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1/2HR CLEANING BOREHOLE POSITION
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH3 Sheet 2 of 4
CLIENT: BARNSLEY MBC		SITE: FOULSTONE & WOMBWELL SCHOOL, BARNSLEY	

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
20/09/06-21/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				(Continued boring in same stratum)			
10.50	BULK			Grey/brown MUDSTONE weathered to silty sandy gravelly clay at surface becoming fresh with depth (1.70)	10.30		
11.00-11.45	SPT	23					
12.00	BULK			Grey MUDSTONE (6.70)	12.00		
12.50-12.95	SPT	22					
13.50	BULK						
13.80-14.25	SPT	50/150MM					
				Grey SILTSTONE (7.60)	18.70		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
17.00					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1/2HR CLEANING BOREHOLE POSITION
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH3 Sheet 3 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
20/09/06-21/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	SAMPLE RECORD TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				(Continued boring in same stratum)			
				Grey MUDSTONE	26.30		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
17.00					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1/2HR CLEANING BOREHOLE POSITION
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH3 Sheet 4 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
20/09/06-21/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	SAMPLE RECORD TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				(Continued boring in same stratum)			
				BOREHOLE TERMINATED - NO VOIDS OR LOSS IN FLUSH ENCOUNTERED	35.00		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
17.00					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1/2HR CLEANING BOREHOLE POSITION
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH4 Sheet 1 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
15/09/06-21/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				Grassed TOPSOIL (0.30)			
0.50	BULK			Medium dense MADE GROUND comprising brick, ash, coal and gravel in sand (3.20)	0.30		
1.20 - 1.65	SPT	11					
1.50	BULK						
2.00 - 2.45	SPT	17					
2.50	BULK						
3.00 - 3.45	SPT	14					
3.50	BULK			MADE GROUND comprising soft dark grey silty very sandy clay (2.20)	3.50		
4.00 - 4.45	SPT	6					
4.50	BULK						
5.00 - 5.45	SPT	6					
6.00	BULK			Medium dense MADE GROUND comprising ash, brick, coal and gravel in sand (1.60)	5.70		
6.50 - 6.95	SPT	19					
7.50	BULK			MADE GROUND comprising grey mudstone sand and gravel (0.30)	7.30		
				MADE GROUND comprising coal sand and gravel (0.20)	7.60		
8.00 - 8.45	SPT	17		Medium dense MADE GROUND comprising brick, ash, coal and gravel in sand (1.10)	7.80		
9.00	BULK			Medium dense MADE GROUND comprising grey mudstone sand and gravel (1.00)	8.90		
9.50 - 9.95	SPT	20					
					9.90		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
15.50					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD
1/2HR CLEANING BOREHOLE POSITION
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH4 Sheet 2 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
15/09/06-21/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				Brown fine/medium/coarse SAND with occasional gravel (1.00) (Continued boring in same stratum)			
10.50	BULK						
11.00-11.45	SPT	23		Grey MUDSTONE weathered to silty sandy gravelly clay at surface becoming fresh with depth (2.60)	10.90		
12.00	BULK						
12.50-12.95	SPT	50/150MM					
				Brown MUDSTONE (2.80)	13.50		
				Grey MUDSTONE	16.30		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
15.50					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD
1/2HR CLEANING BOREHOLE POSITION
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical
Tel: 0151-523-0202
Fax: 0151-523-0252

BOREHOLE LOG

HOLE NO. BH4
Sheet 3 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
15/09/06-21/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				(Continued boring in same stratum)			

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
15.50					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD
1/2HR CLEANING BOREHOLE POSITION
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical
Tel: 0151-523-0202
Fax: 0151-523-0252

BOREHOLE LOG

HOLE NO. BH4
Sheet 4 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
15/09/06-21/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	SAMPLE RECORD TYPE	SPT N (C_u-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				(Continued boring in same stratum)			
				BOREHOLE TERMINATED - NO VOIDS OR LOSS IN FLUSH ENCOUNTERED	35.00		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
15.50					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD
1/2HR CLEANING BOREHOLE POSITION
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH5 Sheet 1 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
21/09/06-22/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				Grassed TOPSOIL (0.30)			
0.50	BULK			Medium dense MADE GROUND comprising brick, ash, coal and gravel in sand (7.60)	0.30		
1.20 - 1.65	SPT	11					
1.50	BULK						
2.00 - 2.45	SPT	12					
2.50	BULK						
3.00 - 3.45	SPT	14					
3.50	BULK						
4.00 - 4.45	SPT	18					
4.50	BULK						
5.00 - 5.45	SPT	21					
6.00	BULK						
6.50 - 6.95	SPT	18					
7.50	BULK						
8.00 - 8.45	SPT	21		Grey/brown MUDSTONE weathered to silty sandy gravelly clay at surface becoming fresh with depth (4.10)	7.90		
9.00	BULK						
9.50 - 9.95	SPT	23					

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
15.50					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH5 Sheet 2 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
21/09/06-22/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	SAMPLE RECORD TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
10.50	BULK			(Continued boring in same stratum)			
11.00-11.45	SPT	50/225MM					
				Grey/brown MUDSTONE (6.70)	12.00		
				Blue/grey SILTSTONE (1.80)	18.70		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	~~REMARKS ON GROUNDWATER AND CASING~~
15.50					STANDING LEVEL EOS

BORING METHOD AND REMARKS

~~DANDO 150~~
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH5 Sheet 3 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
21/09/06-22/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	SAMPLE RECORD TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				(Continued boring in same stratum)			
				Grey MUDSTONE	20.50		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
15.50					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH5 Sheet 4 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
21/09/06-22/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	SAMPLE RECORD TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				(Continued boring in same stratum)			
				BOREHOLE TERMINATED - NO VOIDS OR LOSS IN FLUSH ENCOUNTERED	35.00		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
15.50					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical
Tel: 0151-523-0202
Fax: 0151-523-0252

BOREHOLE LOG

HOLE NO. BH6
Sheet 1 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
22/09/06-23/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				Grassed TOPSOIL (0.30)			
0.50	BULK			Medium dense MADE GROUND comprising brick, ash, coal and gravel in sand (8.30)	0.30		
1.20 - 1.65	SPT	15					
1.50	BULK						
2.00 - 2.45	SPT	12					
2.50	BULK						
3.00 - 3.45	SPT	16					
3.50	BULK						
4.00 - 4.45	SPT	13					
4.50	BULK						
5.00 - 5.45	SPT	11					
6.00	BULK						
6.50 - 6.95	SPT	13					
7.50	BULK						
8.00 - 8.45	SPT	14					
9.00	BULK			Grey MUDSTONE weathered to silty sandy gravelly clay at surface becoming fresh with depth (3.70)	8.60		
9.50 - 9.95	SPT	17					

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
15.50					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH6 Sheet 2 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
22/09/06-23/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	SAMPLE RECORD TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
10.50	BULK			(Continued boring in same stratum)			
11.00-11.45	SPT	23					
12.00	BULK						
12.30-12.75	SPT	50/225MM		Grey MUDSTONE	12.30		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
15.50					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH6 Sheet 3 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
22/09/06-23/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	SAMPLE RECORD TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				(Continued boring in same stratum)			

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
15.50					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH6 Sheet 4 of 4

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
22/09/06-23/09/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	SAMPLE RECORD TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				(Continued boring in same stratum)			
				BOREHOLE TERMINATED - NO VOIDS OR LOSS IN FLUSH ENCOUNTERED	35.00		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
15.50					STANDING LEVEL EOS

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD
DANDO TOPDRIVE

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH7 Sheet 1 of 1

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
10/10/06-10/10/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				Grassed TOPSOIL (0.10)	0.10		
0.50	BULK			Medium dense MADE GROUND comprising brick, ash and gravel in sand (1.70)			
1.20 - 1.65	SPT	25					
1.50	BULK						
2.00 - 2.45	SPT	27		Firm occasionally soft brown silty sandy gravelly CLAY (3.40)	1.80		
2.50	BULK						
3.00 - 3.45	SPT	2					
3.50	BULK						
4.00 - 4.45	SPT	16					
4.50	BULK						
5.00 - 5.45	SPT	28					
5.50	BULK			MUDSTONE weathered to silty sandy gravel at surface becoming fresh with depth	5.20		
6.00 - 6.45	SPT	32		BOREHOLE TERMINATED	6.00		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
NS					BOREHOLE DRY

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT
1HR CHISELLING ON ROCKHEAD

All dimensions are in metres unless otherwise stated

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	BOREHOLE LOG	HOLE NO. BH8 Sheet 1 of 1

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
10/10/06-10/10/06	1:50	SEE LOCATION PLAN	AR/CJB	RR	06/3908/9

SAMPLE RECORD DEPTH	TYPE	SPT N (Cu-kN/m^2)	Standp/ Piezo	DESCRIPTION OF STRATUM (thickness)	DEPTH	REDUCED LEVEL	LEGEND
				Grassed TOPSOIL (0.10)	0.10		
0.50	BULK			Medium dense MADE GROUND comprising brick and gravel in sand (1.10)			
1.20 - 1.65	SPT	27			1.20		
1.50	BULK			Medium dense MADE GROUND comprising ash and gravel in sand (0.40)	1.60		
2.00 - 2.45	SPT	29		Firm occasionally soft brown silty sandy gravelly CLAY (2.20)			
2.50	BULK						
3.00 - 3.45	SPT	5					
3.50	BULK						
4.00 - 4.45	SPT	18		MUDSTONE weathered to silty sandy gravel at surface becoming fresh with depth (2.00)	3.80		
4.50	BULK						
5.00 - 5.45	SPT	31					
5.50	BULK						
6.00 - 6.45	SPT	30		COAL BOREHOLE TERMINATED	5.80 6.00		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
NS					BOREHOLE DRY

BORING METHOD AND REMARKS

DANDO 150
1HR DIGGING 1.2M SERVICE PIT

All dimensions are in metres unless otherwise stated

APPENDIX C

TRIAL PIT SECTION SHEETS

CC Geotechnical Tel: 0151-523-0202 Fax: 0151-523-0252

TRIAL PIT LOG

TRIAL PIT NO. TP3
Sheet 1 of 1

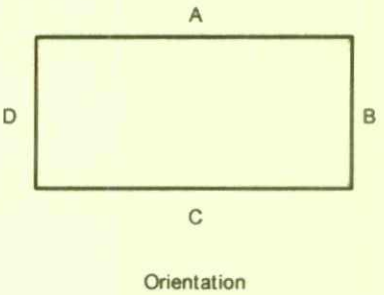
CLIENT: BARNSLEY MBC

SITE: FOULSTONE & WOMBWELL SCHOOLS, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
10/08/06-10/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/9

PIT DIMENSIONS A/C : 3.00 B/D : 1.00

ORIENTATION



Orientation

DEPTH	FACE A	FACE B	FACE C	FACE D
0.10				
1.50				
2.00				

FACE AND POSITION LOGGED ALL

SAMPLE AND TEST RECORD DEPTH	TYPE	RESULT	DEPTH	DESCRIPTION OF STRATUM (thickness)	STRATUM NO.	WATER DEPTH
			0.10	Grassed TOPSOIL (0.10)		
0.50	CBR	4%		MADE GROUND comprising brick, ash, timber and gravel in sand (1.40)		
0.70	TUB					
			1.50	MADE GROUND comprising soft red/pink/white mottled very silty very sandy clay (0.50)		
1.80	TUB		2.00			
				Soft/firm brown silty sandy CLAY		
2.50	TUB					
			3.00	TRIAL PIT TERMINATED		

GROUNDWATER INFORMATION

DEPTH STRUCK	ELAPSED TIME	WATER LEVEL	REMARKS ON GROUNDWATER
NS			TRIAL PIT DRY

EXCAVATION METHOD AND REMARKS

JCB 3C

All dimensions are in metres unless otherwise stated

CC Geotechnical Tel: 0151-523-0202 Fax: 0151-523-0252

TRIAL PIT LOG

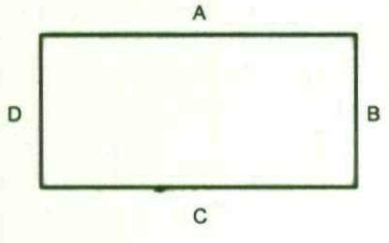
TRIAL PIT NO. TP4
Sheet 1 of 1

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOLS, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
10/08/06-10/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/9

PIT DIMENSIONS A/C : 3.00 B/D : 1.00

ORIENTATION



Orientation

DEPTH	FACE A	FACE B	FACE C	FACE D
0.10				
2.50				

FACE AND POSITION LOGGED ALL

SAMPLE AND TEST RECORD DEPTH	TYPE	RESULT	DEPTH	DESCRIPTION OF STRATUM (thickness)	STRATUM NO.	WATER DEPTH
			0.10	Grassed TOPSOIL (0.10)		
				MADE GROUND comprising brick, concrete and gravel in sand (2.40)		
0.50	CBR	3%				
0.70	TUB					
			2.50	Firm brown silty sandy CLAY		
			3.00	TRIAL PIT TERMINATED - SIFDES COLLAPSING		

GROUNDWATER INFORMATION

DEPTH STRUCK	ELAPSED TIME	WATER LEVEL	REMARKS ON GROUNDWATER
NS			TRIAL PIT DRY

EXCAVATION METHOD AND REMARKS

JCB 3C

All dimensions are in metres unless otherwise stated

CC Geotechnical Tel: 0151-523-0202 Fax: 0151-523-0252

TRIAL PIT LOG

TRIAL PIT NO. TP8
Sheet 1 of 1

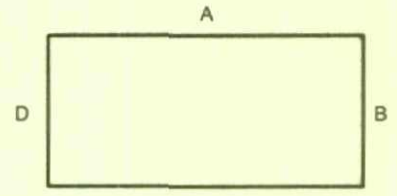
CLIENT: BARNSLEY MBC

SITE: FOULSTONE & WOMBWELL SCHOOLS, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
10/08/06-10/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/9

PIT DIMENSIONS A/C : 3.00 B/D : 1.00

ORIENTATION



Orientation

DEPTH	FACE A	FACE B	FACE C	FACE D
0.20				
1.30				
2.50				

FACE AND POSITION LOGGED ALL

SAMPLE AND TEST RECORD DEPTH	TYPE	RESULT	DEPTH	DESCRIPTION OF STRATUM (thickness)	STRATUM NO.	WATER DEPTH
			0.20	Grassed TOPSOIL (0.20)		
0.50	CBR	4%		MADE GROUND comprising red shale sand and gravel (1.10)		
0.70	TUB					
			1.30			
1.50	TUB			MADE GROUND comprising dark grey mudstone and coal sand and gravel (1.20)		
			2.50			
2.70	TUB			MADE GROUND comprising mottled yellow/red clayey mudstone gravel		
			3.00	TRIAL PIT TERMINATED		

GROUNDWATER INFORMATION

DEPTH STRUCK	ELAPSED TIME	WATER LEVEL	REMARKS ON GROUNDWATER
NS			TRIAL PIT DRY

EXCAVATION METHOD AND REMARKS

JCB 3C

All dimensions are in metres unless otherwise stated

CC Geotechnical
Tel: 0151-523-0202
Fax: 0151-523-0252

TRIAL PIT LOG

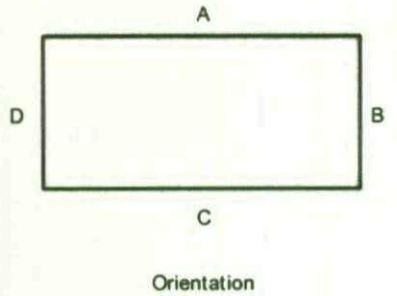
TRIAL PIT NO. TP9
Sheet 1 of 1

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOLS, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
10/08/06-10/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/9

PIT DIMENSIONS A/C : 3.00 B/D : 1.00

ORIENTATION



Orientation

DEPTH	FACE A	FACE B	FACE C	FACE D
0.30				

FACE AND POSITION LOGGED ALL

SAMPLE AND TEST RECORD DEPTH	TYPE	RESULT	DEPTH	DESCRIPTION OF STRATUM (thickness)	STRATUM NO.	WATER DEPTH
				Grassed TOPSOIL (0.30)		
0.50	CBR	4%	0.30	MADE GROUND comprising brick, coal, metal, shale and gravel in sand		
0.70	TUB					
			2.30	TRIAL PIT TERMINATED - HAMPERED BY LARGE METAL OBSTRUCTIONS		

GROUNDWATER INFORMATION

DEPTH STRUCK	ELAPSED TIME	WATER LEVEL	REMARKS ON GROUNDWATER
NS			TRIAL PIT DRY

EXCAVATION METHOD AND REMARKS

JCB 3C
3 X METAL OBSTRUCTIONS ENCOUNTERED AT 0.6MBGL

All dimensions are in metres unless otherwise stated

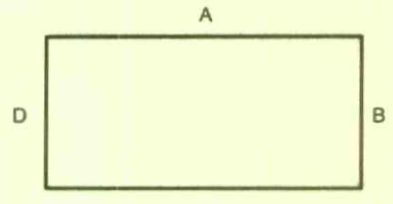
CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	TRIAL PIT LOG	TRIAL PIT NO. TP10 Sheet 1 of 1

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOLS, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
10/08/06-10/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/9

PIT DIMENSIONS A/C : 3.00
B/D : 1.00

ORIENTATION



Orientation

DEPTH	FACE A	FACE B	FACE C	FACE D
0.20				

FACE AND POSITION LOGGED ALL

SAMPLE AND TEST RECORD DEPTH	TYPE	RESULT	DEPTH	DESCRIPTION OF STRATUM (thickness)	STRATUM NO.	WATER DEPTH
			0.20	Grassed TOPSOIL (0.20)		
0.50	CBR	4%		MADE GROUND comprising brick, clay, gravel and occasional coal in sand		
0.70	TUB					
2.00	TUB					
			3.00	TRIAL PIT TERMINATED		

GROUNDWATER INFORMATION

DEPTH STRUCK	ELAPSED TIME	WATER LEVEL	REMARKS ON GROUNDWATER
NS			TRIAL PIT DRY

EXCAVATION METHOD AND REMARKS

JCB 3C

All dimensions are in metres unless otherwise stated

CC Geotechnical Tel: 0151-523-0202 Fax: 0151-523-0252

TRIAL PIT LOG

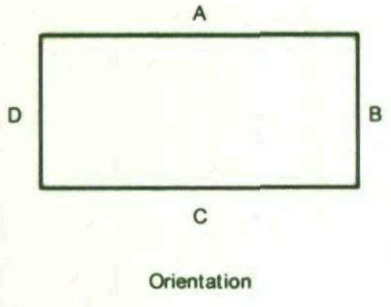
TRIAL PIT NO. TP11 Sheet 1 of 1

CLIENT	SITE
BARNSLEY MBC	FOULSTONE & WOMBWELL SCHOOLS, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
10/08/06-10/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/9

PIT DIMENSIONS A/C : 3.00 B/D : 1.00

ORIENTATION



Orientation

DEPTH	FACE A	FACE B	FACE C	FACE D
0.20				
1.00				

FACE AND POSITION LOGGED ALL

SAMPLE AND TEST RECORD DEPTH	TYPE	RESULT	DEPTH	DESCRIPTION OF STRATUM (thickness)	STRATUM NO.	WATER DEPTH
			0.20	Grassed TOPSOIL (0.20)		
0.50	CBR	4%		MADE GROUND comprising brick, gravel and occasional coal in sand (0.80)		
0.70	TUB		1.00			
				Dark grey MUDSTONE recovered as SAND and GRAVEL		
			3.00	TRIAL PIT TERMINATED		

GROUNDWATER INFORMATION

DEPTH STRUCK	ELAPSED TIME	WATER LEVEL	REMARKS ON GROUNDWATER
NS			TRIAL PIT DRY

EXCAVATION METHOD AND REMARKS

JCB 3C

All dimensions are in metres unless otherwise stated

CC Geotechnical Tel: 0151-523-0202 Fax: 0151-523-0252

TRIAL PIT LOG

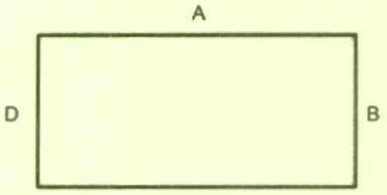
TRIAL PIT NO. TP12
Sheet 1 of 1

CLIENT	BARNSLEY MBC
SITE	FOULSTONE & WOMBWELL SCHOOLS, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
10/08/06-10/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/9

PIT DIMENSIONS A/C : 3.00 B/D : 1.00

ORIENTATION



Orientation

DEPTH	FACE A	FACE B	FACE C	FACE D
0.10				
2.20				

FACE AND POSITION LOGGED ALL

SAMPLE AND TEST RECORD DEPTH	TYPE	RESULT	DEPTH	DESCRIPTION OF STRATUM (thickness)	STRATUM NO.	WATER DEPTH
			0.10	Grassed TOPSOIL (0.10)		
0.50	CBR	3%		MADE GROUND comprising brick, ash, clay and gravel in sand (2.10)		
0.70	TUB					
			2.20			
2.50	TUB			Soft dark grey rapidly becoming mottled grey/orange/ brown silty sandy CLAY		
			3.00	TRIAL PIT TERMINATED		

GROUNDWATER INFORMATION

DEPTH STRUCK	ELAPSED TIME	WATER LEVEL	REMARKS ON GROUNDWATER
NS			TRIAL PIT DRY

EXCAVATION METHOD AND REMARKS

JCB 3C

All dimensions are in metres unless otherwise stated



TP3



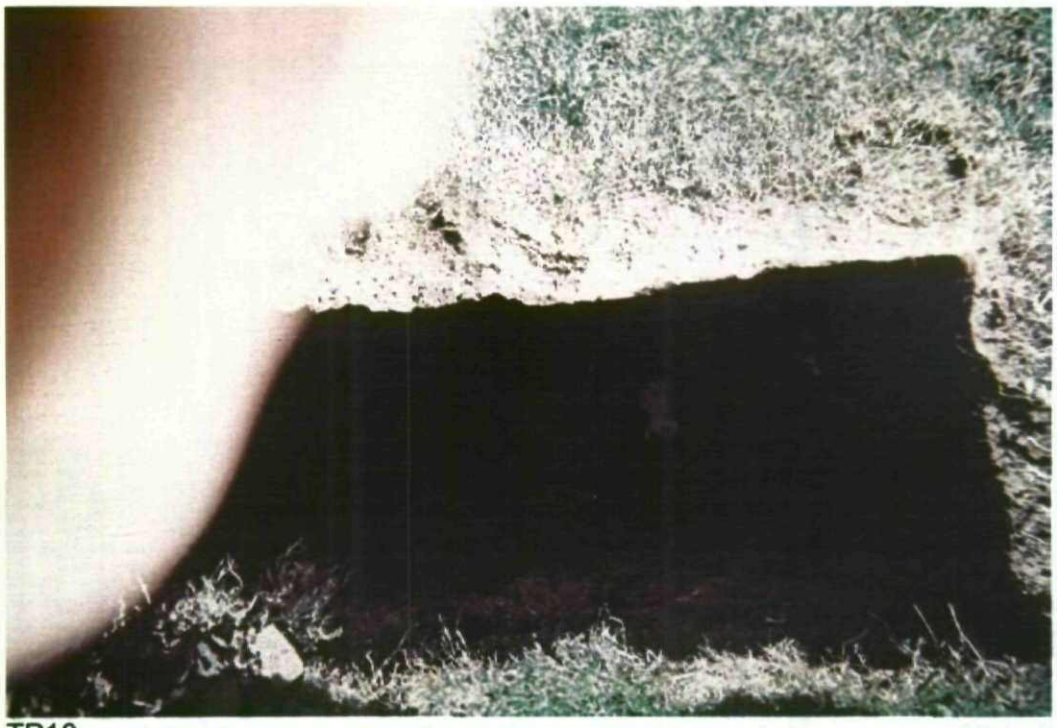
TP4



TP9



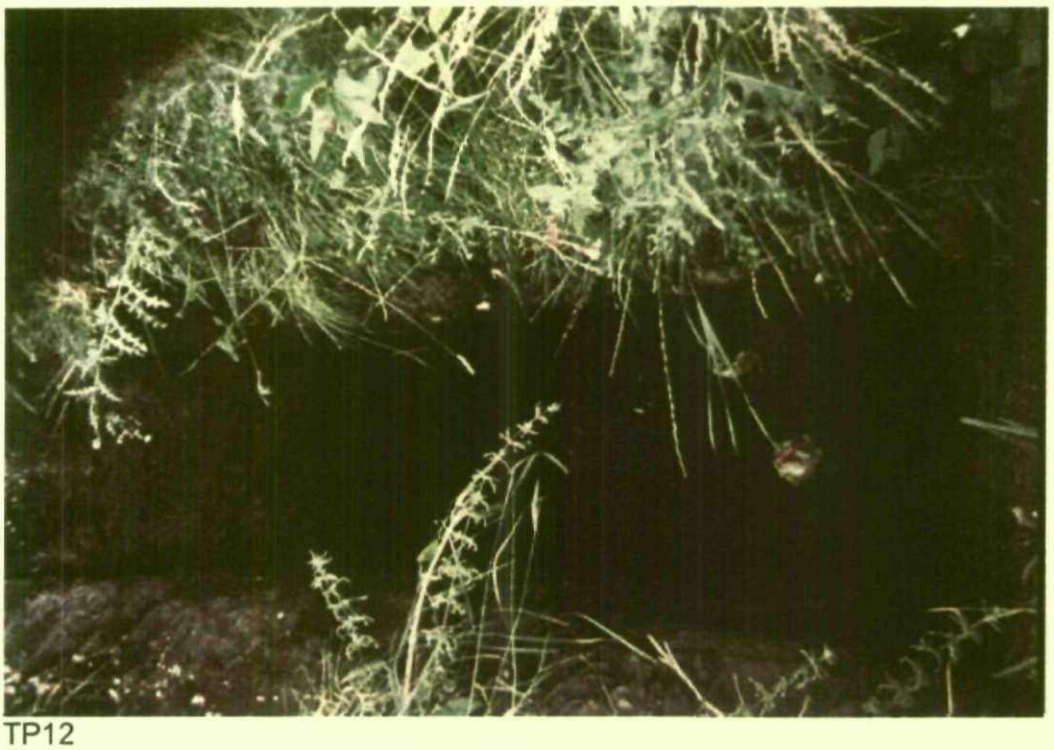
TP9



TP10



TP11



TP12

APPENDIX D

GROUND GAS MONITORING DATA

GAS MONITORING RESULTS

Job Number:	06/3908/9		Site Name:	Foulstone & Wombwell School, Barnsley

	VISIT NUMBER	1	2	3	4	5	6	7	8	9	10
	DATE	28/09/06	04/10/06	12/10/06	18/10/06	26/10/06	30/10/06				
BH	ATMOSPHERIC PRESSURE (mB)	999	1003	1014	999	1003	1002				
	AIR TEMPERATURE (^{O}C)	20	15	15	16	15	12				
	CLOUD COVER	Light	Nil	Light	Light	Overcast	Overcast				
	WIND VELOCITY (MPH)	Moderate	Nil	Light	Light	Light	Light				
	PRECIPITATION	Nil	Nil	Nil	Nil	Nil	Nil				
	STATE OF GROUND	Dry	Damp	Dry	Damp	Damp	Damp				
1	CH_4 (%)	Nil	Nil	Nil	Nil	Nil	Nil				
	CO_2 (%)	0.9	5.1	0.3	5.7	2.3	3.1				
	O_2 (%)	18.4	7.0	20.2	4.0	15.5	14.2				
	H_2S (p.p.m.)	Nil	Nil	Nil	Nil	Nil	Nil				
	CO (p.p.m.)	Nil	Nil	Nil	Nil	Nil	Nil				
	FLOW (l/hr)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	STANDING WATER LEVEL (m)	Dry	Dry	Dry	Dry	Dry	Dry				
3	CH_4 (%)	Nil	Nil	Nil	Nil	Nil	Nil				
	CO_2 (%)	0.1	1.1	Nil	3.0	0.5	0.7				
	O_2 (%)	20.4	19.3	20.5	17.7	19.9	19.4				
	H_2S (p.p.m.)	Nil	Nil	Nil	Nil	Nil	Nil				
	CO (p.p.m.)	Nil	Nil	Nil	Nil	Nil	Nil				
	FLOW (l/hr)	<0.1	<0.1	0.1	<0.1	<0.1	<0.1				
	STANDING WATER LEVEL (m)	Dry	Dry	Dry	Dry	Dry	Dry				
5	CH_4 (%)	Nil	Nil	Nil	Nil	Nil	Nil				
	CO_2 (%)	Nil	0.1	2.0	2.2	2.0	2.1				
	O_2 (%)	20.5	20.3	18.3	17.1	18.5	17.8				
	H_2S (p.p.m.)	Nil	Nil	Nil	Nil	Nil	Nil				
	CO (p.p.m.)	Nil	Nil	Nil	Nil	Nil	Nil				
	FLOW (l/hr)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	STANDING WATER LEVEL (m)	Dry	Dry	Dry	Dry	Dry	Dry				
6	CH_4 (%)	Nil	Nil	Nil	Nil	Nil	Nil				
	CO_2 (%)	4.6	0.1	0.3	0.5	0.4	0.3				
	O_2 (%)	17.1	20.2	20.1	20.0	20.0	20.1				
	H_2S (p.p.m.)	Nil	Nil	Nil	Nil	Nil	Nil				
	CO (p.p.m.)	Nil	Nil	Nil	Nil	Nil	Nil				
	FLOW (l/hr)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
	STANDING WATER LEVEL (m)	Dry	Dry	Dry	Dry	Dry	Dry				

INSTRUMENT: GAS DATA LMSxi GAS ANALYSER

Test Date and Conditions	
Date	22/3/2006
Atmospheric Pressure	1003 mBar
Ambient Temp	17°C

GAS DATA LTD
Pegasus House
Seven Stars Estate
Wheler Rd
Coventry
CV3 4LB
Tel 02476303311 Fax 02476307711

LMS FINAL INSPECTION & CALIBRATION CERTIFICATE

INSTRUMENT DETAILS			
Serial No	5105	CUSTOMER	CC GEOTECHNICAL
S/W Version	G4.19a-LTBxV		

INSTRUMENT CHECKS			
Keyboard	✓	Clock Set / Running	✓
Pump In/Out	✓	Labels Fitted	✓
Display Contrast	✓	Recalibration Due	27/01/2007

GASES					
CH4		CO2		O2	
Test %	Reading %	Test %	Reading %	Test %	Reading
0 accept = 0.1	0	0 accept <= 0.1	0	0 accept <= 0.1	0
5 accept 4.9-5.1	5.0	10 accept 9.8-10.2	10.0	21 accept 20.5-21.2	20.9
50 accept 48.0-52.0	50.0	40 accept 37.0-45.0	40.0		
Environics Serial No :	3268				

PRESSURES			
Absolute/Relative		Differential	
Atmos accept current +/-1	1003	0.0	
Atmos + 50 mbar accept current +48-+52	1054	+30 mbar accept 29.5-30.5	
Atmos - 50 mbar accept current -48--52	954	-30 mbar accept -29.5--30.5	

TEMPERATURE	
Applied °C	Reading °C
0 accept -0.1-+0.1	0
25 accept 24.5-25.5	25.0
40 accept 37.5-40.5	40.0

OPTIONS					
Borehole Flow (See other sheet)	X	LEL	✓	Temp Probe (see above)	X
Extraction Flow	X			Toxic Gasses (see other sheet)	✓

PACKING						
Charger	UK ✓	US ✓	Euro X	Sample Pipe	Standard ✓	Flow ✓
Manual	✓			Serial Cable	✓	
Leather Bag	✓			Software	✓	
Strap	✓			Cal Certificate	✓	

Tested .....

Approved .....

Test Date and Conditions	
Date	22/3/2006
Atmospheric Pressure	1003 – Bar
Ambient Temp	17 °C

GAS DATA LTD
Pegasus House
Seven Stars Estate
Wheler Rd
Coventry
CV3 4LB
Tel: 024 76 303311 Fax: 024 76 307711

LMS FINAL INSPECTION & CALIBRATION CERTIFICATE

(OPTIONS)

INSTRUMENT DETAILS			
Serial No	5105	CUSTOMER	CC GEOTECHNICAL
S/W Version	G4.19a-LTBXV		

Toxic Gasses

Gas Type	Range	Tested @	Reading
H_2S	0-200 ppm	100 ppm	100 ppm
CO	0-1000 ppm	1000 ppm	1000 ppm

Cross Gas Effects

Applied gas		Readings			
Type	Concentration	Toxic 1: H_2S	Toxic 2: CO	Toxic 3:	Toxic 4:
H_2S	100 ppm	100 ppm	0 ppm		
CO	1000 ppm	9.0 ppm	1005 ppm		

Flow Tests - Low Range Option

Target Flow	-5 L/Hr	0 L/Hr	5 L/Hr	10 L/Hr	20 L/Hr
Applied					
Flow Reading	accept applied +/-0.5	accept applied +/-0.0	accept applied +/-0.5	accept applied +/-0.7	accept applied +/-1.0
dp Applied (Pa)		0			
dp Reading (Pa)	accept applied +/-5	accept applied +/-0.0	accept applied +/-5	accept applied +/-10	accept applied +/-20

Flow Tests - High Range Option

Target Flow	-30 L/Hr	0 L/Hr	30 L/Hr	60 L/Hr	180 L/Hr
Applied					
Flow Reading	accept applied +/-3.0	accept applied +/-0.0	accept applied +/-3.0	accept applied +/-4.0	accept applied +/-15
dp Applied (Pa)		0			
dp Reading (Pa)	accept applied +/-15	accept applied +/-0.0	accept applied +/-15	accept applied +/-50	accept applied +/-200

Tested ..... Approved .....

APPENDIX E

SOIL ENGINEERING TEST DATA

SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with BS1377:Part 2:1990 & B.R.E. IP 4/93 (soil suction values)

BH / TP / WS Number	Type	Depth From (m)	Depth To (m)	Moisture Content (%)	Bulk Density (Mg/m^3)	Dry Density (Mg/m^3)	Shear Strength (kN/m^2)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425micron (%)	Soil Classification	Description / Remarks
BH1	BD	0.50	0.50	6.4	-	-	-	-	-	-	-	-	
BH1	BD	1.50	1.50	11	-	-	-	-	-	-	-	NP	Very silty very sandy GRAVEL. (see PSD result sheet)
BH1	BD	2.50	2.50	5.7	-	-	-	-	-	-	-	-	Very silty sandy GRAVEL. (see PSD result sheet)
BH5	BD	0.50	0.50	8.8	-	-	-	-	-	-	-	-	
BH5	BD	1.50	1.50	11	-	-	-	-	-	-	-	NP	Very silty very sandy GRAVEL. (see PSD result sheet)
BH5	BD	2.50	2.50	17	-	-	-	-	-	-	-	-	Very silty very sandy GRAVEL. (see PSD result sheet)
BH5	BD	3.50	3.50	17	-	-	-	-	-	-	-	-	Very silty very sandy GRAVEL. (see PSD result sheet)
BH5	BD	4.50	4.50	15	-	-	-	46	21	25	87	CI	
BH6	BD	0.50	0.50	13	-	-	-	50	23	27	49	CI / CH	
BH6	BD	1.50	1.50	11	-	-	-	-	-	-	-	-	
BH6	BD	2.50	2.50	9.1	-	-	-	-	-	-	-	-	Very sandy slightly silty GRAVEL. (see PSD result sheet)
BH6	BD	3.50	3.50	24	-	-	-	-	-	-	-	-	
BH6	BD	4.50	4.50	11	-	-	-	-	-	-	-	-	
BH6	BD	5.50	5.50	19	-	-	-	-	-	-	-	-	Very sandy silty GRAVEL. (see PSD result sheet)

SITE: FOULSTONE & WOMBWELL

CLIENT: BARNSLEY MBC

DATE: Sep-06

SHEET: 1 of 1

CC Geotechnical

Telephone: (0151) 523 0202

Key:- BD = Bulk Disturbed; SD = Small Disturbed; U100 = Undisturbed 100mm

CL = Low Plasticity; CI = Intermediate; CH = High; CV = Very high; CE = Extremely high; NP = Non-plastic

(* Denotes Hand Shear Vane test result)

SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with BS1377:Part 2:1990 & B.R.E. IP 4/93 (soil suction values)

BH / TP / WS Number	Type	Depth From (m)	Depth To (m)	Moisture Content (%)	Bulk Density (Mg/m^3)	Dry Density (Mg/m^3)	Shear Strength (kN/m^2)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425micron (%)	Soil Classification	Description / Remarks
BH7	BD	0.50	0.50	11	-	-	-	-	-	-	-	-	Very silty very gravelly SAND. (see PSD result sheet)
BH7	BD	1.50	1.50	7.9	-	-	-	-	-	-	-	-	Very sandy silty GRAVEL. (see PSD result sheet)
BH7	BD	2.50	2.50	28	-	-	-	51	25	26	99	CH	
BH7	BD	3.50	3.50	14	-	-	-	36	16	20	67	CI	
BH7	BD	4.50	4.50	15	-	-	-	36	17	19	64	CI	
BH7	BD	5.50	5.50	11	-	-	-	-	-	-	-	-	Very sandy silty GRAVEL. (see PSD result sheet)
BH8	BD	0.50	0.50	17	-	-	-	-	-	-	-	-	Very silty very cobbly SAND and GRAVEL. (see PSD result sheet)
BH8	BD	1.50	1.50	16	-	-	-	-	-	-	-	-	Very silty SAND and GRAVEL. (see PSD result sheet)
BH8	BD	2.50	2.50	32	-	-	-	37	19	18	97	CI	Very sandy slightly gravelly CLAY. (see PSD result sheet)
BH8	BD	3.50	3.50	24	-	-	-	-	-	-	-	-	Very sandy CLAY. (see PSD result sheet)
BH8	BD	5.50	5.50	16	-	-	-	36	21	15	99	CI	Very sandy silty GRAVEL. (see PSD result sheet)

SITE: FOULSTONE & WOMBWELL

CLIENT: BARNSLEY MBC

DATE: Oct-06

SHEET: 2 of 2

CC Geotechnical

Telephone: (0151) 523 0202

Key:- BD = Bulk Disturbed; SD = Small Disturbed; U100 = Undisturbed 100mm
CL = Low Plasticity; CI = Intermediate; CH = High; CV = Very high; CE = Extremely high; NP = Non-plastic
(* Denotes Hand Shear Vane test result)

CC Geotechnical
Tel: 0151-523-0202
Fax: 0151-523-0252

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

HOLE NO. BH1

CLIENT: BARNSLEY MBC

SITE: FOULSTONE & WOMBWELL SCHOOL

SAMPLE DEPTH: 1.50 - 1.50

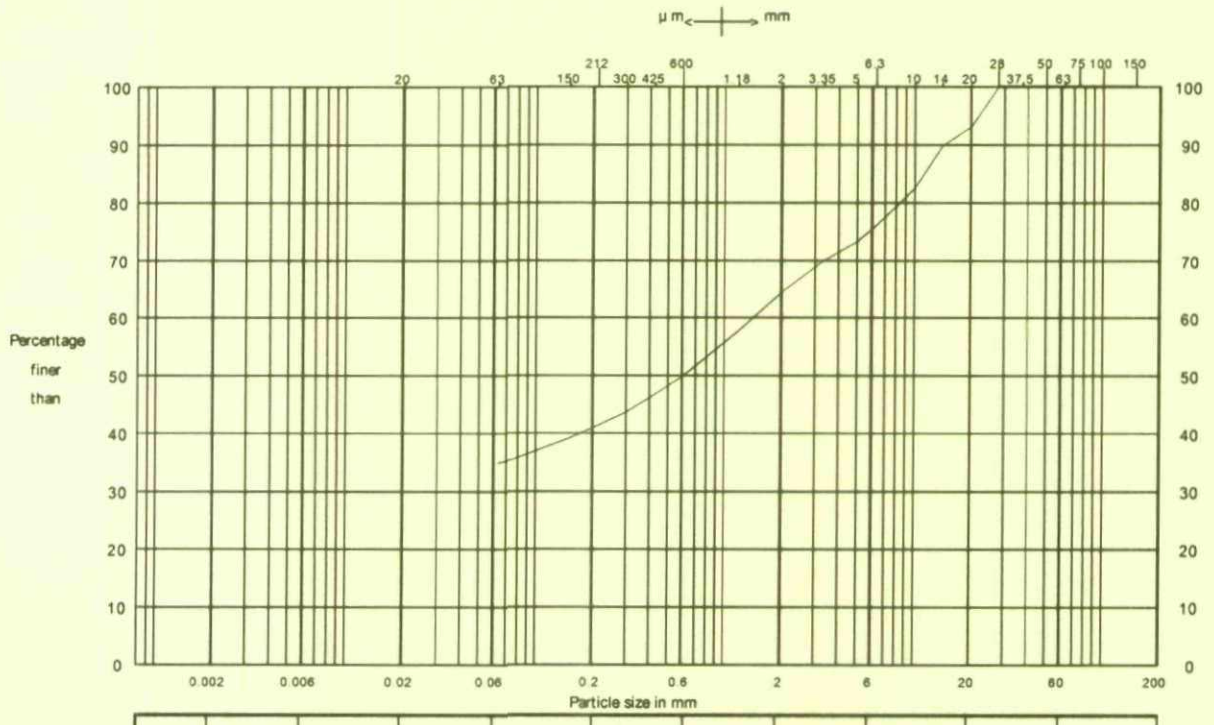
SAMPLE REF: 2

JOB NO. 06/3908/9

METHOD OF PRETREATMENT:

METHOD OF TEST: Wet Sieve

	Size (microns)							Size (mm)													
Sieve Size	63	75	150	212	300	425	600	1.18	2	3.35	5	6.3	10	14	20	28	37.5	50	63	75	100	150
% by Mass passing Sieve	35	35	39	41	44	47	50	58	64	70	73	76	82	90	93	100	100	100	100	100	100	100



