06/3908/5

REPORT ON GROUND INVESTIGATION AT PENISTONE HIGH SCHOOL

FOR

BARNSLEY METROPOLITAN BOROUGH COUNCIL

SEPTEMBER 2006

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REPORT ON SITE INVESTIGATION AT PENISTONE GRAMMAR SCHOOL – BARNSLEY MBC

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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 ***Penistone Grammar School***.

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, 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

Penistone Grammar School is located in Penistone near Barnsley, South Yorkshire, about 11km west of Barnsley Town Centre. The site is located to the east and west of Huddersfield Road as shown on Drawing 3908/5/1. The National Grid Reference for the approximate site centre is E424168 N404070.

The site to the east of Huddersfield Road comprises the existing Penistone High School. The site to the west of Huddersfield Road comprises partially of playing fields presently in the ownership of the school, and partially of agricultural land. The school buildings are mainly concentrated over the northern half of the site to the east of Huddersfield Road. They are of various ages ranging from 1800`s to late 1990`s, constructed of brick and sandstone, with some prefabricated structures.

A footbridge crosses Huddersfield Road linking the school to the playing fields.

The site is situated between Scout Dike to the north east, the River Don to the south, agricultural land to the north, west and east. The confluence of two watercourses is located about 500m to the south of the site. The site slopes from north to south from a elevation of approximately 126mAOD to 201m AOD, and from west to east from an elevation of 225mAOD to 220mAOD. The ground levels have been locally formed by "cut and fill" earthworks.

2.3 Proposed Development

The proposed development layout is illustrated on Drawing 3908/5/2. It can be seen that the development of the main school area includes new 2 storey ALC

blocks, a car park, a parents drop off area, a bus drop off, and extensive landscaping. The playing field to the west of Huddersfield Road will be expanded by land acquisition, and retained as sports pitches.

2.4 Published Geology

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

Table 1
Sheet 86 – GLOSSOP – Solid and Drift Edition, Scale 1:50000

Drift Geology	*River Terrace Deposits (Undifferentiated) of Recent Origins, infringes on the southern tip of the site. No drift documented on the remainder of the site*
Solid Geology	*Penistone Flags,undifferentiad shales and mudstones of Lower Coal Measures of Carboniferous Origins*

As at any previously developed site, it is likely that made ground / reworked soils are present at the surface.

The Lower Coal Measures strata underlying the site contain workable coal seams. The 1:50000 map indicates a seam outcropping at the north western extremity of the site, although this seam will not extend beneath the site.

No mining has taken place beneath the site.

The site lies within 250m of a landfill, which may contain materials which give rise to landfill gas generation.

2.5 Hydrology

The nearest surface watercourse is Scout Dike, which flows on a roughly northwest – southeast alignment, and associated large ponds, located approximately 50m to the east 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
Possible surface deposits of made ground	Probable permeable strata – may store perched 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 five boreholes, and the excavation of eleven trial pits. The positions of the boreholes and trial pits are as shown on Drawing 3908/5/2. 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 boreholes were drilled by cable percussion methods using Dando 150 light cable percussion boring rigs. The boreholes extended to rockhead. Standard Penetration Tests were carried out at regular intervals in granular strata. Where possible, undisturbed sampling was attempted, although the soils were generally unsuited to this form of sampling. Bulk disturbed samples and jar samples were recovered at incremental depths in the boreholes.

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 each borehole. 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 GF60 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 ten soil samples to a broad-spectrum contamination suite.

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 comprises a cover of topsoil overlying weathered sandstone or mudstone.

An exception to this generalisation was observed. In the north east part of the school site, as represented by TP7 and TP10, a depth of about 1m of made ground was encountered, the fill and generally comprising brick, concrete, sand and gravel, with occasional inclusions of timber and wire.

There is not a clearly discernible boundary between the weathered mantle and competent rock, rather the relative proportions of gravel/cobbles within the deposits increase, and progress by excavation or boring becomes increasingly

difficult. Hard stratum was generally encountered at around 2.0mbgl in the proposed building footprint.

Groundwater was not encountered during the initial fieldwork. However, during monitoring of the standpipes, groundwater accumulated to stand at levels up to 1.0mbgl.

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 (see Appendix G), due to the concentration of arsenic, PAH's and TPH's in the soils.

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 underside.

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	761mg/l	Design Sulphate Class of DS-2 and ACEC Class of AC-1s
Lowest pH result	5.8	
Intended Service Life	100 years	Specify concrete to comply with the requirements of Design Chemical Classification of DC-1 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 1 as defined in SA Wilson and GB Card document "Reliability and Risk in Gas Protection Design", and as such, no special gas protection measures are required.