	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			29			36			0

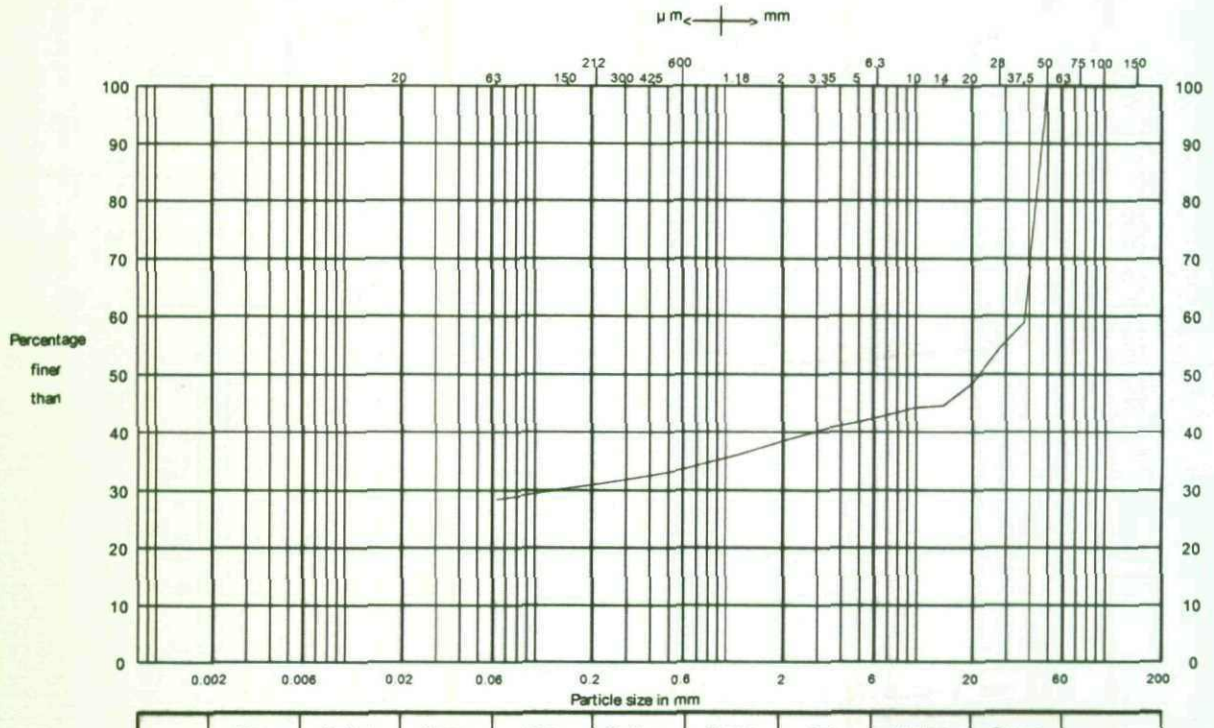
SAMPLE DESCRIPTION

Very silty very sandy GRAVEL

REMARKS

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH1
CLIENT	BARNSLEY MBC	SITE	FOULSTONE & WOMBWELL SCHOOL
SAMPLE DEPTH	2.50 - 2.50	SAMPLE REF 3	JOB NO. 06/3908/9
METHOD OF PRETREATMENT		METHOD OF TEST	Wet Sieve

	Size (microns)							Size (mm)													
Sieve Size	63	75	150	212	300	425	600	1.18	2	3.35	5	6.3	10	14	20	28	37.5	50	63	75	100	150
% by Mass passing Sieve	28	29	30	31	32	33	34	36	38	41	42	42	44	45	48	55	59	100	100	100	100	100

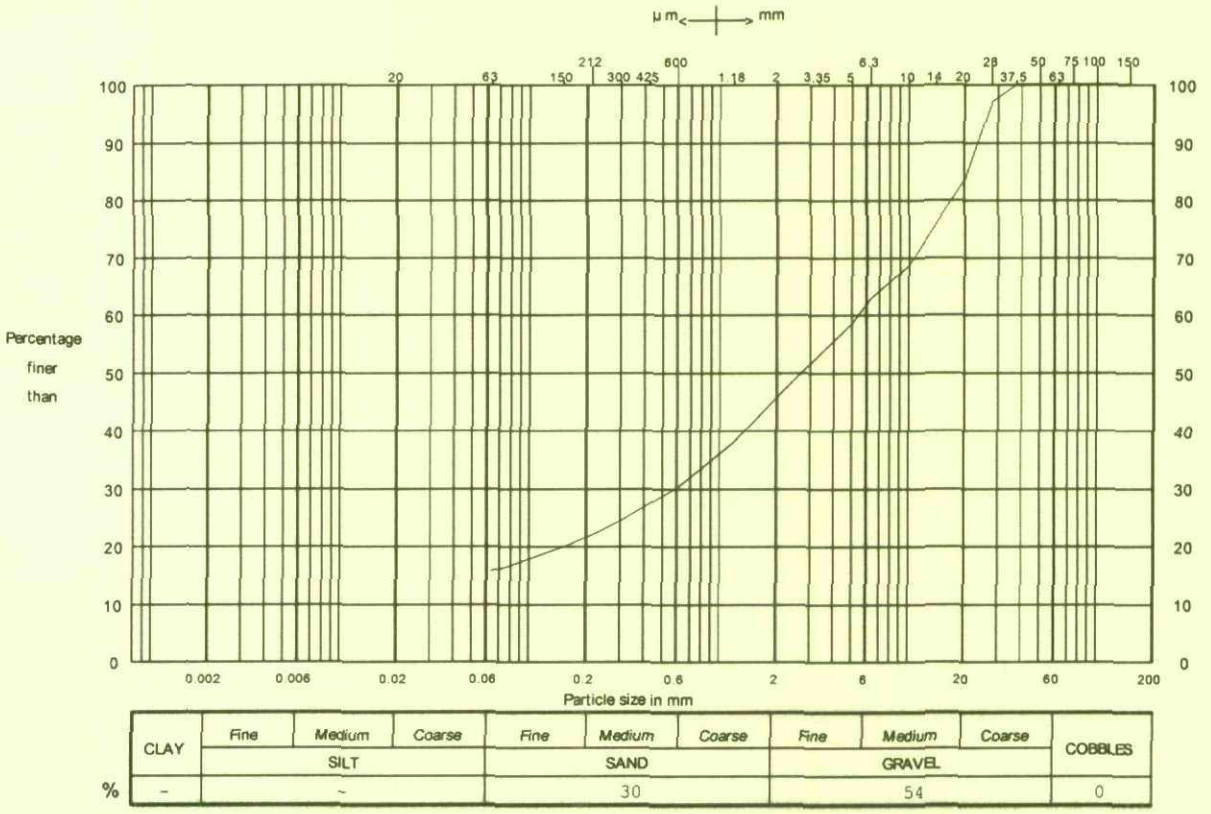


	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			10			62			0

SAMPLE DESCRIPTION	REMARKS
Very silty sandy GRAVEL	

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH5
CLIENT BARNSLEY MBC		SITE FOULSTONE & WOMBWELL SCHOOL	
SAMPLE DEPTH 1.50 - 1.50		SAMPLE REF 2	JOB NO. 06/3908/9
METHOD OF PRETREATMENT		METHOD OF TEST Wet Sieve	

	Size (microns)							Size (mm)													
Sieve Size	63	75	150	212	300	425	600	1.18	2	3.35	5	6.3	10	14	20	28	37.5	50	63	75	100	150
% by Mass passing Sieve	16	16	20	22	24	27	30	38	46	53	59	63	69	76	84	97	100	100	100	100	100	100

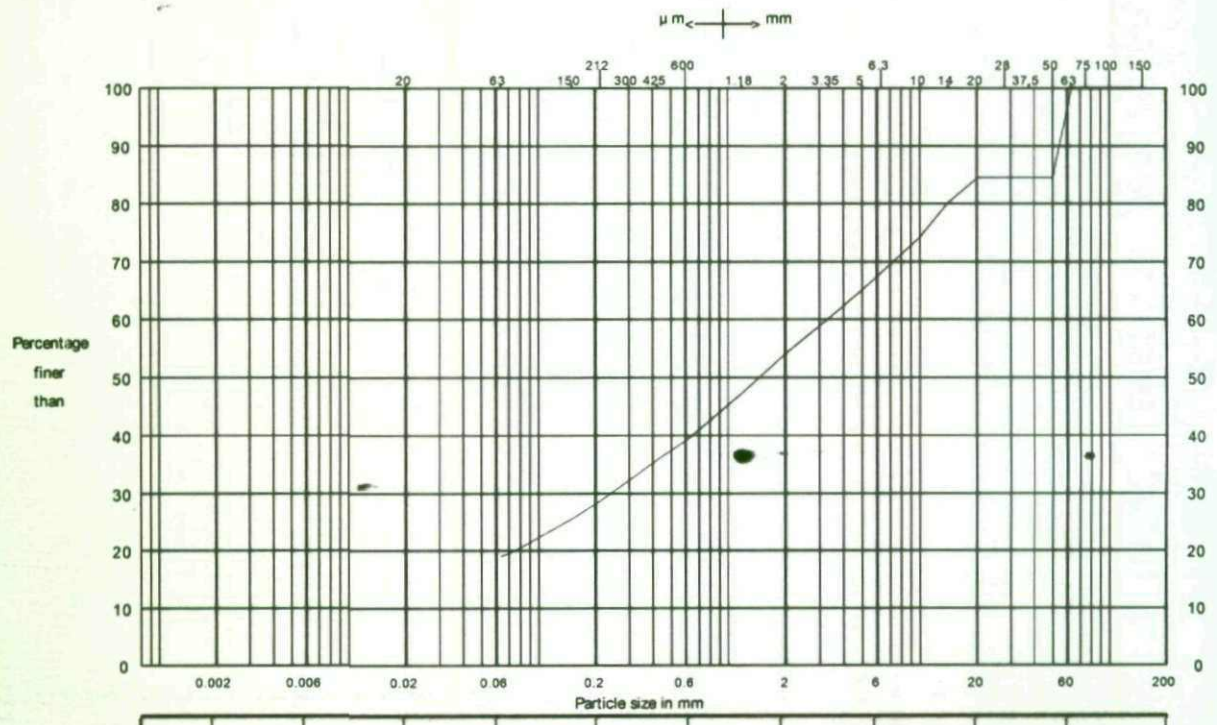


	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			30			54			0

SAMPLE DESCRIPTION	REMARKS
Very silty very sandy GRAVEL	

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH5
CLIENT BARNSLEY MBC		SITE FOULSTONE & WOMBWELL SCHOOL	
SAMPLE DEPTH 2.50 - 2.50		SAMPLE REF 3	JOB NO. 06/3908/9
METHOD OF PRETREATMENT		METHOD OF TEST Wet Sieve	

	Size (microns)							Size (mm)													
Sieve Size	63	75	150	212	300	425	600	1.18	2	3.35	5	6.3	10	14	20	28	37.5	50	63	75	100	150
% by Mass passing Sieve	19	20	26	29	32	36	39	47	54	60	65	68	74	80	84	84	84	84	100	100	100	100



	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			35			46			0

SAMPLE DESCRIPTION

Very silty very sandy GRAVEL

REMARKS

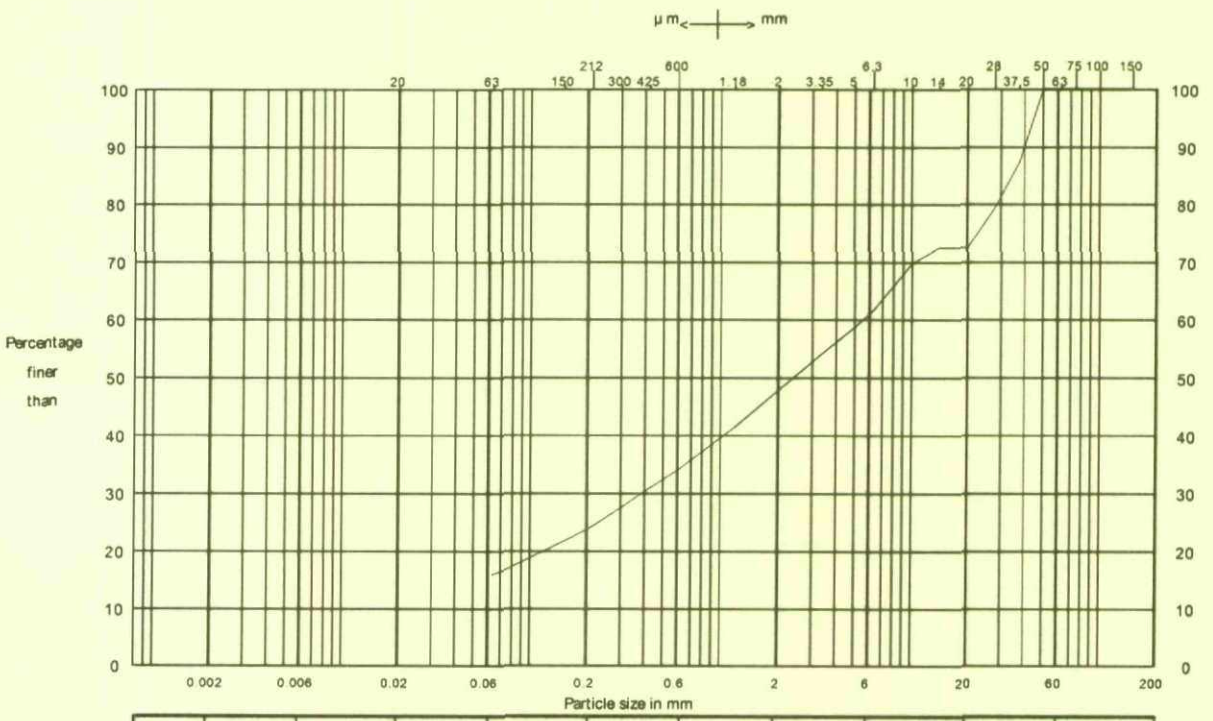
CC Geotechnical
Tel: 0151-523-0202
Fax: 0151-523-0252

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

HOLE NO. BH5

CLIENT: BARNSLEY MBC	SITE: FOULSTONE & WOMBWELL SCHOOL
SAMPLE DEPTH: 3.50 - 3.50	SAMPLE REF: 4
JOB NO.: 06/3908/9	
METHOD OF PRETREATMENT:	METHOD OF TEST: Wet Sieve

	Size (microns)							Size (mm)													
Sieve Size	63	75	150	212	300	425	600	1.18	2	3.35	5	6.3	10	14	20	28	37.5	50	63	75	100	150
% by Mass passing Sieve	16	17	22	24	27	31	34	41	48	54	59	62	70	72	72	79	87	100	100	100	100	100



	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			32			52			0

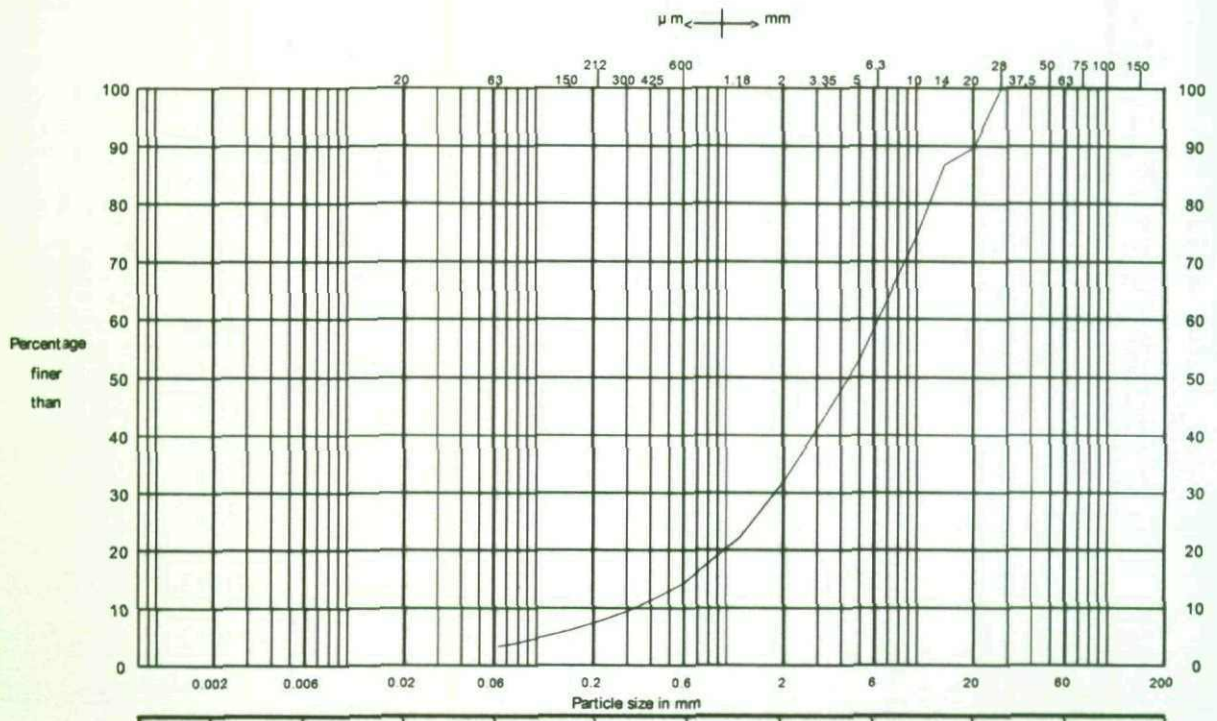
SAMPLE DESCRIPTION

Very silty very sandy GRAVEL

REMARKS

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH6
CLIENT BARNSLEY MBC		SITE FOULSTONE & WOMBWELL SCHOOL	
SAMPLE DEPTH 2.50 - 2.50		SAMPLE REF 3	JOB NO. 06/3908/9
METHOD OF PRETREATMENT		METHOD OF TEST Wet Sieve	

	Size (microns)							Size (mm)													
Sieve Size	63	75	150	212	300	425	600	1.18	2	3.35	5	6.3	10	14	20	28	37.5	50	63	75	100	150
% by Mass passing Sieve	3	4	6	8	9	12	14	22	32	44	53	60	74	87	90	100	100	100	100	100	100	100

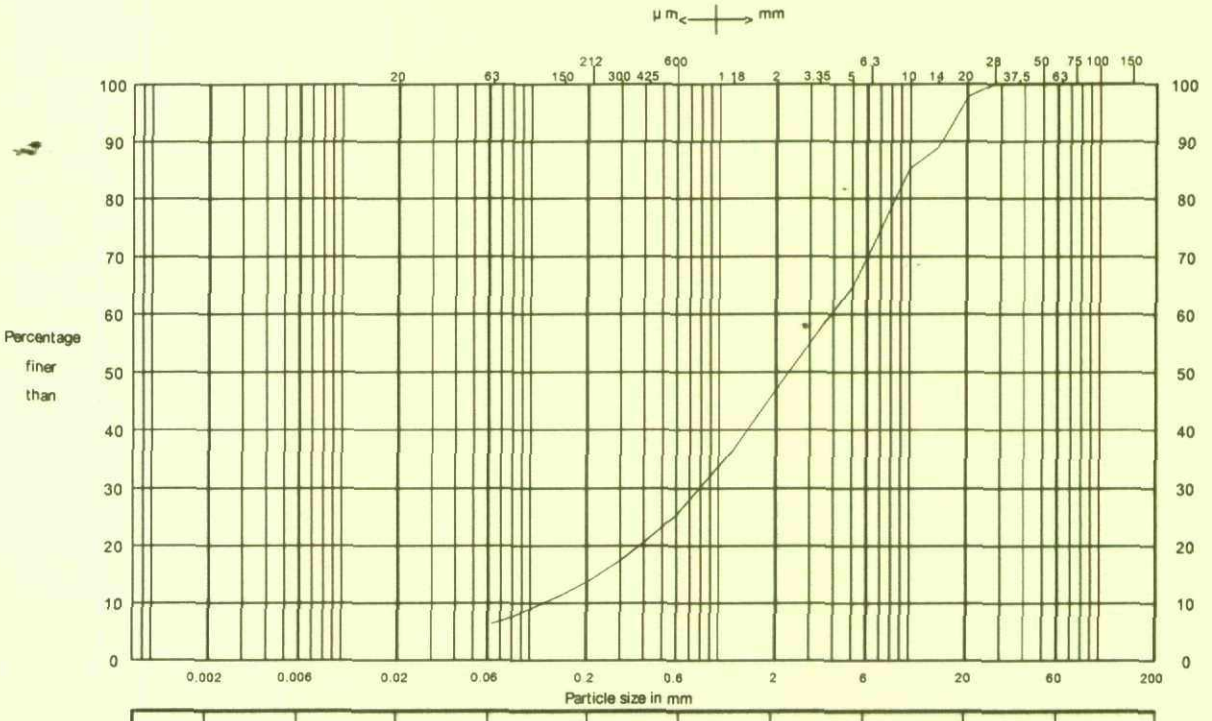


	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			29			68			0

SAMPLE DESCRIPTION	REMARKS
Very sandy slightly silty GRAVEL	

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH6
CLIENT BARNSLEY MBC		SITE FOULSTONE & WOMBWELL SCHOOL	
SAMPLE DEPTH 5.50 - 5.50		SAMPLE REF 6	JOB NO. 06/3908/9
METHOD OF PRETREATMENT		METHOD OF TEST Wet Sieve	

	Size (microns)							Size (mm)													
Sieve Size	63	75	150	212	300	425	600	1.18	2	3.35	5	6.3	10	14	20	28	37.5	50	63	75	100	150
% by Mass passing Sieve	6	7	11	14	17	21	25	36	47	57	65	71	85	89	98	100	100	100	100	100	100	100

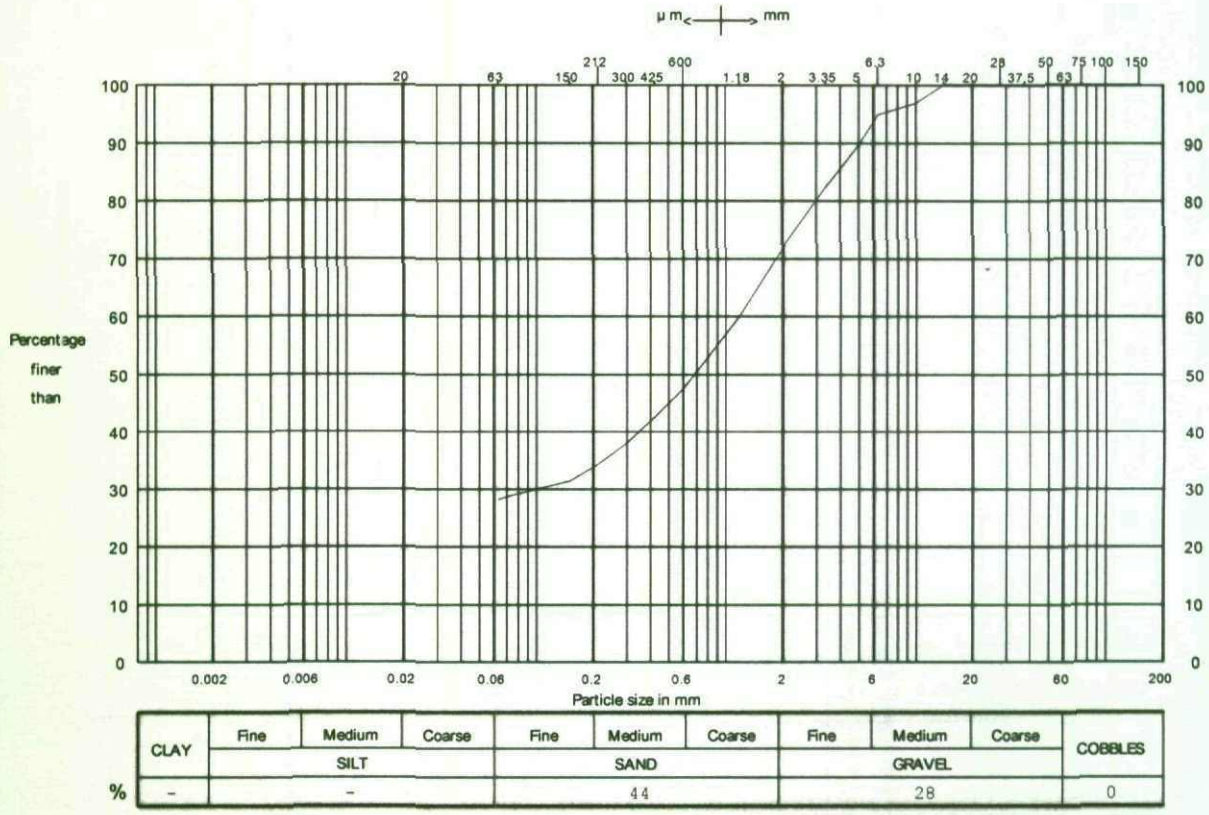


	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			41			53			0

SAMPLE DESCRIPTION	REMARKS
Very sandy silty GRAVEL	

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH7
CLIENT BARNSLEY MBC		SITE FOULSTONE & WOMBWELL SCHOOL	
SAMPLE DEPTH 0.50 - 0.50		SAMPLE REF 1	JOB NO. 06/3908/9
METHOD OF PRETREATMENT		METHOD OF TEST Wet Sieve	

	Size (microns)							Size (mm)													
Sieve Size	63	75	150	212	300	425	600	1.18	2	3.35	5	6.3	10	14	20	28	37.5	50	63	75	100	150
% by Mass passing Sieve	28	29	31	34	38	43	48	60	72	82	90	95	97	100	100	100	100	100	100	100	100	100

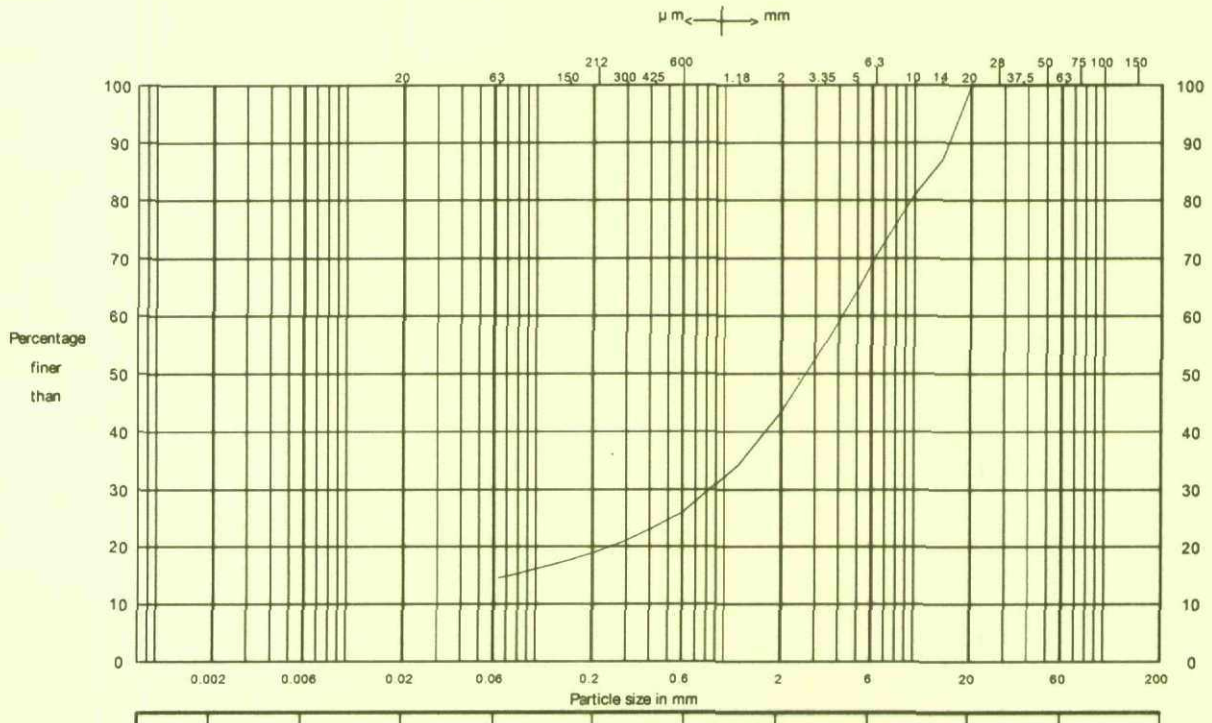


	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			44			28			0

SAMPLE DESCRIPTION	REMARKS
Very silty very gravelly SAND	

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH7
CLIENT BARNSLEY MBC		SITE FOULSTONE & WOMBWELL SCHOOL	
SAMPLE DEPTH 1.50 - 1.50		SAMPLE REF 2	JOB NO. 06/3908/9
METHOD OF PRETREATMENT		METHOD OF TEST Wet Sieve	

	Size (microns)							Size (mm)													
Sieve Size	63	75	150	212	300	425	600	1.18	2	3.35	5	6.3	10	14	20	28	37.5	50	63	75	100	150
% by Mass passing Sieve	14	15	18	19	21	23	26	34	44	55	64	70	81	87	100	100	100	100	100	100	100	100

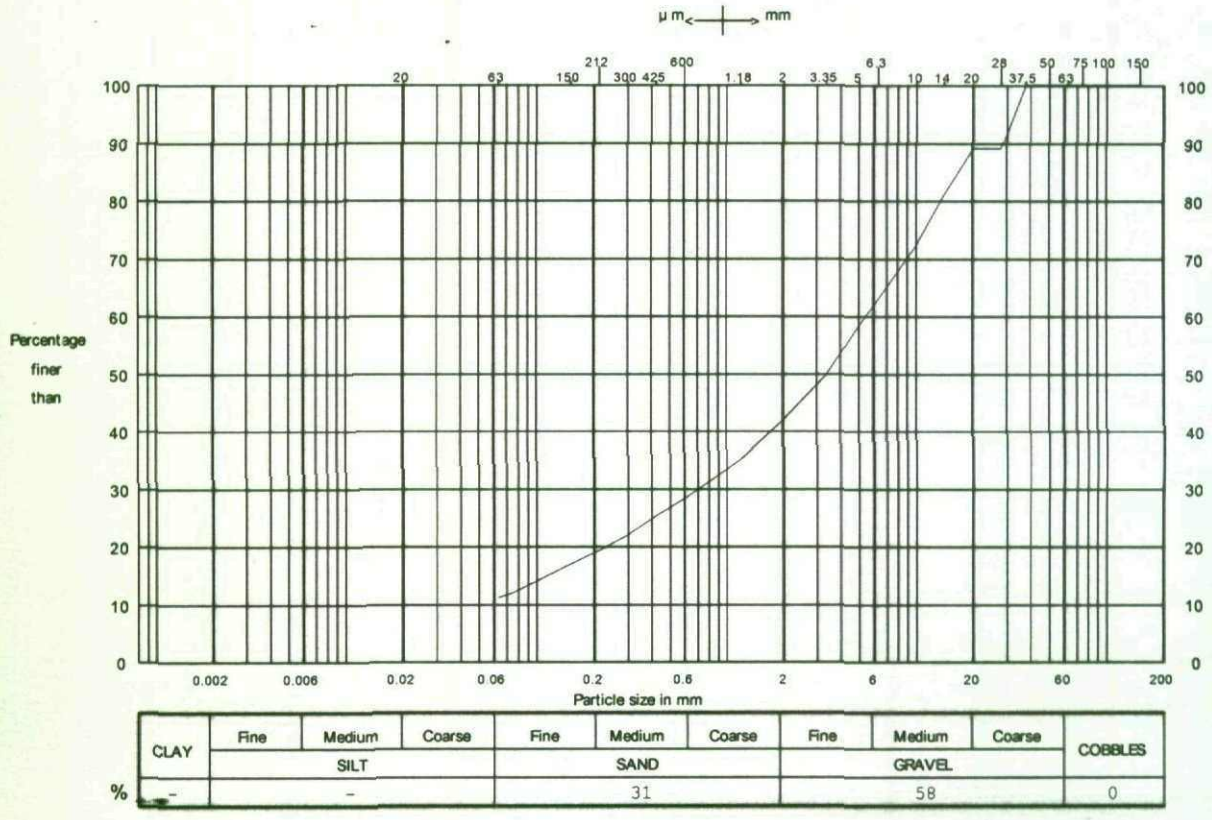


	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			30			56			0

SAMPLE DESCRIPTION	REMARKS
Very sandy silty GRAVEL	

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH7
CLIENT	BARNSLEY MBC	SITE	FOULSTONE & WOMBWELL SCHOOL
SAMPLE DEPTH	5.50 - 5.50	SAMPLE REF	5
JOB NO.	06/3908/9		
METHOD OF PRETREATMENT		METHOD OF TEST	Wet Sieve

	Size (microns)							Size (mm)													
Sieve Size	63	75	150	212	300	425	600	1.18	2	3.35	5	6.3	10	14	20	28	37.5	50	63	75	100	150
% by Mass passing Sieve	11	12	17	19	22.	25	28	35	42	50	58	63	72	81	89	89	100	100	100	100	100	100

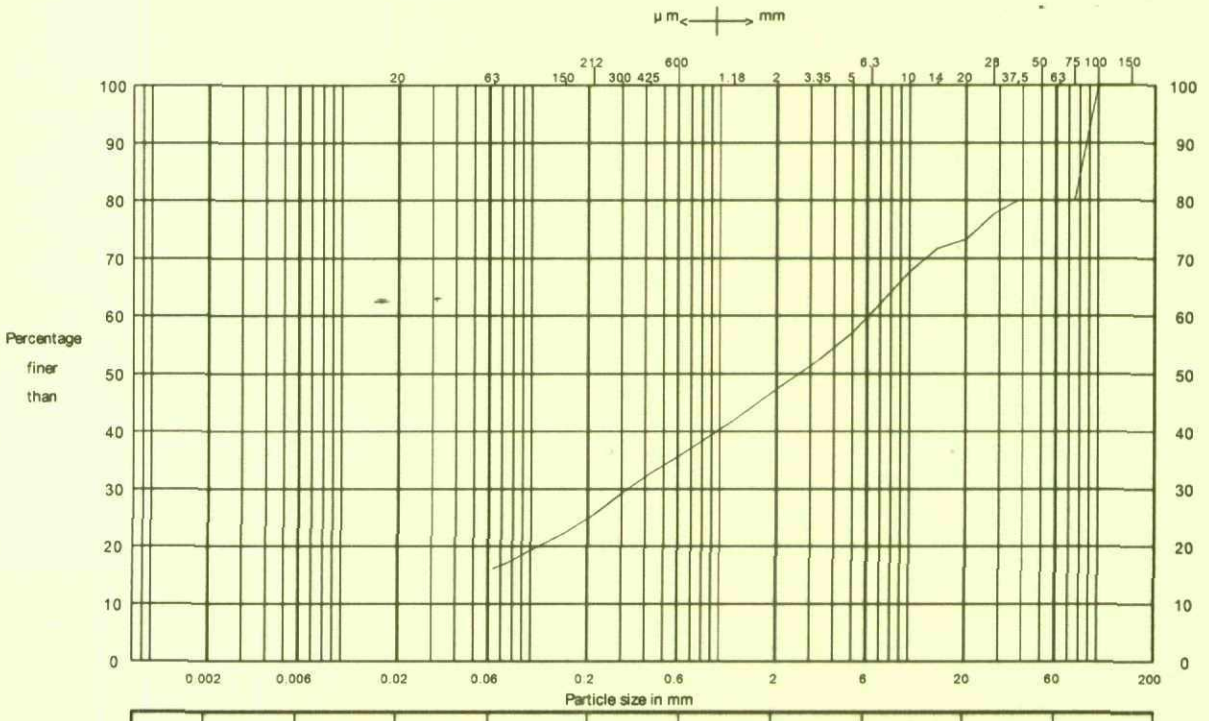


	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			31			58			0

SAMPLE DESCRIPTION	REMARKS
Very sandy silty GRAVEL	

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH8
CLIENT	BARNSLEY MBC	SITE	FOULSTONE & WOMBWELL SCHOOL
SAMPLE DEPTH	0.50 - 0.50	SAMPLE REF	1
JOB NO.	06/3908/9		
METHOD OF PRETREATMENT		METHOD OF TEST	Wet Sieve

	Size (microns)							Size (mm)													
Sieve Size	63	75	150	212	300	425	600	1.18	2	3.35	5	6.3	10	14	20	28	37.5	50	63	75	100	150
% by Mass passing Sieve	16	17	22	25	29	33	36	42	47	52	57	60	68	72	73	78	80	80	80	80	100	100

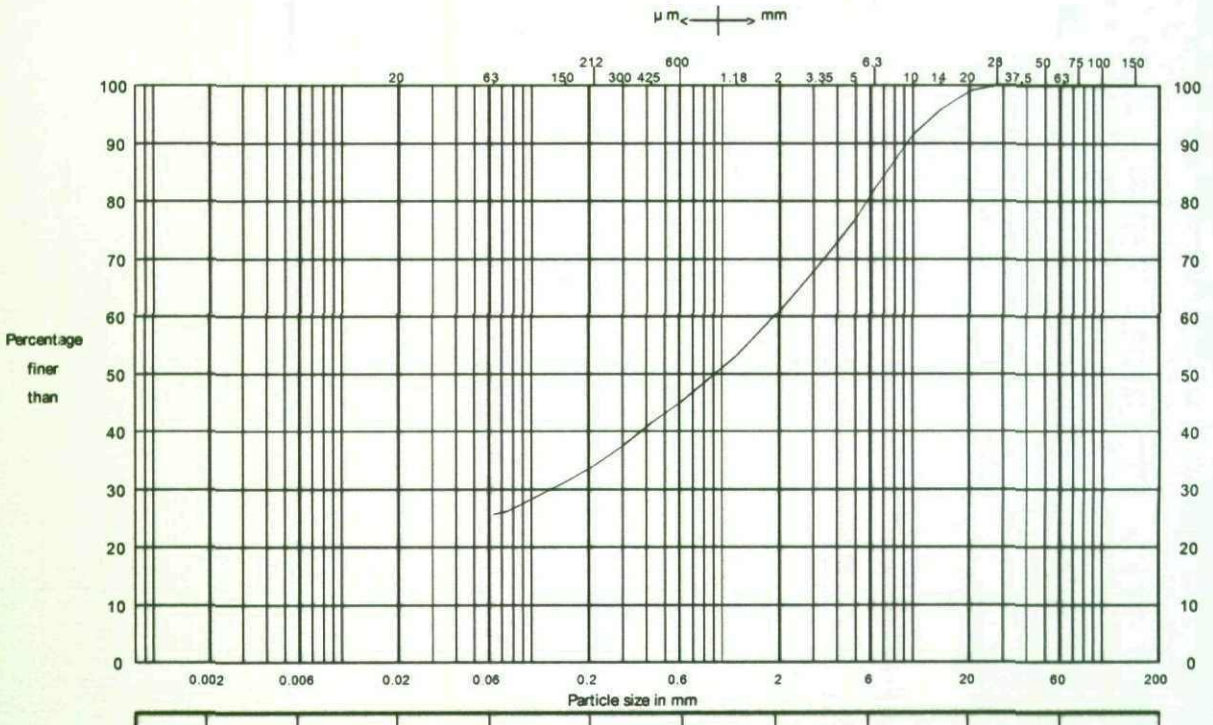


	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			31			33			20

SAMPLE DESCRIPTION	REMARKS
Very silty very cobbly SAND and GRAVEL	

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH8
CLIENT	BARNSLEY MBC	SITE	FOULSTONE & WOMBWELL SCHOOL
SAMPLE DEPTH	1.50 - 1.50	SAMPLE REF	2
			JOB NO. 06/3908/9
METHOD OF PRETREATMENT		METHOD OF TEST	Wet Sieve

	Size (microns)							Size (mm)													
Sieve Size	63	75	150	212	300	425	600	1.18	2	3.35	5	6.3	10	14	20	28	37.5	50	63	75	100	150
% by Mass passing Sieve	26	26	31	34	37	41	45	53	61	70	77	82	91	96	99	100	100	100	100	100	100	100

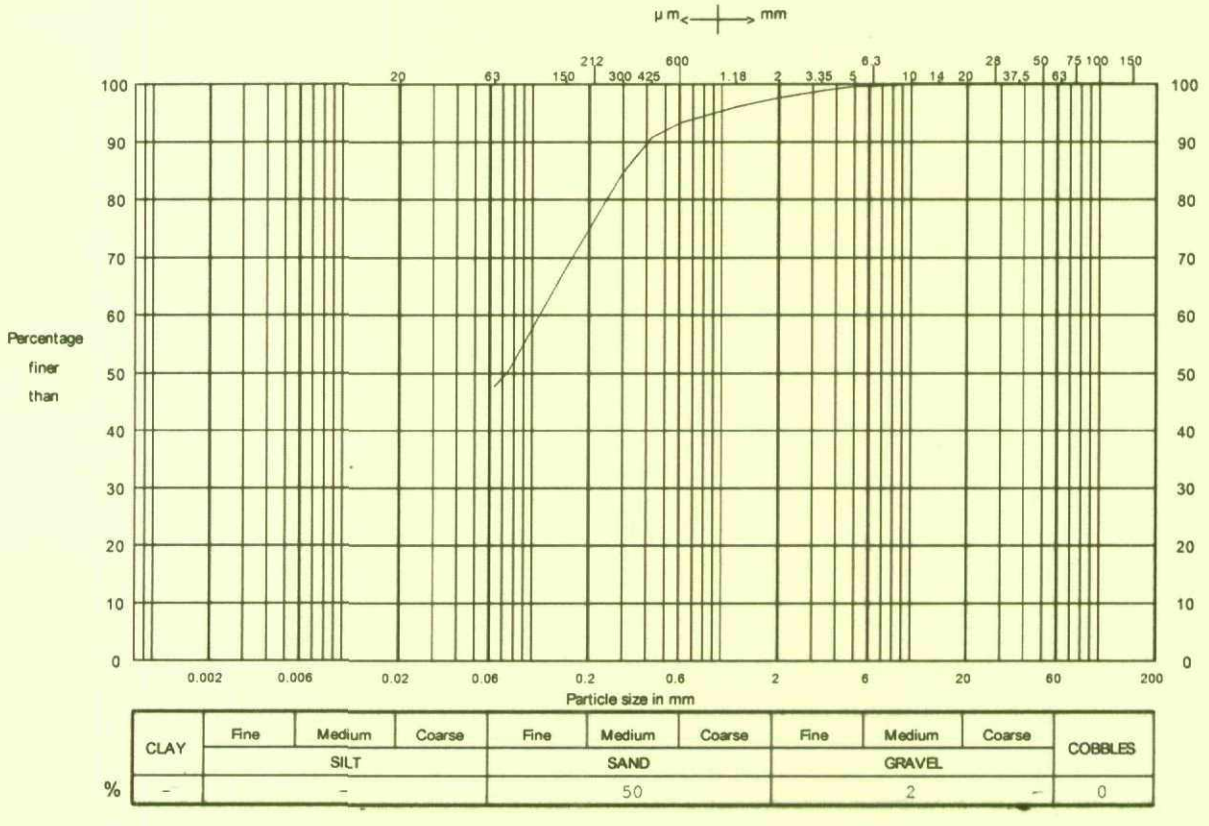


	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			35			39			0

SAMPLE DESCRIPTION	REMARKS
Very silty SAND and GRAVEL	

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH8
CLIENT BARNSLEY MBC		SITE FOULSTONE & WOMBWELL SCHOOL	
SAMPLE DEPTH 2.50 - 2.50		SAMPLE REF 4	JOB NO. 06/3908/9
METHOD OF PRETREATMENT		METHOD OF TEST Wet Sieve	

	Size (microns)							Size (mm)													
Sieve Size	63	75	150	212	300	425	600	1.18	2	3.35	5	6.3	10	14	20	28	37.5	50	63	75	100	150
% by Mass passing Sieve	48	50	68	76	85	91	93	96	98	99	100	100	100	100	100	100	100	100	100	100	100	100