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 27 contaminants fail the Maximum Value Test.

The results for benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene and TPH C21-C35 at TP7 and benzo(a)pyrene and TPH C21-C35 at TP10 have all been identified as outliers, and have 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 F. The 95th UCL values obtained from these analyses have been compared to their relevant SGV / GAC, as shown in Table 4 of Appendix J.

It can be seen that all the 95th UCL's are below their relevant criteria.

10.4 Asbestos Analyses

Asbestos fibres were not detected in any sample analysed.

10.5 Assessment of Individual Results

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

- The concentration of benzo(a)anthracene at TP7 exceeds the GAC

- The concentration of chrysene at TP7 exceeds the GAC
- The concentration of benzo(b)fluoranthene at TP7 exceeds the GAC
- The concentration of benzo(a)pyrene in TP7 and TP10 exceeds the GAC
- The concentration of TPH C21-C35 at TP7 and TP10 exceed the GAC

11.0 SUMMARY CONCEPTUAL MODEL

The construction of a conceptual model based on the ***source–pathway-receptor*** principle, requires that each component of the linkage be present. Based on the foregoing assessment, the investigation has demonstrated that there are sources of contamination to satisfy the source-pathway-target basis of risk assessment, and hence a conceptual model can be constructed, as presented below:

Table 3 – Conceptual Model and Mitigation Measures

SOURCE	PATHWAY	TARGET	MITIGATION MEASURE
Benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(a)pyrene and TPH at TP7 and TP10	Accidental ingestion of soil Dermal contact with soil Dermal contact with dust Ingestion of dust Inhalation of dust	Human pupils and staff	Provide 600mm clean imported subsoil / topsoil over playing field and landscaped areas in the vicinity of TP7 and TP10 as delineated on Drawing 3908/5/2
Arsenic, PAH's and TPH's in water main alignment	Direct attack on plastic mains – permeation through walls of mains	Installation and maintenance workers Human pupils and staff	Use PE/Al/PE mains laid in a sterile trench alignment

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 proposed for offsite disposal originating from the made ground in the vicinity of TP7 and TP10 will classify as "Hazardous" waste. All other spoil from the site will classify as "Non-Hazardous" waste.

The calculations are given in Appendix K.

13.0 FOUNDATION RECOMMENDATIONS

Based on the borehole observations, bedrock (hard stratum) is encountered at a consistent depth of about 1.5mbgl under the proposed building footprint, indicating that it generally follows the site topography. Spread foundations can bear directly on this hard stratum prepared as "benched" levels for strip or pad bases.

It is recommended that foundations be designed on the basis of a Presumed Bearing Value of 200kN/m^2.

14.0 GROUND SLABS

It is assumed that the building will be divided into a series of stepped ground floor levels to accommodate the site topography.

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

15.0 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.

For foundations bearing at about 1.5mbgl, support of excavations will not be required.

16.0 PAVEMENT DESIGN

External works may require cut and fill operations to prepare road and car park levels. Where pavements levels are close to existing ground levels, then they should be designed on a CBR of 5%.

17.0 SOAKAWAY ASSESSMENT

A soakaway test conducted at a location adjacent to the proposed car park and parents drop off point gave a soil infiltration rate of $8 \times 10^{-6} m.sec^{-1}$. This indicates relatively poor drainage characteristics, and soakaways must be sized accordingly

18.0 CONCLUSIONS AND RECOMMENDATIONS

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

- The site is locally affected by contamination in the vicinity of TP7 and TP10. Remediation of this area should comprise the placement of 600mm clean imported subsoil / topsoil over cultivated areas such as landscaping of playing fields. This area is delineated on Drawing 3908/5/2.
- The gas monitoring data obtained on this site, indicates that the site complies with Characteristic Situation 1 as defined in SA Wilson and GB Card document "Reliability and Risk in Gas Protection Design", and as such, no special gas protection measures are required.
- Based on the borehole observations, bedrock (hard stratum) is encountered at a consistent depth of about 1.5mbgl under the

proposed building footprint, indicating that it generally follows the site topography. Spread foundations can bear directly on this hard stratum prepared as "benched" levels for strip or pad bases. It is recommended that foundations be designed on the basis of a Presumed Bearing Value of 200kN/m^2.