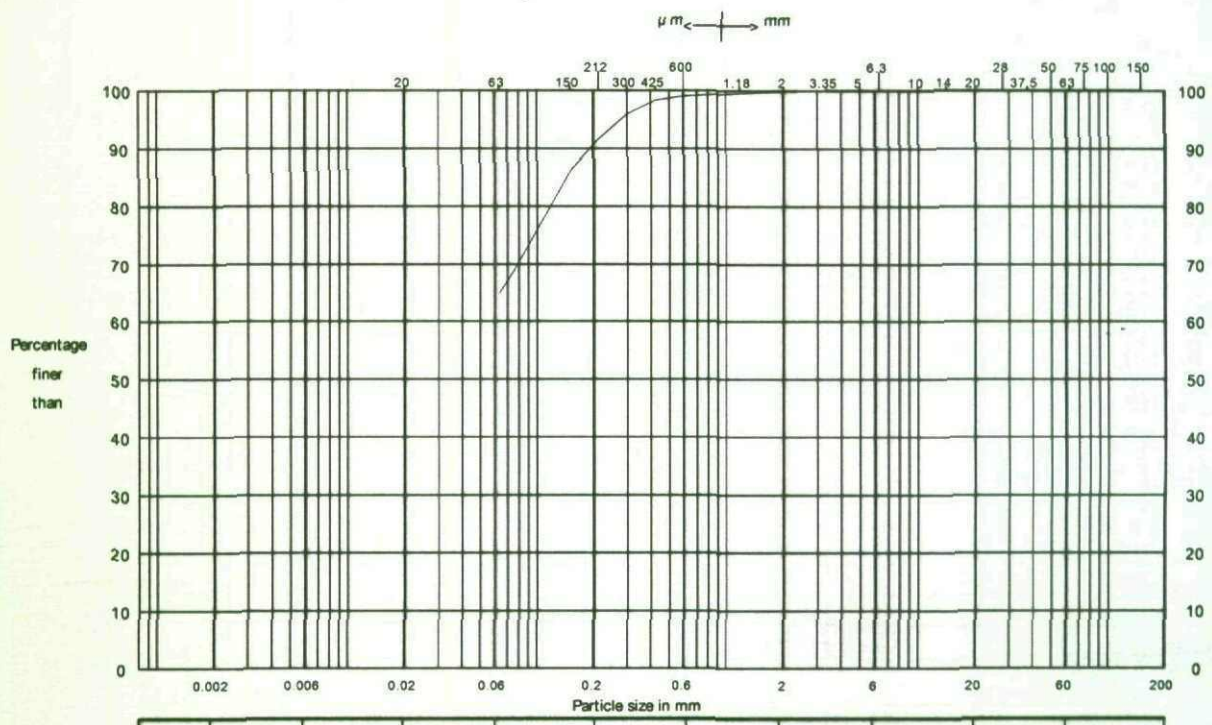


	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			50			2		-	0

SAMPLE DESCRIPTION	REMARKS
Very sandy slightly gravelly CLAY	

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH8
CLIENT BARNSLEY MBC		SITE FOULSTONE & WOMBWELL SCHOOL	
SAMPLE DEPTH 3.50 - 3.50		SAMPLE REF 5	JOB NO. 06/3908/9
METHOD OF PRETREATMENT		METHOD OF TEST Wet Sieve	

	Size (microns)							Size (mm)													
Sieve Size	63	75	150	212	300	425	600	1.18	2	3.35	5	6.3	10	14	20	28	37.5	50	63	75	100	150
% by Mass passing Sieve	65	69	86	92	96	98	99	99	100	100	100	100	100	100	100	100	100	100	100	100	100	100



	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			35			0			0

SAMPLE DESCRIPTION	REMARKS
Very sandy CLAY	

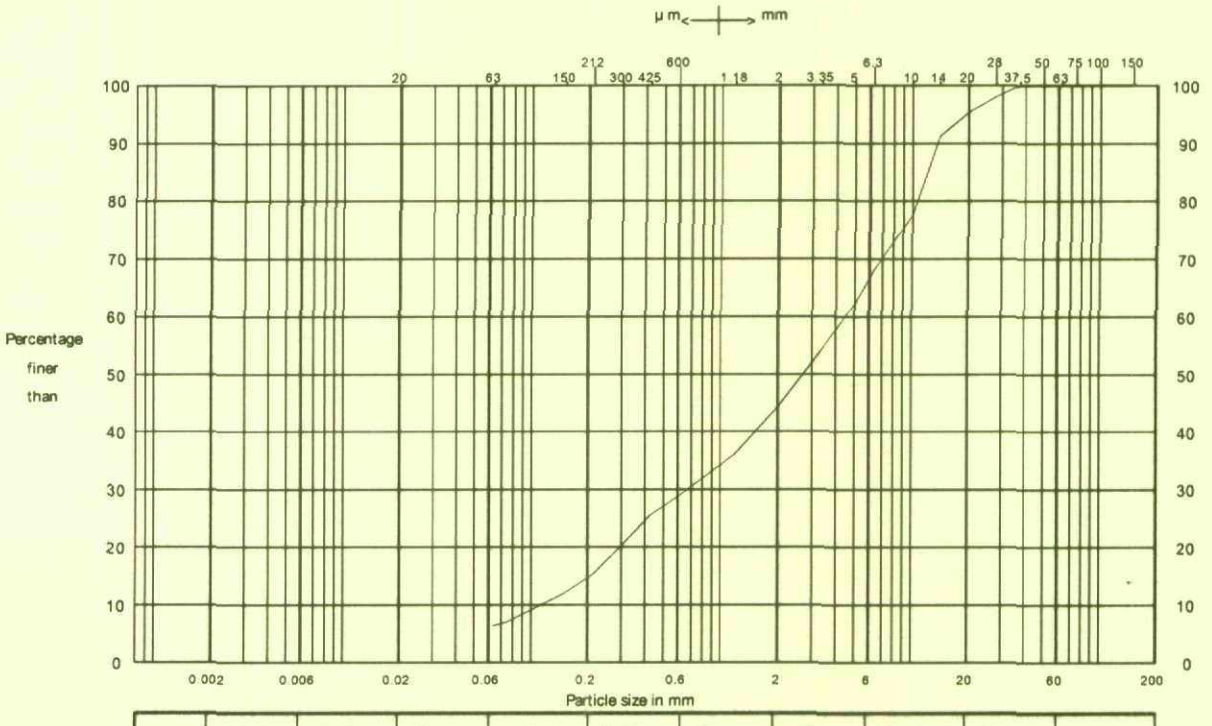
CC Geotechnical
Tel: 0151-523-0202
Fax: 0151-523-0252

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

HOLE NO. BH8

CLIENT: BARNSLEY MBC	SITE: FOULSTONE & WOMBWELL SCHOOL
SAMPLE DEPTH: 5.50 - 5.50	SAMPLE REF: 6
	JOB NO.: 06/3908/9
METHOD OF PRETREATMENT:	METHOD OF TEST: Wet Sieve

	Size (microns)							Size (mm)													
Sieve Size	63	75	150	212	300	425	600	1.18	2	3.35	5	6.3	10	14	20	28	37.5	50	63	75	100	150
% by Mass passing Sieve	6	7	12	15	20	25	29	36	44	54	62	68	77	91	95	98	100	100	100	100	100	100



	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			38			56			0

SAMPLE DESCRIPTION

Very sandy silty GRAVEL

REMARKS

APPENDIX F

SOIL CONTAMINATION TEST DATA

Client: **CC GEOTECHNICAL**
Essex House
Bridle Road
Bootle
Liverpool
Merseyside
L30 4UE

FAO: Mr R Roberts

Analytical Report Number: R06/8417

Client Project Name:	**Folkstone & Wombwell Schools, Barnsley**
Client Project Number:	**06/3908/9**
Your Order Number:	**None Specified**
Order Receipt Date:	**01/09/06**
Reporting Date:	**Friday 15 September 2006**

If you have any queries regarding this report please contact our Customer Services Manager

ECõS Environmental Limited
Low Moor Business Park, Common Road, Bradford BD12 0NB
Tel: 01274 691122 Fax: 01274 608100

Client Project Name: Folkstone & Wombwell Schools, Barnsley **Client: CC GEOTECHNICAL**

Project Number: 06/3908/9 **Reporting Date: Friday 15 September 2006**

Comments

All analyses are carried out using the laboratory's standard methods unless otherwise agreed.

The test results in this report refer only to the actual samples on which testing has been performed.

Any opinions and/or interpretations expressed herein are outside the scope of the testing laboratory's UKAS accreditation.

The test report shall not be reproduced, except in full, without the testing laboratory's written approval.

This testing laboratory cannot be held responsible for the condition or suitability of samples submitted for testing by a third party or for the competency of personnel other than its own staff.

Soil Samples

Results are expressed based on air dried mass @ 40°C unless otherwise stated.

See key in Notes section for explanation of numerical categories for asbestos results, if applicable.

Stones (for example inert flints and inorganic minerals) >10mm are removed prior to analysis. Unless otherwise stated, results have not been corrected for this loss.

Samples submitted for leachate determination were prepared using agreed procedures and analysed using UKAS accredited methodology where appropriate.

Results are expressed without correction for recovery factors.

Key:

Accreditation:

MCERTS = This test is accredited to the British Standard BS EN ISO/IEC 17025:2000 and the Environment Agency MCERTS for soil standard.

17025 = This test is accredited to the British Standard BS EN ISO/IEC 17025:2000.

None = This test is currently not on our scope of accreditation.

Sample Pretreatment (Appended to Method of Detection)

D = Air Dried @ 40°C

R = As Received

Sample Type

B = Bulk disturbed sample
C = Core Sample
D = Small disturbed sample
P = Piston sample
U = Undisturbed sample - open drive
W = Water Sample

Sample Results

Analysis not requested
*** Test not completed. Please see notes on last page

Signed: _____

For and on behalf of ECõS Environmental Limited

Approved signatories:

Name	Position
J R Brown	Business Development Manager
L Dewell	Production Manager
P Richardson	Section Head
J Stoddart	Technical Manager

Client Project Name: Folkstone & Wombwell Schools, Barnsley **Client: CC GEOTECHNICAL**

Project Number: 06/3908/9 **Reporting Date: Friday 15 September 2006**

Soil Samples

Method Statement

Determinand	Method of Detection	Sample Pretreatment	Limit of Detection	Accredi-tation	Sub-Contracted	Result Date
Arsenic	ICP-OES	D	0.1 mg/kg	17025	No	08/09/06
Cadmium	ICP-OES	D	0.2 mg/kg	17025	No	08/09/06
Chromium (hexavalent)	ICP-OES	D	1.0 mg/kg	17025	No	08/09/06
Chromium (total)	ICP-OES	D	0.2 mg/kg	17025	No	08/09/06
Lead	ICP-OES	D	0.5 mg/kg	17025	No	08/09/06
Mercury	ICP-OES	D	0.1 mg/kg	17025	No	08/09/06
Selenium	ICP-OES	D	1.0 mg/kg	17025	No	08/09/06
Boron (water soluble)	ICP-OES	D	0.5 mg/kg	17025	No	11/09/06
Copper	ICP-OES	D	0.2 mg/kg	17025	No	08/09/06
Nickel	ICP-OES	D	0.2 mg/kg	17025	No	08/09/06
Zinc	ICP-OES	D	0.2 mg/kg	17025	No	08/09/06
PAH (sum of EPA 16)	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Phenols (monohydric)	Colorimetry	R	2.0 mg/kg	17025	No	06/09/06
Cyanide (free)	Colorimetry	R	2.0 mg/kg	17025	No	08/09/06
Cyanide (total)	Colorimetry	R	2.0 mg/kg	17025	No	08/09/06
Cyanide (complex)	Colorimetry	R	2.0 mg/kg	17025	No	08/09/06
Sulphate (water soluble)	HPLC-IC	D	0.001 g/l SO4	17025	No	12/09/06
Sulphide	Colorimetry	R	2.0 mg/kg	17025	No	06/09/06
Sulphur (free)	HPLC-UV	D	4 mg/kg	17025	No	15/09/06
pH	pH-meter	D	N/A	17025	No	08/09/06
Naphthalene	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Acenaphthylene	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Acenaphthene	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Fluorene	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Phenanthrene	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Anthracene	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Fluoranthene	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Pyrene	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Benzo(a)anthracene	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Chrysene	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Benzo(b)fluoranthene	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Benzo(k)fluoranthene	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Benzo(a)pyrene	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Indeno(1,2,3-cd)pyrene	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Dibenz(a,h)anthracene	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Benzo(g,h,i)perylene	GC-MS	D	0.1 mg/kg	17025	No	11/09/06
Barium	ICP-OES	D	0.2 mg/kg	None	No	08/09/06
Beryllium	ICP-OES	D	0.2 mg/kg	None	No	08/09/06
Vanadium	ICP-OES	D	0.2 mg/kg	None	No	08/09/06
Nitrate	HPLC-IC	D	2.0 mg/kg	None	No	12/09/06
Sulphate (total)	ICP-OES	D	30 mg/kg SO4	17025	No	08/09/06
Chrysotile (white)	Microscopy	D	0.1% w/w	17025	No	05/09/06

Client Project Name: Folkstone & Wombwell Schools, Barnsley **Client: CC GEOTECHNICAL**

Project Number: 06/3908/9 **Reporting Date: Friday 15 September 2006**

Determinand	Method of Detection	Sample Pretreatment	Limit of Detection	Accredi-tation	Sub-Contracted	Result Date
Amosite (brown)	Microscopy	D	0.1% w/w	17025	No	05/09/06
Crocidolite (blue)	Microscopy	D	0.1% w/w	17025	No	05/09/06
Anthophyllite	Microscopy	D	0.1% w/w	17025	No	05/09/06
Actinolite	Microscopy	D	0.1% w/w	17025	No	05/09/06
Tremolite	Microscopy	D	0.1% w/w	17025	No	05/09/06
Non-Asbestos fibres	Microscopy	D	0.1% w/w	None	No	05/09/06
Test sample weight	Gravimetric	D	0.1g	None	No	05/09/06
Est. weight asbestos material	Gravimetric	D	0.1g	None	No	05/09/06
Estimated % (w/w) of asbestos	Microscopy	D	0.1% w/w	None	No	05/09/06
Organic Matter	Titration	D	0.1 %	None	No	08/09/06
TPH	GC-FID	D	5.0 mg/kg	17025	No	08/09/06
TPH C10-C12	GC-FID	D	5.0 mg/kg	None	No	08/09/06
TPH C12-C16	GC-FID	D	5.0 mg/kg	None	No	08/09/06
TPH C16-C21	GC-FID	D	5.0 mg/kg	None	No	08/09/06
TPH C21-C35	GC-FID	D	5.0 mg/kg	None	No	08/09/06
TPH C35-C40	GC-FID	D	5.0 mg/kg	None	No	08/09/06

Client Project Name: Folkstone & Wombwell Schools, Barnsley **Client: CC GEOTECHNICAL**

Project Number: 06/3908/9 **Reporting Date: Friday 15 September 2006**

	BH/TP	TP3	TP4	TP8	TP8	TP9
	Top Depth / m	1.80	0.70	0.70	1.50	0.70
	Bottom Depth / m					
	Customer ID					
	Sample Type					
	Date Sampled					
	Receipt Date	01/09/06	01/09/06	01/09/06	01/09/06	01/09/06
	ECõS Sample ID	S0683336	S0683337	S0683338	S0683339	S0683340
	Matrix Type	Soil	Soil	Soil	Soil	Soil
Determinand	**Units**					
Arsenic	mg/kg	124.4	23.4	20.0	46.5	30.1
Cadmium	mg/kg	0.3	<0.2	<0.2	<0.2	<0.2
Chromium (hexavalent)	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Chromium (total)	mg/kg	21.9	5.0	19.4	7.7	18.2
Lead	mg/kg	78.7	30.7	18.9	24.4	34.1
Mercury	mg/kg	0.4	1.2	0.1	0.1	<0.1
Selenium	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Boron (water soluble)	mg/kg	0.7	0.5	0.9	0.8	0.9
Copper	mg/kg	28.3	44.0	5.4	24.3	33.7
Nickel	mg/kg	5.0	4.0	38.7	7.1	28.0
Zinc	mg/kg	13.6	17.2	85.2	20.9	141.1
PAH (sum of EPA 16)	mg/kg	0.5	20.4	2.3	7.6	6.0
Phenols (monohydric)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
Cyanide (free)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
Cyanide (total)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
Cyanide (complex)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
Sulphate (water soluble)	g/l SO4	1.684	0.262	0.096	0.120	1.976
Sulphide	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0
Sulphur (free)	mg/kg	<4	16	<4	22	8
pH	N/A	3.6	5.2	7.1	4.6	6.2
Naphthalene	mg/kg	<0.1	1.8	0.3	1.0	0.6
Acenaphthylene	mg/kg	<0.1	0.1	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Fluorene	mg/kg	<0.1	0.3	<0.1	<0.1	<0.1
Phenanthrene	mg/kg	0.2	6.9	0.6	4.8	1.0
Anthracene	mg/kg	<0.1	0.6	0.2	0.1	0.2
Fluoranthene	mg/kg	0.2	3.3	0.5	0.6	1.2
Pyrene	mg/kg	0.1	2.6	0.4	0.5	1.0
Benzo(a)anthracene	mg/kg	<0.1	1.4	<0.1	0.3	0.5
Chrysene	mg/kg	<0.1	1.7	0.3	0.5	0.5
Benzo(b)fluoranthene	mg/kg	<0.1	0.6	0.2	<0.1	0.5
Benzo(k)fluoranthene	mg/kg	<0.1	0.6	<0.1	<0.1	0.4
Benzo(a)pyrene	mg/kg	<0.1	0.5	<0.1	<0.1	0.3
Indeno(1,2,3-cd)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Dibenz(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1

Client Project Name: Folkstone & Wombwell Schools, Barnsley **Client: CC GEOTECHNICAL**

Project Number: 06/3908/9 **Reporting Date: Friday 15 September 2006**

	BH/TP	TP3	TP4	TP8	TP8	TP9
	Top Depth / m	1.80	0.70	0.70	1.50	0.70
	Bottom Depth / m					
	Customer ID					
	Sample Type					
	Date Sampled					
	Receipt Date	01/09/06	01/09/06	01/09/06	01/09/06	01/09/06
	ECõS Sample ID	S0683336	S0683337	S0683338	S0683339	S0683340
	Matrix Type	Soil	Soil	Soil	Soil	Soil
Determinand	**Units**					
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Barium	mg/kg	138.3	192.8	111.7	72.3	98.6
Beryllium	mg/kg	2.1	<0.2	2.0	0.4	1.6
Vanadium	mg/kg	66.2	14.0	39.7	19.4	36.9
Nitrate	mg/kg	<2.0	15.1	2.4	32.2	3.5
Sulphate (total)	mg/kg SO4	65880	8918	1812	11888	8859
Chrysotile (white)	Category	ND	ND	ND	ND	ND
Amosite (brown)	Category	ND	ND	ND	ND	ND
Crocidolite (blue)	Category	ND	ND	ND	ND	ND
Anthophyllite	*Category*	*ND*	*ND*	*ND*	*ND*	*ND*
Actinolite	Category	ND	ND	ND	ND	ND
Tremolite	Category	ND	ND	ND	ND	ND
Non-Asbestos fibres	Category	ND	P	P	P	P
Test sample weight	g	1318.0	536.0	1601.0	1262.0	1482.0
Est. weight asbestos material	g	<0.1	<0.1	<0.1	<0.1	<0.1
Estimated % (w/w) of asbestos	%	<0.1	<0.1	<0.1	<0.1	<0.1
Organic Matter	%	<0.1	33.6	1.2	17.2	2.0
TPH	mg/kg	<5.0	1001.6	12.9	77.7	46.8
TPH C10-C12	mg/kg	<5.0	16.4	<5.0	<5.0	<5.0
TPH C12-C16	mg/kg	<5.0	70.0	<5.0	18.1	<5.0
TPH C16-C21	mg/kg	<5.0	187.3	<5.0	25.4	9.5
TPH C21-C35	mg/kg	<5.0	663.2	7.4	29.5	32.8
TPH C35-C40	mg/kg	<5.0	64.8	<5.0	<5.0	<5.0

Client Project Name: Folkstone & Wombwell Schools, Barnsley **Client: CC GEOTECHNICAL**

Project Number: 06/3908/9 **Reporting Date: Friday 15 September 2006**

	BH/TP	TP10	TP11	TP12	TP8
	Top Depth / m	0.70	0.70	0.70	2.70
	Bottom Depth / m				
	Customer ID				
	Sample Type				
	Date Sampled				
	Receipt Date	01/09/06	01/09/06	01/09/06	01/09/06
	ECõS Sample ID	S0683341	S0683342	S0683343	S0683344
	Matrix Type	Soil	Soil	Soil	Soil
Determinand	Units				
Arsenic	mg/kg	***	26.1	37.9	52.0
Cadmium	mg/kg	***	<0.2	<0.2	<0.2
Chromium (hexavalent)	mg/kg	***	<1.0	<1.0	<1.0
Chromium (total)	mg/kg	***	16.1	13.9	14.1
Lead	mg/kg	***	41.7	64.1	23.5
Mercury	mg/kg	***	<0.1	0.1	<0.1
Selenium	mg/kg	***	<1.0	<1.0	<1.0
Boron (water soluble)	mg/kg	***	0.8	1.6	<0.5
Copper	mg/kg	***	38.3	40.5	13.8
Nickel	mg/kg	***	27.7	26.4	10.4
Zinc	mg/kg	***	87.6	107.7	24.0
PAH (sum of EPA 16)	mg/kg	***	6.7	7.1	0.1
Phenols (monohydric)	mg/kg	***	<2.0	<2.0	<2.0
Cyanide (free)	mg/kg	***	<2.0	<2.0	<2.0
Cyanide (total)	mg/kg	***	<2.0	<2.0	<2.0
Cyanide (complex)	mg/kg	***	<2.0	<2.0	<2.0
Sulphate (water soluble)	g/l SO4	***	0.079	1.720	0.209
Sulphide	mg/kg	***	<2.0	<2.0	<2.0
Sulphur (free)	mg/kg	***	15	23	<4
pH	N/A	***	6.9	7.0	4.3
Naphthalene	mg/kg	***	3.4	3.0	<0.1
Acenaphthylene	mg/kg	***	<0.1	<0.1	<0.1
Acenaphthene	mg/kg	***	<0.1	<0.1	<0.1
Fluorene	mg/kg	***	<0.1	0.3	<0.1
Phenanthrene	mg/kg	***	2.0	2.1	<0.1
Anthracene	mg/kg	***	0.2	0.3	<0.1
Fluoranthene	mg/kg	***	0.4	0.5	0.1
Pyrene	mg/kg	***	0.3	0.6	<0.1
Benzo(a)anthracene	mg/kg	***	0.2	0.2	<0.1
Chrysene	mg/kg	***	0.2	0.3	<0.1
Benzo(b)fluoranthene	mg/kg	***	<0.1	<0.1	<0.1
Benzo(k)fluoranthene	mg/kg	***	<0.1	<0.1	<0.1
Benzo(a)pyrene	mg/kg	***	<0.1	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	mg/kg	***	<0.1	<0.1	<0.1
Dibenz(a,h)anthracene	mg/kg	***	<0.1	<0.1	<0.1

Client Project Name: Folkstone & Wombwell Schools, Barnsley **Client: CC GEOTECHNICAL**

Project Number: 06/3908/9 **Reporting Date: Friday 15 September 2006**

	BH/TP	TP10	TP11	TP12	TP8
	Top Depth / m	0.70	0.70	0.70	2.70
	Bottom Depth / m				
	Customer ID				
	Sample Type				
	Date Sampled				
	Receipt Date	01/09/06	01/09/06	01/09/06	01/09/06
	ECõS Sample ID	S0683341	S0683342	S0683343	S0683344
	Matrix Type	Soil	Soil	Soil	Soil
Determinand	**Units**				
Benzo(g,h,i)perylene	mg/kg	***	<0.1	<0.1	<0.1
Barium	mg/kg	***	97.8	77.4	87.7
Beryllium	mg/kg	***	1.4	1.6	0.8
Vanadium	mg/kg	***	34.8	34.1	26.1
Nitrate	mg/kg	***	9.3	<2.0	<2.0
Sulphate (total)	mg/kg SO4	***	5012	6878	40455
Chrysotile (white)	Category	1	ND	ND	ND
Amosite (brown)	Category	ND	ND	ND	ND
Crocidolite (blue)	Category	ND	ND	ND	ND
Anthophyllite	Category	ND	ND	ND	ND
Actinolite	Category	ND	ND	ND	ND
Tremolite	Category	ND	ND	ND	ND
Non-Asbestos fibres	Category	P	ND	P	ND
Test sample weight	g	1449.0	1402.0	1380.0	767.0
Est. weight asbestos material	g	trace	<0.1	<0.1	<0.1
Estimated % (w/w) of asbestos	%	<0.1	<0.1	<0.1	<0.1
Organic Matter	%	***	5.9	6.8	0.2
TPH	mg/kg	***	91.1	147.3	<5.0
TPH C10-C12	mg/kg	***	<5.0	6.3	10.4
TPH C12-C16	mg/kg	***	28.4	35.5	<5.0
TPH C16-C21	mg/kg	***	26.5	33.8	<5.0
TPH C21-C35	mg/kg	***	29.6	64.0	<5.0
TPH C35-C40	mg/kg	***	<5.0	<5.0	<5.0

Client Project Name: Folkstone & Wombwell Schools, Barnsley **Client: CC GEOTECHNICAL**

Project Number: 06/3908/9 **Reporting Date: Friday 15 September 2006**

Notes and Preservation Details

*** Sample unsuitable for chemical analysis due to asbestos contamination.

ASBESTOS BULK MATERIAL ANALYSIS

Samples analysed using polarised light optical microscopy with dispersion staining in accordance with a documented in-house procedure based on HSG 248 - Asbestos in Bulk Materials.

KEY TO ASBESTOS RESULTS

The standard analytical method used for asbestos identification cannot give an accurate quantitative value for percentage asbestos content. The following numerical categories however may be used to assess the approximate quantity of asbestos present in the sample as submitted to the laboratory:

ND	-	No fibres detected (based on a detection limit of 0.1% by weight)
1	-	Fibres detected - less than 0.1% by weight
2	-	Fibres detected - greater than 0.1% by weight
P	-	Non - asbestos fibres present

Quantitative estimates, to which the above numerical categories apply, are outside the scope of the laboratory's UKAS accreditation, which covers asbestos identification only.

Client: **CC GEOTECHNICAL**
Essex House
Bridle Road
Bootle
Liverpool
Merseyside
L30 4UE

FAO: Mr R Roberts

Analytical Report Number: R06/8477

Client Project Name:	**Foulstone & Wombwell Schools, Barnsley**
Client Project Number:	**None Specified**
Your Order Number:	**None Specified**
Order Receipt Date:	**22/09/06**
Reporting Date:	**Tuesday 3 October 2006**

If you have any queries regarding this report please contact our Customer Services Manager

ECôS Environmental Limited
Low Moor Business Park, Common Road, Bradford BD12 0NB
Tel: 01274 691122 Fax: 01274 608100

Client Project Name: Foulstone & Wombwell Schools, Barnsley **Client: CC GEOTECHNICAL**

Project Number: None Specified **Reporting Date: Tuesday 3 October 2006**

Comments

All analyses are carried out using the laboratory's standard methods unless otherwise agreed.

The test results in this report refer only to the actual samples on which testing has been performed.

Any opinions and/or interpretations expressed herein are outside the scope of the testing laboratory's UKAS accreditation.

The test report shall not be reproduced, except in full, without the testing laboratory's written approval.

This testing laboratory cannot be held responsible for the condition or suitability of samples submitted for testing by a third party or for the competency of personnel other than its own staff.

Soil Samples

Results are expressed based on air dried mass @ 40°C unless otherwise stated.

See key in Notes section for explanation of numerical categories for asbestos results, if applicable.

Stones (for example inert flints and inorganic minerals) >10mm are removed prior to analysis. Unless otherwise stated, results have not been corrected for this loss.

Samples submitted for leachate determination were prepared using agreed procedures and analysed using UKAS accredited methodology where appropriate.

Results are expressed without correction for recovery factors.

Key:

Accreditation:

MCERTS = This test is accredited to the British Standard BS EN ISO/IEC 17025:2000 and the Environment Agency MCERTS for soil standard.

17025 = This test is accredited to the British Standard BS EN ISO/IEC 17025:2000.

None = This test is currently not on our scope of accreditation.

Sample Pretreatment (Appended to Method of Detection)

D = Air Dried @ 40°C R = As Received

Sample Type

B = Bulk disturbed sample
C = Core Sample
D = Small disturbed sample
P = Piston sample
U = Undisturbed sample - open drive
W = Water Sample

Sample Results

Analysis not requested
*** Test not completed. Please see notes on last page

Signed: _____

For and on behalf of ECõS Environmental Limited

Approved signatories:

Name	Position
J R Brown	Business Development Manager
L Dewell	Production Manager
P Richardson	Section Head
J Stoddart	Technical Manager

Client Project Name: Foulstone & Wombwell Schools, Barnsley **Client: CC GEOTECHNICAL**

Project Number: None Specified **Reporting Date: Tuesday 3 October 2006**

Soil Samples

Method Statement

Determinand	Method of Detection	Sample Pretreatment	Limit of Detection	Accredi-tation	Sub-Contracted	Result Date
TPH Aromatic EC5-EC7	HS-GC-FID	R	0.02 mg/kg	None	No	02/10/06
TPH Aromatic EC7-EC8	HS-GC-FID	R	0.02 mg/kg	None	No	02/10/06
TPH Aromatic EC8-EC10	HS-GC-FID	R	0.1 mg/kg	None	No	02/10/06
TPH Aromatic EC10-EC12	GC-FID	D	5.0 mg/kg	None	No	03/10/06
TPH Aromatic EC12-EC16	GC-FID	D	5.0 mg/kg	None	No	03/10/06
TPH Aromatic EC16-EC21	GC-FID	D	5.0 mg/kg	None	No	03/10/06
TPH Aromatic EC21-EC35	GC-FID	D	5.0 mg/kg	None	No	03/10/06
TPH Aliphatic EC5-EC6	HS-GC-FID	R	0.1 mg/kg	None	No	02/10/06
TPH Aliphatic EC6-EC8	HS-GC-FID	R	0.1 mg/kg	None	No	02/10/06
TPH Aliphatic EC8-EC10	HS-GC-FID	R	0.1 mg/kg	None	No	02/10/06
TPH Aliphatic EC10-EC12	GC-FID	D	5.0 mg/kg	None	No	03/10/06
TPH Aliphatic EC12-EC16	GC-FID	D	5.0 mg/kg	None	No	03/10/06
TPH Aliphatic EC16-EC35	GC-FID	D	5.0 mg/kg	None	No	03/10/06
Benzene	HS-GC-FID	R	0.02 mg/kg	None	No	02/10/06
Toluene	HS-GC-FID	R	0.02 mg/kg	None	No	02/10/06
Ethyl Benzene	HS-GC-FID	R	0.02 mg/kg	None	No	02/10/06
m+p-Xylene	HS-GC-FID	R	0.04 mg/kg	17025	No	02/10/06
o-Xylene	HS-GC-FID	R	0.02 mg/kg	None	No	02/10/06

Client Project Name: Foulstone & Wombwell Schools, Barnsley **Client: CC GEOTECHNICAL**

Project Number: None Specified **Reporting Date: Tuesday 3 October 2006**

BH/TP	TP4
Top Depth / m	0.70
Bottom Depth / m	
Customer ID	
Sample Type	
Date Sampled	
Receipt Date	22/09/06
ECõS Sample ID	S0683757
Matrix Type	Soil

Determinand	Units	
TPH Aromatic EC5-EC7	mg/kg	<0.02
TPH Aromatic EC7-EC8	mg/kg	<0.02
TPH Aromatic EC8-EC10	mg/kg	<0.1
TPH Aromatic EC10-EC12	mg/kg	<5.0
TPH Aromatic EC12-EC16	mg/kg	9.2
TPH Aromatic EC16-EC21	mg/kg	15.7
TPH Aromatic EC21-EC35	mg/kg	<5.0
TPH Aliphatic EC5-EC6	mg/kg	<0.1
TPH Aliphatic EC6-EC8	mg/kg	<0.1
TPH Aliphatic EC8-EC10	mg/kg	<0.1
TPH Aliphatic EC10-EC12	mg/kg	<5.0
TPH Aliphatic EC12-EC16	mg/kg	<5.0
TPH Aliphatic EC16-EC35	mg/kg	<5.0
Benzene	mg/kg	<0.02
Toluene	mg/kg	<0.02
Ethyl Benzene	mg/kg	<0.02
m+p-Xylene	mg/kg	<0.04
o-Xylene	mg/kg	<0.02

Notes and Preservation Details

None

APPENDIX G

WRAS ASSESSMENT TABLE FOR WATER MAINS SPECIFICATION

CC Geotechnical

WRAS ANALYSIS OF CONTAMINATION DATA

Job Number 06/3908/9 Created by: RR

Name Foulstone & Wombwell School, Reviewed by: PB

	Arithmetric Mean (mg/kg)	Geometric Mean (mg/kg)	UCL_{95}	WRAS threshold value (mg/kg)
Arsenic	45.05		53.17	10
Cadmium	0.21		0.21	3
Chromium (hexavalent)	1.00		1.00	25
Chromium (total)	14.54		18.10	600
Lead		35.26	45.51	500
Mercury	0.28		0.55	1
Selenium	1.00		1.00	3
PAH (total)	6.34		10.67	50
Phenols (monohydric)	2.00		2.00	5
Cyanide (free)	2.00		2.00	25
Cyanide (complex)	2.00		2.00	250
Sulphide	2.00		2.00	250
Sulphur (free)	12.00		17.34	5000
pH	5.61		6.41	5<pH>8
TPH	173.43		413.22	50

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.

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

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.

APPENDIX I

TOXICOLOGICAL INPUT PARAMETERS / GAC DERIVATION WORKSHEETS

CONTAMINANT	RESIDENTIAL WITHOUT PLANT UPTAKE HCV (mg/kg)			
	SGV	GAC	DERMAL ASC	COMBINED SGV/GAC
Arsenic	20		590	19.34
Cadmium	30		59000	29.98
Chromium (hexavalent)	200		17700	197.7
Chromium (total)	200		17700	197.7
Lead	450			450
Mercury	15		1770	14.87
Selenium	260		2950	238
Boron (water soluble)				
Copper				
Nickel	75			
Zinc				
Phenols (monohydric)	21900		413000	20797
Cyanide (free)		53		53
Cyanide (total)		53		53
Cyanide (complex)		53		53
Sulphate (water soluble) g/l				
SO_4				
Sulphide				
Sulphur (free)				
pH				
TPH				
PAH (total)				
Naphthalene		33.4	9076	33.3
Acenaphthylene		2030		1650
Acenaphthene		2030		1650
Fluorene		811	18514	776
Phenanthrene		2030		1650
Anthracene		6089	136153	5828
Fluoranthene		2550	136153	2503
Pyrene		255	13615	250
Benzo(a)anthracene		20.3		16.5
Chrysene		20.3		16.5
Benzo(b)fluoranthene		20.3		16.5
Benzo(k)fluoranthene		20.3		16.5
Benzo(a)pyrene		2.03	9.08	1.65
Indeno(1,2,3-cd)pyrene		20.3		16.5
Dibenz(a,h)anthracene		2.03		1.65
Benzo(g,h,i)perylene		20.3		16.5
Barium				
Beryllium				
Vanadium				
Nitrate				
Sulphate (total)				
Organic Matter				
TPH C10-C12				

CONTAMINANT	RESIDENTIAL WITHOUT PLANT UPTAKE HCV (mg/kg)			
	SGV	GAC	DERMAL ASC	COMBINED SGV/GAC
TPH C12-C16				
TPH C16-C21				
TPH C21-C35				
TPH C35-C40				
TPH Aromatic EC5-EC7		0.134	171	0.133
TPH Aromatic EC7-EC8	3		118000	2.9
TPH Aromatic EC8-EC10		15.99	24000	15.97
TPH Aromatic EC10-EC12		79.6	24000	77.0
TPH Aromatic EC12-EC16		291.7	24000	288.1
TPH Aromatic EC16-EC21		608	17700	587.8
TPH Aromatic EC21-EC35		608	17700	587.8
TPH Aliphatic EC5-EC6		24.07	>1000000	24.06
TPH Aliphatic EC6-EC8		52.79	>1000000	52.78
TPH Aliphatic EC8-EC10		9.96	59000	9.95
TPH Aliphatic EC10-EC12		45.28	59000	52.54
TPH Aliphatic EC12-EC16		198.54	59000	197.8
TPH Aliphatic EC16-EC34		40596	>1000000	3901
Benzene		0.134	171	0.133
Toluene	3		118000	3
Ethyl Benzene	16		59000	15.99
m+p-Xylene		22.91	105610	22.90
o-Xylene		22.91	105610	22.90

Derivation of ASC for the Dermal Pathway

Equation 3.1 from CLEA CLR 10

$$ADE = \frac{IR_{DERMAL} \times EF \times ED}{BW \times AT}$$

ADE – Average Daly Exposure (mg/kg bw/day)
IR_{DERMAL} – Chemical Exposure Rate via the Dermal Pathway
EF - Exposure Frequency (days/year)
ED – Exposure Duration (years)
BW – Body Weight (kg)
AT – Averaging Time (day)

Equation 6.6 from CLEA CLR 10

$$IR_{DERMAL} = (DA \times A_{SKIN})_{OUTDOOE} + (DA \times A_{SKIN} \times F_{DUST})_{INDOOR}$$

DA – Average Absorbed Contaminant dose per unit area of skin ($mg/cm^2/day$)
A_{skin} – Exposed Skin Area (cm^2)
F_{dust} – Fraction of locally derived soil in indoor dust

$$C_{soil} = \frac{BW \times AT \times HCV}{\left((AF \times ABS \times A_{AKIN})_{OUTDOOR} + (AF \times ABS \times A_{SKIN} \times F_{DUST})_{INDOOR}\right) \times EF \times ED \times 10^{-6}}$$

C_{soil} is equivalent to ASC_{dermal}

The SSAC including the dermal pathway is:

$$\frac{1}{SSAC_{TOTAL}} = \frac{1}{SSAC_{SNIFFER}} + \frac{1}{ASC_{CDERMAL}}$$

For residential scenarios (both Residential With and Without Plant Uptake) the following input parameters are used:

BW	= 11.15kg	- Taken from SNIFFER
AT	= 2190 days	- Taken from SNIFFER
$AF_{outdoor}$	=1mg/cm^2	- Taken from CLEA Briefing Note 1
AF_{indoor}	=0.06mg/cm^2	- Taken from CLEA Briefing Note 1
ABS	= CONTAMINANT SPECIFIC	
$A_{skin\text{-}outdoor}$	=544cm^2	- Time Averaged exposed skin based on data from CLEA Briefing Note 1
$A_{skin\text{-}indoor}$	= 685cm^2	- Time Averaged exposed skin based on data from CLEA Briefing Note 1
ED	= 120 days	- Taken from CLEA CLR 10
ED	= 6 years	- Taken from CLEA CLR 10
10^{-6}	= conversion factor for kg to mg	
HCV	= CONTAMINANT SPECIFIC	

For Residential scenarios ASC_{DERMAL} is:

$$ASC_{DERMAL} = \frac{11.15 \times 2190 \times HCV}{\left((1 \times ABS \times 544) + (0.06 \times ABS \times 685 \times 0.75)\right) \times 120 \times 6 \times 10^{-6}}$$

$$ASC_{DERMAL} = \frac{24418.5}{\left((544 \times ABS) + (30.825 \times ABS)\right) \times 0.00072} = \frac{33914583.33}{574.825} \frac{HCV}{ABS} = 58999.98 \bullet \frac{HCV}{ABS}$$

CONTAMINANT	ABS	HCV	ASC_{DERMAL}
Arsenic	0.03	0.0003	590.00
Cadmium	0.001	0.001	59,000
Chromium (hexavalent)	0.01	0.003	17,700
Chromium (total)	0.01	0.003	17,700
Lead			
Mercury	0.01	0.0003	1,770
Selenium	0.01	0.005	2,950
Nickel	0.01	0.005	29,500
Phenols (monohydric)	0.1	0.7	413,000
Naphthalene	0.13	0.02	9076.92
Fluorene	0.13	0.04	18,514
Anthracene	0.13	0.3	136,153
Fluoranthene	0.13	0.3	136,153
Pyrene	0.13	0.03	13,615
Benzo(a)pyrene	0.13	0.00002	9.08
TPH Aromatic EC5-EC7	0.1	0.00029	171
TPH Aromatic EC7-EC8	0.1	0.2	118,000
TPH Aromatic EC8-EC10	0.1	0.04	24,000
TPH Aromatic EC10-EC12	0.1	0.04	24,000
TPH Aromatic EC12-EC16	0.1	0.04	24,000
TPH Aromatic EC16-EC21	0.1	0.03	17,700
TPH Aromatic EC21-EC35	0.1	0.03	17,700
TPH Aliphatic EC5-EC6	0.1	5	>1,000,000
TPH Aliphatic EC6-EC8	0.1	5	>1,000,000
TPH Aliphatic EC8-EC10	0.1	0.1	59,000
TPH Aliphatic EC10-EC12	0.1	0.1	59,000
TPH Aliphatic EC12-EC16	0.1	0.1	59,000
TPH Aliphatic EC16-EC34	0.1	2.0	>1,000,000
Benzene	0.1	0.00029	171
Toluene	0.1	0.2	118,000
Ethyl Benzene	0.1	0.1	59,000
M+p-Xylene	0.1	0.179	105,610
o-Xylene	0.1	0.179	105,610

References:

Draft Human Health and Ecological Risk Assessment for the Georgia-Pacific California Wood Products Manufacturing Facility

Basis and Background of the Soil Remediation Standards for the Combined Ingestion and Dermal Absorption Pathway

INPUT DATA FOR GAC'S

Assumptions made in the derivation of GAC's:

The following assumptions have been made in the derivation of GAC's:

- The soil is a sand matrix
- The Soil Organic Matter Content is 1%

The input parameters used in the derivation worksheets are presented hereunder:

Parameter	Value	Justification
Childhood Ingestion Factor	0.485	Taken from Table 3.6 LQ01
Time Averaged Body Weight	11.15kg	Table 3-2 of LQ01
Childhood Inhalation Factor	0.362	Taken from Table 3-6 of LQ01
Time Averaged Body Height	0.93m	Table 3-4 of LQ01
Soil Density	1.6 g dry weight/cm^3	CLEA Briefing Note 2
Soil-Water content by volume (Water filled porosity)	0.15 cm^3/cm^3	CLEA Briefing Note 2
Soil-Air content by volume (Air filled porosity)	0.31 cm^3/cm^3	CLEA Briefing Note 2
Dilution Ratio	20,000	Taken from LQ01 (page 63)
Temperature	12°C	Taken from 6.99 of CLEA CLR 10
Ambient air velocity in the mixing zone	3m/s	Taken from LQ01
Source Zone Width Parallel to Wind Direction	15m	LQ01
Depth to Subsurface Contamination	1m	LQ01

Receptor Data Used in the Derivation of GAC's:

The critical receptor for the 'Residential Without Plant Uptake' scenario is a female child. The selection of an Exposure Duration and averaging period of 0-6 years is considered appropriate; hence the averaging time is 2190 days, a Time Averaged Body Weight (TABW) of 11.15kg and a Time Averaged Body Height (TABH) of10.93m.

ARSENIC

Arsenic occurs naturally in many soils. A survey of 2691 uncontaminated sites is (Berrow and Reaves, 1984) indicates that the mean concentration of arsenic in 'uncontaminated' soils to be 10 mg/kg. Urban surveys of soils in Wolverhampton and Stoke has reported arsenic concentrations in the range of 2-167mg kg^{-1} (EA, in preparation).

The data collated from literature review of the toxicological properties of arsenic are summarised below:

	Data	Organisation	Reference
Authoritative UK Bodies	Yes	DEFRA	CLEA CLR TOX 1 – March 2002
European Commission Committees	N/A		
Other national organisations	N/A		
Authoritative organisations	N/A		

A summary of the toxicological properties are presented below:

		Description effects	Source
Acute Oral Toxicity	70mg – Lethal Dose	Severe gastroinintestional damage and heamorrhaging, vomiting and diarrhea, cramps and cardiac abnormalities	CLEA CLR TOX 1
Repeated oral toxicity	Index Dose is 0.3µg/kg bw/day	Skin cancer, thickening the walls blood vessels	CLEA CLR TOX 1
Inhalation Toxicity	Index Dose is 0.002µg/kg bw/day	Lung cancer	CLEA CLR SGV 1

Epidermological studies indicate that skin lesions are the most sensitive indicator of chronic toxicity.

The ingestion Index Dose is based on WHO drinking water guidance of 10µg/l, which has an associated lifetime excess cancer risk of $6x10^{-4}$.

The dermal and inhalation pathways account for less that 1% of the overall exposure (CLEA CLR SGV 1), hence they have not been taken into account.

CADMIUM

Cadmium occurs naturally in soils, but is normally expected to be less than 1mg/kg (Alloway,1995).

The data collated from literature review of the toxicological properties cadmium are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	Yes	DEFRA	CLEA CLR TOX 3
European Commission Committees	N/A		
Other national organisations	N/A		
Authoritative organisations	N/a		

A summary of the toxicological properties are presented below;

		Description effects	Source
Acute Effects	Lethal Dose 25mg/kg bw	Hemorrhages in the gastrointestinal tract, odema, severe liver and kidney damage	CLEA CLR TOX 3
Ingestion and inhalation chronic exposure	TDI_{ing} 1µg/kg bw/day	Damage to the kidneys	CLEA CLR TOX 3 - JECFA
Inhalation Toxicity	ID_{inh} 0.001µg/kg bw/day	Nasal itching, runny nose, nose bleeding, nasal mucosal atrophy, bronchitis, pneumonia and lung cancer	CLEA CLR TOX 3

The background exposure data for cadmium is presented below:

	Value	Source
$MDI_{ingestion}$	16ug/kg bw/day	CLEA CLR TOX 3

The empirical relationship between plant uptake and pH of the soil should not be used where the pH is less than 6.5, and the soil to plant concentration factor should be determined on a site specific basis.

The dermal and inhalation pathways account for less that 1% of the overall exposure (CLEA CLR SGV 3), hence they have not been taken into account. This may not be the case on sites where:

- The majority of the site is bare for long periods and dry/windy conditions prevail
- Activities such as vehicle movements increase dust generation
- The contamination itself is in a dry and/or dusty form

HEXAVALENT CHROMIUM

Cadmium is a common element in rocks, and soils in England and Wales have a chromium content in the range of 0.2mg/kg to 838mg/kg, with a median of 39.2mg/kg (McGrath and Loveland, 1992)

The data collated from literature review of the toxicological properties of chromium are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	Yes	DEFRA	CLEA CLR TOX 4 – March 2002
European Commission Committees	N/A		
Other national organisations	N/A		
Authoritative organisations	N/A		

A summary of the toxicological properties are presented below;

		Description effects	Source
Acute Effects	Lethal Dose – 300mg	Hemorrhaging in the gastrointestinal tract, odema, severe kidney and liver damage	CLEA CLR TOX 4
Ingestion and inhalation chronic exposure	TDI_{ing} 3µg/kg bw/day	Affects on gastrointestinal tract (oral ulcer, diarrhea, vomiting, abdominal pain and indigestion) and the blood	CLEA CLR TOX 4
Inhalation Toxicity	ID_{ing} 0.0013µg/kg bw/day	Lung cancer	CLEA CLR TOX 4

The background exposure data for hexavalent chromium is presented below:

	Value	Source
$MDI_{ingestion}$	13ug/kg bw/day	CLEA CLR TOX 4

The SGV for hexavalent chromium is also used for total chromium as it is assumed that all other forms of chromium in the soil can be transformed to the hexavalent form.

The dermal and inhalation pathways account for less that 1% of the overall exposure (CLEA CLR SGV 3), hence they have not been taken into account. This may not be the case on sites where:

- The majority of the site is bare for long periods and dry/windy conditions prevail
- Activities such as vehicle movements increase dust generation

- The contamination itself is in a dry and/or dusty form

INORGANIC FREE CYANIDE

The GAC for free cyanide for the 'Residential With Plant Uptake' scenario is 53mg/kg.

The data collated from literature review of the toxicological properties chromium are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	Yes	DEFRA	CLEA CLR TOX 5 – March 2002
European Commission Committees	N/A		
Other national organisations	N/A		
Authoritative organisations	N/A		

A summary of the toxicological properties are presented below;

		Description effects	Source
Acute Effects	Fatal oral dose 0.56mg kg-1 bw *Fatal dermal* dose 100mg kg-1 bw	Death	CLEA CLR TOX 5

The GAC for free cyanide is based on acute effects and is derived using the following algorithm:

$$SSAC = \frac{(LDL_0/UF) \times BW}{OTSIR}$$

where LDL_0 is the lowest lethal dose, UF is the safety factor, BW is body weight, and OTSIR is time soil ingestion rate.

Based on a LDL_0 of 0.56mg/kg bw/day, an UF 50, a BW 11.15kg and an OTSIR 2g, the GAC is 53mg/kg.

The dermal and inhalation pathways account for less that 1% of the overall exposure (CLEA CLR SGV 3), hence they have not been taken into account.

Soil parameters are based on a sandy soil and have been taken from CLEA CLR 10 and/or the CLEA Briefing Notes

MERCURY

The data collated from literature review of the toxicological properties of mercury are summarised below;

	Data	Organisation	Reference
Authoritative UK Bodies	Yes	DEFRA	CLEA CLR TOX 7 – March 2002
European Commission Committees	N/A		
Other national organisations	N/A		
Authoritative organisations	N/A		

A summary of the toxicological properties for elemental mercury are presented below;

		Description effects	Source
Acute Effects from inhalation	$1mg/m^3$	Damage to major organs, particularly the lungs	CLEA CLR TOX 7
Inhalation chronic exposure	TDI_{ing} 0.3µg/kg bw/day	Damage to the kidneys	CLEA CLR TOX 7

A summary of the toxicological properties for inorganic mercury are presented below;

		Description effects	Source
Acute Effects	Lethal Dose – 0.7g	Severe gastrointestinal damage, cardiovascular collapse, renal failure.	CLEA CLR TOX 7
Ingestion and inhalation chronic exposure	TDI_{ing} 0.3µg/kg bw/day	Damage to the kidneys	CLEA CLR TOX 7
Inhalation Toxicity	ID_{ing} 0.3µg/kg bw/day		CLEA CLR TOX 7

The background exposure data for inorganic mercury is presented below:

	Value	Source
$MDI_{ingestion}$	2.5ug/kg bw/day	CLEA CLR TOX 7

The dermal and inhalation pathways account for less that 1% of the overall exposure (CLEA CLR SGV 5), *hence they have not been taken into account. This may not be the case on sites where:*

- The majority of the site is bare for long periods and dry/windy conditions prevail
- Activities such as vehicle movements increase dust generation

- The contamination itself is in a dry and/or dusty form

NICKEL

The SGV published for nickel by the Environment Agency for the 'Residential With Plant Uptake' scenario is 50mg/kg.

The data collated from literature review of the toxicological properties of nickel are summarised below;

	Data	Organisation	Reference
Authoritative UK Bodies	Yes	DEFRA	CLEA CLR TOX 8 – March 2002
European Commission Committees	N/A		
Other national organisations	N/A		
Authoritative organisations	N/A		

A summary of the toxicological properties for nickel is presented below:

		Description effects	Source
Acute Effects	Lethal Dose – 382mg/m^3	Headache, nausea, vomiting, insomnia, irritability and pulmonary lesions	CLEA CLR TOX 8
Ingestion chronic exposure	TDI_{ing} 5µg/kg bw/day	Damage to the kidneys	CLEA CLR TOX 8
Inhalation Toxicity	TDI_{inh} / ID_{ing} 0.006µg/kg bw/day	Reduction body weight	CLEA CLR TOX 8

The background exposure data for nickel is presented below:

	Value	Source
$MDI_{ingestion}$	160ug/kg bw/day	CLEA CLR TOX 8
$MDI_{inhalation}$	0.3ug/kg bw/day	CLEA CLR TOX 8

The dermal and inhalation pathways account for less that 1% of the overall exposure (CLEA CLR SGV 7), hence they have not been taken into account. This may not be the case on sites where:

- The majority of the site is bare for long periods and dry/windy conditions prevail
- Activities such as vehicle movements increase dust generation
- The contamination itself is in a dry and/or dusty form

SELENIUM

The data collated from literature review of the toxicological properties of selenium are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	Yes	DEFRA	CLEA CLR TOX 10 – March 2002
European Commission Committees	N/A		
Other national organisations	N/A		
Authoritative organisations	N/A		

A summary of the toxicological properties for selenium is presented below;

		Description of effects	Source
Acute Effects	Lethal dose 250mg	Fever, dermatitis, anorexia and death	CLEA CLR TOX 8
Ingestion chronic exposure	TDI_{ing} 5µg/kg bw/day	Damage to the kidneys	CLEA CLR TOX 8
Inhalation Toxicity	TDI_{inh} / ID_{ing} 0.006µg/kg bw/day	Reduction body weight	CLEA CLR TOX 8

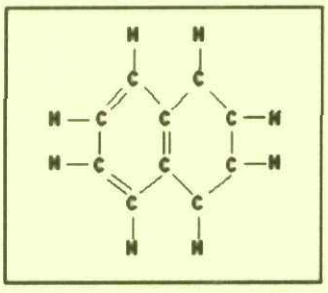
The background exposure data for selenium is presented below:

	Value	Source
$MDI_{ingestion}$	13ug/kg bw/day	CLEA CLR TOX 10

The dermal and inhalation pathways account for less that 1% of the overall exposure (CLEA CLR SGV 9), hence they have not been taken into account. This may not be the case on sites where:

- The majority of the site is bare for long periods and dry/windy conditions prevail
- Activities such as vehicle movements increase dust generation
- The contamination itself is in a dry and/or dusty form

NAPHTHALENE



Structure naphthalene

The data collated from literature review of the toxicological properties of naphthalene are summarised below;

	Data	Organisation	Reference
Authoritative UK Bodies	Yes	DEFRA	CLEA CLR TOX 20 – April 2002
European Commission Committees	N/A		
Other national organisations	N/A		
Authoritative organisations	N/A		

A summary of the toxicological properties for naphthalene is presented below;

		Description effects	Source
Acute Effects	LD 2000mg	In humans, the deliberate ingestion of naphthalene mothballs has caused nausea, vomiting, lethargy, ataxia, convulsions, abdominal pain, hemolytic anemia (resulting from red cell breakdown), liver toxicity, renal failure, coma and death (ATSDR, 1995; EC-JRC, 2003; IPCS, 1998).	CLEA CLR TOX 20
Ingestion chronic exposure	20ug/kg bw/day	Oral toxicity was moderate in mice (LD50 400 to 700 mg kg–1 bw (milligrams per kilogram body weight)) and moderate to low in rats (LD50 about 500 to 9400 mg kg–1 bw) (EC-JRC, 2003; IPCS, 1998). An 8-hour LC50 value greater than 0.5 mg L–1 (500 mg m-3) air for inhalation has been reported for rats (IPCS, 1998). Bronchiolar necrosis was seen in mice exposed for 4 hours at 0.1 mg L–1 (100 mg m–3) (Buckpitt and Franklin, 1989). Acute dermal toxicity in rats was low (LD50 > 2500 g kg–1 bw; probably 24/48-hour covered contact) (EC-JRC, 2003; IPCS, 1998). Rodents do not appear to be sensitive to the blood effects naphthalene, and this should be considered when using rodent data to derive tolerable naphthalene exposure levels for humans. Naphthalene induced hemolytic anemia has been reported in dogs (Zuelzer and Apt, 1949).	CLEA CLR TOX 20

Chronic Inhalation Toxicity	0.86 *mg/kg* bw/day	Individuals living in houses where large numbers *mothballs were* distributed have suffered anemia and kidney effects (ATSDR, 1995; EC-JRC, 2003; IPCS, 1998). There is limited evidence linking occupational inhalation naphthalene with cataracts in humans, but the studies are old and typically involved co-exposure to other substances (ATSDR, 1995; EC-JRC, 2003; IPCS, 1998). No reports lung damage to humans exposed to naphthalene by the inhalation (or any other) route were found during this review. A woman who ingested 400 mg naphthalene per day for 7 days (for medicinal purposes) suffered numb extremities and enlarged liver and spleen, while hemoglobin and albumin were detected in the urine (MacGregor, 1954).	CLEA CLR *TOX 20*

The background exposure data for naphthalene is presented below:

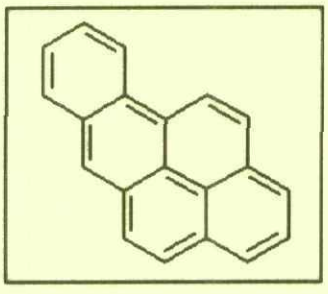
	Value	Source
$MDI_{ingestion}$	7ug/kg bw/day	CLEA CLR TOX 20
$MDI_{inhalation}$	2.8ug/kg bw/day	CLEA CLR TOX 20

The USEPA classes naphthalene as a "possibly carcinogenic to humans".

The physical properties of naphthalene used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	2511 l water per l octanol	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	2000 cm^3/g	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	0.0198	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$7.5x10^{-10}$ m^2/s	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$5.9x10^{-6}$ m^2/s	BP RISC V4.03 DATABASE
Molecular weight	128.2 g/mole	BP RISC V4.03 DATABASE
Saturated vapour pressure	0.085 mmHg	BP RISC V4.03 DATABASE

BENZO(a)PYRENE



Structure benzo(a)pyrene

The data collated from literature review of the toxicological properties of benzo(a)pyrene are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	Yes	DEFRA	CLEA CLR TOX 2 – April 2002
European Commission Committees	N/A		
Other national organisations	N/A		
Authoritative organisations	N/A		

A summary of the toxicological properties for benzo(a)pyrene is presented below;

		Description effects	Source
Acute Effects	Lethal dose for mice 1,600mg	Death	CLEA CLR TOX 2
Ingestion chronic exposure	ID_{ing} 0.02µg/kg bw/day	Dermatitis, breathing problems, chest pains, skin and lung cancer, depressed immune system	CLEA CLR TOX 2
Chronic Inhalation Toxicity	ID_{inh} 7ng/kg bw/day	Lung cancer	CLEA CLR TOX 2
Chronic Dermal Toxicity	N/A	Skin cancer	CLEA CLR TOX 2

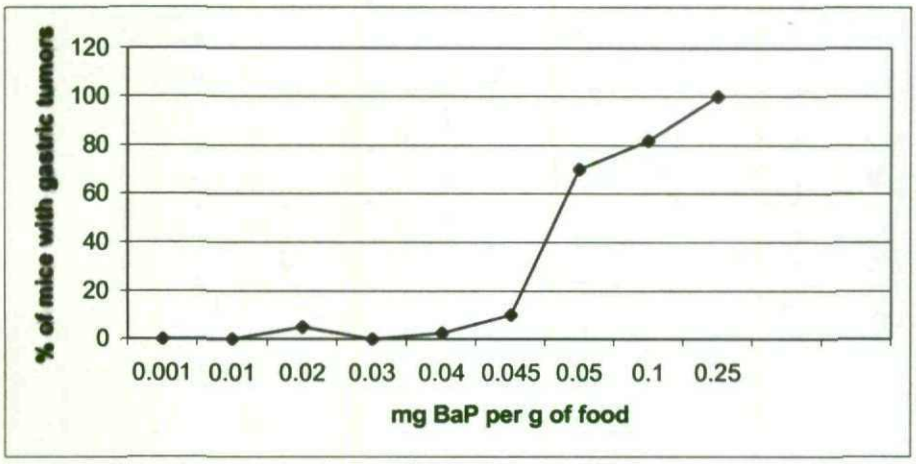
The USEPA classes benzo(a)pyrene as a "probable human carcinogen".

The ingestion Index Dose is based on WHO guidelines 0.7µg/L, which is based on an excess lifetime cancer risk 10^{-5} (WHO 1996).

The inhalation Index Dose is based on the air quality standard 0.25ng/m^3.

No toxicological data is available for the dermal pathway.

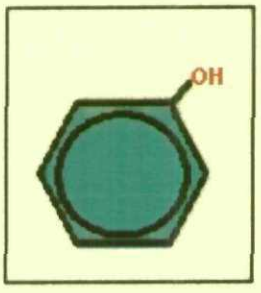
A review of the primary literature (Neal 1967) indicates that benzo(a)pyrene may be a non-threshold substance. A plot of dose versus reaction is presented below:



The physical properties of benzo(a)pyrene used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	1258925 l water per l octanol	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	1000000 cm^3/g	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	0.0000463	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$9x10^{-10}$ m^2/s	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$4.3x10^{-6}$ m^2/s	BP RISC V4.03 DATABASE
Molecular weight	252.3	BP RISC V4.03 DATABASE
Saturated vapor pressure	$5.5x10^{-9}$ mmHg	BP RISC V4.03 DATABASE

PHENOL



The data collated from literature review of the toxicological properties of phenol are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	Yes	DEFRA	CLEA CLR TOX 9 – April 2002
European Commission Committees	N/A		
Other national organisations	N/A		
Authoritative organisations	N/A		

A summary of the toxicological properties for phenol is presented below;

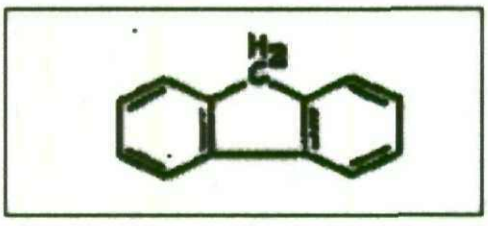
		Description effects	Source
Acute Effects	LD 140mg/kg bw	Nercosis, cardiovascular effects, cardiovascular effects, metabolic acidosis and cyanosis	CLEA CLR TOX 9
Ingestion chronic exposure	TDI_{ing}=0.7mg/kg bw/day	Mouth sores, diarrhea and dark urine	CLEA CLR TOX 9

The physical properties of phenol used in the derivation of the SGV are presented below:

Property	Value	Source
Log Kow (octanol/water partition coefficient)	1.47	CLEA SGV 8
Log Koc (organic carbon-water partition coefficient)	1.46 cm^3/g	CLEA SGV 8
***Dimensionless* Henry's constant**	$3.97x10^{-7}$ $atm.m^3.mol^{-1}$	CLEA SGV 8
Diffusion coefficient in water	$9.1x10^{-10}m^2/s$	CLEA SGV 8
Diffusion coefficient in soil air	$8.2x10^{-6}m^2/s$	CLEA SGV 8

Saturated vapor pressure	48 Pa	CLEA SGV 8
Molecular Weight	94.11 g/mol	CLEA SGV 8

FLUORENE



Structure of Fluorere

The data collated from literature review of the toxicological properties of fluorene are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	No		
European Commission Committees	No		
Other national organisations	Yes	IRIS	www.epa.gov/iris
Authoritative organisations	N/A		

The selected Relevant Health Criteria value for ingestion for fluorene as a threshold substance was the Oral Reference Dose, which is equivalent to the TDI.

The Oral TDI is 0.04mg/kg bw/day. No information on the MDI has been found during the literature search, hence the TDSI is assumed to be 20% of the TDI.

The data is based on Mouse oral subchronic toxicity study. Prepared by Toxicity Research Laboratories, LTD., Muskegon, MI for the fice Solid Waste, Washington, DC.

The USEPA have a low confidence in the RfD (TDI).

Soil parameters have been taken from CLEA CLR 10 and/or the CLEA Briefing Notes

The physical properties of fluorene used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	15848 l water per l octanol	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	14000 cm^3/g	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	0.0261	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$7.9x10^{-10}m^2/s$	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$3.6x10^{-2}m^2/s$	BP RISC V4.03 DATABASE
Saturated Vapor Pressure	0.0084 mmHg	BP RISC V4.03 DATABASE
Molecular Weight	166.2 g/mole	BP RISC V4.03 DATABASE

ANTHRACENE

The data collated from literature review of the toxicological properties of anthracene are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	No		
European Commission Committees	No		
Other national organisations	Yes	IRIS	www.epa.gov/iris
Authoritative organisations	N/A		

The selected Relevant Health Criteria value for ingestion for anthracene as a threshold substance was the Oral Reference Dose, which is equivalent to the TDI.

The Oral TDI is 0.3mg/kg bw/day. No information on the MDI has been found during the literature search; hence the TDSI is assumed to be 20% of the TDI.

The data is based on a Subchronic toxicity in mice with anthracene. Final Report. Hazelton Laboratories America, Inc. Prepared for the fice of Solid Waste, Washington, DC.

The USEPA have a low confidence in the RfD (TDI).

The physical properties of anthracene used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	39810 l water per l octanol	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	30000 cm^3/g	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	0.00267	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$7.7x10^{-10}m^2/s$	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$3.2x10^{-6}m^2/s$	BP RISC V4.03 DATABASE
Saturated Vapor Pressure	0.0000027mmHg	BP RISC V4.03 DATABASE
Molecular Weight	178.2 g/mol	BP RISC V4.03 DATABASE

FLUORANTHENE

The data collated from literature review of the toxicological properties of fluoranthene are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	No		
European Commission Committees	No		
Other national organisations	Yes	IRIS	www.epa.gov/iris
Authoritative organisations	N/A		

The Oral TDI is 0.3mg/kg bw/day. No information on the MDI has been found during the literature search, hence the TDSI is assumed to be 20% of the TDI.

The data is based on a 13-Week mouse oral subchronic toxicity study. Prepared by Toxicity Research Laboratories, Ltd., Muskegon, MI for the fice Solid Waste, Washington, DC.

The USEPA have a low confidence in the RfD (TDI).

The critical receptor for this scenario is a female adult. The selection of an Exposure Duration and averaging period 0-6 years is considered appropriate, as is the chosen receptor body weight.

Soil parameters have been taken from CLEA CLR 10 and/or the CLEA Briefing Notes

The physical properties of fluoranthene used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	125892 l water per l octanol	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	110000 cm^3/g	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	0.00066	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$6.4x10^{-10}$ m^2/s	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$3.0x10^{-6}m^2/s$	BP RISC V4.03 DATABASE
Saturated Vapour Pressure	$1.2x10^{-8}$mmHg	BP RISC V4.03 DATABASE
Molecular Weight	202.3 g/mol	BP RISC V4.03 DATABASE

PYRENE

The data collated from literature review of the toxicological properties of pyrene are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	No		
European Commission Committees	No		
Other national organisations	Yes	IRIS	www.epa.gov/iris
Authoritative organisations	N/A		

The selected Relevant Health Criteria value for ingestion for pyrene as a threshold substance was the Oral Reference Dose, which is equivalent to the TDI.

The Oral TDI is 0.03mg/kg bw/day. No information on the MDI has been found during the literature search, hence the TDSI is assumed to be 20% of the TDI.

The data is based on a Mouse Oral Subchronic Toxicity Pyrene. Study conducted by *Toxicity* Research Laboratories, Muskegon, MI for the fice Solid Waste, Washington, DC.

The USEPA have a low confidence in the RfD (TDI).

Soil parameters have been taken from CLEA CLR 10 and/or the CLEA Briefing Notes

The physical properties of pyrene used in the derivation GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	125892 l water per l octanol	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	110000 cm^3/g	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	0.000137	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$7.2x10^{-10}m^2/s$	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$2.7x10^{-6}m^2/s$	BP RISC V4.03 DATABASE
Saturated Vapor Pressure	$2.5x10^{-6}$ mmHg	BP RISC V4.03 DATABASE
Molecular Weight	202.3 g/mol	BP RISC V4.03 DATABASE

ACENAPHTHYLENE

There is currently no toxicological data available, hence Toxicity Equivalent Factors (TEF) have been used do derive an GAC based on the GAC benzo(a)pyrene.

The TEF for acenaphthylene is 0.001.

ACENAPHTHENE

There is currently no toxicological data available, hence Toxicity Equivalent Factors (TEF) have been used do derive an GAC based on the GAC benzo(a)pyrene.

The TEF for aecnaphthene is 0.001.

BENZO(A)ANTHRACENE

There is currently no toxicological data available, hence Toxicity Equivalent Factors (TEF) have been used do derive an GAC based on the GAC benzo(a)pyrene.

The TEF for benzo(a)anthracene is 0.1

PHENANTHRENE

There is currently no toxicological data available, hence Toxicity Equivalent Factors (TEF) have been used do derive an GAC based on the GAC benzo(a)pyrene.

The TEF for phenanthrene is 0.001.

CHRYSENE

There is currently no toxicological data available, hence Toxicity Equivalent Factors (TEF) have been used do derive an GAC based on the GAC benzo(a)pyrene.

The TEF for chrysene is 0.1

BENZO(B)FLUORANTHENE

There is currently no toxicological data available, hence Toxicity Equivalent Factors (TEF) have been used do derive an GAC based on the GAC benzo(a)pyrene.

The TEF for benzo(b)fluoranthene is 0.1

BENZO(K)FLUORANTHENE

There is currently no toxicological data available, hence Toxicity Equivalent Factors (TEF) have been used do derive an GAC based on the GAC benzo(a)pyrene.

The TEF for benzo(k)fluoranthene is 0.1

INDENO(1,2,3-CD)PYRENE

There is currently no toxicological data available, hence Toxicity Equivalent Factors (TEF) have been used do derive an GAC based on the GAC benzo(a)pyrene.

The TEF for indeno(1,2,3-CD)pyrene is 0.1

DEBENZ(A,H)ANTHRACENE

There is currently no toxicological data available, hence Toxicity Equivalent Factors (TEF) have been used do derive an GAC based on the GAC benzo(a)pyrene.

The TEF for dibenz(a,h)anthracene is 1.0

BENZO(G,H,I)PERYLENE

There is currently no toxicological data available, hence Toxicity Equivalent Factors (TEF) have been used do derive an GAC based on the GAC benzo(a)pyrene.

The TEF for benzo(g,h,I)perylene is 0.1

HYDROCARBONS

AROMATIC EC5-EC7 (BENZENE)

The data collated from literature review of the toxicological properties of the aromatic EC5-EC7 (benzene) fraction are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	Yes	DEFRA	CLEA CLR TOX 11
European Commission Committees	No		
Other national organisations	No		
Authoritative organisations	N/A		

The oral index dose for benzene is 0.00029mg/kg bw/day and the inhalation index dose is 0.00091mg/kg bw/day.

The physical properties the aromatic EC5-EC7 fractions used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	125.89254	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	59	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	0.228	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$9.8x10^{-10}$	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$8.8x10^{-6}$	BP RISC V4.03 DATABASE
Saturated Vapor Pressure	95	BP RISC V4.03 DATABASE
Molecular Weight	78	BP RISC V4.03 DATABASE

AROMATIC EC7-EC8 (TOLUENE)

The data collated from literature review of the toxicological properties of the Aromatic EC7-EC8 (toluene) fraction are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	Yes	DEFRA	CLEA CLR TOX 14
European Commission Committees	No		
Other national organisations	No		
Authoritative organisations	N/A		

The oral tolerable daily intake for toluene is 200ug/kg bw/day and the inhalation tolerable daily intake is 74ug/kg bw/day.

The mean daily intake for toluene is 10ug/day for ingestion and 124ug/day for inhalation.

AROMATIC EC8-EC10

The data collated from literature review of the toxicological properties of the aromatic EC8-EC10 fraction are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	No		
European Commission Committees	No		
Other national organisations	Yes	TPHCWG	
Authoritative organisations	N/A		

The ingestion tolerable daily intake for the aromatic EC8-EC10 fraction is 0.04mg/kg bw/day and the inhalation tolerable daily intake is 0.04mg/kg bw/day.

No data is available on the mean daily intake of this fraction, hence it will be assumed to be 80% of the tolerable daily intakes.

The physical properties the aromatic EC8-EC10 fractions used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	1258.9254	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	1600	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	0.49	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$1x10^{-9}$	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$1x10^{-5}$	BP RISC V4.03 DATABASE
Saturated Vapour Pressure	4.8	BP RISC V4.03 DATABASE
Molecular Weight	120	BP RISC V4.03 DATABASE

AROMATIC EC10-EC12

The data collated from literature review of the toxicological properties of the aromatic EC10-EC12 fraction are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	No		
European Commission Committees	No		
Other national organisations	Yes	TPHCWG	
Authoritative organisations	N/A		

The ingestion tolerable daily intake for the aromatic EC10-EC12 fraction is 0.04mg/kg bw/day and the inhalation tolerable daily intake is 0.04mg/kg bw/day.

No data is available on the mean daily intake of this fraction, hence it will be assumed to be 80% of the tolerable daily intakes.

The physical properties the aromatic EC10-EC12 fractions used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	3162.2777	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	2500	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	0.14	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$1X10^{-9}$	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$1X10^{-5}$	BP RISC V4.03 DATABASE
Saturated Vapour Pressure	0.48	BP RISC V4.03 DATABASE
Molecular Weight	130	BP RISC V4.03 DATABASE

AROMATIC EC12-EC16

The data collated from literature review of the toxicological properties of the aromatic EC12-EC16 fraction are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	No		
European Commission Committees	No		
Other national organisations	Yes	TPHCWG	
Authoritative organisations	N/A		

The ingestion tolerable daily intake for the aromatic EC12-EC16 fraction is 0.04mg/kg bw/day and the inhalation tolerable daily intake is 0.04mg/kg bw/day.

No data is available on the mean daily intake of this fraction, hence it will be assumed to be 80% of the tolerable daily intakes.

The physical properties the aromatic EC12-EC16 fractions used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	7943.2823	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	5000	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	0.054	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$1x10^{-9}$	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$1x10^{-5}$	BP RISC V4.03 DATABASE
Saturated Vapour Pressure	0.036	BP RISC V4.03 DATABASE
Molecular Weight	150	BP RISC V4.03 DATABASE

AROMATIC EC16-EC21

The data collated from literature review of the toxicological properties of the aromatic EC16-EC21 fraction are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	No		
European Commission Committees	No		
Other national organisations	Yes	TPHCWG	
Authoritative organisations	N/A		

The ingestion tolerable daily intake for the aromatic EC16-EC21 fraction is 0.03mg/kg bw/day.

No data is available on the mean daily intake of this fraction, hence it will be assumed to be 80% of the tolerable daily intakes.

The physical properties the aromatic EC16-EC21 fractions used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	50118.723	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	16000	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	0.013	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$1x10^{-9}$	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$1x10^{-5}$	BP RISC V4.03 DATABASE
Saturated Vapour Pressure	$5.8x10^{-3}$	BP RISC V4.03 DATABASE
Molecular Weight	190	BP RISC V4.03 DATABASE

AROMATIC EC21-EC35

The data collated from literature review of the toxicological properties of the aromatic EC21-EC35 fraction are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	No		
European Commission Committees	No		
Other national organisations	Yes	TPHCWG	
Authoritative organisations	N/A		

The ingestion tolerable daily intake for the aromatic EC21-EC35 fraction is 0.03mg/kg bw/day.

No data is available on the mean daily intake of this fraction, hence it will be assumed to be 80% of the tolerable daily intakes.

The physical properties the aromatic EC21-EC35 fractions used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	1258925.4	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	130000	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	$6.8X10^{-4}$	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$1x10^{-9}$	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$1x10^{-5}$	BP RISC V4.03 DATABASE
Saturated Vapour Pressure	$3.3X10^{-6}$	BP RISC V4.03 DATABASE
Molecular Weight	240	BP RISC V4.03 DATABASE

ALIPHATIC EC5-EC6

The data collated from literature review of the toxicological properties of the aliphatic EC5-EC6 fraction are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	No		
European Commission Committees	No		
Other national organisations	Yes	TPHCWG	
Authoritative organisations	N/A		

The ingestion tolerable daily intake for the aliphatic EC5-EC6 fraction is 5mg/kg bw/day and the inhalation tolerable daily intake is 5.26mg/kg bw/day.

No data is available on the mean daily intake of this fraction, hence it will be assumed to be 80% of the tolerable daily intakes.

The physical properties of the aliphatic EC5-EC6 fraction used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	1995.2623	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	790	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	34	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$1x10^{-9}$	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$1x10^{-5}$	BP RISC V4.03 DATABASE
Saturated Vapour Pressure	270	BP RISC V4.03 DATABASE
Molecular Weight	81	BP RISC V4.03 DATABASE

ALIPHATIC EC6-EC8

The data collated from literature review of the toxicological properties of the aliphatic EC6-EC8 fraction are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	No		
European Commission Committees	No		
Other national organisations	Yes	TPHCWG	
Authoritative organisations	N/A		

The ingestion tolerable daily intake for the aliphatic EC6-EC8 fraction is 5mg/kg bw/day and the inhalation tolerable daily intake is 5.26mg/kg bw/day.

No data is available on the mean daily intake of this fraction, hence it will be assumed to be 80% of the tolerable daily intakes.

The physical properties of the aliphatic EC6-EC8 fraction used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	10000	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	4000	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	51	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$1x10^{-9}$	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$1x10^{-5}$	BP RISC V4.03 DATABASE
Saturated Vapour Pressure	48	BP RISC V4.03 DATABASE
Molecular Weight	100	BP RISC V4.03 DATABASE

ALIPHATIC EC8-EC10

The data collated from literature review of the toxicological properties of the aliphatic EC8-EC10 fraction are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	No		
European Commission Committees	No		
Other national organisations	Yes	TPHCWG	
Authoritative organisations	N/A		

The ingestion tolerable daily intake for the aliphatic EC8-EC10 fraction is 0.1mg/kg bw/day and the inhalation tolerable daily intake is 0.29mg/kg bw/day.

No data is available on the mean daily intake of this fraction, hence it will be assumed to be 80% of the tolerable daily intakes.

The physical properties of the aliphatic EC8-EC10 fraction used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	63095.734	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	32000	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	82	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$1x10^{-9}$	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$1x10^{-5}$	BP RISC V4.03 DATABASE
Saturated Vapour Pressure	4.8	BP RISC V4.03 DATABASE
Molecular Weight	130	BP RISC V4.03 DATABASE

ALIPHATIC EC10-EC12

The data collated from literature review of the toxicological properties of the aliphatic EC10-EC12 fraction are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	No		
European Commission Committees	No		
Other national organisations	Yes	TPHCWG	
Authoritative organisations	N/A		

The ingestion tolerable daily intake for the aliphatic EC10-EC12 fraction is 0.1mg/kg bw/day and the inhalation tolerable daily intake is 0.29mg/kg bw/day.

No data is available on the mean daily intake of this fraction, hence it will be assumed to be 80% of the tolerable daily intakes.

The physical properties of the aliphatic EC10-EC12 fraction used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	398107.17	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	$2.5X10^{5}$	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	130	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$1x10^{-9}$	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$1x10^{-5}$	BP RISC V4.03 DATABASE
Saturated Vapour Pressure	0.49	BP RISC V4.03 DATABASE
Molecular Weight	160	BP RISC V4.03 DATABASE

ALIPHATIC EC12-EC16

The data collated from literature review of the toxicological properties of the aliphatic EC12-EC16 fraction are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	No		
European Commission Committees	No		
Other national organisations	Yes	TPHCWG	
Authoritative organisations	N/A		

The ingestion tolerable daily intake for the aliphatic EC12-EC16 fraction is 0.1mg/kg bw/day and the inhalation tolerable daily intake is 0.29mg/kg bw/day.

No data is available on the mean daily intake of this fraction, hence it will be assumed to be 80% of the tolerable daily intakes.

The physical properties of the aliphatic EC12-EC16 fraction used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	6309573.4	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	$5X10^{6}$	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	540	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$1x10^{-9}$	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$1x10^{-5}$	BP RISC V4.03 DATABASE
Saturated Vapour Pressure	0.036	BP RISC V4.03 DATABASE
Molecular Weight	200	BP RISC V4.03 DATABASE

ALIPHATIC EC16-EC35

The data collated from literature review of the toxicological properties of the aliphatic EC16-EC35 fraction are summarized below;

	Data	Organisation	Reference
Authoritative UK Bodies	No		
European Commission Committees	No		
Other national organisations	Yes	TPHCWG	
Authoritative organisations	N/A		

The ingestion tolerable daily intake for the aliphatic EC16-EC35 fraction is 2.0mg/kg bw/day.

No data is available on the mean daily intake of this fraction, hence it will be assumed to be 80% of the tolerable daily intakes.

The physical properties of the aliphatic EC16-EC35 fraction used in the derivation of GAC's are presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	$10^{8.9}$	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	$1X10^{9}$	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	6400	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$1x10^{-9}$	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$1x10^{-5}$	BP RISC V4.03 DATABASE
Saturated Vapour Pressure	$5.8X10^{-3}$	BP RISC V4.03 DATABASE
Molecular Weight	270	BP RISC V4.03 DATABASE

XYLENES

The data collated from literature review of the toxicological properties of xylenes are summarised below;

	Data	Organisation	Reference
Authoritative UK Bodies	Yes	DEFRA	CLEA CLR TOX 20 – April 2002
European Commission Committees	N/A		
Other national organisations	N/A		
Authoritative organisations	N/A		

A summary of the toxicological properties for naphthalene is presented below;

The tolerable daily intake for ingestion and inhalation are 179ug/kg bw/day and 63ug/kg bw/day.

The mean daily intake for ingestion and inhalation are 20ug/day and 112ug/day.

The physical properties of xylenes used in the derivation of the GAC is presented below:

Property	Value	Source
Kow (octanol/water partition coefficient)	1995.2623	BP RISC V4.03 DATABASE
Koc (organic carbon-water partition coefficient)	240	BP RISC V4.03 DATABASE
Dimensionless Henry's constant	0.29	BP RISC V4.03 DATABASE
Diffusion coefficient in water	$8.5x10^{-10}$	BP RISC V4.03 DATABASE
Diffusion coefficient in soil air	$7.2x10^{-6}$	BP RISC V4.03 DATABASE
Molecular weight	106.2	BP RISC V4.03 DATABASE
Saturated vapour pressure	8.8	BP RISC V4.03 DATABASE

SNIFFER Version 1.02

SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by Paul Brew on 08/07/2006

and has been checked by Christopher Bolan on 08/07/2006

3 It relates to Aliphatic EC5-EC8 found at Residential Without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Y or N) N

5a Insert the relevant health criterion for ingestion
For a non threshold substance the relevant health criterion is the Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI). 5.00E+00 mg per kg body weight per day

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

0 mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unkown? (Y or N)

Y

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

0.485

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Ingestion

10a *For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated* using the formula: RI_{ingest}=ID

mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=0.2TDI

1 mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N)

N

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (indicative) Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

5.26E+00 mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

[ ] mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unknown? (Y or N)

[Y]

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.382
16-59	1

[0.382]

Receptor Body Weight

9b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

[11.15] kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: RI_{inhal}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: RI_{inhal}=0.2TDI

1.062 mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

Y

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{drvg} from this table, depending on your choice of land use

Land Use	SEI_{drvg} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{drvg} = 9.85E-06

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

N

If Y insert the representative fraction here (default=1)

The amended SEI_{drvg} = SEI_{drvg} * bioaccessibility fraction

9.85319E-06 kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: ASC_{drvg} = RI_{ingest}/SEI_{drvg}

ASC_{drvg} = 1.00000E+00 mg per kg body weight per day / 9.85319E-06 kg soil per kg body weight per day = 101490.0249 mg per kg soil

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Y or N) N

Measured Concentration Factor for leafy vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 18 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) 1995.262315 water per l octanol

a representative value of ϕ (soil density) 1.8 g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient): 790 cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil): 5.98802E-03 kg OC per kg soil

a representative value of θ (soil-water content by volume) 0.15 cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{-0.434*(logKow-1.78)^2/2.44} + (10^{0.95logKow-2.05}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))$

CF_{leafy}= 0.818976571 ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root} = (10^{0.77logKow-1.52}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))*0.01$

CF_{root}= 0.023495113 * ug per g fresh weight plant per ug per g dry weight soil

* Note - If the soil correction factor $(\phi/(\theta+\phi K_{oc}f_{oc}))$ is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight conversion factor when using measured CF values.
Is a dry weight conversion required? (Y or N) N

Calculation of SEI_{veg}
The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/day)	TAVCR*BF*CF*DW	TAVCR*BF*CF
Brussel sprouts	5.04750E-03	calc not required	2.60898E-03
Cabbage	4.86885E-03	calc not required	2.49524E-03
Carrot	7.38094E-03	calc not required	7.06093E-05
Leafy salads	3.25677E-03	calc not required	4.66855E-04
Onion	3.89474E-03	calc not required	5.04372E-05
Potato	4.41616E-02	calc not required	3.88593E-04

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	5.45443E-04
Allotments	5.45443E-04

SEI_{veg}= 5.45E-04 kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{oral}/SEI_{veg}$

ASC_{veg} = 1.00000E+00 (mg per kg body weight per day) / 5.45443E-04 (kg soil per kg body weight per day) = 1833.3712 mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to paragraph 25.