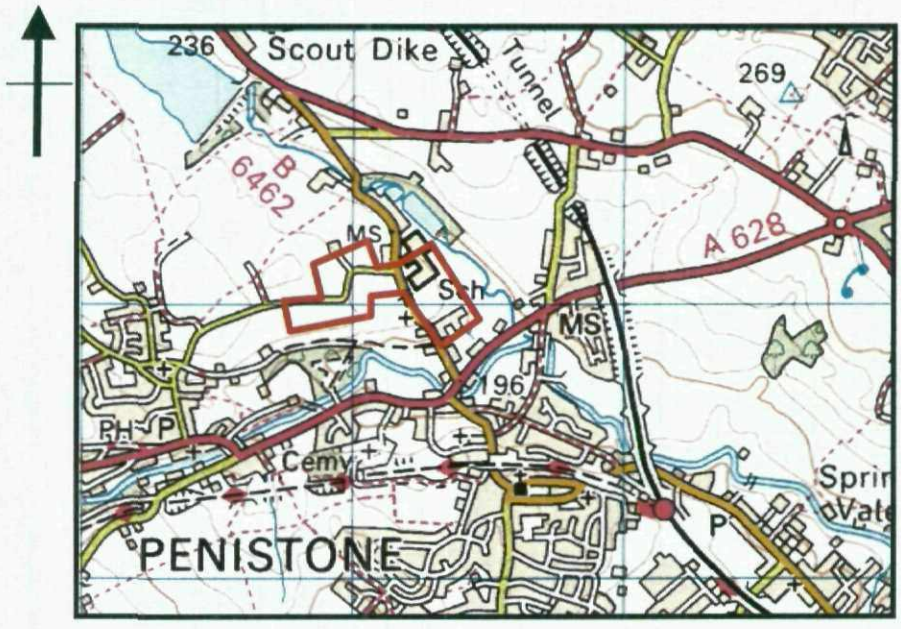
- For normal service applications, ground bearing slabs may be considered, subject to appropriate preparation of the ground
- Concrete in the ground should be specified in accordance with Design Chemical Class DC-1 as defined in BRE Special Digest 1:2005
- Normal plastic water mains are not suitable for this site due to the concentrations of arsenic, PAH's and TPH's in the soils. 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 underside.
- Spoil for disposal arising from the made ground in the vicinity of TP7 and TP10, as delineated on Drawing 3908/5/2, will classify as hazardous waste. Al other spoil will classify as non hazardous waste.
- Soakaway drains should be designed on a soil infiltration rate of 8 x 10^{-6}m.sec^{-1}.