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$= 1.1272E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N) N

Insert the representative fraction here (default=1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect} = RI_{typical}/SEI_{indirect}$

$ASC_{indirect}$ = 1.00000E+00 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 887131.6833 mg per kg soil

Intake via Inhalation of Outdoor Air

25 This pathway only applies to substances with H' greater than or equal to 10^{-5}.
To use the formulae for inhalation of outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W=	15 metres
Depth to subsurface contamination	d_s=	1 metres

Soil Matrix

Soil organic matter content	SOM=	1	%	
Mass fraction of organic carbon in soil	f_{oc}=	1	/167	5.98802E-03 kg OC per kg soil
Air filled porosity	θ_{air}=	0.31	unitless	
Water filled porosity	θ_{wat}=	0.15	unitless	
Total porosity	θ_{tot}=	0.46	unitless	
Bulk soil density	ρ_b=	1.8	kg soil per l soil	

Contaminant

Organic carbon/water partition coefficient	K_{oc}=	790 l water per kg OC
Dimensionless Henry's constant	H'=	34 l water per l air
Diffusion coefficient in water	D_{wat}=	1.00E-09 m^2 per s
Diffusion coefficient in soil air	D_s=	1.00E-05 m^2 per s
Air in soil		9.52847E-02 unitless
Water in soil		8.47485E-03 unitless
Air term		9.52847E-07 m^2 per s
Water term		2.49254E-13 m^2 per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	9.52848E-07 m^2 per s
Molecular weight	MW=	81 g per mol
Saturated vapour pressure	SatVP=	270 mm Hg

Pathway parameters

Dilution ratio	DR=	20000	unitless	
Temperature	Temp=	12	°C + 273 =	285 K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air}=	3	m per s	

Receptor characteristics

Time-averaged body height TAH= 0.93 m
Height of mixing zone h= 0.93 /2 = 0.465 m

26 Contaminant Volatilisation Factor (CVF)

CVF= 3.07254E-06 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	$TAAI_{outv}$ m^3 air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residental without plant uptake	7.27421E-02
Allotments	1.55783E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate $TAAI_{outv}$ here 7.27E-02 m^3 air per (kg body weight per day)

28 Soil equivalent intake

Calculate the soil equivalent intake for inhalation of outdoor air
using the formula: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

2.22048E-03 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air
using the formula: $ASC_{outv} = RI_{outv}/SEI_{outv}$

ASC_{outv} = 1.05200E+00 mg per kg body weight per day / 2.22048E-03 kg soil per kg body weight per day = 473.7714317 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios:
Residential with plant uptake, Residential without plant uptake, Commercial/Industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{av}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/industrial	4.34795E-02

Insert the appropriate $TAAI_{av}$ here: 2.78E-01 m³ air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF = K_{oc} \times f_{oc} / H'$

SF= 0.139133468 l air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC= 2.879375121 kg soil per l air

34 The soil equivalent intakes for inhalation of indoor air is calculated using the formula: $SEI_{iv} = (TAAI_{iv} \times 1000 \times SVPC)/DR$

SEI_{iv}= 4.14697E-02 kg soil/(kg body weight per day)

35 The nominal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{iv} = RI_{iv}/SEI_{iv}$

ASC_{iv} = 1.05200E+00 mg per kg body weight per day / 4.14697E-02 kg soil per kg body weight per day = 25.3678985 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^6)/(760 mmHg \times R \times Temp)$

C_{sat}= 1.23044E+09 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{iv} \times SVPC$

C_{sv}= 7.55805E+01 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat}= 6.14258E-08 (mg per l air) per (mm Hg.g per mol)

If the ratio is greated than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (ISSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-3}

soil ingestion pathway	$1/ASC_{ing}$=	1/	101480.0249	=	9.85319E-06 kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/	1833.3712	=	5.45443E-04 kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/	887131.6633	=	1.12723E-06 kg soil per mg
inhalation of outdoor air	$1/ASC_{outh}$=	1/	473.7714317	=	2.11072E-03 kg soil per mg
inhalation of indoor air	$1/ASC_{inh}$=	1/	25.3078965	=	3.94199E-02 kg soil per mg

The integrated Site Specific Assessment Criterion (ISSAC)

39	For the residential with plant uptake land use the $SSAC_{rep}$ =		mg per kg soil
40	For the allotments land use the $SSAC_{all}$ =		mg per kg soil
41	For the residential without plant uptake land use the $SSAC_{other}$ =	24.07290734	mg per kg soil
	For the commercial/industrial land use the $SSAC_{other}$=		mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for Aliphatic EC5-EC in the Residential without plant uptake scenario is 24.07291 mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-3}

soil ingestion pathway	$1/ASC_{ing}$=	1/		=	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/		=	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/		=	kg soil per mg

The integrated Site Specific Assessment Criterion

43	For the residential with plant uptake land use the $SSAC_{rep}$ =	mg per kg soil
	For the allotments land use the $SSAC_{all}$ =	mg per kg soil
	For the residential without plant uptake land use the $SSAC_{other}$ =	mg per kg soil
	For the commercial/industrial land use the $SSAC_{other}$=	mg per kg soil

The Level 1 Site Specific Assessment Criterion for Aliphatic EC5-EC in the scenario is mg per kg soil

Risk Evaluation

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site. Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. Critical Receptor	Y
iv. Pathways included/omitted (including bioaccessibility if used)	Y
v. Soil Parameters, e.g. pH	Y

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SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by Paul Brew on 08/07/2006

and has been checked by Christopher Bolan on 08/07/2006

3 It relates to Aliphatic EC6-EC8 found at Residential Without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Y or N) N

5a Insert the relevant health criterion for ingestion 5.00E+00 mg per kg body weight per day
For a non threshold substance the relevant health criterion is the Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

0 mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unkown? (Y or N)

Y

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

0.485

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Ingestion

10a For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated using the formula: RI_{ingest}=ID

mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=0.2TDI

1 mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N)

N

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (indicative) Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

5.26E+00 mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unknown? (Y or N)

Y

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.362
16-59	1

0.362

Receptor Body Weight

9b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: $RI_{inhal}=ID$

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: $RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)^*$

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: $RI_{inhal}=0.2TDI$

1.052 mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

Y

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{dirq} from this table, depending on your choice of land use

Land Use	SEI_{dirq} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{dirq} = 9.85E-06

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

N

If Y insert the representative fraction here (default=1)

The amended SEI_{dirq} = SEI_{dirq} * bioaccessibility fraction

9.85319E-06 kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: $ASC_{dirq} = RI_{ingest}/SEI_{dirq}$

ASC_{dirq} = 1.00000E+00 mg per kg body weight per day / 9.85319E-06 kg soil per kg body weight per day = 101490.0249 mg per kg soil

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25 .
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Y or N) **N**

Measured Concentration Factor for leafy vegetables _____ ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables _____ ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 18 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) **10000** l water per l octanol

a representative value of ϕ (soil density) **1.6** g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient) : **4333** cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil) : **5.98802E-03** kg OC per kg soil

a representative value of θ (soil-water content by volume) **0.15** cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{-0.434*(logKow-1.78)^2/2.44})*(10^{0.95logKow-2.05}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))$

CF_{leafy}= **0.228221055** * ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root}=(10^{0.77logKow-1.52}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))*0.01$

CF_{root}= **0.014258068** * ug per g fresh weight plant per ug per g dry weight soil

* Note - If the soil correction factor $(\phi/(\theta+\phi K_{oc}f_{oc}))$ is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight conversion factor when using measured CF values.
Is a dry weight conversion required? (Y or N) **N**

Calculation of SEI_{veg}
The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/day)	TAVCR*DF*CF*DW	TAVCR*DF*CF
Brussel sprouts	5.84750E-03	calc not required	7.27308E-04
Cabbage	4.86885E-03	calc not required	6.95340E-04
Carrot	7.38084E-03	calc not required	4.28225E-05
Leafy salads	3.25677E-03	calc not required	1.30097E-04
Onion	3.69474E-03	calc not required	3.08602E-05
Potato	4.41616E-02	calc not required	2.36221E-04

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	1.67044E-04
Allotments	1.67044E-04

SEI_{veg}= **1.67E-04** kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{organic}/SEI_{veg}$

ASC_{veg} = **1.00000E+00** mg per kg body weight per day / **1.67044E-04** kg soil per kg body weight per day = **5986.428908** mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to paragraph 25.

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$= 1.1272E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N) N

Insert the representative fraction here (default=1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect}$ = $RI_{target}/SEI_{indirect}$

$ASC_{indirect}$ = 1.00000E+00 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 887131.6833 mg per kg soil

Intake via Inhalation of Outdoor Air

25 This pathway only applies to substances with H' greater than or equal to 10^{-3}.
To use the formulae for inhalation of outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W=	15 metres
Depth to subsurface contamination	d_s=	1 metres

Soil Matrix

Soil organic matter content	SOM=	1	%	
Mass fraction of organic carbon in soil	f_{oc}=	1	/167	5.98802E-03 kg OC per kg soil
Air filled porosity	θ_{ws}=	0.31	unitless	
Water filed porosity	θ_{ws}=	0.15	unitless	
Total porosity	θ_{total}=	0.46	unitless	
Bulk soil density	ρ=	1.6	kg soil per l soil	

Contaminant

Organic carbon/water partition coefficient	K_{oc}=	4333	l water per kg OC
Dimensionless Henry's constant	H'=	48	l water per l air
Diffusion coefficient in water	D_{wat}=	1.00E-09	m^2 per s
Diffusion coefficient in soil air	D_s=	1.00E-05	m^2 per s
Air in soil		9.52847E-02	unitless
Water in soil		8.47485E-03	unitless
Air term		9.52847E-07	m^2 per s
Water term		1.76555E-13	m^2 per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	9.52847E-07	m^2 per s
Molecular weight	MW=	100	g per mol
Saturated vapour pressure	SatVP=	48	mmHg

Pathway parameters

Dilution ratio	DR=	20000	unitless	
Temperature	Temp=	12	°C + 273 =	285 K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air}=	3	m per s	

Receptor characteristics

Time-averaged body height TAH= 0.93 m

Height of mixing zone hm= 0.93 /2 = 0.465 m

26 Contaminant Volatilisation Factor (CVF)

CVF= 1.39159E-05 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	TAAIoutv m^3 air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residential without plant uptake	7.27421E-02
Allotments	1.55763E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate $TAAI_{outv}$ here 7.27E-02 m^3 air per (kg body weight per day)

28 Soil equivalent intake

Calculate the soil equivalent intake for inhalation of outdoor air using the formula: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

1.01227E-03 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air using the formula: $ASC_{outv} = RI_{outv}/SEI_{outv}$

ASC_{outv} = 1.05200E+00 mg per kg body weight per day / 1.01227E-03 kg soil per kg body weight per day = 1039.244296 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios:
Residential with plant uptake, Residential without plant uptake, Commercial/industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{in}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/industrial	4.34795E-02

Insert the appropriate $TAAI_{in}$ here: 2.78E-01 m³ air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF=K_{oc} \times f_{oc}/H'$

SF= 0.540543912 l air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC= 1.358238761 kg soil per l air

34 The soil equivalent intakes for inhalation of indoor air is calculated using the formula: $SEI_{in} = (TAAI_{in} \times 1000 \times SVPC)/DR$

SEI_{in}= 1.89053E-02 kg soil/(kg body weight per day)

35 The nominal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{in} = RI_{in}/SEI_{in}$

ASC_{in} = 1.05200E+00 mg per kg body weight per day / 1.89053E-02 kg soil per kg body weight per day = 55.64590863 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^{6})/(760mmHg \times R \times Temp)$

C_{sat}= 2.70054E+08 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{in} \times SVPC$

C_{sv}= 7.55805E+01 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat}= 2.79871E-07 (mg per l air) per (mm Hg.g per mol)

If the ratio is greated than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (ISSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-3}

soil ingestion pathway	$1/ASC_{ding}$ =	1/ 101490.0249	=	9.85319E-06	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$ =	1/ 5986.426908	=	1.67044E-04	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$ =	1/ 887131.6833	=	1.12723E-06	kg soil per mg
inhalation of outdoor air	$1/ASC_{outh}$ =	1/ 1039.244296	=	9.62238E-04	kg soil per mg
inhalation of indoor air	$1/ASC_{inh}$ =	1/ 55.64590863	=	1.79706E-02	kg soil per mg

The integrated Site Specific Assessment Criterion (ISSAC)

38	For the residential with plant uptake land use the $SSAC_{rsp}$ =		mg per kg soil
40	For the allotments land use the $SSAC_{all}$ =		mg per kg soil
41	For the residential without plant uptake land use the $SSAC_{other}$ =	52.79032785	mg per kg soil
	For the commercial/industrial land use the $SSAC_{other}$=		mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for Aliphatic EC6-EC in the Residential without plant uptake scenario is 52.79033 mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-3}

soil ingestion pathway	$1/ASC_{ding}$ =	1/	=		kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$ =	1/	=		kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$ =	1/	=		kg soil per mg

The integrated Site Specific Assessment Criterion

43	For the residential with plant uptake land use the $SSAC_{rsp}$ =		mg per kg soil
	For the allotments land use the $SSAC_{all}$ =		mg per kg soil
	For the residential without plant uptake land use the $SSAC_{other}$ =		mg per kg soil
	For the commercial/industrial land use the $SSAC_{other}$=		mg per kg soil

The Level 1 Site Specific Assessment Criterion for Aliphatic EC6-EC in the scenario is mg per kg soil

Risk Evaluation

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site. Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. Critical Receptor	Y
iv. Pathways included/omitted (*including bioaccessibility if used*)	Y
v. Soil Parameters, e.g. pH	Y

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SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by Paul Brew on 08/07/2006

and has been checked by Christopher Bolan on 08/07/2006

3 It relates to Aliphatic EC8-EC10 found at Residential Without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Y or N) N

5a Insert the relevant health criterion for ingestion 1.00E-01 mg per kg body weight per day
For a non threshold substance the relevant health criterion is the Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

[ ] mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unkown? (Y or N)

[Y]

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

[0.485]

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

[11.15] kg body weight

Reference Intake for Ingestion

10a For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated using the formula: RI_{ingest}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=0.2TDI

[0.02] mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N)

[N]

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (indicative) Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

[2.90E-01] mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero) — mg per day

Is the MDI equal to or greater than 60% of the TDI or is the MDI unknown? (Y or N) — Y

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.362
16-59	1

0.362

Receptor Body Weight

9b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: RI_{inhal}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: RI_{inhal}=0.2TDI

0.058 mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

[Y]

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{derg} from this table, depending on your choice of land use

Land Use	SEI_{derg} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{derg} = 9.85E-06

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

[ ]

If Y insert the representative fraction here (default=1)

[ ]

The amended SEI_{derg} = SEI_{derg} * bioaccessibility fraction

9.85319E-06 kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: ASC_{derg} = RI_{ingest}/SEI_{derg}

ASC_{derg} = 2.00000E-02 mg per kg body weight per day / 9.85319E-06 kg soil per kg body weight per day = 2029.800499 mg per kg soil

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25.
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Y or N) N

Measured Concentration Factor for leafy vegetables ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 18 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) 63095.73445 water per l octanol

a representative value of ϕ (soil density) 1.6 g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient): 3.20E+04 cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil): 5.98802E-03 kg OC per kg soil

a representative value of θ (soil-water content by volume) 0.15 cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{-0.434*(logKow-1.78)^2/2.44}+(10^{0.95logKow-2.05}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))$

CF_{leafy}= 0.031661886 ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root}=(10^{0.77logKow-1.52}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))*0.01$

CF_{root}= 0.007865426 ug per g fresh weight plant per ug per g dry weight soil

* Note - If the soil correction factor $(\phi/(\theta+\phi K_{oc}f_{oc}))$ is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight conversion factor when using measured CF values.
Is a dry weight conversion required? (Y or N) N

Calculation of SEI_{veg}

The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/day)	TAVCR *CF DW	TAVCR *CF
Brussel sprouts	5.84750E-03	calc not required	1.00801E-04
Cabbage	4.86885E-03	calc not required	9.64663E-05
Carrot	7.38094E-03	calc not required	2.36781E-05
Leafy salads	3.25677E-03	calc not required	1.80487E-05
Onion	3.69474E-03	calc not required	1.69136E-05
Potato	4.41616E-02	calc not required	1.30311E-04

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	3.46474E-05
Allotments	3.46474E-05

SEI_{veg}= 3.46E-05 kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{organic}/SEI_{veg}$

ASC_{veg} = 2.00000E-02 mg per kg body weight per day / 3.46474E-05 kg soil per kg body weight per day = 577.2441854 mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to paragraph 25.

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$ = 1.1272E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N) N

Insert the representative fraction here (default=1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect} = RI_{typical}/SEI_{indirect}$

$ASC_{indirect}$ = 2.00000E-02 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 17742.63367 mg per kg soil

Intake via Inhalation of Outdoor Air

25 This pathway only applies to substances with H' greater than or equal to 10^{-3}.
To use the formulae for inhalation of outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W =	15 metres
Depth to subsurface contamination	d_s =	1 metres

Soil Matrix

Soil organic matter content	SOM =	1	%	
Mass fraction of organic carbon in soil	f_{oc} =	1	/167	5.98802E-03 kg OC per kg soil
Air filled porosity	θ_{air} =	0.31	unitless	
Water filled porosity	θ_{wat} =	0.15	unitless	
Total porosity	θ_{total} =	0.46	unitless	
Bulk soil density	ρ_b =	1.8	kg soil per l soil	

Contaminant

Organic carbon/water partition coefficient	K_{oc} =	32000	l water per kg OC
Dimensionless Henry's constant	H' =	82	l water per l air
Diffusion coefficient in water	D_{wat} =	1.00E-09	m^2 per s
Diffusion coefficient in soil air	D_i =	1.00E-05	m^2 per s
Air in soil		9.52847E-02	unitless
Water in soil		8.47485E-03	unitless
Air term		9.52847E-07	m^2 per s
Water term		1.03349E-13	m^2 per s per (l water per l air)
Effective diffusion coefficient	D_{eff} =	9.52847E-07	m^2 per s
Molecular weight	MW =	130	g per mol
Saturated vapour pressure	SatVP =	4.8	mmHg

Pathway parameters

Dilution ratio	DR =	20000	unitless	
Temperature	Temp =	12	°C + 273 =	285 K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air} =	3	m per s	

Receptor characteristics

Time-averaged body height — TAH= 0.93 m

Height of mixing zone — lv= 0.93 /2 = 0.465 m

26 Contaminant Volatilisation Factor (CVF)

CVF= 4.04694E-06 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	TAAIoutv m³ air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residential without plant uptake	7.27421E-02
Allotments	1.55763E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate $TAAI_{out}$ here: 7.27E-02 m³ air per (kg body weight per day)

28 Soil equivalent intake

Calculate the soil equivalent intake for inhalation of outdoor air using the formula: $SEI_{out} = TAAI_{out} \times CVF \times 1000$

2.94383E-04 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air using the formula: $ASC_{out} = RI_{out}/SEI_{out}$

ASC_{out} = 5.80000E-02 mg per kg body weight per day / 2.94383E-04 kg soil per kg body weight per day = 197.0224539 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios: Residential with plant uptake, Residential without plant uptake, Commercial/Industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{inv}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/Industrial	4.34795E-02

Insert the appropriate $TAAI_{inv}$ here: 2.78E-01 m³ air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF=K_{oc} \times f_{oc}/H'$

SF= 2.336789835 l air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC= 0.39499414 kg soil per l air

34 The soil equivalent intakes for *inhalation of* indoor air is calculated using the formula: $SEI_{inv} = (TAAI_{inv} \times 1000 \times SVPC)/DR$

SEI_{inv}= 5.49790E-03 kg soil/(kg body weight per day)

35 The nominal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{inv} = RI_{inv}/SEI_{inv}$

ASC_{inv} = 5.80000E-02 mg per kg body weight per day / 5.49790E-03 kg soil per kg body weight per day = 10.54948549 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^6)/(760mmHg \times R \times Temp)$

C_{sat}= 3.51071E+07 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{inv} \times SVPC$

C_{sv}= 4.16698E+00 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat}= 1.18694E-07 (mg per l air) per (mm Hg.g per mol)

If the ratio is greated than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (SSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-3}

soil ingestion pathway	$1/ASC_{ing}$=	1/ 2029.800499	=	4.92659E-04	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/ 577.2441854	=	1.73237E-03	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/ 17742.63367	=	5.63614E-05	kg soil per mg
inhalation of outdoor air	$1/ASC_{out}$=	1/ 197.0224539	=	5.07556E-03	kg soil per mg
inhalation of indoor air	$1/ASC_{in}$=	1/ 10.54948549	=	9.47914E-02	kg soil per mg

The integrated Site Specific Assessment Criterion (SSAC)

39 For the residential with plant uptake land use the $SSAC_{res}$ = mg per kg soil

40 For the allotments land use the $SSAC_{all}$ = mg per kg soil

41 For the residential without plant uptake land use the $SSAC_{other}$ = 9.964171275 mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$= mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for Aliphatic EC8-EC in the Residential without plant uptake scenario is 9.964171 mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-3}

soil ingestion pathway	$1/ASC_{ing}$=	1/	=		kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/	=		kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/	=		kg soil per mg

The integrated Site Specific Assessment Criterion

43 For the residential with plant uptake land use the $SSAC_{res}$ = mg per kg soil

For the allotments land use the $SSAC_{all}$ = mg per kg soil

For the residential without plant uptake land use the $SSAC_{other}$ = mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$= mg per kg soil

The Level 1 Site Specific Assessment Criterion for Aliphatic EC8-EC1 in the scenario is mg per kg soil

Risk Evaluation

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site. Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. Critical Receptor	Y
iv. Pathways included/omitted (including bioaccessibility if used)	Y
v. Soil Parameters, e.g. pH	Y

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SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by Paul Brew on 08/07/2006

and has been checked by Christopher Bolan on 08/07/2006

3 It relates to Aliphatic EC10-EC12 found at Residential Without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Y or N) N

5a Insert the relevant health criterion for ingestion
For a non threshold substance the relevant health criterion is the Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI). 1.00E-01 mg per kg body weight per day

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

0 mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unkown? (Y or N)

Y

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

0.485

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Ingestion

10a For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated using the formula: RI_{ingest}=ID

mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=0.2TDI

0.02 mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N)

N

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (indicative) Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

2.90E-01 mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unknown? (Y or N)

Y

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF)
which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.362
16-59	1

0.362

Receptor Body Weight

9b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: RI_{inhal}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{Ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: RI_{inhal}=0.2TDI

0.058 mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

[ ]

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{drvg} from this table, depending on your choice of land use

Land Use	SEI_{drvg} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{drvg} = 9.85E-06

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

[ ]

If Y insert the representative fraction here (default=1)

[ ]

The amended SEI_{drvg} = SEI_{drvg} * bioaccessibility fraction

9.85319E-06 kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: ASC_{drvg} = RI_{Ingest}/SEI_{drvg}

ASC_{drvg} = 2.00000E-02 (mg per kg body weight per day) / 9.85319E-06 (kg soil per kg body weight per day) = 2029.800499 mg per kg soil

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25 .
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Y or N) N

Measured Concentration Factor for leafy vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 16 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) 388107.1706 l water per l octanol

a representative value of ϕ (soil density) 1.6 g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient): 2.50E+05 cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil): 5.98802E-03 kg OC per kg soil

a representative value of θ (soil-water content by volume) 0.15 cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{-0.434*(logKow-1.78)^2/2.44} + (10^{0.95logKow-2.05}+0.82)*(\phi/(\theta+\phi K_{oc} f_{oc}))$

CF_{leafy}= 0.002475843 * ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root} = (10^{0.77logKow-1.52}+0.82)*(\phi/(\theta+\phi K_{oc} f_{oc}))*0.01$

CF_{root}= 0.004143085 * ug per g fresh weight plant per ug per g dry weight soil

* Note - If the soil correction factor $(\phi/(\theta+\phi K_{oc} f_{oc}))$ is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight conversion factor when using measured CF values.
Is a dry weight conversion required? (Y or N) N

Calculation of SEI_{veg}
The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/day)	TAVCR*IF*CF*DW	TAVCR*IF*CF
Brussel sprouts	5.04750E-03	calc not required	7.88014E-06
Cabbage	4.86885E-03	calc not required	7.54335E-06
Carrot	7.38084E-03	calc not required	1.24723E-05
Leafy salads	3.25677E-03	calc not required	1.41135E-06
Onion	3.89474E-03	calc not required	8.90918E-06
Potato	4.41616E-02	calc not required	6.86407E-05

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	9.58449E-06
Allotments	9.58449E-06

SEI_{veg}= 9.58E-06 kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{Target}/SEI_{veg}$

ASC_{veg} = 2.80000E-02 mg per kg body weight per day / 9.58449E-06 kg soil per kg body weight per day = 2986.705472 mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to paragraph 25.

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$ = 1.1272E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N) N

Insert the representative fraction here (default=1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect} = RI_{oral}/SEI_{indirect}$

$ASC_{indirect}$ = 2.00000E-02 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 17742.83367 mg per kg soil

Intake via Inhalation of Outdoor Air

25 This pathway only applies to substances with H' greater than or equal to 10^{-3}.
To use the formulae for inhalation of outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W=	15 metres
Depth to subsurface contamination	d_s=	1 metres

Soil Matrix

Soil organic matter content	SOM=	1	%
Mass fraction of organic carbon in soil	f_{oc}=	1 /167	5.98802E-03 kg OC per kg soil
Air filled porosity	θ_{as}=	0.31	unitless
Water filled porosity	θ_{ws}=	0.15	unitless
Total porosity	θ_{Tot}=	0.46	unitless
Bulk soil density	ρ_b=	1.5	kg soil per l soil

Contaminant

Organic carbon/water partition coefficient	K_{oc}=	250000 l water per kg OC
Dimensionless Henry's constant	H'=	130 l water per l air
Diffusion coefficient in water	D_{wat}=	1.00E-09 m² per s
Diffusion coefficient in soil air	D_s=	1.00E-05 m² per s
Air in soil		8.52847E-02 unitless
Water in soil		8.47465E-03 unitless
Air term		9.52847E-07 m² per s
Water term		6.51896E-14 m² per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	9.52847E-07 m² per s
Molecular weight	MW=	180 g per mol
Saturated vapour pressure	SatVP=	0.49 mm Hg

Pathway parameters

Dilution ratio	DR=	20000	unitless
Temperature	Temp=	12 °C + 273 =	285 K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air}=	3 m per s	

Receptor characteristics

Time-averaged body height TAH= 0.93 m

Height of mixing zone h= 0.93 /2 = 0.465 m

26 Contaminant Volatilisation Factor (CVF)

CVF= 8.74843E-07 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	TAAIoutv m^3 air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residental without plant uptake	7.27421E-02
Allotments	1.55763E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate $TAAI_{outv}$ here 7.27E-02 m^3 air per (kg body weight per day)

28 Soil equivalent intake

Calculate the soil equivalent intake for inhalation of outdoor air using the formula: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

6.36456E-05 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air using the formula: $ASC_{outv} = RI_{outv}/SEI_{outv}$

ASC_{outv} = 5.80000E-02 mg per kg body weight per day / 6.36456E-05 kg soil per kg body weight per day = 911.2963563 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios:
Residential with plant uptake, Residential without plant uptake, Commercial/industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{iv}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/industrial	4.34795E-02

Insert the appropriate $TAAI_{iv}$ here: 2.78E-01 m³ air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF = K_{oc} \times f_{oc} / H'$

SF= 11.51543068 g air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC= 0.085387812 kg soil per l air

34 The soil equivalent intakes for inhalation of indoor air is calculated using the formula: $SEI_{iv} = (TAAI_{iv} \times 1000 \times SVPC)/DR$

SEI_{iv}= 1.18865E-03 kg soil/(kg body weight per day)

35 The nominal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{iv} = RI_{iv}/SEI_{iv}$

ASC_{iv} = 5.80000E-02 mg per kg body weight per day / 1.18865E-03 kg soil per kg body weight per day = 48.7948847 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^3)/(760 mmHg \times R \times Temp)$

C_{sat}= 4.41089E+06 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{iv} \times SVPC$

C_{sv}= 4.16698E+00 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat}= 9.44704E-07 (mg per l air) per (mm Hg.g per mol)

If the ratio is greated than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (SSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-3}

soil ingestion pathway	$1/ASC_{ing}$=	1/	2029.800499	=	4.92659E-04 kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/	2086.705472	=	4.79224E-04 kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/	17742.63367	=	5.63614E-05 kg soil per mg
inhalation of outdoor air	$1/ASC_{outh}$=	1/	911.2963863	=	1.09734E-03 kg soil per mg
inhalation of indoor air	$1/ASC_{inh}$=	1/	48.7949847	=	2.04939E-02 kg soil per mg

The integrated Site Specific Assessment Criterion (SSAC)

38 For the residential with plant uptake land use the $SSAC_{rwp}$ = mg per kg soil

40 For the allotments land use the $SSAC_{all}$ = mg per kg soil

41 For the residential without plant uptake land use the $SSAC_{other}$ = 45.28184344 mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$= mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for phatic EC10-EC in the Residential without plant uptake scenario is 45.28184 mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-3}

soil ingestion pathway	$1/ASC_{ing}$=	1/		=	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/		=	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/		=	kg soil per mg

The integrated Site Specific Assessment Criterion

43 For the residential with plant uptake land use the $SSAC_{rwp}$ = mg per kg soil

For the allotments land use the $SSAC_{all}$ = mg per kg soil

For the residential without plant uptake land use the $SSAC_{other}$ = mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$= mg per kg soil

The Level 1 Site Specific Assessment Criterion for liphatic EC10-EC in the scenario is mg per kg soil

Risk Evaluation

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site. Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. Critical Receptor	Y
iv. Pathways included/omitted (including bioaccessibility if used)	Y
v. Soil Parameters, e.g. pH	Y

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SNIFFER

Version 1.02

SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by Paul Brew on 08/07/2006

and has been checked by Christopher Bolan on 08/07/2006

3 It relates to Aliphatic EC12-EC16 found at Residential Without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Yor N) N

5a Insert the relevant health criterion for ingestion 1.00E-01 mg per kg body weight per day
For a non threshold substance the relevant health criterion is the Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

[ ] mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unkown? (Y or N)

[Y]

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

[0.485]

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

[11.15] kg body weight

Reference Intake for Ingestion

10a For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated using the formula: RI_{ingest}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=0.2TDI

[0.02] mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N)

[N]

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (indicative) Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

[2.90E-01] mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

mg per day

Is the MDI equal to or greater than 60% of the TDI or is the MDI unknown? (Y or N)

Y

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF)
which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.362
16-59	1

0.362

Receptor Body Weight

9b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: RI_{inhal}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: RI_{inhal}=0.2TDI

0.058 mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

[Y]

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{dirq} from this table, depending on your choice of land use

Land Use	SEI_{dirq} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{dirq} = 9.85E-06

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

[ ]

If Y insert the representative fraction here (default=1)

[ ]

The amended SEI_{dirq} = SEI_{dirq} * bioaccessibility fraction

9.85319E-06 kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: ASC_{dirq} = RI_{ingest}/SEI_{dirq}

ASC_{dirq} = 2.00000E-02 mg per kg body weight per day / 9.85319E-06 kg soil per kg body weight per day = 2029.800499 mg per kg soil

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Y or N) **N**

Measured Concentration Factor for leafy vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 16 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) **6309573.445** l water per l octanol

a representative value of ϕ (soil density) **1.6** g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient): **5.00E+06** cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil): **5.98802E-03** kg OC per kg soil

a representative value of θ (soil-water content by volume) **0.15** cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{-0.434*(logKow-1.78)^2/2.44})*(10^{0.95logKow-2.05}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))$

CF_{leafy}= **2.21671E-06** ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root}=(10^{0.77logKow-1.52}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))*0.01$

CF_{root}= **0.001737055** * ug per g fresh weight plant per ug per g dry weight soil

* Note - If the soil correction factor $(\phi/(\theta+\phi K_{oc}f_{oc}))$ is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight conversion factor when using measured CF values.
Is a dry weight conversion required? (Y or N) **N**

Calculation of SEI_{veg}
The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/day)	TAVCR/ CF Unit	TAVCR/ CF
Brussel sprouts	5.04750E-03	calc not required	7.06432E-08
Cabbage	4.86885E-03	calc not required	6.75383E-08
Carrot	7.38094E-03	calc not required	5.22923E-06
Leafy salads	3.25677E-03	calc not required	1.26363E-08
Onion	3.69474E-03	calc not required	3.73532E-06
Potato	4.41616E-02	calc not required	2.87787E-05

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	3.39857E-06
Allotments	3.39857E-06

SEI_{veg}= **3.40E-06** kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{organic}/SEI_{veg}$

ASC_{veg} = **2.00000E-02** mg per kg body weight per day / **3.39857E-06** kg soil per kg body weight per day = **5884.825504** mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to paragraph 25.

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$ = 1.1272E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N) N

Insert the representative fraction here (default=1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect} = RI_{input}/SEI_{indirect}$

$ASC_{indirect}$ = 2.00000E-02 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 17742.63367 mg per kg soil

Intake via Inhalation of Outdoor Air

25 This pathway only applies to substances with H' greater than or equal to 10^{-3}.
To use the formulae for inhalation of outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W=	15 metres
Depth to subsurface contamination	d_s=	1 metres

Soil Matrix

Soil organic matter content	SOM=	1	%	
Mass fraction of organic carbon in soil	f_{oc}=	1	/167	5.98802E-03 kg OC per kg soil
Air filled porosity	θ_{air}=	0.31	unitless	
Water filled porosity	θ_{wat}=	0.15	unitless	
Total porosity	θ_{total}=	0.46	unitless	
Bulk soil density	ρ_b=	1.5	kg soil per l soil	

Contaminant

Organic carbon/water partition coefficient	K_{oc}=	5000000	l water per kg OC
Dimensionless Henry's constant	H'=	540	l water per l air
Diffusion coefficient in water	D_{wat}=	1.00E-09	m^2 per s
Diffusion coefficient in soil air	D_s=	1.00E-05	m^2 per s
Air in soil		9.52847E-02	unitless
Water in soil		8.47465E-03	unitless
Air term		9.52847E-07	m^2 per s
Water term		1.56938E-14	m^2 per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	9.52847E-07	m^2 per s
Molecular weight	MW=	200	g per mol
Saturated vapour pressure	SatVP=	3.60E-02	mmHg

Pathway parameters

Dilution ratio	DR=	20000	unitless	
Temperature	Temp=	12	°C + 273 =	285 K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air}=	3	m per s	

Receptor characteristics

Time-averaged body height TAH= 0.93 m

Height of mixing zone h= 0.93 /2 = 0.465 m

26 Contaminant Volatilisation Factor (CVF)

CVF= 1.84146E-07 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	TAAIoutv m^3 air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residental without plant uptake	7.27421E-02
Allotments	1.55763E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate $TAAI_{outv}$ here 7.27E-02 m^3 air per (kg body weight per day)

28 Soil equivalent Intake

Calculate the soil equivalent intake for inhalation of outdoor air
using the formula: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

1.33951E-05 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air
using the formula: $ASC_{outv} = RI_{outv}/SEI_{outv}$

ASC_{outv} = 5.80000E-02 mg per kg body weight per day / 1.33951E-05 kg soil per kg body weight per day = 4329.946503 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios:
Residential with plant uptake, Residential without plant uptake, Commercial/industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{av}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/industrial	4.34795E-02

Insert the appropriate $TAAI_{av}$ here: 2.78E-01 m³ air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF=K_{oc} \times f_{oc}/H'$

SF= 55.44486822 l air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC= 0.017973137 kg soil per l air

34 The soil equivalent intakes for inhalation of indoor air is calculated using the formula: $SEI_{av} = (TAAI_{av} \times 1000 \times SVPC)/DR$

SEI_{av}= 2.50167E-04 kg soil/(kg body weight per day)

35 The norminal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{av} = RI_{av}/SEI_{av}$

ASC_{av} = 5.80000E-02 mg per kg body weight per day / 2.50167E-04 kg soil per kg body weight per day = 231.8451665 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^6)/(760mmHg \times R \times Temp)$

C_{sat}= 4.05082E+05 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{av} \times SVPC$

C_{sv}= 4.16698E+00 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat}= 1.02868E-05 (mg per l air) per (mm Hg.g per mol)

If the ratio is greated than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (SSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-3}

soil ingestion pathway	$1/ASC_{ding}$=	1/	2029.800499	=	4.92659E-04 kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/	5984.825504	=	1.67029E-04 kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/	17742.63367	=	5.63614E-05 kg soil per mg
inhalation of outdoor air	$1/ASC_{outh}$=	1/	4329.946503	=	2.30950E-04 kg soil per mg
inhalation of indoor air	$1/ASC_{inh}$=	1/	231.8451665	=	4.31322E-03 kg soil per mg

The integrated Site Specific Assessment Criterion (SSAC)

38 For the residential with plant uptake land use the $SSAC_{rep}$ = mg per kg soil

40 For the allotments land use the $SSAC_{all}$ = mg per kg soil

41 For the residential without plant uptake land use the $SSAC_{other}$ = 198.5374776 mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$= mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for phatic EC12-EC in the Residential without plant uptake scenario is 198.5375 mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-3}

soil ingestion pathway	$1/ASC_{ding}$=	1/		=	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/		=	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/		=	kg soil per mg

The integrated Site Specific Assessment Criterion

43 For the residential with plant uptake land use the $SSAC_{rep}$ = mg per kg soil

For the allotments land use the $SSAC_{all}$ = mg per kg soil

For the residential without plant uptake land use the $SSAC_{other}$ = mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$= mg per kg soil

The Level 1 Site Specific Assessment Criterion for liphatic EC12-EC in the scenario is mg per kg soil

Risk Evaluation

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site. Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. Critical Receptor	Y
iv. Pathways included/omitted (including bioaccessibility if used)	Y
v. Soil Parameters, e.g. pH	Y

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SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by Paul Brew on 06/07/2006

and has been checked by Christopher Bolan on 06/07/2006

3 It relates to Aliphatic EC16-EC35 found at Residential Without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Yor N) N

5a Insert the relevant health criterion for ingestion
For a non threshold substance the relevant health criterion is the Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI). 2.00E+00 mg per kg body weight per day

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

[ ] mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unkown? (Y or N)

[Y]

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

[0.485]

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

[11.15] kg body weight

Reference Intake for Ingestion

10a For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated using the formula: RI_{Ingest}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{Ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{Ingest}=0.2TDI

[0.4] mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N)

[N]

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (indicative) Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

[0.00E+00] mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(if the contaminant is a non threshold substance insert zero)

mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unknown? (Y or N)

Y

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.362
16-59	1

0.362

Receptor Body Weight

9b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: RI_{inhal}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: RI_{inhal}=0.2TDI

0 mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

N

Inhalation pathway should not be selected if H' < 1E-3

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{derg} from this table, depending on your choice of land use

Land Use	SEI_{derg} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{derg} = 9.85E-06

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

N

If Y insert the representative fraction here (default=1)

The amended SEI_{derg} = SEI_{derg} * bioaccessibility fraction

9.85319E-06 kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: ASC_{derg} = RI_{ingest}/SEI_{derg}

ASC_{derg} = 4.00000E-01 mg per kg body weight per day / 9.85319E-06 kg soil per kg body weight per day = 40596.00998 mg per kg soil

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Y or N) N

Measured Concentration Factor for leafy vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 18 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) 784328234.7 l water per l octanol

a representative value of ϕ (soil density) 1.6 g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient): 1.00E+09 cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil): 5.98802E-03 kg OC per kg soil

a representative value of θ (soil-water content by volume) 0.15 cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{-0.434*(logKow-1.78)^2/2.44}+(10^{0.95logKow-2.05}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))$

CF_{leafy}= 3.19947E-10 * ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root}=(10^{0.77logKow-1.52}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))*0.01$

CF_{root}= 0.000359516 * ug per g fresh weight plant per ug per g dry weight soil

* Note - If the soil correction factor $(\phi/(\theta+\phi K_{oc}f_{oc}))$ is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight conversion factor when using measured CF values.
Is a dry weight conversion required? (Y or N) N

Calculation of SEI_{veg}
The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/day)	TAVCR*IR*CF*DW	TAVCR*IR*CF
Brussel sprouts	5.84750E-03	calc not required	1.01962E-12
Cabbage	4.86885E-03	calc not required	9.74808E-13
Carrot	7.38084E-03	calc not required	1.08229E-06
Leafy salads	3.25677E-03	calc not required	1.82385E-13
Onion	3.69474E-03	calc not required	7.73093E-07
Potato	4.41616E-02	calc not required	5.95629E-06

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	7.00598E-07
Allotments	7.00598E-07

SEI_{veg}= 7.01E-07 kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{ingest}/SEI_{veg}$

ASC_{veg} = 4.00000E-01 mg per kg body weight per day / 7.00598E-07 kg soil per kg body weight per day = 570940.5202 mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to paragraph 25.

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$ = 1.1272E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N) N

Insert the representative fraction here (default=1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect} = RI_{Organ}/SEI_{indirect}$

$ASC_{indirect}$ = 4.00000E-01 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 354852.8733 mg per kg soil

Intake via Inhalation of Outdoor Air

25 This pathway only applies to substances with H' greater than or equal to 10^{-3}.
To use the formulae for inhalation of outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W=	15 metres
Depth to subsurface contamination	d_s=	1 metres

Soil Matrix

Soil organic matter content	SOM=	1 %	
Mass fraction of organic carbon in soil	f_{oc}=	1 /167	5.988023E-03 kg OC per kg soil
Air filled porosity	θ_{as}=	0.31 unitless	
Water filled porosity	θ_{ws}=	0.15 unitless	
Total porosity	θ_{Tot}=	0.46 unitless	
Bulk soil density	ρ_b=	1.6 kg soil per l soil	

Contaminant

Organic carbon/water partition coefficient	K_{oc}=	1000000000 l water per kg OC
Dimensionless Henry's constant	H'=	6.40E+03 l water per l air
Diffusion coefficient in water	D_{wat}=	1.00E-09 m² per s
Diffusion coefficient in soil air	D_s=	1.00E-05 m² per s
Air in soil		8.52847E-02 unitless
Water in soil		8.47485E-03 unitless
Air term		9.52847E-07 m² per s
Water term		1.32416E-15 m² per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	9.52847E-07 m² per s
Molecular weight	MW=	270 g per mol
Saturated vapour pressure	SatVP=	5.80E-03 mmHg

Pathway parameters

Dilution ratio	DR=	20000 unitless	
Temperature	Temp=	12 °C + 273 =	285 K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air}=	3 m per s	

Receptor characteristics

Time-averaged body height TAH= 0.93 m

Height of mixing zone h= 0.93 /2 = 0.465 m

26 Contaminant Volatilisation Factor (CVF)

CVF= 1.09482E-08 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	TAAIoutv m^3 air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residental without plant uptake	7.27421E-02
Allotments	1.55763E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate $TAAI_{out}$ here 7.27E-02 m^3 air per (kg body weight per day)

28 Soil equivalent intake

Calculate the soil equivalent intake for inhalation of outdoor air using the formula: SEI_{out} = $TAAI_{out}$ x CVF x 1000

7.96394E-07 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air using the formula: ASC_{out} = RI_{out}/SEI_{out}

ASC_{out} = 0.00000E+00 mg per kg body weight per day / 7.96394E-07 kg soil per kg body weight per day = 0 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios: Residential with plant uptake, Residential without plant uptake, Commercial/Industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{inv}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/Industrial	4.34795E-02

Insert the appropriate $TAAI_{inv}$ here: 2.78E-01 m³ air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF=K_{oc} \times f_{oc}/H'$

SF= 935.6287425 l air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC= 0.001068579 kg soil per l air

34 The soil equivalent intakes for inhalation of indoor air is calculated using the formula: $SEI_{inv} = (TAAI_{inv} \times 1000 \times SVPC)/DR$

SEI_{inv}= 1.48735E-05 kg soil/(kg body weight per day)

35 The nominal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{inv} = RI_{inv}/SEI_{inv}$

ASC_{inv} = 0.00000E+00 mg per kg body weight per day / 1.48735E-05 kg soil per kg body weight per day = 0 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^6)/(760mmHg \times R \times Temp)$

C_{sat}= 8.81053E+04 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{inv} \times SVPC$

C_{sv}= 0.00000E+00 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat}= 0 (mg per l air) per (mm Hg.g per mol)

If the ratio is greated than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (SSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-3}

soil ingestion pathway	$1/ASC_{ding}$ =	1/		=	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$ =	1/		=	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$ =	1/		=	kg soil per mg
inhalation of outdoor air	$1/ASC_{oah}$ =	1/		=	kg soil per mg
inhalation of indoor air	$1/ASC_{ihi}$ =	1/		=	kg soil per mg

The integrated Site Specific Assessment Criterion (SSAC)

39	For the residential with plant uptake land use the $SSAC_{rep}$ =	mg per kg soil
40	For the allotments land use the $SSAC_{all}$ =	mg per kg soil
41	For the residential without plant uptake land use the $SSAC_{other}$ =	mg per kg soil
	For the commercial/industrial land use the $SSAC_{other}$ =	mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for phatic EC16-EC in the scenario is mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-3}

soil ingestion pathway	$1/ASC_{ding}$ =	1/	40596.00998	=	2.4633E-05 kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$ =	1/	570940.5202	=	1.7515E-06 kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$ =	1/	354852.6733	=	2.81807E-06 kg soil per mg

The integrated Site Specific Assessment Criterion

43	For the residential with plant uptake land use the $SSAC_{rep}$ =	mg per kg soil
	For the allotments land use the $SSAC_{all}$ =	mg per kg soil
	For the residential without plant uptake land use the $SSAC_{other}$ =	40596.00998 mg per kg soil
	For the commercial/industrial land use the $SSAC_{other}$ =	mg per kg soil

The Level 1 Site Specific Assessment Criterion for liphatic EC16-EC in the *Residential without plant uptake* scenario is 40596.01 mg per kg soil

Risk Evaluation

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site. Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. Critical Receptor	Y
iv. Pathways included/omitted (including bioaccessibility if used)	Y
v. Soil Parameters, e.g. pH	Y

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SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by Paul Brew on 08/07/2006

and has been checked by Christopher Bolan on 08/07/2006

3 It relates to Aromatic EC5-EC7 found at Residential Without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Y or N) Y

5a Insert the relevant health criterion for ingestion
For a non threshold substance the relevant health criterion is the Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI). 2.90E-04 mg per kg body weight per day

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

0.00E+00 mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unkown? (Y or N)

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

0.485

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Ingestion

10a For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated using the formula: RI_{ingest}=ID

0.00029 mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=0.2TDI

mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N)

Y

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (indicative) Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

9.10E-04 mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero) 0.00E+00 mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unknown? (Y or N)

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF)
which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.362
16-59	1

0.362

Receptor Body Weight

9b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: RI_{inhal}=ID

0.00091 mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

mg per kg body weight per day

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: RI_{inhal}=0.2TDI

mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

Y

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{dirq} from this table, depending on your choice of land use

Land Use	SEI_{dirq} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{dirq} = 9.85E-06

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

N

If Y insert the representative fraction here (default=1)

The amended SEI_{dirq} = SEI_{dirq} * bioaccessibility fraction

9.85319E-06 kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: ASC_{dirq} = RI_{ingest}/SEI_{dirq}

ASC_{dirq} = 2.90000E-04 mg per kg body weight per day / 9.85319E-06 kg soil per kg body weight per day = 29.43210723 mg per kg soil

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25.
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Y or N) **N**

Measured Concentration Factor for leafy vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 18 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) **125.8925412** l water per l octanol

a representative value of ϕ (soil density) **1.6** g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient): **50** cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil): **5.98802E-03** kg OC per kg soil

a representative value of θ (soil-water content by volume) **0.15** cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{-0.434*(logKow-1.78)^2/2.44}+(10^{0.95logKow-2.05}+0.82)*(\phi/((\theta+\phi K_{oc}f_{oc}))$

CF_{leafy}= **1.278848457** ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root}=(10^{0.77logKow-1.52}+0.82)*(\phi/((\theta+\phi K_{oc}f_{oc}))*0.01$

CF_{root}= **0.02070259** ug per g fresh weight plant per ug per g dry weight soil

* Note - If the soil correction factor $(\phi/((\theta+\phi K_{oc}f_{oc}))$ is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight conversion factor when using measured CF values.
Is a dry weight conversion required? (Y or N) **N**

Calculation of SEI_{veg}
The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/kg/day)	TAVCR*RF*CF*DW	TAVCR*RF*CF
Brussel sprouts	5.04750E-03	calc not required	4.07550E-03
Cabbage	4.86885E-03	calc not required	3.89637E-03
Carrot	7.38084E-03	calc not required	6.23231E-05
Leafy salads	3.25677E-03	calc not required	7.29004E-04
Onion	3.69474E-03	calc not required	4.45183E-05
Potato	4.41616E-02	calc not required	3.42991E-04

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	8.20691E-04
Allotments	8.20691E-04

SEI_{veg}= **8.21E-04** kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{organic}/SEI_{veg}$

ASC_{veg} = **2.90000E-04** mg per kg body weight per day / **8.20691E-04** kg soil per kg body weight per day = **0.353360747** mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to paragraph 25.