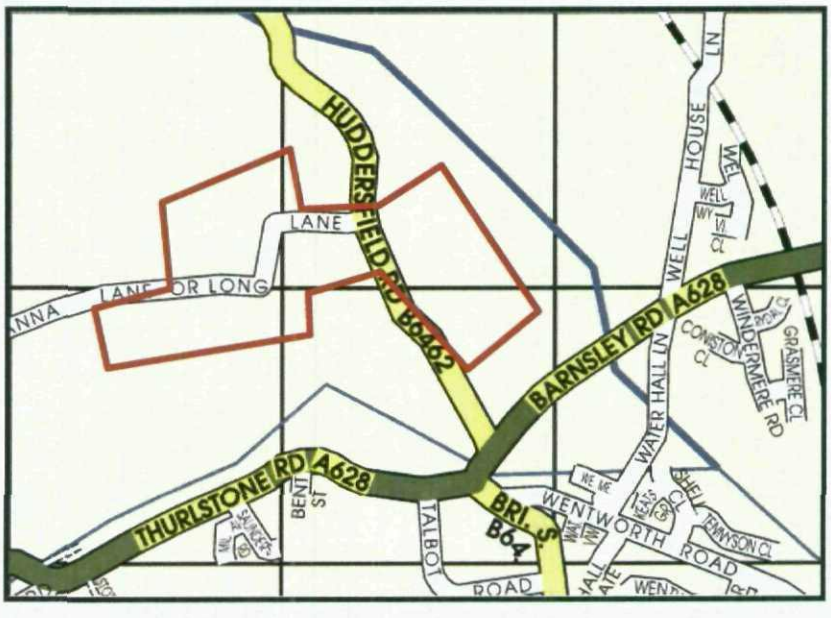
APPENDIX A

DRAWINGS

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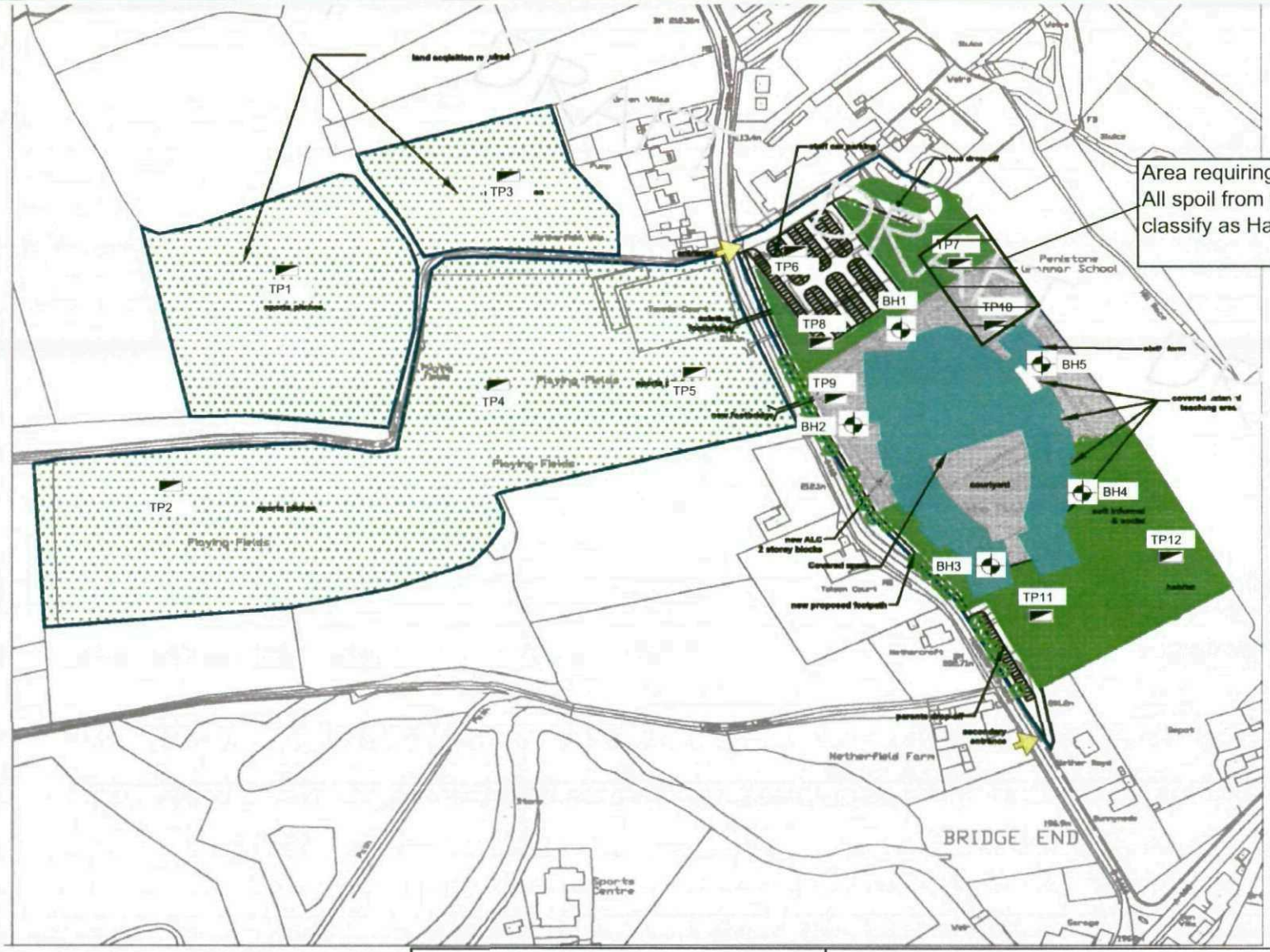
Penistone High School, Barnsley

Location Plan

3908/5/1

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TP1 NOT ACCESSIBLE

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Project	Penistone Grammar School
Drawing	Development & Site Investigation Layout
Scale	NTS
Date	September 2006 **Number** 3908/5/2

APPENDIX B

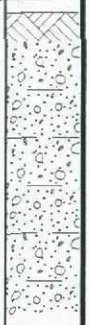
BOREHOLE SECTION SHEETS

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

CLIENT	SITE
BARNSLEY MBC	PENISTONE HIGH SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
27/07/06-27/07/06	1:50	SEE LOCATION PLAN	AR	DH	06/3908/5

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			SANDSTONE completely weathered to yellow/brown very gravelly cobbly sand - with occasionally clayey pockets			
1.20 - 1.65	SPT	30					
1.50	BULK						
2.00 - 2.05	SPT	50/50MM		BOREHOLE TERMINATED	2.05		



GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
NS					BOREHOLE DRY
NS					dry on 15/09/06

BORING METHOD AND REMARKS

DANDO 150

1 HOUR DAYWORKS DIGGING 1.20M SERVICE PIT

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 1

CLIENT	SITE
BARNSLEY MBC	PENISTONE HIGH SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
27/07/06-27/07/06	1:50	SEE LOCATION PLAN	AR	DH	06/3908/5

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			SANDSTONE completely weathered to yellow/brown very gravelly cobbly sand - becoming fresher with depth			
1.20 - 1.65	SPT	33					
1.65	BULK						
2.00 - 2.45	SPT	52					
2.50	BULK						
2.55 - 2.60	SPT	50/75MM		BOREHOLE TERMINATED	2.60		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
NS					BOREHOLE DRY
NS					dry on 15/09/06

BORING METHOD AND REMARKS

DANDO 150
1 HOUR DIGGING 1.20M SERVICE PIT
1 HOUR CHISELLING

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 1

CLIENT	SITE
BARNSLEY MBC	PENISTONE HIGH SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
27/07/06-27/07/06	1:50	SEE LOCATION PLAN	AR	DH	06/3908/5

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			SANDSTONE weathered to very dense gravelly cobbly sand			
1.00 - 1.45	SPT	75/50MM					
				BOREHOLE TERMINATED	1.45		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
NS					BOREHOLE DRY
NS					dry on 15/09/06

BORING METHOD AND REMARKS

DANDO 150
1 HOUR DIGGING 1.20M SERVICE PIT
1 HOUR CHISELLING

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 1

CLIENT	SITE
BARNSLEY MBC	PENISTONE HIGH SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
27/07/06-27/07/06	1:50	SEE LOCATION PLAN	AR	DH	06/3908/5

SAMPLE RECORD DEPTH	SAMPLE RECORD 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			SANDSTONE completely weathered to slightly clayey very gravelly cobbly sand			
1.20 - 1.65	SPT	31					
1.65	BULK						
2.00 - 2.05	SPT	75/50MM		BOREHOLE TERMIANTED	2.05		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
NS					BOREHOLE DRY
NS					dry on 15/09/06

BORING METHOD AND REMARKS

DANDO 150
1 HOUR DAYWORKS DIGGING 1.20M SERVICE PIT
1 HOUR CHISELLING

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 1

CLIENT	SITE
BARNSLEY MBC	PENISTONE HIGH SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	OPERATOR	LOGGED BY	JOB NO.
27/07/06-27/07/06	1:50	SEE LOCATION PLAN	AR	DH	06/3908/5

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		
				SANDSTONE weathered to clayey gravelly cobbly sand			
0.50	BULK						
1.20 - 1.65	SPT	29					
1.65	BULK						
1.70 - 1.75	SPT	75/50MM					
				BOREHOLE TERMINATED	2.00		

GROUNDWATER AND CASING INFORMATION

DEPTH STRUCK	DEPTH CASED	ELAPSED TIME	WATER LEVEL	DEPTH SEALED	REMARKS ON GROUNDWATER AND CASING
NS					BOREHOLE DRY
NS					dry on 15/09/06

BORING METHOD AND REMARKS

DANDO 150

All dimensions are in metres unless otherwise stated

APPENDIX C

TRIAL PIT SECTION SHEETS

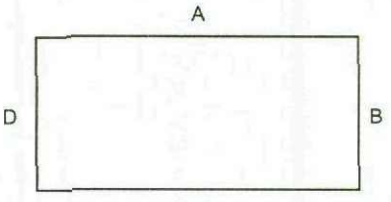
CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	TRIAL PIT LOG	TRIAL PIT NO. TP2 Sheet 1 of 1

CLIENT	SITE
BARNSLEY MBC	PENISTONE HIGH SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
14/08/06-14/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/5

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	5%	0.30	Orange/brown SANDSTONE recovered as very gravelly very cobbly SAND with occasional boulders PID HEADSPACE = 0.0ppm		
0.70	TUB					
			1.00	TRIAL PIT TERMINATED ON ROCKHEAD		

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

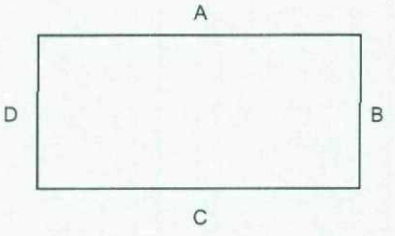
CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	TRIAL PIT LOG	TRIAL PIT NO. TP3 Sheet 1 of 1