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$ = 1.1272E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N) N

Insert the representative fraction here (default=1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect} = RI_{vegan}/SEI_{indirect}$

$ASC_{indirect}$ = 2.90000E-04 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 257.2681881 mg per kg soil

Intake via Inhalation of Outdoor Air

25 This pathway only applies to substances with H' greater than or equal to 10^{-3}.
To use the formulae for inhalation of outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W=	15 metres
Depth to subsurface contamination	d_s=	1 metres

Soil Matrix

Soil organic matter content	SOM=	1	%	
Mass fraction of organic carbon in soil	f_{oc}=	1	/167	5.98802E-03 kg OC per kg soil
Air filled porosity	θ_{air}=	0.31	unitless	
Water filled porosity	θ_{wat}=	0.15	unitless	
Total porosity	θ_{total}=	0.46	unitless	
Bulk soil density	ρ_b=	1.6	kg soil per l soil	

Contaminant

Organic carbon/water partition coefficient	K_{oc}=	59 l water per kg OC
Dimensionless Henry's constant	H'=	0.228 l water per l air
Diffusion coefficient in water	D_{wat}=	9.80E-10 m² per s
Diffusion coefficient in soil air	D_s=	8.80E-06 m² per s
Air in soil		8.52847E-02 unitless
Water in soil		8.47485E-03 unitless
Air term		8.38506E-07 m² per s
Water term		3.64261E-11 m² per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	8.38542E-07 m² per s
Molecular weight	MW=	78 g per mol
Saturated vapour pressure	SatVP=	95 mmHg

Pathway parameters

Dilution ratio	DR=	20000	unitless	
Temperature	Temp=	12	°C + 273 =	285 K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air}=	3	m per s	

Receptor characteristics

Time-averaged body height TAH= 0.93 m

Height of mixing zone h= 0.93 /2 = 0.465 m

26 Contaminant Volatilisation Factor (CVF)

CVF= 4.18503E-06 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	TAA_{outdv} m^3 air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residental without plant uptake	7.27421E-02
Allotments	1.55763E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate TAA_{outdv} here 7.27E-02 m^3 air per (kg body weight per day)

28 Soil equivalent intake

Calculate the soil equivalent intake for inhalation of outdoor air using the formula: $SEI_{outdv} = TAA_{outdv} \times CVF \times 1000$

3.04427E-04 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air using the formula: $ASC_{outdv} = RI_{outdv}/SEI_{outdv}$

ASC_{outdv} = 9.10000E-04 mg per kg body weight per day / 3.04427E-04 kg soil per kg body weight per day = 2.988217672 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios:
Residential with plant uptake, Residential without plant uptake, Commercial/industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{inv}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/industrial	4.34795E-02

Insert the appropriate $TAAI_{inv}$ here: 2.78E-01 m³ air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF = K_{oc} \times f_{oc}/H'$

SF= 1.549532514 l air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC= 0.464151982 kg soil per l air

34 The soil equivalent intakes for inhalation of indoor air is calculated using the formula: $SEI_{inv} = (TAAI_{inv} \times 1000 \times SVPC)/DR$

SEI_{inv}= 6.46050E-03 kg soil/(kg body weight per day)

35 The nominal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{inv} = RI_{inv}/SEI_{inv}$

ASC_{inv} = 9.10000E-04 mg per kg body weight per day / 6.46050E-03 kg soil per kg body weight per day = 0.140855926 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^3)/(760mmHg \times R \times Temp)$

C_{sat}= 4.16899E+06 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{inv} \times SVPC$

C_{sv}= 6.53786E-02 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat}= 1.56822E-10 (mg per l air) per (mm Hg.g per mol)

If the ratio is greated than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (ISSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-3}

soil ingestion pathway	$1/ASC_{ding}$ =	1/ 29.43210723	=	3.39765E-02	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$ =	1/ 0.353360747	=	2.82967E+00	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$ =	1/ 257.2681881	=	3.88699E-03	kg soil per mg
inhalation of outdoor air	$1/ASC_{outh}$ =	1/ 2.989217672	=	3.34536E-01	kg soil per mg
inhalation of indoor air	$1/ASC_{inh}$ =	1/ 0.140855926	=	7.09945E+00	kg soil per mg

The integrated Site Specific Assessment Criterion (ISSAC)

39 For the residential with plant uptake land use the $SSAC_{rep}$ = [redacted] mg per kg soil

40 For the allotments land use the $SSAC_{all}$ = [redacted] mg per kg soil

41 For the residential without plant uptake land use the $SSAC_{other}$ = 0.133905287 mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$ = [redacted] mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for [redacted]romatic EC5-EC[redacted] in the Residential without plant uptake scenario is 0.133905 mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-3}

soil ingestion pathway	$1/ASC_{ding}$ =	1/ [redacted]	=	[redacted]	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$ =	1/ [redacted]	=	[redacted]	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$ =	1/ [redacted]	=	[redacted]	kg soil per mg

The integrated Site Specific Assessment Criterion

43 For the residential with plant uptake land use the $SSAC_{rep}$ = [redacted] mg per kg soil

For the allotments land use the $SSAC_{all}$ = [redacted] mg per kg soil

For the residential without plant uptake land use the $SSAC_{other}$ = [redacted] mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$ = [redacted] mg per kg soil

The Level 1 Site Specific Assessment Criterion for [redacted]romatic EC5-EC[redacted] in the [redacted] scenario is [redacted] mg per kg soil

Risk Evaluation

SNIFFER Version 1.02

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site. Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. Critical Receptor	Y
iv. Pathways included/omitted (including bioaccessibility if used)	Y
v. Soil Parameters, e.g. pH	Y

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SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by Paul Brew on 08/07/2006

and has been checked by Christopher Bolan on 08/07/2006

3 It relates to Aromatic EC8-EC10 found at Residential Without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Y or N) N

5a Insert the relevant health criterion for ingestion
For a non threshold substance the relevant health criterion is the Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI). 4.00E-02 mg per kg body weight per day

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/Industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

0 mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unkown? (Y or N)

Y

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

0.485

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Ingestion

10a For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated using the formula: RI_{ingest}=ID

mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=0.2TDI

0.008 mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N)

N

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (indicative) Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

6.00E-02 mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

[ ] mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unknown? (Y or N)

[Y]

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.382
16-59	1

[0.382]

Receptor Body Weight

8b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-3	11.15
16-59	46.4

[11.15] kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: RI_{inhal}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: RI_{inhal}=0.2TDI

0.012 mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

Y

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{dirq} from this table, depending on your choice of land use

Land Use	SEI_{dirq} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{dirq} = 9.85E-06

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

If Y insert the representative fraction here (default=1)

The amended SEI_{dirq} = SEI_{dirq} * bioaccessibility fraction

9.85319E-06 kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: ASC_{dirq} = RI_{ingest}/SEI_{dirq}

ASC_{dirq} = 8.00000E-03 mg per kg body weight per day / 9.85319E-06 kg soil per kg body weight per day = 811.9201995 mg per kg soil

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25.
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Y or N) N

Measured Concentration Factor for leafy vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 18 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) 1258.925412 l water per l octanol

a representative value of ϕ (soil density) 1.6 g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient): 1600 cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil): 5.98802E-03 kg OC per kg soil

a representative value of θ (soil-water content by volume) 0.15 cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{-0.434*(logKow-1.78)^2/2.44}+(10^{0.95logKow-2.05}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))$

CF_{leafy}= 0.344272232 ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root}=(10^{0.77logKow-1.52}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))*0.01$

CF_{root}= 0.008457281 ug per g fresh weight plant per ug per g dry weight soil

* Note - If the soil correction factor $(\phi/(\theta+\phi K_{oc}f_{oc}))$ is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight conversion factor when using measured CF values.
Is a dry weight conversion required? (Y or N) N

Calculation of SEI_{veg}
The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/day)	TAVCR*DF*CF*DW	TAVCR*DF*CF
Brussel sprouts	5.04750E-03	calc not required	1.09714E-03
Cabbage	4.86885E-03	calc not required	1.04892E-03
Carrot	7.38094E-03	calc not required	2.54598E-05
Leafy salads	3.25677E-03	calc not required	1.96251E-04
Onion	3.69474E-03	calc not required	1.81863E-05
Potato	4.41816E-02	calc not required	1.40116E-04

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	2.26554E-04
Allotments	2.26554E-04

SEI_{veg}= 2.27E-04 kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{organic}/SEI_{veg}$

ASC_{veg} = 8.00000E-03 mg per kg body weight per day / 2.26554E-04 kg soil per kg body weight per day = 35.31163297 mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to paragraph 25.

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$ = 1.1272E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N) N

Insert the representative fraction here (default= 1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect} = RI_{ingest}/SEI_{indirect}$

$ASC_{indirect}$ = 8.00000E-03 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 7097.053466 mg per kg soil

Intake via Inhalation of Outdoor Air

25 This pathway only applies to substances with H' greater than or equal to 10^{-3}.
To use the formulae for inhalation of outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W=	15	metres
Depth to subsurface contamination	d_s=	1	metres

Soil Matrix

Soil organic matter content	SOM=	1	%		
Mass fraction of organic carbon in soil	f_{oc}=	1		/167	5.98802E-03 kg OC per kg soil
Air filled porosity	θ_{vap}=	0.31	unitless		
Water filed porosity	θ_{wat}=	0.15	unitless		
Total porosity	θ_{total}=	0.46	unitless		
Bulk soil density	ρ_b=	1.6	kg soil per l soil		

Contaminant

Organic carbon/water partition coefficient	K_{oc}=	1600	l water per kg OC
Dimensionless Henry's constant	H'=	0.49	l water per l air
Diffusion coefficient in water	D_{wat}=	1.00E-09	m^2 per s
Diffusion coefficient in soil air	D_i=	1.00E-05	m^2 per s
Air in soil		9.52847E-02	unitless
Water in soil		8.47485E-03	unitless
Air term		9.52847E-07	m^2 per s
Water term		1.72952E-11	m^2 per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	9.52865E-07	m^2 per s
Molecular weight	MW=	120	g per mol
Saturated vapour pressure	SatVP=	4.8	mmHg

Pathway parameters

Dilution ratio	DR=	20000	unitless		
Temperature	Temp=	12	°C + 273 =	285	K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air}=	3	m per s		

Receptor characteristics

Time-averaged body height TAH = 0.93 m

Height of mixing zone hz = 0.93 /2 = 0.465 m

26 Contaminant Volatilisation Factor (CVF)

CVF = 5.13486E-07 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	$TAAI_{outv}$ m^3 air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residental without plant uptake	7.27421E-02
Allotments	1.55763E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate $TAAI_{outv}$ here 7.27E-02 m^3 air per (kg body weight per day)

28 Soil equivalent Intake

Calculate the soil equivalent intake for inhalation of outdoor air using the formula: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

3.73811E-05 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air using the formula: $ASC_{outv} = RI_{outv}/SEI_{outv}$

ASC_{outv} = 1.20000E-02 mg per kg body weight per day / 3.73811E-05 kg soil per kg body weight per day = 321.0178624 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios:
Residential with plant uptake, Residential without plant uptake, Commercial/industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{av}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/industrial	4.34795E-02

Insert the appropriate $TAAI_{av}$ here: 2.78E-01 m^3 air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF=K_{oc} \times f_{oc}/H'$

SF= 10.55273127 g air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC= 0.050155965 kg soil per l air

34 The soil equivalent intakes for inhalation of indoor air is calculated using the formula: $SEI_{av} = (TAAI_{av} \times 1000 \times SVPC)/DR$

SEI_{av}= 6.98118E-04 kg soil/(kg body weight per day)

35 The nominal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{av} = RI_{av}/SEI_{av}$

ASC_{av} = 1.20000E-02 mg per kg body weight per day / 6.98118E-04 kg soil per kg body weight per day = 17.18907829 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^6)/(760mmHg \times R \times Temp)$

C_{sat}= 3.24065E+07 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{av} \times SVPC$

C_{sv}= 8.62135E-01 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat}= 2.66037E-08 (mg per l air) per (mm Hg.g per mol)

If the ratio is greated than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (SSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-3}

soil ingestion pathway	$1/ASC_{dirg}$ =	1/ 811.9201995	=	1.23165E-03	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$ =	1/ 35.31163297	=	2.83193E-02	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$ =	1/ 7097.053466	=	1.40904E-04	kg soil per mg
inhalation of outdoor air	$1/ASC_{out}$ =	1/ 321.0179624	=	3.11509E-03	kg soil per mg
inhalation of indoor air	$1/ASC_{in}$ =	1/ 17.18907829	=	5.81765E-02	kg soil per mg

The integrated Site Specific Assessment Criterion (SSAC)

38 For the residential with plant uptake land use the $SSAC_{rsp}$ = mg per kg soil

40 For the allotments land use the $SSAC_{ag}$ = mg per kg soil

41 For the residential without plant uptake land use the $SSAC_{other}$ = 15.99405902 mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$ = mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for omaric EC8-EC in the Residential without plant uptake scenario is 15.99406 mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-3}

soil ingestion pathway	$1/ASC_{dirg}$ =	1/	=		kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$ =	1/	=		kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$ =	1/	=		kg soil per mg

The integrated Site Specific Assessment Criterion

43 For the residential with plant uptake land use the $SSAC_{rsp}$ = mg per kg soil

For the allotments land use the $SSAC_{ag}$ = mg per kg soil

For the residential without plant uptake land use the $SSAC_{other}$ = mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$ = mg per kg soil

The Level 1 Site Specific Assessment Criterion for romaric EC8-EC1 in the scenario is mg per kg soil

Risk Evaluation

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site.
Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. Critical Receptor	Y
iv. Pathways included/omitted (including bioaccessibility if used)	Y
v. Soil Parameters, e.g. pH	Y

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SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by *Paul Brew* on 08/07/2006

and has been checked by Christopher Bolan on 08/07/2006

3 It relates to Aromatic EC8-EC10 found at Residential Without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Yor N) N

5a Insert the relevant health criterion for ingestion 4.00E-02 mg per kg body weight per day
For a non threshold substance the relevant health criterion is the Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unkown? (Y or N)

Y

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

0.485

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Ingestion

10a For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated *using the formula:* $RI_{ingest}=ID$

mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: $RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)^*$

mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: $RI_{ingest}=0.2TDI$

0.008 mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N)

N

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (indicative) Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

6.00E-02 mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unknown? (Y or N)

Y

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF)
which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.362
16-59	1

0.362

Receptor Body Weight

9b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: RI_{inhal}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: RI_{inhal}=0.2TDI

0.012 mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

Y

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{dirq} from this table, depending on your choice of land use

Land Use	SEI_{dirq} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{dirq} = 9.85E-06

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

If Y insert the representative fraction here (default=1)

The amended SEI_{dirq} = SEI_{dirq} * bioaccessibility fraction

9.85319E-06 kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: ASC_{dirq} = RI_{ingest}/SEI_{dirq}

ASC_{dirq} = 8.00000E-03 mg per kg body weight per day / 9.85319E-06 kg soil per kg body weight per day = 811.8201995 mg per kg soil

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25.
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Y or N) N

Measured Concentration Factor for leafy vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 18 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) 3162.27766 water per l octanol

a representative value of ϕ (soil density) 1.6 g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient): 2500 cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil): 5.98802E-03 kg OC per kg soil

a representative value of θ (soil-water content by volume) 0.15 cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{-0.434*(\log Kow-1.78)^2/2.44}+(10^{0.95\log Kow-2.05}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))$

CF_{leafy}= 0.304565014 ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root}=(10^{0.77\log Kow-1.52}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))*0.01$

CF_{root}= 0.018477002 ug per g fresh weight plant per ug per g dry weight soil

* Note - If the soil correction factor $(\phi/(\theta+\phi K_{oc}f_{oc}))$ is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight conversion factor when using measured CF values.
Is a dry weight conversion required? (Y or N) N

Calculation of SEI_{veg}
The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/day)	TAVCR*IF*CF*DW	TAVCR*IF*CF
Brussel sprouts	5.04750E-03	calc not required	9.70603E-04
Cabbage	4.86885E-03	calc not required	9.27943E-04
Carrot	7.38094E-03	calc not required	3.15400E-05
Leafy salads	3.25677E-03	calc not required	1.73616E-04
Onion	3.69474E-03	calc not required	2.25295E-05
Potato	4.41616E-02	calc not required	1.73578E-04

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	2.06261E-04
Allotments	2.06261E-04

SEI_{veg}= 2.06E-04 kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{oral}/SEI_{veg}$

ASC_{veg} = 8.00000E-03 mg per kg body weight per day / 2.06261E-04 kg soil per kg body weight per day = 38.78581768 mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to paragraph 25.

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$ = 1.1272E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

N

Insert the representative fraction here (default=1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction = 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect} = RI_{typical}/SEI_{indirect}$

$ASC_{indirect}$ = 8.00000E-03 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 7097.053466 mg per kg soil

Intake via Inhalation of Outdoor Air

25 This pathway only applies to substances with H' greater than or equal to 10^{-3}.
To use the formulae for inhalation of outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W=	15 metres
Depth to subsurface contamination	d_s=	1 metres

Soil Matrix

Soil organic matter content	SOM=	1	%	
Mass fraction of organic carbon in soil	f_{oc}=	1	/167	5.98802E-03 kg OC per kg soil
Air filled porosity	θ_{air}=	0.31	unitless	
Water filed porosity	θ_{wat}=	0.15	unitless	
Total porosity	θ_{total}=	0.46	unitless	
Bulk soil density	ρ_b=	1.6	kg soil per l soil	

Contaminant

Organic carbon/water partition coefficient	K_{oc}=	2500	l water per kg OC
Dimensionless Henry's constant	H'=	0.14	l water per l air
Diffusion coefficient in water	D_{wat}=	1.00E-09	m^2 per s
Diffusion coefficient in soil air	D_i=	1.00E-05	m^2 per s
Air in soil		9.52847E-02	unitless
Water in soil		8.47485E-03	unitless
Air term		9.52847E-07	m^2 per s
Water term		6.05332E-11	m^2 per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	9.52908E-07	m^2 per s
Molecular weight	MW=	130	g per mol
Saturated vapour pressure	SatVP=	0.48	mm Hg

Pathway parameters

Dilution ratio	DR=	20000	unitless	
Temperature	Temp=	12	°C + 273 =	285 K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air}=	3	m per s	

Receptor characteristics

Time-averaged body height TAH= 0.93 m
Height of mixing zone h= 0.93 /2 = 0.465 m

26 Contaminant Volatilisation Factor (CVF)

CVF= 8.50851E-08 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	TAAIoutv m^3 air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residental without plant uptake	7.27421E-02
Allotments	1.55763E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate $TAAI_{outv}$ here 7.27E-02 m^3 air per (kg body weight per day)

28 Soil equivalent intake

Calculate the soil equivalent intake for inhalation of outdoor air
using the formula: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

6.91450E-06 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air
using the formula: $ASC_{outv} = RI_{outv}/SEI_{outv}$

ASC_{outv} = 1.20000E-02 mg per kg body weight per day / 6.91450E-06 kg soil per kg body weight per day = 1735.462331 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios:
Residential with plant uptake, Residential without plant uptake, Commercial/industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{iv}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/industrial	4.34795E-02

Insert the appropriate $TAAI_{iv}$ here: 2.78E-01 m³ air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF = K_{oc} \times f_{oc}/H'$

SF= 106.9289991 l air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC= 0.009277093 kg soil per l air

34 The soil equivalent intakes for inhalation of indoor air is calculated using the formula: $SEI_{iv} = (TAAI_{iv} \times 1000 \times SVPC)/DR$

SEI_{iv}= 1.29127E-04 kg soil/(kg body weight per day)

35 The nominal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{iv} = RI_{iv}/SEI_{iv}$

ASC_{iv} = 1.20000E-02 mg per kg body weight per day / 1.29127E-04 kg soil per kg body weight per day = 92.93157419 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^6)/(760 mmHg \times R \times Temp)$

C_{sat}= 3.51071E+06 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{iv} \times SVPC$

C_{sv}= 8.62135E-01 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat}= 2.45573E-07 (mg per l air) per (mm Hg.g per mol)

If the ratio is greated than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (SSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-3}

soil ingestion pathway	$1/ASC_{ding}$=	1/ 811.9201995	=	1.23165E-03 kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/ 38.78561768	=	2.57826E-02 kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/ 7097.053466	=	1.40904E-04 kg soil per mg
inhalation of outdoor air	$1/ASC_{oair}$=	1/ 1735.482331	=	5.76209E-04 kg soil per mg
inhalation of indoor air	$1/ASC_{iair}$=	1/ 92.93157419	=	1.07606E-02 kg soil per mg

The integrated Site Specific Assessment Criterion (SSAC)

39 For the residential with plant uptake land use the $SSAC_{rup}$ = mg per kg soil

40 For the allotments land use the $SSAC_{all}$ = mg per kg soil

41 For the residential without plant uptake land use the $SSAC_{other}$ = 79.56422641 mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$= mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for omatic EC8-EC in the Residential without plant uptake scenario is 79.56423 mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-3}

soil ingestion pathway	$1/ASC_{ding}$=	1/	=	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/	=	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/	=	kg soil per mg

The integrated Site Specific Assessment Criterion

43 For the residential with plant uptake land use the $SSAC_{rup}$ = mg per kg soil

For the allotments land use the $SSAC_{all}$ = mg per kg soil

For the residential without plant uptake land use the $SSAC_{other}$ = mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$= mg per kg soil

The Level 1 Site Specific Assessment Criterion for omatic EC8-EC1 in the scenario is mg per kg soil

Risk Evaluation

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site. Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. Critical Receptor	Y
iv. Pathways included/omitted (including bioaccessibility if used)	Y
v. Soil Parameters, e.g. pH	Y

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SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by Paul Brew on 08/07/2006

and has been checked by Christopher Bolan on 08/07/2006

3 It relates to Aromatic EC12-EC16 found at Residential Without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Y or N) N

5a Insert the relevant health criterion for ingestion. For a non threshold substance the relevant health criterion is the Index Dose (ID). For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI). 4.00E-02 mg per kg body weight per day

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses. Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero) — mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unkown? (Y or N) — Y

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

0.485

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Ingestion

10a For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated using the formula: RI_{ingest}=ID — mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)* — mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=0.2TDI — 0.008 mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N) — N

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (indicative) Index Dose (ID). For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI). — 6.00E-02 mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

mg per day

Is the MDI equal to or greater than 60% of the TDI *or is the MDI unknown? (Y or N)*

Y

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF)
which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.362
16-59	1

0.362

Receptor Body Weight

9b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: RI_{inhal}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABVi)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: RI_{inhal}=0.2TDI

0.012 mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

Y

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{dirq} from this table, depending on your choice of land use

Land Use	SEI_{dirq} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{dirq} = 9.85E-06

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

[ ]

If Y insert the representative fraction here (default=1)

[ ]

The amended SEI_{dirq} = SEI_{dirq} * bioaccessibility fraction

9.85319E-06 kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: ASC_{dirq} = RI_{ingest}/SEI_{dirq}

ASC_{dirq} = 8.00000E-03 mg per kg body weight per day / 9.85319E-06 kg soil per kg body weight per day = 811.9201995 mg per kg soil

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Y or N)

N

Measured Concentration Factor for leafy vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 18 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) 7943.282347 l water per l octanol

a representative value of ϕ (soil density) 1.6 g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient): 5000 cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil): 5.98802E-03 kg OC per kg soil

a representative value of θ (soil-water content by volume) 0.15 cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{(-0.434*(logKow-1.78)^2/2.44)}+(10^{(0.95logKow-2.05)}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))$

CF_{leafy}= 0.190590674 ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root}=(10^{(0.77logKow-1.52)}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))*0.01$

CF_{root}= 0.010397878 ug per g fresh weight plant per ug per g dry weight soil

* Note - If the soil correction factor $(\phi/(\theta+\phi K_{oc}f_{oc}))$ is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight conversion factor when using measured CF values.
Is a dry weight conversion required? (Y or N)

N

Calculation of SEI_{veg}
The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/day)	TAVCR*IF*CF*DW$_a$	TAVCR*IF*CF
Brussel sprouts	5.04750E-03	calc not required	6.07384E-04
Cabbage	4.86885E-03	calc not required	5.80688E-04
Carrot	7.38094E-03	calc not required	3.13018E-05
Leafy salads	3.25677E-03	calc not required	1.08646E-04
Onion	3.69474E-03	calc not required	2.23593E-05
Potato	4.41616E-02	calc not required	1.72267E-04

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	1.36560E-04
Allotments	1.36560E-04

SEI_{veg}= 1.37E-04 kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{appv}/SEI_{veg}$

ASC_{veg} = 8.00000E-03 mg per kg body weight per day / 1.36560E-04 kg soil per kg body weight per day = 58.5822401 mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to paragraph 25.

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$ = 1.1272E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N) N

Insert the representative fraction here (default=1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect} = RI_{TDI}/SEI_{indirect}$

$ASC_{indirect}$ = 8.00000E-03 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 7097.053466 mg per kg soil

Intake via Inhalation of Outdoor Air

25 This pathway only applies to substances with H' greater than or equal to 10^{-3}.
To use the formulae for inhalation of outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W=	15 metres
Depth to subsurface contamination	d_s=	1 metres

Soil Matrix

Soil organic matter content	SOM=	1	%	
Mass fraction of organic carbon in soil	f_{oc}=	1	/167	5.98802E-03 kg OC per kg soil
Air filled porosity	θ_{as}=	0.31	unitless	
Water filed porosity	θ_{ws}=	0.15	unitless	
Total porosity	θ_{total}=	0.46	unitless	
Bulk soil density	ρ_b=	1.6	kg soil per l soil	

Contaminant

Organic carbon/water partition coefficient	K_{oc}=	5000	l water per kg OC
Dimensionless Henry's constant	H'=	0.054	l water per l air
Diffusion coefficient in water	D_{wat}=	1.00E-09	m^2 per s
Diffusion coefficient in soil air	D_a=	1.00E-05	m^2 per s
Air in soil		8.52847E-02	unitless
Water in soil		8.47485E-03	unitless
Air term		9.52847E-07	m^2 per s
Water term		1.56938E-10	m^2 per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	9.53004E-07	m^2 per s
Molecular weight	MW=	150	g per mol
Saturated vapour pressure	SatVP=	0.036	mmHg

Pathway parameters

Dilution ratio	DR=	20000	unitless	
Temperature	Temp=	12	°C + 273 =	285 K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air}=	3	m per s	

Receptor characteristics

Time-averaged body height TAH= 0.93 m

Height of mixing zone h= 0.93 /2 = 0.465 m

26 Contaminant Volatilisation Factor (CVF)

CVF= 1.84517E-06 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	TAAIoutv m^3 air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residental without plant uptake	7.27421E-02
Allotments	1.55763E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate $TAAI_{out}$ here 7.27E-02 m^3 air per (kg body weight per day)

28 Soil equivalent intake

Calculate the soil equivalent intake for inhalation of outdoor air using the formula: $SEI_{out} = TAAI_{out} \times CVF \times 1000$

1.33975E-06 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air using the formula: $ASC_{out} = RI_{out}/SEI_{out}$

ASC_{out} = 1.20000E-02 mg per kg body weight per day / 1.33975E-06 kg soil per kg body weight per day = 8956.883984 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios:
Residential with plant uptake, Residential without plant uptake, Commercial/industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{inv}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/industrial	4.34795E-02

Insert the appropriate $TAAI_{inv}$ here: 2.78E-01 m³ air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF=K_{oc} \times 1_{oc}/H'$

SF= 554.4466822 air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC= 0.001797344 kg soil per l air

34 The soil equivalent intakes for inhalation of indoor air is calculated using the formula: $SEI_{inv} = (TAAI_{inv} \times 1000 \times SVPC)/DR$

SEI_{inv}= 2.50171E-05 kg soil/(kg body weight per day)

35 The nominal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{inv} = RI_{inv}/SEI_{inv}$

ASC_{inv} = 1.20000E-02 mg per kg body weight per day / 2.50171E-05 kg soil per kg body weight per day = 479.8715723 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^6)/(760mmHg \times R \times Temp)$

C_{sat}= 3.03811E+05 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{inv} \times SVPC$

C_{sv}= 8.62135E-01 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat}= 2.83773E-06 (mg per l air) per (mm Hg.g per mol)

If the ratio is greated than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (SSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-3}

soil ingestion pathway	$1/ASC_{dirg}$ =	1/	811.9201995	=	1.23165E-03 mg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$ =	1/	58.5822401	=	1.70700E-02 mg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$ =	1/	7097.053486	=	1.40904E-04 mg soil per mg
inhalation of outdoor air	$1/ASC_{outv}$ =	1/	8956.883984	=	1.11640E-04 mg soil per mg
inhalation of indoor air	$1/ASC_{inv}$ =	1/	479.6715723	=	2.08476E-03 mg soil per mg

The integrated Site Specific Assessment Criterion (SSAC)

39 For the residential with plant uptake land use the $SSAC_{rwp}$ = mg per kg soil

40 For the allotments land use the $SSAC_{all}$ = mg per kg soil

41 For the residential without plant uptake land use the $SSAC_{other}$ = 291.7107007 mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$ = mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for omatic EC12-EC in the Residential without plant uptake scenario is 291.7107 mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-3}

soil ingestion pathway	$1/ASC_{dirg}$ =	1/		=	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$ =	1/		=	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$ =	1/		=	kg soil per mg

The integrated Site Specific Assessment Criterion

43 For the residential with plant uptake land use the $SSAC_{rwp}$ = mg per kg soil

For the allotments land use the $SSAC_{all}$ = mg per kg soil

For the residential without plant uptake land use the $SSAC_{other}$ = mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$ = mg per kg soil

The Level 1 Site Specific Assessment Criterion for omatic EC12-EC in the scenario is mg per kg soil

Risk Evaluation

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site. Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. Critical Receptor	Y
iv. Pathways included/omitted (including bioaccessibility if used)	Y
v. Soil Parameters, e.g. pH	Y

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SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by Paul Brew on 08/07/2006

and has been checked by Christopher Bolan on 08/07/2006

3 It relates to Aromatic EC16-EC21 found at Residential Without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Y or N) N

5a Insert the relevant health criterion for ingestion 3.00E-02 mg per kg body weight per day
For a non threshold substance the relevant health criterion is the Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

0 mg per day

Is the MDI equal to or greater than 60% *of the TDI or is the* MDI unkown? (Y or N)

Y

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

0.485

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Ingestion

10a For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated using the formula: RI_{ingest}=ID

mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 60% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=0.2TDI

0.006 mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N)

N

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (indicative) Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

0.00E+00 mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unknown? (Y or N)

Y

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF)
which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.362
16-59	1

0.362

Receptor Body Weight

9b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: RI_{inhal}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: RI_{inhal}=0.2TDI

[0] mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

[N]

Inhalation pathway should not be selected if H' < 1E-3

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{drvg} from this table, depending on your choice of land use

Land Use	SEI_{drvg} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{drvg} = [9.85E-06]

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

[N]

If Y insert the representative fraction here (default=1)

[ ]

The amended SEI_{drvg} = SEI_{drvg} * bioaccessibility fraction

[9.85319E-06] kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: ASC_{drvg} = RI_{ingest}/SEI_{drvg}

ASC_{drvg} = [6.00000E-03] mg per kg body weight per day / [9.85319E-06] kg soil per kg body weight per day = [608.9401496] mg per kg soil

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25.
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Y or N) **N**

Measured Concentration Factor for leafy vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 18 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) **50118.72336** l water per l octanol

a representative value of ϕ (soil density) **1.6** g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient): **16000** cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil): **5.98802E-03** kg OC per kg soil

a representative value of θ (soil-water content by volume) **0.15** cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{-0.434*(logKow-1.78)^2/2.44}+(10^{0.95logKow-2.05}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))$

CF_{leafy}= **0.06490442** * ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root}=(10^{0.77logKow-1.52}+0.82)*(\phi/(\theta+\phi K_{OC}f_{OC}))*0.01$

CF_{root}= **0.013182501** * ug per g fresh weight plant per ug per g dry weight soil

* Note - If the soil correction factor $(\phi/(\theta+\phi K_{oc}f_{oc}))$ is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight convertion factor when using measured CF values.
Is a dry weight conversion required? (Y or N) **N**

Calculation of SEI_{veg}
The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/day)	TAVCR*10*CF*DW	TAVCR*10*CF
Brussel sprouts	5.04750E-03	calc not required	2.06841E-04
Cabbage	4.86885E-03	calc not required	1.97750E-04
Carrot	7.38094E-03	calc not required	3.96846E-05
Leafy salads	3.25677E-03	calc not required	3.69886E-05
Onion	3.69474E-03	calc not required	2.83473E-05
Potato	4.41616E-02	calc not required	2.18401E-04

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	6.52935E-05
Allotments	6.52935E-05

SEI_{veg}= **6.53E-05** kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{organic}/SEI_{veg}$

ASC_{veg} = **6.00000E-03** mg per kg body weight per day / **6.52935E-05** kg soil per kg body weight per day = **91.89281415** mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 This pathway only applies to two land uses: *residential with plant uptake and allotments. For other land uses go directly to paragraph 25.*

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$ = 1.12723E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N) N

Insert the representative fraction here (default=1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect} = RI_{input}/SEI_{indirect}$

$ASC_{indirect}$ = 6.00000E-03 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 5322.7901 mg per kg soil

Intake via Inhalation of Outdoor Air

25 *This pathway only applies to substances with H' greater than or equal to 10^{-3}.*
To use the formulae for inhalation of outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W=	15 metres
Depth to subsurface contamination	d_s=	1 metres

Soil Matrix

Soil organic matter content	SOM=	1	%	
Mass fraction of organic carbon in soil	f_{oc}=	1	/167	5.98802E-03 kg OC per kg soil
Air filled porosity	θ_{vap}=	0.31	unitless	
Water filled porosity	θ_{wat}=	0.15	unitless	
Total porosity	θ_{total}=	0.46	unitless	
Bulk soil density	ρ_b=	1.6	kg soil per l soil	

Contaminant

Organic carbon/water partition coefficient	K_{oc}=	16000 l water per kg OC
Dimensionless Henry's constant	H'=	0.013 l water per l air
Diffusion coefficient in water	D_{wat}=	1.00E-09 m^2 per s
Diffusion coefficient in soil air	D_a=	1.00E-05 m^2 per s
Air in soil		9.52847E-02 unitless
Water in soil		6.47465E-03 unitless
Air term		9.52847E-07 m^2 per s
Water term		6.51896E-10 m^2 per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	9.53499E-07 m^2 per s
Molecular weight	MW=	190 g per mol
Saturated vapour pressure	SatVP=	5.80E-03 mm-Hg

Pathway parameters

Dilution ratio	DR=	20000	unitless	
Temperature	Temp=	12	°C + 273 =	285 K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air}=	3	m per s	

Receptor characteristics

Time-averaged body height — TAH = 0.93 m

Height of mixing zone — hz = 0.93

/2 = 0.465 m

26 Contaminant Volatilisation Factor (CVF)

CVF = 1.38975E-09 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	$TAAI_{outv}$ m^3 air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residental without plant uptake	7.27421E-02
Allotments	1.55763E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate $TAAI_{outv}$ here: 7.27E-02 m^3 air per (kg body weight per day)

28 Soil equivalent Intake

Calculate the soil equivalent intake for inhalation of outdoor air using the formula: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

1.01093E-07 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air using the formula: $ASC_{outv} = RI_{outv}/SEI_{outv}$

ASC_{outv} = 0.00000E+00 mg per kg body weight per day / 1.01093E-07 kg soil per kg body weight per day = 0 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios:
Residential with plant uptake, Residential without plant uptake, Commercial/Industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{in}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/industrial	4.34795E-02

Insert the appropriate $TAAI_{in}$ here: 2.78E-01 m³ air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF=K_{oc} \times f_{oc}/H'$

SF= 7369.875633 l air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC= 0.000135551 kg soil per l air

34 The soil equivalent intakes for inhalation of indoor air is calculated using the formula: $SEI_{in} = (TAAI_{in} \times 1000 \times SVPC)/DR$

SEI_{in}= 1.88673E-06 kg soil/(kg body weight per day)

35 The nominal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{inv} = RI_{in}/SEI_{in}$

ASC_{inv} = 0.00000E+00 *mg per kg body weight per day* / 1.88673E-06 kg soil per kg body weight per day = 0 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^6)/(760mmHg \times R \times Temp)$

C_{sat}= 6.20000E+04 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{inv} \times SVPC$

C_{sv}= 0.00000E+00 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat}= 0 (mg per l air) per (mm Hg.g per mol)

If the ratio is greater than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (SSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-3}

soil ingestion pathway	$1/ASC_{derg}$=	1/	=	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/	=	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/	=	kg soil per mg
inhalation of outdoor air	$1/ASC_{oa}$=	1/	=	kg soil per mg
inhalation of indoor air	$1/ASC_{ia}$=	1/	=	kg soil per mg

The integrated Site Specific Assessment Criterion (SSAC)

39	For the residential with plant uptake land use the $SSAC_{rwp}$ =	mg per kg soil
40	For the allotments land use the $SSAC_{all}$ =	mg per kg soil
41	For the residential without plant uptake land use the $SSAC_{other}$ =	mg per kg soil
	For the commercial/industrial land use the $SSAC_{other}$=	mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for matic EC16-EC in the scenario is mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-3}

soil ingestion pathway	$1/ASC_{derg}$=	1/	608.9401496	=	0.001642198 kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/	81.89281415	=	0.010882244 kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/	5322.7901	=	0.000187871 kg soil per mg

The integrated Site Specific Assessment Criterion

43	For the residential with plant uptake land use the $SSAC_{rwp}$ =	mg per kg soil
	For the allotments land use the $SSAC_{all}$ =	mg per kg soil
	For the residential without plant uptake land use the $SSAC_{other}$ = 608.9401496	mg per kg soil
	For the commercial/industrial land use the $SSAC_{other}$=	mg per kg soil

The Level 1 Site Specific Assessment Criterion for matic EC16-EC in the Residential without plant uptake scenario is 608.94015 mg per kg soil

Risk Evaluation

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site.
Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. Critical Receptor	Y
iv. Pathways included/omitted (including bioaccessibility if used)	Y
v. Soil Parameters, e.g. pH	Y

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SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by Paul Brew on 08/07/2006

and has been checked by Christopher Bolan on 08/07/2006

3 It relates to Aromatic EC21-EC35 found at Residential Without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Y or N) N

5a Insert the relevant health criterion for ingestion
For a non threshold substance the relevant health criterion is the Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI). 3.00E-02 mg per kg body weight per day

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

[ ] mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unkown? (Y or N)

[Y]

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

[0.485]

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

[11.15] kg body weight

Reference Intake for Ingestion

10a For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated using the formula: RI_{ingest}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach *in CLR 9*, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=0.2TDI

[0.006] mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N)

[N]

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (indicative) Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

[0.00E+00] mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unknown? (Y or N)

Y

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF)
which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.362
16-59	1

0.362

Receptor Body Weight

9b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: RI_{inhal}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: RI_{inhal}=0.2TDI

0 mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

N

Inhalation pathway should not be selected if H' < 1E-3

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{dirq} from this table, depending on your choice of land use

Land Use	SEI_{dirq} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{dirq} = 9.85E-06

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

N

If Y insert the representative fraction here (default=1)

The amended SEI_{dirq} = SEI_{dirq} * bioaccessibility fraction

9.85319E-06 kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: ASC_{dirq} = RI_{ingest}/SEI_{dirq}

ASC_{dirq} = 6.00000E-03 mg per kg body weight per day / 9.85319E-06 kg soil per kg body weight per day = 608.9401490 mg per kg soil

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25.
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Y or N)

N

Measured Concentration Factor for leafy vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 18 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) 1258925.412 l water per l octanol

a representative value of ϕ (soil density) 1.6 g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient): 1.30E+05 cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil): 5.98802E-03 kg OC per kg soil

a representative value of θ (soil-water content by volume) 0.15 cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{-0.434*(logKow-1.78)^2/2.44}+(10^{0.95logKow-2.05}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))$

CF_{leafy}= 0.002683127 [1] ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root}=(10^{0.77logKow-1.52}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))*0.01$

CF_{root}= 0.0193178 [1] ug per g fresh weight plant per ug per g dry weight soil

[1] Note - If the soil correction factor $(\phi/(\theta+\phi K_{oc}f_{oc}))$ is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight conversion factor when using measured CF values.
Is a dry weight conversion required? (Y or N)

N

Calculation of SEI_{veg}

The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/day)	TAVCR*IF*CF*DW	TAVCR*IF*CF
Brussel sprouts	5.04750E-03	calc not required	8.55072E-06
Cabbage	4.86685E-03	calc not required	8.17490E-06
Carrot	7.38094E-03	calc not required	5.81543E-05
Leafy salads	3.25677E-03	calc not required	1.52951E-06
Onion	3.69474E-03	calc not required	4.15405E-05
Potato	4.41616E-02	calc not required	3.20048E-04

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	3.92823E-05
Allotments	3.92823E-05

SEI_{veg}= 3.93E-05 kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{target}/SEI_{veg}$

ASC_{veg} = 6.00000E-03 mg per kg body weight per day / 3.92823E-05 kg soil per kg body weight per day = 152.7403895 mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to paragraph 25.