CLIENT	SITE
BARNSLEY MBC	PENISTONE HIGH SCHOOL, BARNSLEY

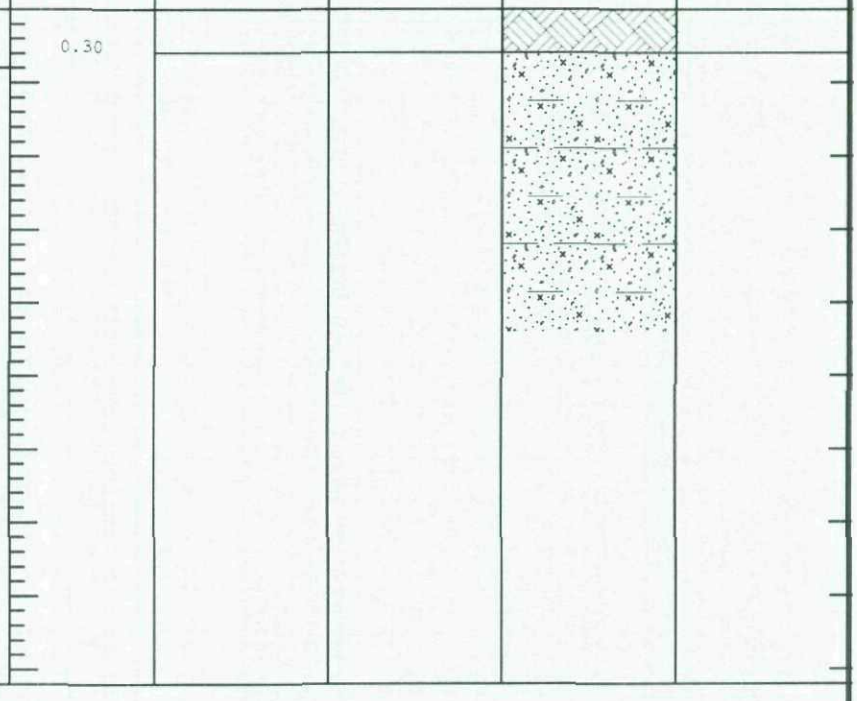
DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
14/08/06-14/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/5

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

ORIENTATION



Orientation



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)		
			0.30			
0.50	CBR	4%		Light brown slightly clayey silty gravelly SAND with much sandstone gravels and cobbles from 0.7mbgl		
0.70	TUB			PID HEADSPACE = 0.0ppm		
			2.20	TRIAL PIT TERMINATED ON ROCKHEAD		

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

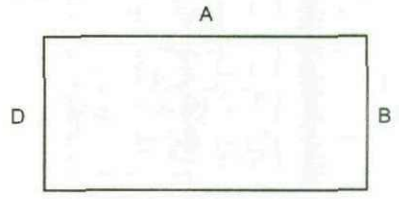
CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	TRIAL PIT LOG	TRIAL PIT NO. TP4 Sheet 1 of 1

CLIENT	SITE
BARNSLEY MBC	PENISTONE HIGH SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
14/08/06-14/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/5

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	5%		Orange/brown SANDSTONE recovered as very gravelly very cobbly SAND		
0.70	TUB					
			1.50	TRIAL PIT TERMINATED ON ROKCHEAD		

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. TP5
Sheet 1 of 1

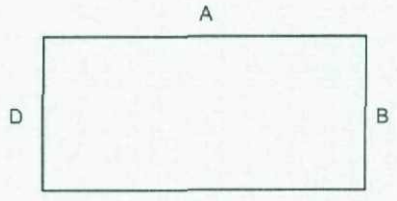
CLIENT: BARNSLEY MBC

SITE: PENISTONE HIGH SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
14/08/06-14/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/5

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%		Light brown silty gravelly occasionally clayey SAND with much sandstone gravel and cobbles from 0.5mbgl		
0.70	TUB			PID HEADSPACE = 0.0ppm		
			1.00	TRIAL PIT TERMINATED ON ROCKHEAD		