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$ = 1.1272E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N) — N

Insert the representative fraction here (default=1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction — 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect} = RI_{tri,ref}/SEI_{indirect}$

$ASC_{indirect}$ = 6.00000E-03 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 5322.7901 mg per kg soil

Intake via Inhalation of Outdoor Air

25 This pathway *only* applies to substances with H' greater than or equal to 10^{-3}.
To use the formulae for inhalation *of* outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W =	15 metres
Depth to subsurface contamination	d_s =	1 metres

Soil Matrix

Soil organic matter content	SOM =	1	%
Mass fraction of organic carbon in soil	f_{oc} =	1 /167	5.98802E-03 kg OC per kg soil
Air filled porosity	θ_{air} =	0.31	unitless
Water filed porosity	θ_{wat} =	0.15	unitless
Total porosity	θ_{total} =	0.46	unitless
Bulk soil density	ρ_b =	1.8	kg soil per l soil

Contaminant

Organic carbon/water partition coefficient	K_{oc} =	130000 l water per kg OC
Dimensionless Henry's constant	H' =	6.80E-04 l water per l air
Diffusion coefficient in water	D_{wat} =	1.00E-09 m^2 per s
Diffusion coefficient in soil air	D_a =	1.00E-05 m^2 per s
Air in soil		9.52847E-02 unitless
Water in soil		8.47465E-03 unitless
Air term		9.52847E-07 m^2 per s
Water term		1.24627E-08 m^2 per s per (l water per l air)
Effective diffusion coefficient	D_{eff} =	9.65310E-07 m^2 per s
Molecular weight	MW =	240 g per mol
Saturated vapour pressure	SatVP =	3.30E-06 mmHg

Pathway parameters

Dilution ratio	DR =	20000	unitless
Temperature	Temp =	12 °C + 273 =	285 K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air} =	3 m per s	

Receptor characteristics

Time-averaged body height TAH= 0.93 m

Height of mixing zone h= 0.93 /2 = 0.465 m

26 Contaminant Volatilisation Factor (CVF)

CVF= 9.00538E-12 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	TAAIoutv m^3 air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residential without plant uptake	7.27421E-02
Allotments	1.55763E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate $TAAI_{outv}$ here 7.27E-02 m^3 air per (kg body weight per day)

28 Soil equivalent intake

Calculate the soil equivalent intake for inhalation of outdoor air using the formula: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

6.59469E-10 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air using the formula: $ASC_{outv} = RI_{outv}/SEI_{outv}$

ASC_{outv} = 0.00000E+00 mg per kg body weight per day / 6.59469E-10 kg soil per kg body weight per day = 0 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios:
Residential with plant uptake, Residential without plant uptake, Commercial/Industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{inv}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/Industrial	4.34795E-02

Insert the appropriate $TAAI_{inv}$ here: 2.78E-01 m³ air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF=K_{oc} \times f_{oc}/H'$

SF= 1144769.285 l air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC= 8.73433E-07 kg soil per l air

34 The soil equivalent intakes for *inhalation of indoor* air is calculated using the formula: $SEI_{inv} = (TAAI_{inv} \times 1000 \times SVPC)/DR$

SEI_{inv}= 1.21573E-08 kg soil/(kg body weight per day)

35 The nominal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{inv} = RI_{inv}/SEI_{inv}$

ASC_{inv} = 0.00000E+00 mg per kg body weight per day / 1.21573E-08 kg soil per kg body weight per day = 0 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^{6})/(760mmHg \times R \times Temp)$

C_{sat}= 4.45590E+01 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{inv} \times SVPC$

C_{sv}= 0.00000E+00 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat}= 0 (mg per l air) per (mm Hg.g per mol)

If the ratio is greated than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (SSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-3}

soil ingestion pathway	$1/ASC_{ding}$=	1/		=		mg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/		=		mg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/		=		mg soil per mg
inhalation of outdoor air	$1/ASC_{outair}$=	1/		=		mg soil per mg
inhalation of indoor air	$1/ASC_{inair}$=	1/		=		mg soil per mg

The integrated Site Specific Assessment Criterion (SSAC)

39 For the residential with plant uptake land use the $SSAC_{rsp}$ = mg per kg soil

40 For the allotments land use the $SSAC_{all}$ = mg per kg soil

41 For the residential without plant uptake land use the $SSAC_{other}$ = mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$= mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for matic EC21-EC in the scenario is mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-3}

soil ingestion pathway	$1/ASC_{ding}$=	1/	608.9401496	=	0.001642198	mg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/	152.7403895	=	0.006547057	mg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/	5322.7901	=	0.000187871	mg soil per mg

The integrated Site Specific Assessment Criterion

43 For the residential with plant uptake land use the $SSAC_{rsp}$ = mg per kg soil

For the allotments land use the $SSAC_{all}$ = mg per kg soil

For the residential without plant uptake land use the $SSAC_{other}$ = 608.9401496 mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$= mg per kg soil

The Level 1 Site Specific Assessment Criterion for matic EC21-EC in the Residential without plant uptake scenario is 608.94015 mg per kg soil

Risk Evaluation

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site.
Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. *Critical Receptor*	Y
iv. Pathways included/omitted (including bioaccessibility *if used*)	Y
v. Soil Parameters, e.g. pH	Y

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SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by Paul Brew on 01/09/2006

and has been checked by Christopher Bolan on 01/09/2006

3 It relates to Naphthalene found at Residential without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Y or N) N

5a Insert the relevant health criterion for ingestion
For a non threshold substance the relevant health criterion is the Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI). 2.00E-02 mg per kg body weight per day

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

7.60E-03 mg per day

Is the MDI equal to or greater than 60% of the TDI or is the MDI unkown? (Y or N)

N

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

0.485

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Ingestion

10a For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated using the formula: $RI_{ingest}=ID$

mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: $RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)$*

1.97962E-02 mg per kg body weight per day

* Note - The background component is in line with the approach *in* CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 60% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: $RI_{ingest}=0.2TDI$

mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N)

N

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (indicative) Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

8.60E-04 mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero) 2.80E-03 mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unknown? (Y or N) N

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF)
which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.362
16-59	1

0.362

Receptor Body Weight

9b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: $RI_{inhal}=ID$

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: $RI_{Ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)^{A}$

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

7.99742E-04 mg per kg body weight per day

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: $RI_{inhal}=0.2TDI$

[ ] mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

Y

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{dirq} from this table, depending on your choice of land use

Land Use	SEI_{dirq} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{dirq} = 9.85E-06

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

N

If Y insert the representative fraction here (default=1)

The amended SEI_{dirq} = SEI_{dirq} * bioaccessibility fraction

9.85319E-06 kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: $ASC_{dirq}=RI_{Ingest}/SEI_{dirq}$

ASC_{dirq} = 1.97982E-02 mg per kg body weight per day / 9.85319E-06 kg soil per kg body weight per day = 2009.316808 mg per kg soil

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Y or N) N

Measured Concentration Factor for leafy vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 18 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) 2511 water per l octanol

a representative value of ϕ (soil density) 1.6 g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient): 2000 cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil): 5.98802E-03 kg OC per kg soil

a representative value of θ (soil-water content by volume) 0.15 cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{-0.434*(logKow-1.78)^2/2.44}+(10^{0.95logKow-2.05}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))$

CF_{leafy}= 0.353737193 * ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root}=(10^{0.77logKow-1.52}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))*0.01$

CF_{root}= 0.011059014 * ug per g fresh weight plant per ug per g dry weight soil

* Note - If the soil correction factor $(\phi/(\theta+\phi K_{oc}f_{oc}))$ is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight conversion factor when using measured CF values.
Is a dry weight conversion required? (Y or N) N

Calculation of SEI_{veg}
The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/day)	TAVCR*IF*CF*DW	TAVCR*IF*CF
Brussel sprouts	5.04750E-03	calc not required	1.12731E-03
Cabbage	4.86885E-03	calc not required	1.07776E-03
Carrot	7.38084E-03	calc not required	3.32921E-05
Leafy salads	3.25677E-03	calc not required	2.01647E-04
Onion	3.89474E-03	calc not required	2.37810E-05
Potato	4.41616E-02	calc not required	1.83221E-04

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	2.37400E-04
Allotments	2.37400E-04

SEI_{veg}= 2.37E-04 kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{organic}/SEI_{veg}$

ASC_{veg} = 1.97982E-02 mg per kg body weight per day / 2.37400E-04 kg soil per kg body weight per day = 83.39591004 mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to paragraph 25.

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$ = 1.1272E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N) N

Insert the representative fraction here (default=1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect} = RI_{trigger}/SEI_{indirect}$

$ASC_{indirect}$ = 1.97982E-02 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 17563.58424 mg per kg soil

Intake via Inhalation of Outdoor Air

25 This pathway only applies to substances with H' greater than or equal to 10^{-3}.
To use the formulae for inhalation of outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W=	15 metres
Depth to subsurface contamination	d_s=	1 metres

Soil Matrix

Soil organic matter content	SOM=	1	%	
Mass fraction of organic carbon in soil	f_{oc}=	1	/167	5.98802E-03 kg OC per kg soil
Air filled porosity	θ_{air}=	0.31	unitless	
Water filed porosity	θ_{wat}=	0.15	unitless	
Total porosity	θ_{total}=	0.46	unitless	
Bulk soil density	ρ_b=	1.6	kg soil per l soil	

Contaminant

Organic carbon/water partition coefficient	K_{oc}=	2000	l water per kg OC
Dimensionless Henry's constant	H'=	0.0198	l water per l air
Diffusion coefficient in water	D_{wat}=	7.50E-10	m^2 per s
Diffusion coefficient in soil air	D_s=	5.90E-06	m^2 per s
Air in soil		9.52847E-02	unitless
Water in soil		8.47465E-03	unitless
Air term		5.62180E-07	m^2 per s
Water term		3.21010E-10	m^2 per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	5.62501E-07	m^2 per s
Molecular weight	MW=	128.2	g per mol
Saturated vapour pressure	SatVP	0.085	mmHg

Pathway parameters

Dilution ratio	DR=	20000	unitless	
Temperature	Temp=	12	°C + 273 =	285 K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air}=	3	m per s	

Receptor characteristics

Time-averaged body height — TAH= 0.93 m

Height of mixing zone — hz= 0.93

/2 = 0.465 m

26 Contaminant Volatilisation Factor (CVF)

CVF= 3.91893E-06 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	TAAloutv m^3 air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residential without plant uptake	7.27421E-02
Allotments	1.55763E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate TAA_{outv} here: 7.27E-02 m^3 air per (kg body weight per day)

28 Soil equivalent intake

Calculate the soil equivalent intake for inhalation of outdoor air using the formula: $SEI_{outv} = TAA_{outv} \times CVF \times 1000$

7.21524E-07 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air using the formula: $ASC_{outv} = RI_{outv}/SEI_{outv}$

ASC_{outv} = 7.99742E-04 mg per kg body weight per day / 7.21524E-07 kg soil per kg body weight per day = 1108.407959 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios:
Residential with plant uptake, Residential without plant uptake, Commercial/Industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{inv}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/Industrial	4.34795E-02

Insert the appropriate $TAAI_{inv}$ here: 2.78E-01 m^3 air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF=K_{oc} \times f_{oc}/H'$

SF= 604.8509043 g air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC= 0.001639937 kg soil per l air

34 The soil equivalent intakes for inhalation of indoor air is calculated using the formula: $SEI_{inv} = (TAAI_{inv} \times 1000 \times SVPC)/DR$

SEI_{inv}= 2.28262E-05 kg soil/(kg body weight per day)

35 The nominal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{inv} = RI_{inv}/SEI_{inv}$

ASC_{inv} = 7.90742E-04 mg per kg body weight per day / 2.28262E-05 kg soil per kg body weight per day = 35.03619167 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^6)/(760mmHg \times R \times Temp)$

C_{sat}= 6.13080E+05 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{inv} \times SVPC$

C_{sv}= 5.74571E-02 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat}= 9.37189E-08 (mg per l air) per (mm Hg.g per mol)

If the ratio is greated than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (SSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-3}

soil ingestion pathway	$1/ASC_{ding}$ =	1/ 2009.316808	=	4.97682E-04	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$ =	1/ 83.39591004	=	1.19910E-02	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$ =	1/ 17563.58424	=	5.69360E-05	kg soil per mg
inhalation of outdoor air	$1/ASC_{outh}$ =	1/ 1108.407959	=	9.02195E-04	kg soil per mg
inhalation of indoor air	$1/ASC_{inh}$ =	1/ 35.03619167	=	2.85419E-02	kg soil per mg

The Integrated Site Specific Assessment Criterion (SSAC)

39	For the residential with plant uptake land use the $SSAC_{rwp}$ =		mg per kg soil
40	For the allotments land use the $SSAC_{all}$ =		mg per kg soil
41	For the residential without plant uptake land use the $SSAC_{other}$ =	33.39813533	mg per kg soil
	For the commercial/industrial land use the $SSAC_{other}$ =		mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for **Naphthalene** in the **Residential without plant uptake** scenario is **33.39814** mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-3}

soil ingestion pathway	$1/ASC_{ding}$ =	1/	=		kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$ =	1/	=		kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$ =	1/	=		kg soil per mg

The Integrated Site Specific Assessment Criterion

43	For the residential with plant uptake land use the $SSAC_{rwp}$ =		mg per kg soil
	For the allotments land use the $SSAC_{all}$ =		mg per kg soil
	For the residential without plant uptake land use the $SSAC_{other}$ =		mg per kg soil
	For the commercial/industrial land use the $SSAC_{other}$ =		mg per kg soil

0 The Level 1 Site Specific Assessment Criterion for **Naphthalene** in the scenario is mg per kg soil

Risk Evaluation

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site. Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. Critical Receptor	Y
iv. Pathways included/omitted (including bioaccessibility if used)	Y
v. Soil Parameters, e.g. pH	Y

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SNIFFER Version 1.02

SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by Paul Brew on 09/07/2006

and has been checked by Christopher Bolan on 09/07/2006

3 It relates to Anthracene found at Residential Without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Y or N) N

5a Insert the relevant health criterion for ingestion 3.00E-01 mg per kg body weight per day
For a non threshold substance the relevant health criterion is the Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unkown? (Y or N)

Y

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

0.485

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Ingestion

10a For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated using the formula: RI_{Ingest}=ID

mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{Ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{Ingest}=0.2TDI

0.06 mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N)

N

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (indicative) Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

0.00E+00 mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/Industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(if the contaminant is a non threshold substance insert zero)

mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unknown? (Y or N)

Y

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF)
which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.362
16-59	1

0.362

Receptor Body Weight

9b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: RI_{inhal}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: RI_{inhal}=0.2TDI

[0] mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

[N]

Inhalation pathway should not be selected if H' < 1E-3

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{dirg} from this table, depending on your choice of land use

Land Use	SEI_{dirg} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{dirg} = [9.85E-06]

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

[N]

If Y insert the representative fraction here (default=1)

[ ]

The amended SEI_{dirg} = SEI_{dirg} * bioaccessibility fraction

[9.85319E-06] kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: ASC_{dirg} = RI_{ingest}/SEI_{dirg}

ASC_{dirg} = [6.00000E-02] / [9.85319E-06] = [6089.401496] mg per kg soil

mg per kg body weight per day

kg soil per kg body weight per day

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25.
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Y or N) **N**

Measured Concentration Factor for leafy vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 18 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) **39810** l water per l octanol

a representative value of ϕ (soil density) **1.6** g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient): **30000** cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil): **5.98802E-03** kg OC per kg soil

a representative value of θ (soil-water content by volume) **0.15** cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{-0.434*(logKow-1.78)^2/2.44}+(10^{0.95logKow-2.05}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))$

CF_{leafy}= **0.03522914** * ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root}=(10^{0.77logKow-1.52}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))*0.01$

CF_{root}= **0.005898408** * ug per g fresh weight plant per ug per g dry weight soil

* Note - If the soil correction factor ($\phi/(\theta+\phi K_{oc}f_{oc})$) is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight conversion factor when using measured CF values.
Is a dry weight conversion required? (Y or N) **N**

Calculation of SEI_{veg}

The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/day)	TAVCR*FP*CF*DW	TAVCR*FP*CF
Brussel sprouts	5.04750E-03	calc not required	1.12270E-04
Cabbage	4.86885E-03	calc not required	1.07335E-04
Carrot	7.38084E-03	calc not required	1.77586E-05
Leafy salads	3.25677E-03	calc not required	2.00823E-05
Onion	3.69474E-03	calc not required	1.26838E-05
Potato	4.41618E-02	calc not required	9.77220E-05

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	3.29910E-05
Allotments	3.29910E-05

SEI_{veg}= **3.30E-05** kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{organic}/SEI_{veg}$

ASC_{veg} = **5.00000E-02** mg per kg body weight per day / **3.29910E-05** kg soil per kg body weight per day = **1516.675551** mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 *This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to paragraph 25.*

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$ = 1.1272E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N) — N

Insert the representative fraction here (default=1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction — 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect} = RI_{target}/SEI_{indirect}$

$ASC_{indirect}$ = 6.00000E-02 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 53227.901 mg per kg soil

Intake via Inhalation of Outdoor Air

25 This pathway only applies to substances with H' greater than or equal to 10^{-3}.
To use the formulae for inhalation of outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W=	15 metres
Depth to subsurface contamination	d_s=	1 metres

Soil Matrix

Soil organic matter content	SOM=	1	%	
Mass fraction of organic carbon in soil	f_{oc}=	1	/167	5.98802E-03 kg OC per kg soil
Air filled porosity	θ_{as}=	0.31	unitless	
Water filled porosity	θ_{ws}=	0.15	unitless	
Total porosity	θ_{Tot}=	0.46	unitless	
Bulk soil density	ρ_b=	1.8	kg soil per l soil	

Contaminant

Organic carbon/water partition coefficient	K_{oc}=	30000 l water per kg OC
Dimensionless Henry's constant	H'=	0.00267 l water per l air
Diffusion coefficient in water	D_{wat}=	7.70E-10 m² per s
Diffusion coefficient in soil air	D_s=	3.20E-06 m² per s
Air in soil		9.52847E-02 unitless
Water in soil		8.47465E-03 unitless
Air term		3.04911E-07 m² per s
Water term		2.44400E-09 m² per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	3.07355E-07 m² per s
Molecular weight	MW=	178.2 g per mol
Saturated vapour pressure	SatVP	0.0000027 mmHg

Pathway parameters

Dilution ratio	DR=	20000	unitless	
Temperature	Temp=	12	°C + 273 =	285 K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air}=	3	m per s	

Receptor characteristics

Time-averaged body height: TAHv = 0.93 m

Height of mixing zone: hv = 0.93 m /2 = 0.465 m

26 Contaminant Volatilisation Factor (CVF)

CVF = 4.90647E-11 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	TAAloutv m^3 air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residential without plant uptake	7.27421E-02
Allotments	1.55763E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate $TAAI_{out,v}$ here: 7.27E-02 m^3 air per (kg body weight per day)

28 Soil equivalent intake

Calculate the soil equivalent intake for inhalation of outdoor air using the formula: $SEI_{out,v} = TAAI_{out,v} \times CVF \times 1000$

3.57125E-09 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air using the formula: $ASC_{out,v} = RI_{out,v}/SEI_{out,v}$

$ASC_{out,v}$ = 0.00000E+00 mg per kg body weight per day / 3.57125E-09 kg soil per kg body weight per day = 0 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios:
Residential with plant uptake, Residential without plant uptake, Commercial/industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{in}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/industrial	4.34795E-02

Insert the appropriate $TAAI_{in}$ here: 2.78E-01 m³ air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF = K_{oc} \times f_{oc}/H'$

SF= 67281.168 l air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC= 1.48552E-05 kg soil per l air

34 The soil equivalent intakes for inhalation of indoor air is calculated using the formula: $SEI_{in} = (TAAI_{in} \times 1000 \times SVPC)/DR$

SEI_{in}= 2.08769E-07 kg soil/(kg body weight per day)

35 The nominal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{in} = RI_{in}/SEI_{in}$

ASC_{in} = 0.00000E+00 mg per kg body weight per day / 2.08769E-07 kg soil per kg body weight per day = 0 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^6)/(760mmHg \times R \times Temp)$

C_{sat}= 2.70696E+01 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{in} \times SVPC$

C_{sv}= 0.00000E+00 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat}= 0 (mg per l air) per (mm Hg.g per mol)

If the ratio is greated than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (SSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-5}

soil ingestion pathway	$1/ASC_{ing}$=	1/	=	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/	=	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/	=	kg soil per mg
inhalation of outdoor air	$1/ASC_{outd}$=	1/	=	kg soil per mg
inhalation of indoor air	$1/ASC_{ind}$=	1/	=	kg soil per mg

The Integrated Site Specific Assessment Criterion (SSAC)

38 For the residential with plant uptake land use the $SSAC_{res}$ = mg per kg soil

40 For the allotments land use the $SSAC_{all}$ = mg per kg soil

41 For the residential without plant uptake land use the $SSAC_{other}$ = mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$= mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for Anthracene in the scenario is mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-5}

soil ingestion pathway	$1/ASC_{ing}$=	1/6089.401496	=	0.00016422 kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/1818.875551	=	0.000549851 kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/53227.901	=	1.87871E-05 kg soil per mg

The Integrated Site Specific Assessment Criterion

43 For the residential with plant uptake land use the $SSAC_{res}$ = mg per kg soil

For the allotments land use the $SSAC_{all}$ = mg per kg soil

For the residential without plant uptake land use the $SSAC_{other}$ = 6089.401496 mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$= mg per kg soil

The Level 1 Site Specific Assessment Criterion for Anthracene in the Residential without plant uptake scenario is 6089.4015 mg per kg soil

Risk Evaluation

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site. Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. Critical Receptor	Y
iv. Pathways included/omitted (including bioaccessibility if used)	Y
v. Soil Parameters, e.g. pH	Y

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SNIFFER Version 1.02

SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by Paul Brew on 08/07/2006

and has been checked by Christopher Bolan on 08/07/2006

3 It relates to Fluoranthene found at Residential Without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Y or N) N

5a Insert the relevant health criterion for ingestion
For a non threshold substance the relevant health criterion is the Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI). 3.00E-01 mg per kg body weight per day

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

[ ] mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unkown? (Y or N)

[Y]

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

[0.485]

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

[11.15] kg body weight

Reference Intake for Ingestion

10a For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated using the formula: RI_{ingest}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=0.2TDI

[0.06] mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N)

[N]

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (Indicative) Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

[0.00E+00] mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unknown? (Y or N)

Y

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.362
16-59	1

0.362

Receptor Body Weight

9b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	49.4

11.15 kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: RI_{inhal}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: RI_{inhal}=0.2TDI

[0] mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

[N]

Inhalation pathway should not be selected if H' < 1E-3

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{dirq} from this table, depending on your choice of land use

Land Use	SEI_{dirq} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{dirq} = [9.85E-06]

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

[N]

If Y insert the representative fraction here (default=1)

[ ]

The amended SEI_{dirq} = SEI_{dirq} * bioaccessibility fraction

[9.85319E-06] kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: ASC_{dirq} = RI_{ingest}/SEI_{dirq}

ASC_{dirq} = [6.00000E-02] mg per kg body weight per day / [9.85319E-06] kg soil per kg body weight per day = [6089.401496] mg per kg soil

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Yor N) **N**

Measured Concentration Factor for leafy vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 18 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) **125892** l water per l octanol

a representative value of ϕ (soil density) **1.6** g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient): **110000** cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil): **5.98802E-03** kg OC per kg soil

a representative value of θ (soil-water content by volume) **0.15** cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{-0.434*(logKow-1.78)^2/2.44}+(10^{0.95logKow-2.05}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))$

CF_{leafy}= **0.008139681** * ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root}=(10^{0.77logKow-1.52}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))*0.01$

CF_{root}= **0.003867348** * ug per g fresh weight plant per ug per g dry weight soil

* Note - If the soil correction factor $(\phi/(\theta+\phi K_{oc}f_{oc}))$ is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight conversion factor when using measured CF values.
Is a dry weight conversion required? (Y or N) **N**

Calculation of SEI_{veg}
The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/day)	TAVCR *CF DW	TAVCR *CF
Brussel sprouts	5.04750E-03	calc not required	2.59399E-05
Cabbage	4.86885E-03	calc not required	2.47998E-05
Carrot	7.38094E-03	calc not required	1.17025E-05
Leafy salads	3.25677E-03	calc not required	4.64000E-06
Onion	3.69474E-03	calc not required	8.35925E-06
Potato	4.41816E-02	calc not required	6.44037E-05

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	1.25422E-05
Allotments	1.25422E-05

SEI_{veg}= **1.25E-05** kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{organic}/SEI_{veg}$

ASC_{veg} = **6.00000E-02** mg per kg body weight per day / **1.25422E-05** kg soil per kg body weight per day = **4783.860035** mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to paragraph 25.

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$ = 1.1272E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N) N

Insert the representative fraction here (default=1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect} = RI_{organ}/SEI_{indirect}$

$ASC_{indirect}$ = 6.00000E-02 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 53227.901 mg per kg soil

Intake via Inhalation of Outdoor Air

25 This pathway only applies to substances with H' greater than or equal to 10^{-3}.
To use the formulae for inhalation of outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W=	15 metres
Depth to subsurface contamination	d_s=	1 metres

Soil Matrix

Soil organic matter content	SOM=	1	%	
Mass fraction of organic carbon in soil	f_{oc}=	1	/167	5.98802E-03 kg OC per kg soil
Air filled porosity	θ_{as}=	0.31	unitless	
Water filled porosity	θ_{ws}=	0.15	unitless	
Total porosity	θ_{tot}=	0.46	unitless	
Bulk soil density	ρ_b=	1.6	kg soil per l soil	

Contaminant

Organic carbon/water partition coefficient	K_{oc}=	110000 l water per kg OC
Dimensionless Henry's constant	H'=	0.00267 l water per l air
Diffusion coefficient in water	D_{wat}=	6.40E-10 m² per s
Diffusion coefficient in soil air	D_s=	3.00E-06 m² per s
Air in soil		8.52847E-02 unitless
Water in soil		6.47465E-03 unitless
Air term		2.85854E-07 m² per s
Water term		2.03138E-09 m² per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	2.87889E-07 m² per s
Molecular weight	MW=	202.3 g per mol
Saturated vapour pressure	SatVP=	1.20E-06 mmHg

Pathway parameters

Dilution ratio	DR=	20000	unitless	
Temperature	Temp=	12	°C + 273 =	285 K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air}=	3	m per s	

Receptor characteristics

Time-averaged body height — TAH= 0.93 m

Height of mixing zone — h= 0.93 m /2 = 0.465 m

26 Contaminant Volatilisation Factor (CVF)

CVF= 1.25481E-11 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	TAA_{outv} m³ air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residental without plant uptake	7.27421E-02
Allotments	1.55763E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate TAA_{outv} here 7.27E-02 m³ air per (kg body weight per day)

28 Soil equivalent intake

Calculate the soil equivalent intake for inhalation of outdoor air using the formula: $SEI_{outv} = TAA_{outv} \times CVF \times 1000$

9.12629E-10 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air using the formula: $ASC_{outv} = RI_{outv}/SEI_{outv}$

ASC_{outv} = 0.00000E+00 mg per kg body weight per day / 9.12629E-10 kg soil per kg body weight per day = 0 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios:
Residential with plant uptake, Residential without plant uptake, Commercial/industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{inv}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/industrial	4.34795E-02

Insert the appropriate $TAAI_{inv}$ here: 2.78E-01 m³ air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF = K_{oc} \times f_{oc}/H'$

SF = 246687.616 l air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC = 4.05297E-06 kg soil per l air

34 The soil equivalent intakes for inhalation of indoor air is calculated using the formula: $SEI_{inv} = (TAAI_{inv} \times 1000 \times SVPC)/DR$

SEI_{inv} = 5.84130E-08 kg soil/(kg body weight per day)

35 The nominal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{inv} = RI_{inv}/SEI_{inv}$

ASC_{inv} = 0.00000E+00 (mg per kg body weight per day) / 5.84130E-08 (kg soil per kg body weight per day) = 0 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^6)/(760 mmHg \times R \times Temp)$

C_{sat} = 1.36580E-01 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{inv} \times SVPC$

C_{sv} = 0.00000E+00 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat} = 0 (mg per l air) per (mm Hg.g per mol)

If the ratio is greated than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (ISSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-3}

soil ingestion pathway	$1/ASC_{dirq}$ =	1/		=	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$ =	1/		=	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$ =	1/		=	kg soil per mg
inhalation of outdoor air	$1/ASC_{outh}$ =	1/		=	kg soil per mg
inhalation of indoor air	$1/ASC_{inh}$ =	1/		=	kg soil per mg

The integrated Site Specific Assessment Criterion (ISSAC)

39 For the residential with plant uptake land use the $SSAC_{rvp}$ = mg per kg soil

40 For the allotments land use the $SSAC_{all}$ = mg per kg soil

41 For the residential without plant uptake land use the $SSAC_{other}$ = mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$ = mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for Fluoranthene in the scenario is mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-3}

soil ingestion pathway	$1/ASC_{dirq}$ =	1/	6089.401496	=	0.00016422 kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$ =	1/	4783.860035	=	0.000209036 kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$ =	1/	53227.901	=	1.87871E-05 kg soil per mg

The integrated Site Specific Assessment Criterion

43 For the residential with plant uptake land use the $SSAC_{rvp}$ = mg per kg soil

For the allotments land use the $SSAC_{all}$ = mg per kg soil

For the residential without plant uptake land use the $SSAC_{other}$ = 6089.401496 mg per kg soil

For the commercial/industrial land use the $SSAC_{other}$ = mg per kg soil

The Level 1 Site Specific Assessment Criterion for Fluoranthene in the Residential without plant uptake scenario is 6089.4015 mg per kg soil

Risk Evaluation

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site. Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. Critical Receptor	Y
iv. Pathways included/omitted (including bioaccessibility if used)	Y
v. Soil Parameters, e.g. pH	Y

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SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by Paul Brew on 08/07/2006

and has been checked by Christopher Bolan on 08/07/2006

3 It relates to Fluorene found at Residential Without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Y or N) N

5a Insert the relevant health criterion for ingestion. For a non threshold substance the relevant health criterion is the Index Dose (ID). For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI). 4.00E-02 mg per kg body weight per day

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses. Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

[ ] mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unkown? (Y or N)

[Y]

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

[0.485]

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

[11.15] kg body weight

Reference Intake for Ingestion

10a For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated using the formula: RI_{ingest}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70)x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=0.2TDI

[0.008] mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N)

[N]

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (indicative) Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

[0.00E+00] mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unknown? (Y or N)

Y

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF)
which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.382
16-59	1

0.382

Receptor Body Weight

9b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: RI_{inhal}=ID

[ ] mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

[ ] mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: RI_{inhal}=0.2TDI

0 mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

N

Inhalation pathway should not be selected if H' < 1E-3

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{drcg} from this table, depending on your choice of land use

Land Use	SEI_{drcg} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{drcg} = 9.85E-06

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

If Y insert the representative fraction here (default=1)

The amended SEI_{drcg} = SEI_{drcg} * bioaccessibility fraction

9.85319E-06 kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: ASC_{drcg} = RI_{ingest}/SEI_{drcg}

ASC_{drcg} = 8.00000E-03 mg per kg body weight per day / 9.85319E-06 kg soil per kg body weight per day = 811.9201995 mg per kg soil

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Y or N)

N

Measured Concentration Factor for leafy vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 18 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) 15848 l water per l octanol

a representative value of ϕ (soil density) 1.6 g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient): 14000 cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil): 5.98802E-03 kg OC per kg soil

a representative value of θ (soil-water content by volume) 0.15 cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{-0.434*(\log(Kow-1.78))^2/2.44}+(10^{0.95\log(Kow-2.05)}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))$

CF_{leafy}= 0.074613187 ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root}=(10^{0.77\log(Kow-1.52)}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))*0.01$

CF_{root}= 0.006264839 ug per g fresh weight plant per ug per g dry weight soil

* Note - If the soil correction factor ($\phi/(\theta+\phi K_{oc}f_{oc})$) is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight conversion factor when using measured CF values.
Is a dry weight conversion required? (Y or N)

N

Calculation of SEI_{veg}
The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/day)	TAVCR*fP*CF*DW	TAVCR*fP*CF
Brussel sprouts	5.04750E-03	calc not required	2.37781E-04
Cabbage	4.86885E-03	calc not required	2.27330E-04
Carrot	7.38094E-03	calc not required	1.88597E-05
Leafy salads	3.25677E-03	calc not required	4.25331E-05
Onion	3.69474E-03	calc not required	1.34717E-05
Potato	4.41616E-02	calc not required	1.03793E-04

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	5.77371E-05
Allotments	5.77371E-05

SEI_{veg}= 5.77E-05 kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{veg,ref}/SEI_{veg}$

ASC_{veg} = 8.00000E-03 mg per kg body weight per day / 5.77371E-05 kg soil per kg body weight per day = 138.5581475 mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to paragraph 25.

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$ = 1.1272E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N) N

Insert the representative fraction here (default=1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect} = RI_{input}/SEI_{indirect}$

$ASC_{indirect}$ = 8.00000E-03 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 7097.053466 mg per kg soil

Intake via Inhalation of Outdoor Air

25 This pathway only applies to substances with H' greater than or equal to 10^{-3}.
To use the formulae for inhalation of outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W=	15 metres
Depth to subsurface contamination	d_s=	1 metres

Soil Matrix

Soil organic matter content	SOM=	1	%	
Mass fraction of organic carbon in soil	f_{oc}=	1	/167	5.98802E-03 kg OC per kg soil
Air filled porosity	θ_{air}=	0.31	unitless	
Water filled porosity	θ_{wat}=	0.15	unitless	
Total porosity	θ_{total}=	0.46	unitless	
Bulk soil density	ρ_b=	1.6	kg soil per l soil	

Contaminant

Organic carbon/water partition coefficient	K_{oc}=	14000	l water per kg OC
Dimensionless Henry's constant	H'=	0.0261	l water per l air
Diffusion coefficient in water	D_{wat}=	7.90E-10	m^2 per s
Diffusion coefficient in soil air	D_s=	3.60E-06	m^2 per s
Air in soil		9.52847E-02	unitless
Water in soil		8.47465E-03	unitless
Air term		3.43025E-07	m^2 per s
Water term		2.56512E-10	m^2 per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	3.43282E-07	m^2 per s
Molecular weight	MW=	168.2	g per mol
Saturated vapour pressure	SatVP	0.0084	mm-Hg

Pathway parameters

Dilution ratio	DR=	20000	unitless	
Temperature	Temp=	12	°C + 273 =	285 K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air}=	3	m per s	

Receptor characteristics

Time-averaged body height: TAH = 0.93 m

Height of mixing zone: lm = [illegible] m /2 = [illegible] m

26 Contaminant Volatilisation Factor (CVF)

CVF = 1.14785E-06 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	TAAIoutv m^3 air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residential without plant uptake	7.27421E-02
Allotments	1.55763E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate $TAAI_{out}$ here: 7.27E-02 m^3 air per (kg body weight per day)

28 Soil equivalent intake

Calculate the soil equivalent intake for inhalation of outdoor air using the formula: $SEI_{out} = TAAI_{out} \times CVF \times 1000$

8.34966E-08 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air using the formula: $ASC_{out} = RI_{out}/SEI_{out}$

ASC_{out} = 0.00000E+00 mg per kg body weight per day / 8.34966E-08 kg soil per kg body weight per day = 0 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios:
Residential with plant uptake, Residential without plant uptake, Commercial/industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{inv}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/industrial	4.34795E-02

Insert the appropriate $TAAI_{inv}$ here: 2.78E-01 m³ air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF=K_{oc} \times f_{oc}/H'$

SF= 3211.966871 l air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC= 0.000310869 kg soil per l air

34 The soil equivalent intakes for *inhalation of* indoor air is calculated using the formula: $SEI_{inv} = (TAAI_{inv} \times 1000 \times SVPC)/DR$

SEI_{inv}= 4.32836E-06 kg soil/(kg body weight per day)

35 The nominal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{inv} = RI_{inv}/SEI_{inv}$

ASC_{inv} = 0.00000E+00 mg per kg body weight per day / 4.32836E-06 kg soil per kg body weight per day = 0 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^{3})/(760mmHg \times R \times Temp)$

C_{sat}= 7.85453E+04 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{inv} \times SVPC$

C_{sv}= 0.00000E+00 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat}= 0 (mg per l air) per (mm Hg.g per mol)

If the ratio is greated than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (SSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-5}

soil ingestion pathway	$1/ASC_{dirg}$=	1/	=	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/	=	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/	=	kg soil per mg
inhalation of outdoor air	$1/ASC_{outair}$=	1/	=	kg soil per mg
inhalation of indoor air	$1/ASC_{inair}$=	1/	=	kg soil per mg

The integrated Site Specific Assessment Criterion (SSAC)

39	For the residential with plant uptake land use the $SSAC_{rwp}$ =	mg per kg soil
40	For the allotments land use the $SSAC_{all}$ =	mg per kg soil
41	For the residential without plant uptake land use the $SSAC_{other}$ =	mg per kg soil
	For the commercial/industrial land use the $SSAC_{other}$=	mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for **Fluorene** in the scenario is mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-5}

soil ingestion pathway	$1/ASC_{dirg}$=	1/ 811.9201995	=	0.001231648 kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/ 138.5591475	=	0.007217134 kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/ 7097.053486	=	0.000140904 kg soil per mg

The integrated Site Specific Assessment Criterion

43	For the residential with plant uptake land use the $SSAC_{rwp}$ =	mg per kg soil
	For the allotments land use the $SSAC_{all}$ =	mg per kg soil
	For the residential without plant uptake land use the $SSAC_{other}$ =	811.9201995 mg per kg soil
	For the commercial/industrial land use the $SSAC_{other}$=	mg per kg soil

The Level 1 Site Specific Assessment Criterion for **Fluorene** in the **Residential without plant uptake** scenario is **811.9202** mg per kg soil

Risk Evaluation

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site. Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. Critical Receptor	Y
iv. Pathways included/omitted (including bioaccessibility if used)	Y
v. Soil Parameters, e.g. pH	Y

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SNIFFER Method - Organics

Project Ref: GAC **Run No:** 1

1 This worksheet may be used for organic contaminants

2 This worksheet has been completed by Paul Brew on 08/07/2006

and has been checked by Christopher Bolan on 08/07/2006

3 It relates to Benzo(a)pyrene found at Residential Without Plant Uptake Site

INGESTION PATHWAYS

Toxicology for Ingestion Pathways

4a Is the substance a non threshold substance? (Y or N) Y

5a Insert the relevant health criterion for ingestion
For a non threshold substance the relevant health criterion is the Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI). 2.00E-05 mg per kg body weight per day

Land Use

6a The Table below lists the default exposure durations and averaging times, used in the method for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for Ingestion

7a Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

0.00E+00 mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unkown? (Y or N)

8a Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (ingestion)
0-6	0.485
16-59	1

0.485

Receptor Body Weight

9a Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Ingestion

10a For non threshold substances the Reference Intake (RI) for the ingestion pathway is calculated using the formula: RI_{ingest}=ID

0.00002 mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)*

mg per kg body weight per day

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI, or the MDI is unknown, the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=0.2TDI

mg per kg body weight per day

INHALATION PATHWAYS

Toxicology for Inhalation Pathways

4b Is the substance a non threshold substance. (Y or N)

Y

5b Insert the relevant health criterion for inhalation
For a non threshold substance the relevant health criterion is the (indicative) Index Dose (ID).
For threshold substances the relevant health criterion is the Tolerable Daily Intake (TDI).

7.00E-06 mg per kg body weight per day

Land Use

6b The Table below lists the default exposure durations and averaging times, used in the level 1 methodology for standard land uses.
Please insert Y to indicate your choice of land use and acceptance of the default assumptions.

Land Use	Exposure duration (years)		Averaging time (days)	
Residential with plant uptake	0-6		2190	
Residential without plant uptake	0-6	Y	2190	Y
Allotments	0-6		2190	
Commercial/industrial	16-59		15695	

Background Exposure for inhalation

7b Insert Mean Daily Intake (MDI) from non-soil sources
(If the contaminant is a non threshold substance insert zero)

0.00E+00 mg per day

Is the MDI equal to or greater than 80% of the TDI or is the MDI unknown? (Y or N)

8b Because the MDI for children is lower than that for adults, the MDI will need to be corrected by a Childhood Factor (CF) which depends on exposure duration. Insert the appropriate factor here:

Exposure duration (years)	Childhood Factor (inhalation)
0-6	0.302
16-59	1

0.302

Receptor Body Weight

9b Insert the Time-Averaged (female) Body Weight (TABW) depending on the chosen exposure duration

Exposure duration (years)	TABW
0-6	11.15
16-59	46.4

11.15 kg body weight

Reference Intake for Inhalation

10b For non threshold substances the Reference Intake (RI) for the inhalation pathway is calculated using the formula: RI_{inhal}=ID

0.000007 mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{ingest}=(TDI-(MDI/70x46.4)xCF)/TABW)*

* Note - The background component is in line with the approach in CLR 9, namely that the MDI is corrected by the relevant adult body weight.

mg per kg body weight per day

For threshold substances where the background exposure (MDI) is greater than or equal to 80% of the TDI the Reference Intake (RI) for inhalation pathways is calculated using the formula: RI_{inhal}=0.2TDI

mg per kg body weight per day

Pathway Check

11 The relevant pathways for calculating Site Specific Assessment Criteria depend on the land-use scenarios and the relative tendency of a substance to exist as vapour molecules as opposed to being dissolved in water, as expressed in Henry's Law constant.

Is the dimensionless Henry's constant H' greater than or equal to 10^{-3}? (Y or N)
If the answer is Y, include vapour inhalation pathways. If it is N, do not.

N

Inhalation pathway should not be selected if H' < 1E-3

Intake via Soil and Dust Ingestion

12 Select a value for SEI_{ding} from this table, depending on your choice of land use

Land Use	SEI_{ding} (kg soil/kg body weight/day)
Residential with plant uptake	9.85319E-06
Residential without plant uptake	9.85319E-06
Allotments	9.85319E-06
Commercial/Industrial	5.43222E-07

SEI_{ding} = 9.85E-06

13 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N)

N

If Y insert the representative fraction here (default=1)

The amended SEI_{ding} = SEI_{ding} * bioaccessibility fraction

9.85319E-06 kg soil per kg body weight per day

14 The nominal assessment sub criterion for intake via soil and dust ingestion is calculated using the formula: ASC_{ding} = RI_{ingest}/SEI_{ding}

ASC_{ding} = 2.00000E-05 mg per kg body weight per day / 9.85319E-06 kg soil per kg body weight per day = 2.029800499 mg per kg soil

Intake via Consumption of Homegrown Vegetables

15 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to question 25
Select the basis for the Concentration Factor from 16 or 17 below. Select one option only

16 Are measured site specific Concentration Factors for leafy and root plant uptake of organics available? (Y or N) N

Measured Concentration Factor for leafy vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

Measured Concentration Factor for root vegetables [ ] ug per g (dry or fresh)* weight plant per ug per g dry weight soil

* Note - See 18 below

17 Where measured site specific Concentration Factors are not available the following formulae can be used to calculate Concentration Factors for leafy and root vegetable uptake of organics using the Briggs and Ryan approach.

To use the formulae for plant uptake of organics the following data are required:

a representative value for K_{ow} (octanol/water partition coefficient) 1258925 l water per l octanol

a representative value of ϕ (soil density) 1.8 g dry weight per cm^3

a representative value of K_{oc} (organic carbon-water partition coefficient): 1000000 cm^3 per g dry weight

a representative value of f_{oc} (fraction of organic carbon in soil): 5.98802E-03 kg OC per kg soil

a representative value of θ (soil-water content by volume) 0.15 cm^3 per cm^3

For leafy vegetables $CF_{leafy} = (0.784*10^{-0.434*(logKow-1.78)^2/2.44}+(10^{0.95logKow-2.05}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))$

CF_{leafy}= 0.000348843 ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root}=(10^{0.77logKow-1.52}+0.82)*(\phi/(\theta+\phi K_{oc}f_{oc}))*0.01$

CF_{root}= 0.002511577 ug per g fresh weight plant per ug per g dry weight soil

* Note - If the soil correction factor $(\phi/(\theta+\phi K_{oc}f_{oc}))$ is greater than 1 a default value of 1 is used.

18 For calculation of the SEI_{veg} the units for CF_{leafy} and CF_{root} must be ug per g fresh weight plant over ug per g dry weight soil.
It may be necessary to use a dry weight conversion factor when using measured CF values.
Is a dry weight conversion required? (Y or N) N

Calculation of SEI_{veg}
The Time Averaged Vegetable Consumption Rate for homegrown vegetables is given in the Table below.

Vegetable Type	TAVCR (kg FW/day)	TAVCR*BP*CF*BW	TAVCR*BP*CF
Brussel sprouts	5.04750E-03	calc not required	1.11171E-06
Cabbage	4.86885E-03	calc not required	1.06285E-06
Carrot	7.38084E-03	calc not required	7.56085E-06
Leafy salads	3.25677E-03	calc not required	1.98857E-07
Onion	3.89474E-03	calc not required	5.40083E-06
Potato	4.41616E-02	calc not required	4.16106E-05

19 Select a value for SEI_{veg} from this table for the contaminant of concern, depending on your choice of land use and toxicological endpoint

Landuse	SEI_{veg} (kg soil per kg body weight per day)
Residential with plant uptake	5.10724E-06
Allotments	5.10724E-06

SEI_{veg}= 5.11E-06 kg soil per kg body weight per day

20 The nominal assessment sub criterion for intake via consumption of homegrown vegetables is calculated using the formula: $ASC_{veg} = RI_{typical}/SEI_{veg}$

ASC_{veg} = 2.00000E-05 mg per kg body weight per day / 5.10724E-06 kg soil per kg body weight per day = 3.916010858 mg per kg soil

Intake via Ingestion of Soil Attached to Vegetables

21 This pathway only applies to two land uses: residential with plant uptake and allotments. For other land uses go directly to paragraph 25.

22 Select a value for $SEI_{indirect}$ from this table, depending on your choice of land use

Land Use	$SEI_{indirect}$ (kg soil per kg body weight per day)
Residential with plant uptake	1.12723E-06
allotments	1.12723E-06

$SEI_{indirect}$ = 1.1272E-06 kg soil per kg body weight per day

23 Is site specific data on the bioaccessibility of the contaminant in soil available? (Y or N) N

Insert the representative fraction here (default=1)

The amended $SEI_{indirect}$ = $SEI_{indirect}$ * bioaccessibility fraction 1.12723E-06 kg soil per kg body weight per day

24 The nominal assessment sub criterion for intake via indirect soil ingestion using the formula: $ASC_{indirect} = RI_{typical}/SEI_{indirect}$

$ASC_{indirect}$ = 2.00000E-05 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 17.74283367 mg per kg soil

Intake via Inhalation of Outdoor Air

25 This pathway only applies to substances with H' greater than or equal to 10^{-3}.
To use the formulae for inhalation of outdoor air, the following site parameters are required:

Source Area

Source zone width parallel to wind direction	W=	15 metres
Depth to subsurface contamination	d_s=	1 metres

Soil Matrix

Soil organic matter content	SOM=	1	%	
Mass fraction of organic carbon in soil	f_{oc}=	1	/167	5.98802E-03 kg OC per kg soil
Air filled porosity	θ_{air}=	0.31	unitless	
Water filled porosity	θ_{wat}=	0.15	unitless	
Total porosity	θ_{total}=	0.46	unitless	
Bulk soil density	ρ_b=	1.6	kg soil per l soil	

Contaminant

Organic carbon/water partition coefficient	K_{oc}=	1000000	l water per kg OC
Dimensionless Henry's constant	H'=	0.0000463	l water per l air
Diffusion coefficient in water	D_{wat}=	9.00E-10	m^2 per s
Diffusion coefficient in soil air	D_s=	4.30E-06	m^2 per s
Air in soil		8.52847E-02	unitless
Water in soil		8.47485E-03	unitless
Air term		4.09724E-07	m^2 per s
Water term		1.64734E-07	m^2 per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	5.74458E-07	m^2 per s
Molecular weight	MW=	252.3	g per mol
Saturated vapour pressure	SatVP=	5.50E-09	mm-Hg

Pathway parameters

Dilution ratio	DR=	20000	unitless	
Temperature	Temp=	12	°C + 273 =	285 K
Ambient air velocity in the mixing zone (default from CLEA is 3 m per s)	V_{air}=	3	m per s	

Receptor characteristics

Time-averaged body height — TAH = 0.93 m

Height of mixing zone — hm = 0.93 /2 = 0.465 m

26 Contaminant Volatilisation Factor (CVF)

CVF = 4.77598E-14 kg soil per l air

27 Time-Averaged Air Intake Outdoors

Landuse	$TAAI_{outv}$ m^3 air per (kg body weight per day)
Residential with plant uptake	7.27421E-02
Residental without plant uptake	7.27421E-02
Allotments	1.55763E-02
Commercial/Industrial	6.45534E-03

Insert the appropriate $TAAI_{outv}$ here: 7.27E-02 m^3 air per (kg body weight per day)

28 Soil equivalent Intake

Calculate the soil equivalent intake for inhalation of outdoor air using the formula: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

3.47416E-12 kg soil per (kg body weight per day)

29 Nominal Assessment Sub Criterion

Calculate the nominal assessment sub-criteria for intake via outdoor air using the formula: $ASC_{outv} = RI_{outv}/SEI_{outv}$

ASC_{outv} = 7.000000E-06 mg per kg body weight per day / 3.47416E-12 kg soil per kg body weight per day = 2014878.061 mg per kg soil

Intake via Inhalation of Indoor Air

30 Indoor inhalation of vapour

This pathway **only** applies to substances with dimensionless Henry's constant **equal to or greater than 10^{-3}** and to the following land-use scenarios:
Residential with plant uptake, Residential without plant uptake, Commercial/industrial

31 Time-averaged air intake indoors

Landuse	$TAAI_{inv}$ m3 air per (kg body weight per day)
Residential with plant uptake	2.78379E-01
Residential without plant uptake	2.78379E-01
Commercial/industrial	4.34795E-02

Insert the appropriate $TAAI_{inv}$ here: 2.78E-01 m³ air per (kg body weight per day)

32 Soil Factor

Soil Factor is calculated using the formula $SF = K_{oc} \times f_{oc}/H'$

SF = 129330970.9 g air per kg soil

33 Soil vapour partition coefficient

The soil vapour partition coefficient (SVPC) is

SVPC = 7.73158E-09 kg soil per l air

34 The soil equivalent intakes for inhalation of indoor air is calculated using the formula: $SEI_{inv} = (TAAI_{inv} \times 1000 \times SVPC)/DR$

SEI_{inv} = 1.07621E-10 kg soil/(kg body weight per day)

35 The nominal assessment sub criterion for intake via indoor air is calculated using the formula: $ASC_{inv} = RI_{inv}/SEI_{inv}$

ASC_{inv} = 7.00000E-06 mg per kg body weight per day / 1.07621E-10 kg soil per kg body weight per day = 65043.11264 mg per kg soil

36 Saturated vapour concentration

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^6)/(760 mmHg \times R \times Temp)$

C_{sat} = 7.80710E-02 mm Hg.g per mol

37 Equilibrium contaminant concentration in soil vapour

Equilibrium contaminant concentration in soil vapour is calculated using the formula $C_{sv} = ASC_{inv} \times SVPC$

C_{sv} = 5.02912E-04 mg per l air

38 Saturated vapour concentration compared to the equilibrium contaminant concentration in soil vapour: C_{sv} / C_{sat}

C_{sv}/C_{sat} = 0.006441722 (mg per l air) per (mm Hg.g per mol)

If the ratio is greated than 1, Level 1 risk assessment is not appropriate. It should be noted for further site-specific risk assessment that a C_{sv}/C_{sat} ratio greater than 1 may indicate the presence of a free product.

Integrated site specific assessment criteria (SSAC) for substances with dimensionless Henry's constant greater than or equal to 10^{-3}

soil ingestion pathway	$1/ASC_{ing}$=	1/		=	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/		=	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/		=	kg soil per mg
inhalation of outdoor air	$1/ASC_{out}$=	1/		=	kg soil per mg
inhalation of indoor air	$1/ASC_{in}$=	1/		=	kg soil per mg

The integrated Site Specific Assessment Criterion (SSAC)

39	For the residential with plant uptake land use the $SSAC_{rwp}$ =	mg per kg soil
40	For the allotments land use the $SSAC_{all}$ =	mg per kg soil
41	For the residential without plant uptake land use the $SSAC_{other}$ =	mg per kg soil
	For the commercial/industrial land use the $SSAC_{other}$=	mg per kg soil

42 The Level 1 Site Specific Assessment Criterion for Benzo(a)pyrene in the [redacted] scenario is [redacted] mg per kg soil

Integrated site specific assessment criteria for substances with dimensionless Henry's constant less than 10^{-3}

soil ingestion pathway	$1/ASC_{ing}$=	1/	2.029800499	=	0.492659254 kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/	3.916010858	=	0.255361907 kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$=	1/	17.74263367	=	0.056361418 kg soil per mg

The integrated Site Specific Assessment Criterion

43	For the residential with plant uptake land use the $SSAC_{rwp}$ =	mg per kg soil
	For the allotments land use the $SSAC_{all}$ =	mg per kg soil
	For the residential without plant uptake land use the $SSAC_{other}$ =	2.029800499 mg per kg soil
	For the commercial/industrial land use the $SSAC_{other}$=	mg per kg soil

The Level 1 Site Specific Assessment Criterion for Benzo(a)pyrene in the Residential without plant uptake scenario is 2.0298005 mg per kg soil

Risk Evaluation

44 Justify your use of the defaults on the worksheet and characterise the risk associated with the site. Include the following:

	Justification provided (Y or N)
i. Choice of Relevant Health Criteria value	Y
ii. Site use (current and intended), comment on compatibility with land use selected	Y
iii. Critical Receptor	Y
iv. Pathways included/omitted (including bioaccessibility if used)	Y
v. Soil Parameters, e.g. pH	Y

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APPENDIX J

STATISTICAL ASSESSMENTS OF SOIL CONTAMINATION DATA

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TABLE 1 - CONTAMINATION DATA USED IN STATISTICAL ANALYSIS

Job Number 06/3908/9
Site Name Foulstone & Wombwell School, Barnsley
All results in mg/kg unless stated otherwise

Created by: RR
Reviewed by: PB

Position	TP3	TP4	TP8	TP8	TP9	TP10	TP11	TP12	TP8	SGV /
Depth (m)	1.80m	0.70m	0.70m	1.50m	0.70m	0.70m	0.70m	0.70m	2.70m	GAC
Arsenic	124.4	23.4	20	46.5	30.1		26.1	37.9	52	20
Cadmium	0.3	0.2	0.2	0.2	0.2		0.2	0.2	0.2	30
Chromium (hexavalent)	1	1	1	1	1		1	1	1	200
Chromium (total)	21.9	5	19.4	7.7	18.2		16.1	13.9	14.1	200
Lead	78.7	30.7	18.9	24.4	34.1		41.7	64.1	23.5	450
Mercury	0.4	1.2	0.1	0.1	0.1		0.1	0.1	0.1	15
Selenium	1	1	1	1	1		1	1	1	260
Boron (water soluble)	0.7	0.5	0.9	0.8	0.9		0.8	1.6	0.5	
Copper	28.3	44	5.4	24.3	33.7		38.3	40.5	13.8	
Nickel	5	4	38.7	7.1	28		27.7	26.4	10.4	75
Zinc	13.6	17.2	85.2	20.9	141.1		87.6	107.7	24	
Phenols (monohydric)	2	2	2	2	2		2	2	2	21900
Cyanide (free)	2	2	2	2	2		2	2	2	53
Cyanide (total)	2	2	2	2	2		2	2	2	53
Cyanide (complex)	2	2	2	2	2		2	2	2	53
Sulphate (water soluble) g/l SO4	1.684	0.262	0.096	0.12	1.976		0.079	1.72	0.209	
Sulphide	2	2	2	2	2		2	2	2	
Sulphur (free)	4	16	4	22	8		15	23	4	
pH	3.6	5.2	7.1	4.6	6.2		6.9	7	4.3	
TPH	5	1001.6	12.9	77.7	46.8		91.1	147.3	5	
PAH (total)	0.5	20.4	2.3	7.6	6		6.7	7.1	0.1	
Naphthalene	0.1	1.8	0.3	1	0.6		3.4	3	0.1	1904
Acenaphthylene	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.1	2030
Acenaphthene	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.1	2030
Fluorene	0.1	0.3	0.1	0.1	0.1		0.1	0.3	0.1	811
Phenanthrene	0.2	6.9	0.6	4.8	1		2	2.1	0.1	2030
Anthracene	0.1	0.6	0.2	0.1	0.2		0.2	0.3	0.1	6089
Fluoranthene	0.2	3.3	0.5	0.6	1.2		0.4	0.5	0.1	2550
Pyrene	0.1	2.6	0.4	0.5	1		0.3	0.6	0.1	255
Benzo(a)anthracene	0.1	1.4	0.1	0.3	0.5		0.2	0.2	0.1	20.3
Chrysene	0.1	1.7	0.3	0.5	0.5		0.2	0.3	0.1	20.3
Benzo(b)fluoranthene	0.1	0.6	0.2	0.1	0.5		0.1	0.1	0.1	20.3
Benzo(k)fluoranthene	0.1	0.6	0.1	0.1	0.4		0.1	0.1	0.1	20.3
Benzo(a)pyrene	0.1	0.5	0.1	0.1	0.3		0.1	0.1	0.1	2.03
Indeno(1,2,3-cd)pyrene	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.1	20.3
Dibenz(a,h)anthracene	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.1	2.03
Benzo(g,h,i)perylene	0.1	0.1	0.1	0.1	0.1		0.1	0.1	0.1	20.3
Barium	138.3	192.8	111.7	72.3	98.6		97.8	77.4	87.7	
Beryllium	2.1	0.2	2	0.4	1.6		1.4	1.6	0.8	
Vanadium	66.2	14	39.7	19.4	36.9		34.8	34.1	26.1	
Nitrate	2	15.1	2.4	32.2	3.5		9.3	2	2	
Sulphate (total)	65880	8918	1812	11888	8859		5012	6878	40455	
Chrysotile (white)	ND	ND	ND	ND	ND	1	ND	ND	ND	
Amosite (brown)	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Crocidolite (blue)	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Anthophyllite	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Actinolite	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Tremolite	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Non-Asbestos fibres	ND	P	P	P	P	P	ND	P	ND	
Test sample weight (g)	0.1	33.6	1.2	17.2	2		5.9	6.8	0.2	
Est. weight asbestos material (g)										
Estimated % (w/w) of asbestos										
Organic Matter	0.1	33.6	1.2	17.2	2		5.9	6.8	0.2	
TPH C10-C12	5	16.4	5	5	5		5	6.3	10.4	79.6
TPH C12-C16	5	70	5	18.1	5		28.4	35.5	5	291.7
TPH C16-C21	5	187.3	5	25.4	9.5		26.5	33.8	5	608
TPH C21-C35	5	663.2	7.4	29.5	32.8		29.6	64	5	608
TPH C35-C40	5	64.8	5	5	5		5	5	5	608
TPH Aromatic EC5-EC7		0.02								0.134
TPH Aromatic EC7-EC8		0.02								3
TPH Aromatic EC8-EC10		0.1								15.99
TPH Aromatic EC10-EC12		5								79.6
TPH Aromatic EC12-EC16		9.2								291.7
TPH Aromatic EC16-EC21		15.7								608
TPH Aromatic EC21-EC35		5								608
TPH Aliphatic EC5-EC6		0.1								24.07
TPH Aliphatic EC6-EC8		0.1								52.79
TPH Aliphatic EC8-EC10		0.1								9.96
TPH Aliphatic EC10-EC12		5								45.28
TPH Aliphatic EC12-EC16		5								198.54
TPH Aliphatic EC16-EC21		5								40596
TPH Aliphatic EC21-EC35		5								40596
Benzene		0.02								0.134
Toluene		0.02								3
Ethyl Benzene		0.02								6
m+p-Xylene		0.04								22.91
o-Xylene		0.02								22.91

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TABLE 2 - MAXIMUM VALUE TEST AS DESCRIBED IN CLEA CLR 7 APPENDIX A

Job Number 06/3908/9 Created by: RR

Name Foulstone & Wombwell School, Barnsley Reviewed by: PB

	MAXIMUM VALUE TEST (logs)								
	Mean (mg/kg)	Maximum Value (mg/kg)	Standard Deviation	Outlier test Statistic (T)	Number of samples	Critical Value (T_{crit})	Outlier present	Maximum Result (mg/kg)	SGV/GAC (mg/kg)
Arsenic	45.050	124.400	33.968	2.336	8	1.91	YES	124.4	20.0
Cadmium	0.213	0.300	0.035	2.475	8	1.91	YES	0.3	30.0
Chromium (hexavalent)	1.000	1.000	0.000	0.000	8	1.91	NO	1.0	200.0
Chromium (total)	14.538	21.900	5.757	1.279	8	1.91	NO	21.9	200.0
Lead	39.513	78.700	21.252	1.844	8	1.91	NO	78.7	450.0
Mercury	0.275	1.200	0.388	2.383	8	1.91	YES	1.2	15.0
Selenium	1.000	1.000	0.000	0.000	8	1.91	NO	1.0	260.0
Boron (water soluble)	0.838	1.600	0.346	2.203	8	1.91	YES	1.6	
Copper	28.538	44.000	13.494	1.146	8	1.91	NO	44.0	
Nickel	18.413	38.700	13.274	1.528	8	1.91	NO	38.7	75.0
Zinc	62.163	141.100	49.312	1.601	8	1.91	NO	141.1	
Phenols (monohydric)	2.000	2.000	0.000	0.000	8	1.91	NO	2.0	21900.0
Cyanide (free)	2.000	2.000	0.000	0.000	8	1.91	NO	2.0	53.0
Cyanide (total)	2.000	2.000	0.000	0.000	8	1.91	NO	2.0	53.0
Cyanide (complex)	2.000	2.000	0.000	0.000	8	1.91	NO	2.0	53.0
Sulphate (water soluble) g/l SO4	0.768	1.976	0.855	1.412	8	1.91	NO	2.0	
Sulphide	2.000	2.000	0.000	0.000	8	1.91	NO	2.0	
Sulphur (free)	12.000	23.000	8.053	1.366	8	1.91	NO	23.0	
pH	5.613	7.100	1.368	1.087	8	1.91	NO	7.1	
TPH	173.425	1001.600	338.280	2.448	8	1.91	YES	1001.6	
PAH (total)	6.338	20.400	6.430	2.187	8	1.91	YES	20.4	
Naphthalene	1.288	3.400	1.310	1.613	8	1.91	NO	3.4	1904.0
Acenaphthylene	0.100	0.100	0.000	0.000	8	1.91	NO	0.1	2030.0
Acenaphthene	0.100	0.100	0.000	0.000	8	1.91	NO	0.1	2030.0
Fluorene	0.150	0.300	0.093	1.620	8	1.91	NO	0.3	811.0
Phenanthrene	2.213	6.900	2.429	1.930	8	1.91	YES	6.9	2030.0
Anthracene	0.225	0.600	0.167	2.247	8	1.91	YES	0.6	6089.0
Fluoranthene	0.850	3.300	1.043	2.348	8	1.91	YES	3.3	2550.0
Pyrene	0.700	2.600	0.821	2.314	8	1.91	YES	2.6	255.0
Benzo(a)anthracene	0.363	1.400	0.441	2.355	8	1.91	YES	1.4	20.3
Chrysene	0.463	1.700	0.524	2.364	8	1.91	YES	1.7	20.3
Benzo(b)fluoranthene	0.225	0.600	0.205	1.827	8	1.91	NO	0.6	20.3
Benzo(k)fluoranthene	0.200	0.600	0.193	2.075	8	1.91	YES	0.6	20.3
Benzo(a)pyrene	0.175	0.500	0.149	2.184	8	1.91	YES	0.5	2.0
Indeno(1,2,3-cd)pyrene	0.100	0.100	0.000	0.000	8	1.91	NO	0.1	20.3
Dibenz(a,h)anthracene	0.100	0.100	0.000	0.000	8	1.91	NO	0.1	2.0
Benzo(g,h,i)perylene	0.100	0.100	0.000	0.000	8	1.91	NO	0.1	20.3
Barium	109.575	192.800	39.494	2.107	8	1.91	YES	192.8	
Beryllium	1.263	2.100	0.715	1.171	8	1.91	NO	2.1	
Vanadium	33.900	66.200	15.829	2.041	8	1.91	YES	66.2	
Nitrate	8.563	32.200	10.656	2.218	8	1.91	YES	32.2	
Sulphate (total)	18712.750	65880.000	22521.396	2.094	8	1.91	YES	65880.0	
Organic Matter	8.375	33.600	11.651	2.165	8	1.91	YES	33.6	
TPH C10-C12	7.263	16.400	4.138	2.208	8	1.91	YES	16.4	79.6
TPH C12-C16	21.500	70.000	22.980	2.111	8	1.91	YES	70.0	291.7
TPH C16-C21	37.188	187.300	61.729	2.432	8	1.91	YES	187.3	608.0
TPH C21-C35	104.563	663.200	226.587	2.465	8	1.91	YES	663.2	608.0
TPH C35-C40	12.475	64.800	21.142	2.475	8	1.91	YES	64.8	608.0
TPH Aromatic EC5-EC7	0.020	0.020	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	0.0	0.1
TPH Aromatic EC7-EC8	0.020	0.020	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	0.0	3.0
TPH Aromatic EC8-EC10	0.100	0.100	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	0.1	16.0
TPH Aromatic EC10-EC12	5.000	5.000	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	5.0	79.6
TPH Aromatic EC12-EC16	9.200	9.200	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	9.2	291.7
TPH Aromatic EC16-EC21	15.700	15.700	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	15.7	608.0
TPH Aromatic EC21-EC35	5.000	5.000	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	5.0	608.0
TPH Aliphatic EC5-EC6	0.100	0.100	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	0.1	24.1
TPH Aliphatic EC6-EC8	0.100	0.100	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	0.1	52.8
TPH Aliphatic EC8-EC10	0.100	0.100	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	0.1	10.0
TPH Aliphatic EC10-EC12	5.000	5.000	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	5.0	45.3
TPH Aliphatic EC12-EC16	5.000	5.000	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	5.0	198.5
TPH Aliphatic EC16-EC21	5.000	5.000	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	5.0	40596.0
TPH Aliphatic EC21-EC35	5.000	5.000	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	5.0	40596.0
Benzene	0.020	0.020	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	0.02	0.134
Toluene	0.020	0.020	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	0.02	3
Ethyl Benzene	0.020	0.020	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	0.02	6
m+p-Xylene	0.040	0.040	#DIV/0!	#DIV/0!	1	#N/A	#DIV/0!	0.04	22.91

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TABLE 3 - MEAN VALUE TEST AS DISCUSSED IN CLEA CLR 7 APPENDIX A

Job Number 06/3908/9 Created by: RR
Name Foulstone & Wombwell School, Reviewed by: PB

	MEAN VALUE TEST						
	Arithmetric Mean (mg/kg)	Geometric Mean (mg/kg)	Maximum Value (mg/kg)	Number of samples	t	Standard Deviation	UCL_{95}
Arsenic	45.1		124.4	8.0	1.9	12.1	53.2
Cadmium	0.2		0.3	8.0	1.9	0.0	0.2
Chromium (hexavalent)	1.0		1.0	8.0	1.9	0.0	1.0
Chromium (total)	14.5		21.9	8.0	1.9	5.3	18.1
Lead		35.3	78.7	8.0	1.9	15.3	45.5
Mercury	0.3		1.2	8.0	1.9	0.4	0.6
Selenium	1.0		1.0	8.0	1.9	0.0	1.0
Boron (water soluble)	0.8		1.6	8.0	1.9	0.4	1.1
Copper	28.5		44.0	8.0	1.9	14.6	38.3
Nickel	18.4		38.7	8.0	1.9	13.1	27.2
Zinc	62.2		141.1	8.0	1.9	48.9	94.9
Phenols (monohydric)	2.0		2.0	8.0	1.9	0.0	2.0
Cyanide (free)	2.0		2.0	8.0	1.9	0.0	2.0
Cyanide (total)	2.0		2.0	8.0	1.9	0.0	2.0
Cyanide (complex)	2.0		2.0	8.0	1.9	0.0	2.0
Sulphate (water soluble) g/l SO4	0.8		2.0	8.0	1.9	0.8	1.3
Sulphide	2.0		2.0	8.0	1.9	0.0	2.0
Sulphur (free)	12.0		23.0	8.0	1.9	8.0	17.3
pH	5.6		7.1	8.0	1.9	1.2	6.4
TPH	173.4		1001.6	8.0	1.9	357.9	413.2
PAH (total)	6.3		20.4	8.0	1.9	6.5	10.7
Naphthalene	1.3		3.4	8.0	1.9	1.3	2.2
Acenaphthylene	0.1		0.1	8.0	1.9	0.0	0.1
Acenaphthene	0.1		0.1	8.0	1.9	0.0	0.1
Fluorene	0.2		0.3	8.0	1.9	0.1	0.2
Phenanthrene	2.2		6.9	8.0	1.9	2.5	3.9
Anthracene	0.2		0.6	8.0	1.9	0.2	0.3
Fluoranthene	0.9		3.3	8.0	1.9	1.1	1.6
Pyrene	0.7		2.6	8.0	1.9	0.8	1.3
Benzo(a)anthracene	0.4		1.4	8.0	1.9	0.5	0.7
Chrysene	0.5		1.7	8.0	1.9	0.5	0.8
Benzo(b)fluoranthene	0.2		0.6	8.0	1.9	0.2	0.4
Benzo(k)fluoranthene	0.2		0.6	8.0	1.9	0.2	0.3
Benzo(a)pyrene	0.2		0.5	8.0	1.9	0.2	0.3
Indeno(1,2,3-cd)pyrene	0.1		0.1	8.0	1.9	0.0	0.1
Dibenz(a,h)anthracene	0.1		0.1	8.0	1.9	0.0	0.1
Benzo(g,h,i)perylene	0.1		0.1	8.0	1.9	0.0	0.1
Barium	109.6		192.8	8.0	1.9	40.8	136.9
Beryllium	1.3		2.1	8.0	1.9	0.7	1.7
Vanadium	33.9		66.2	8.0	1.9	9.7	40.4
Nitrate	8.6		32.2	8.0	1.9	11.1	16.0
Sulphate (total)	18712.8		65880.0	8.0	1.9	12961.0	27396.4
Organic Matter	8.375		33.60	8.0	1.9	12.06	16.45
TPH C10-C12	7.263		16.40	8.0	1.9	4.36	10.18
TPH C12-C16	21.500		70.00	8.0	1.9	23.75	37.41
TPH C16-C21	37.188		187.30	8.0	1.9	65.18	80.86
TPH C21-C35	104.563		663.20	8.0	1.9	240.85	265.93
TPH C35-C40	12.475		64.80	8.0	1.9	22.60	27.62
TPH Aromatic EC5-EC7	0.0		0.02	1.0	#N/A	#DIV/0!	#N/A
TPH Aromatic EC7-EC8	0.0		0.0	1.0	#N/A	#DIV/0!	#N/A
TPH Aromatic EC8-EC10	0.1		0.1	1.0	#N/A	#DIV/0!	#N/A
TPH Aromatic EC10-EC12	5.0		5.0	1.0	#N/A	#DIV/0!	#N/A
TPH Aromatic EC12-EC16	9.200		9.2	1.0	#N/A	#DIV/0!	#N/A
TPH Aromatic EC16-EC21	15.700		15.70	1.0	#N/A	#DIV/0!	#N/A
TPH Aromatic EC21-EC35	5.000		5.00	1.0	#N/A	#DIV/0!	#N/A
TPH Aliphatic EC5-EC6	0.100		0.10	1.0	#N/A	#DIV/0!	#N/A
TPH Aliphatic EC8-EC10	0.1		0.1	1.0	#N/A	#DIV/0!	#N/A
TPH Aliphatic EC10-EC12	5.0		5.0	1.0	#N/A	#DIV/0!	#N/A
TPH Aliphatic EC12-EC16	5.0		5.0	1.0	#N/A	#DIV/0!	#N/A
TPH Aliphatic EC16-EC21	5.0		5.0	1.0	#N/A	#DIV/0!	#N/A
TPH Aliphatic EC21-EC35	5.0		5.0	1.0	#N/A	#DIV/0!	#N/A
Benzene	0.020		0.020	1.0	#N/A	#DIV/0!	#N/A
Toluene	0.020		0.020	1.0	#N/A	#DIV/0!	#N/A
Ethyl Benzene	0.020		0.020	1.0	#N/A	#DIV/0!	#N/A
m+p-Xylene	0.040		0.040	1.0	#N/A	#DIV/0!	#N/A
o-Xylene	0.020		0.020	1.0	#N/A	#DIV/0!	#N/A

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TABLE 4 - COMPARISON OF 95th UCL TO TIER 1 GAC's

Job Number 06/3908/9 Created by: RR
Name Foulstone & Wombwell School Reviewed by: PB

	MEAN VALUE TEST			Residential Without Plant Uptake HCV (mg/kg)			HQ	Methodology
	Arithmetic Mean (mg/kg)	Geometric Mean (mg/kg)	UCL_{95}	SGV	Tier 1 GAC	SSAC	HQ = UCL_{95}/HCV	Used
Arsenic	45.1		53.2	20.0				1
Cadmium	0.2		0.2	30.0				1
Chromium (hexavalent)	1.0		1.0	200.0				1
Chromium (total)	14.5		18.1	200.0				1
Lead		35.3	45.5	450.0				1
Mercury	0.3		0.6	15.0				1
Selenium	1.0		1.0	260.0				1
Boron (water soluble)	0.8		1.1					
Copper	28.5		38.3					
Nickel	18.4		27.2	75.0				1
Zinc	62.2		94.9					
Phenols (monohydric)	2.0		2.0	21900.0				1
Cyanide (free)	2.0		2.0		53.0			3
Cyanide (total)	2.0		2.0		53.0			
Cyanide (complex)	2.0		2.0		53.0			
Sulphate (water soluble) g/l SO4	0.8		1.3					
Sulphide	2.0		2.0					
Sulphur (free)	12.0		17.3					
pH	5.6		6.4					
TPH	173.4		413.2					
PAH (total)	6.3		10.7					
Naphthalene	1.3		2.2		1904.0		0.0011	4
Acenaphthylene	0.1		0.1		2030.0		0.0000	5
Acenaphthene	0.1		0.1		2030.0		0.0000	5
Fluorene	0.2		0.2		811.0		0.0003	4
Phenanthrene	2.2		3.9		2030.0		0.0019	5
Anthracene	0.2		0.3		6089.0		0.0001	4
Fluoranthene	0.9		1.6		2550.0		0.0006	4
Pyrene	0.7		1.3		255.0		0.0050	4
Benzo(a)anthracene	*0.4*		*0.7*		20.3		*0.0331*	*5*
Chrysene	0.5		0.8		20.3		0.0407	5
Benzo(b)fluoranthene	0.2		0.4		20.3		0.0182	5
Benzo(k)fluoranthene	0.2		0.3		20.3		0.0166	5
Benzo(a)pyrene	0.2		0.3		2.0		0.1381	4
Indeno(1,2,3-cd)pyrene	0.1		0.1		20.3		0.0049	5
Dibenz(a,h)anthracene	0.1		0.1		2.0		0.0493	5
Benzo(g,h,i)perylene	0.1		0.1		20.3		0.0049	5
Sum of PAH's							0.3149	
Barium	109.6		136.9					
Beryllium	1.3		1.7					2
Vanadium	33.9		40.4					2
Nitrate	8.6		16.0					
Sulphate (total)	18712.8		27396.4					
Organic Matter	8.4		16.5					
TPH C10-C12	7.3		10.2		79.6			4
TPH C12-C16	21.5		37.4		291.7			4
TPH C16-C21	37.2		80.9		608.0			4
TPH C21-C35	104.6		265.9		608.0			4
TPH C35-C40	12.5		27.6		608.0			4
TPH Aromatic EC5-EC7	0.020		#N/A		0.13		#N/A	4
TPH Aromatic EC7-EC8	0.020		#N/A	3.0			#N/A	1
TPH Aromatic EC8-EC10	0.1		#N/A		16.0		#N/A	4
TPH Aromatic EC10-EC12	5.0		#N/A		79.6		#N/A	4
TPH Aromatic EC12-EC16	9.2		#N/A		291.7		#N/A	4
TPH Aromatic EC16-EC21	15.7		#N/A		608.0		#N/A	4
TPH Aromatic EC21-EC35	5.0		#N/A		608.0		#N/A	4
TPH Aliphatic EC5-EC6	0.1		#N/A		24.1		#N/A	4
TPH Aliphatic EC6-EC8	0.1		#N/A		52.8		#N/A	4
TPH Aliphatic EC8-EC10	0.1		#N/A		10.0		#N/A	4
TPH Aliphatic EC10-EC12	5.0		#N/A		45.3		#N/A	4
TPH Aliphatic EC12-EC16	5.0		#N/A		198.5		#N/A	4
TPH Aliphatic EC16-EC21	5.0		#N/A		40596.0		#N/A	4
TPH Aliphatic EC21-EC35	5.0		#N/A		40596.0		#N/A	4
Total TPH's							#N/A	
Benzene	0.0		#N/A		0.13			4
Toluene	0.020		#N/A	3.0				1
Ethyl Benzene	0.020		#N/A	6.0				1
m+p-Xylene	0.04		#N/A		22.9			4
o-Xylene	0.02		#N/A		22.9			4

1 - Published SGV
2 - BP RISC v4.02
3 - Acute Exposure
4 - SNIFFER
5 - TEF

APPENDIX K

PRELIMINARY SPOIL CLASSIFICATION

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WASTE CALCULATION SHEETS

Determinand	Poteltially worst compound	Average Concentration (mg/kg)	Deteminand Concentration (% w/w)	Risk Phrases	Hazard Phrases	Threshold (%)	Classification
Arsenic	Arsenic Oxide	45.1	0.01	Carc Cat 1: R45	H7	0.1	Non Hazardous
			0.01	R23/R25	H6 (H5)	3	Non Hazardous
			0.01	R50,53	H14	25	Non Hazardous
	Arsenic Pentoxide	45.1	0.01	Carc Cat 1: R45	H7	0.1	Non Hazardous
			0.01	R23/R25	H6 (H5)	3	Non Hazardous
			0.01	R50-53	H14	25	Non Hazardous
Cadmium	Cadmium Chloride	0.2	0.00	Carc Cat2: R45	H7	0.1	Non Hazardous
			0.00	Muta Cat 2: R46	H11	0.1	Non Hazardous
			0.00	Repr Cat 2: R60,61	H10	0.5	Non Hazardous
Main Menu			0.00	T+:R26	H6 (H5)	0.1	Non Hazardous
			0.00	T:R25, 48/23/25	H6 (H5)	3	Non Hazardous
			0.00	N:R50,53	H14	25	Non Hazardous
	Cadmium Oxide	0.2	0.00	Carc Cat 2:R49	H7	0.1	Non Hazardous
			0.00	T: R48/23/25	H6 (H5)	3	Non Hazardous
			0.00	Xn: R22	H5	25	Non Hazardous
	Cadmium Sulphate	0.2	0.00	Carc Cat 2:R49	H7	0.1	Non Hazardous
			0.00	T: R48/23/25	H6 (H5)	3	Non Hazardous
			0.00	Xn:R22	H5	25	Non Hazardous
			0.00	N:R50,53	H14	25	Non Hazardous
	Cadmium Hydroxide	0.2	0.00	N: R50-53	H14	0.25	Non Hazardous
			0.00	R20/21/22	H5	25	Non Hazardous
Chromium	Chromium Trioxide	14.5	0.00	Carc Cat 1: R49	H7	0.1	Non Hazardous
			0.00	R48/23/25	H6 (H5)	3	Non Hazardous
			0.00	R22	H5	1	Non Hazardous
			0.00	R50/53	H14	25	Non Hazardous
Lead	Lead Sulphate	35.3	0.01	R61	H10	0.5	Non Hazardous
			0.01	R63	N/A	5	Non Hazardous
			0.01	R20/22	H5	25	Non Hazardous
			0.01	R50-53	H14	0.25	Non Hazardous
Mercury	Inorganic Mercury	0.3	0.0000275	T:R23	H6 (H5)	3	Non Hazardous
			0.0000275	T+:R26/27/28	H6 (H5)	0.1	Non Hazardous
			0.0000275	N: R50,53	H14	25	Non Hazardous
Selenium	Selenium	1.0	0.0001	T: R23/25	H6 (H5)	3	Non Hazardous
			0.0001	R53	H14	25	Non Hazardous
Boron	Boron Tribromide	0.8	0.00	T+: R26/28	H6 (H5)	0.1	Non Hazardous
			0.00	C: R34	H8(H4)	5	Non Hazardous
	Boron Trichloride	0.8	0.00	T+: R26/28	H6 (H5)	0.1	Non Hazardous
			0.00	C: R34	H8(H4)	5	Non Hazardous
Copper	Copper Chloride	28.5	0.00	R22	H5	25	Non Hazardous
	Copper Oxide	28.5	0.00	R22	H5	25	Non Hazardous
	Copper Sulphate	28.5	0.01	R22	H5	25	Non Hazardous
Nickel	Nickel Carbonate	18.4	0.00	Carc Cat3: R40	H7	1	Non Hazardous
			0.00	R22	H5	25	Non Hazardous
			0.00	R50-53	H14	25	Non Hazardous
Naphthalene		1.3	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Acenaphthylene		0.1	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Acenaphthene		0.1	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Fluorene		0.2	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Phenanthrene		2.2	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Anthracene		0.2	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Fluoranthene		0.9	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Pyrene		0.7	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Benzo(a)anthracene		0.4	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Chrysene		0.5	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Benzo(b)fluoranthene		0.2	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Benzo(k)fluoranthene		0.2	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Benzo(a)pyrene		0.2	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Indeno(1,2,3-cd)pyrene		0.1	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Dibenz(a,h)anthracene		0.1	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Benzo(g,h,i)perylene		0.1	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
ASSESSMENT OF TPH'S IN SOIL							
TOTAL TPH		173.4	0.02	Cart Cat2:R45	H7	0.1	
If Benzo(a)pyrene present at levels greater then 0.005% w/w then the TPH will classify as 'Hazardous'							
Benzo(a)pyrene level is	0.18	mg/kg					
Total oil content (w/w)	0.017%						
Benzo(a)pyrene threshold is	0.009	mg/kg					Non Hazardous
HIGHEST BANDED TPH		104.6	0.01	Cart Cat2:R45	H7	0.1	
If Benzo(a)pyrene present at levels greater then 0.005% w/w then the TPH will classify as 'Hazardous'							
Benzo(a)pyrene level is	0.18	mg/kg					
Total oil content (w/w)	0.010%						
Benzo(a)pyrene threshold is	0.005	mg/kg					Non Hazardous
TOTAL TPHCWG		55.3	0.01	Cart Cat2:R45	H7	0.1	
If Benzo(a)pyrene present at levels greater then 0.005% w/w then the TPH will classify as 'Hazardous'							
Benzo(a)pyrene level is	0.18	mg/kg					
Total oil content (w/w)	0.006%						
Benzo(a)pyrene threshold is	0.003	mg/kg					Non Hazardous

APPENDIX L

NOTES ON LIMITATIONS

Standard Terms and Conditions of Engagement
Notes on Limitations
For
Geoenvironmental and Geotechnical Consultancy Services

General

CC GEOTECHNICAL has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from CC GEOTECNICAL, and a charge may be levied against such approval.

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1. the consequences of this document being used for any purpose or project other than for which it was commissioned

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Phase I Environmental Audits / Desk Studies

The work undertaken to provide the basis of this report comprised a study of available documented information from a variety of sources (including the client), together with (where appropriate) a brief walk over inspection of the site and meetings and discussions with relevant authorities and other interested parties. The opinions given in this report have been dictated by finite data on which they are based, and are relevant only to the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in the report, CC GEOTECHNICAL reserves the right to review such information and, if warranted, to modify the opinions accordingly.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed; actual risks can only be assessed following a physical investigation of the site.

Phase II Environmental / Geoenvironmental / Geotechnical Investigations

In relation to contamination, the investigation of the site has been carried out with the objective of providing sufficient information concerning the type and degree of soil and/or groundwater contamination, and other relevant soil and groundwater conditions, to allow a credible risk assessment to be made. The objectives of the investigation have been limited to establishing the risks associated with human health, building materials, the environment (including adjacent land), and surface and groundwater.

The locations of exploratory holes may have been restricted by the existence of building(s), other obstructions, or by buried services on the site, and therefore the investigation may not have fully covered the site. In such circumstances, further investigation may be required when hitherto inaccessible areas become accessible.

If estimated costs have been included in relation to proposed site remediation, then these must be considered as tentative only, and must be confirmed by a qualified quantity surveyor.

The exploratory holes undertaken investigate only a small volume of the ground in relation to the size of the site, and can only provide a general indication of site conditions. The number of sampling points and the methods of sampling and testing do not preclude the existence of localised "hotspots" of contamination where concentrations may be significantly higher than those encountered in the investigation.

The risk assessments and opinions provided in relation to soil and/or groundwater contamination, take into consideration currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values.

With regard to geotechnical engineering investigation, the exploratory holes investigate only a small volume of the ground in relation to the size of the site, and can only provide a general indication of the site conditions. The opinions provided and recommendations given in this report are based on the ground conditions apparent at the site of each of the exploratory holes. There may be ground conditions present on the site which have not been disclosed by this investigation, and which have therefore not been taken into account in this report.

The comments made on groundwater conditions are based on observations made at the time that site work was carried out. It should be noted that groundwater levels will vary owing to seasonal, tidal, weather, or other effects.