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

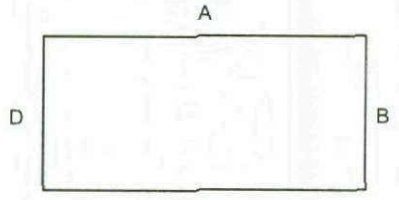
TRIAL PIT NO. TP6
Sheet 1 of 1

CLIENT	SITE
BARNSLEY MBC	PENISTONE HIGH SCHOOL, BARNSLEY

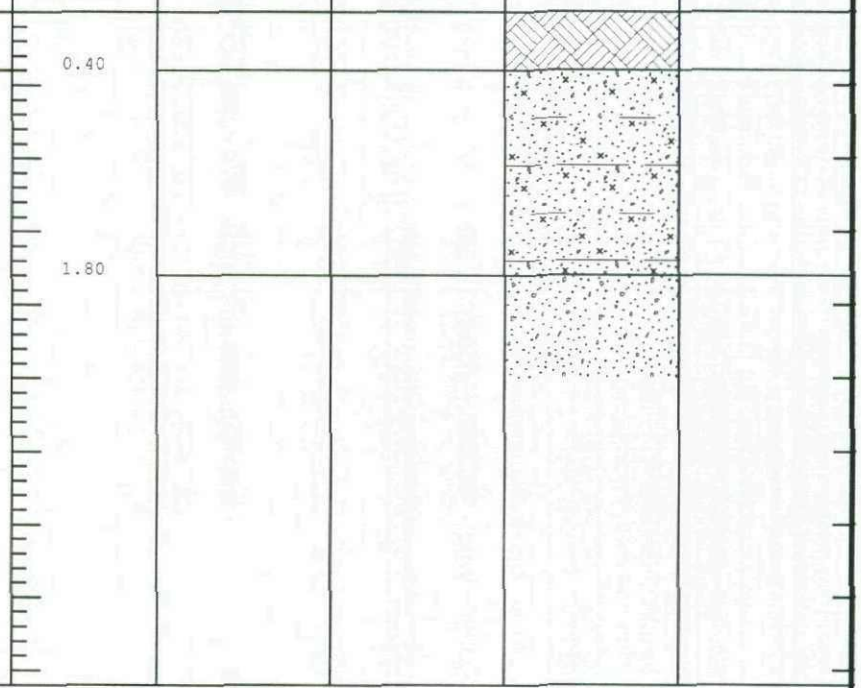
DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
14/08/06-14/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/5

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

ORIENTATION



Orientation



FACE AND POSITION LOGGED ALL

SAMPLE AND TEST RECORD DEPTH	TYPE	RESULT	DEPTH	DESCRIPTION OF STRATUM (thickness)	STRATUM NO.	WATER DEPTH
				Grassed TOPSOIL (0.40)		
0.50	CBR	4%	0.40	Light brown becoming orange/brown slightly clayey silty gravelly SAND becoming more gravelly and cobbly with depth (weathered SANDSTONE) (1.40)		
0.70	TUB			PID HEADSPACE = 0.0ppm		
			1.80			
2.00	TUB			Grey/brown MUDSTONE recovered as SAND and GRAVEL		
			2.50	TRIAL PIT TERMINATED ON ROCKHEAD		

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. TP7
Sheet 1 of 1

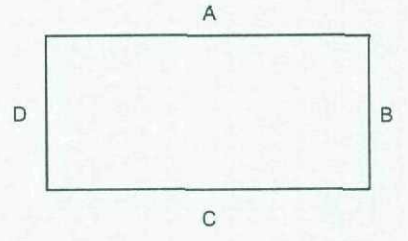
CLIENT: BARNSLEY MBC

SITE: PENISTONE HIGH SCHOOL, BARNSLEY

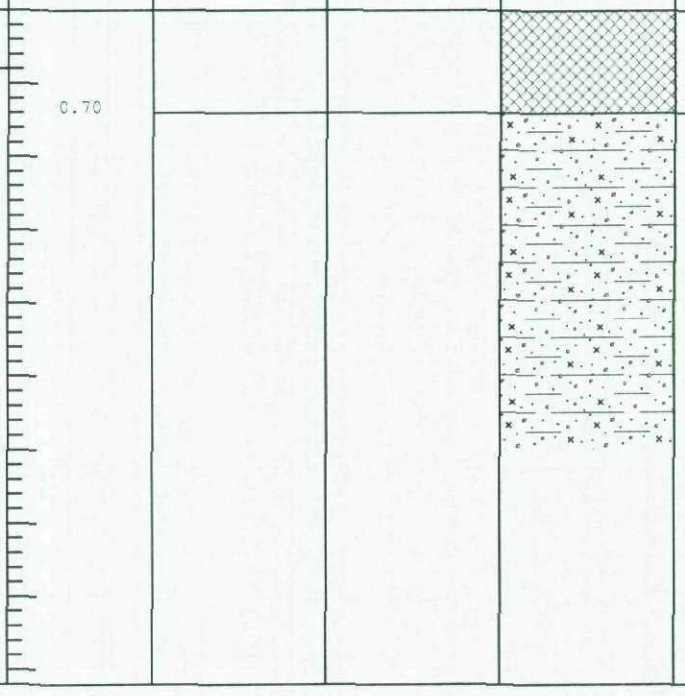
DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
14/08/06-14/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/5

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

ORIENTATION



Orientation



FACE AND POSITION LOGGED ALL

SAMPLE AND TEST RECORD DEPTH	TYPE	RESULT	DEPTH	DESCRIPTION OF STRATUM (thickness)	STRATUM NO.	WATER DEPTH
				MADE GROUND comprising brick, concrete, timber, metal and gravel in sand (0.70)		
0.50	CBR	3%				
0.60	TUB			*PID HEADSPACE = 0.0ppm*		
			0.70			
1.00	TUB			Dark brown becoming light brown very silty very sandy gravelly CLAY often tending to clayey silty SAND becoming more gravelly and cobbly and occasional boulders with depth (weathered SANDSTONE)		
			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. TP8
Sheet 1 of 1

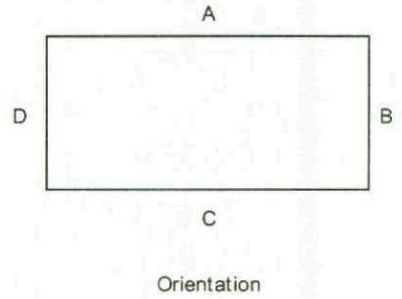
CLIENT: BARNSLEY MBC

SITE: PENISTONE HIGH SCHOOL, BARNSLEY

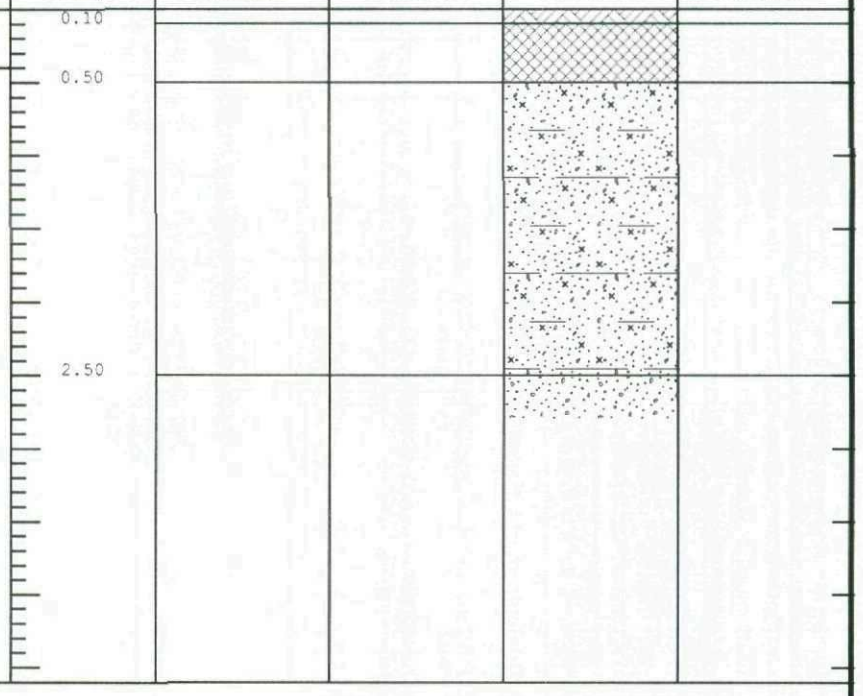
DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
14/08/06-14/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/5

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

ORIENTATION



Orientation



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 and gravel in sand (0.40)		
0.40	TUB		0.50	PID HEADSPACE = 0.0ppm		
0.50	CBR	4%		Light brown becoming grey/brown clayey silty gravelly SAND occasionally tending to silty sandy CLAY becoming more gravelly and cobbly with depth (weathered SANDSTONE) (2.00)		
1.00	TUB					
			2.50			
2.70	TUB			Grey/brown MUDSTONE recovered as SAND and GRAVEL		
			2.80	TRIAL PIT TERMINATED ON ROCKHEAD		

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

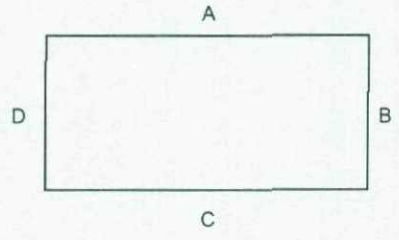
CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	TRIAL PIT LOG	TRIAL PIT NO. TP9 Sheet 1 of 1

CLIENT	SITE
BARNSLEY MBC	PENISTONE HIGH SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
14/08/06-14/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/5

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	Light brown SANDSTONE recovered as very gravelly very cobbly SAND becoming more gravelly and cobbly with depth PID HEADSPACE = 0.0ppm		
0.70	TUB					
			1.50	TRIAL PIT TERMINATED ON ROCKHEAD		

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

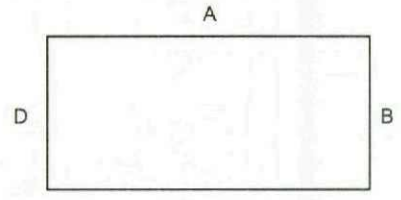
CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	TRIAL PIT LOG	TRIAL PIT NO. TP10 Sheet 1 of 1

CLIENT	SITE
BARNSLEY MBC	PENISTONE HIGH SCHOOL, BARNSLEY

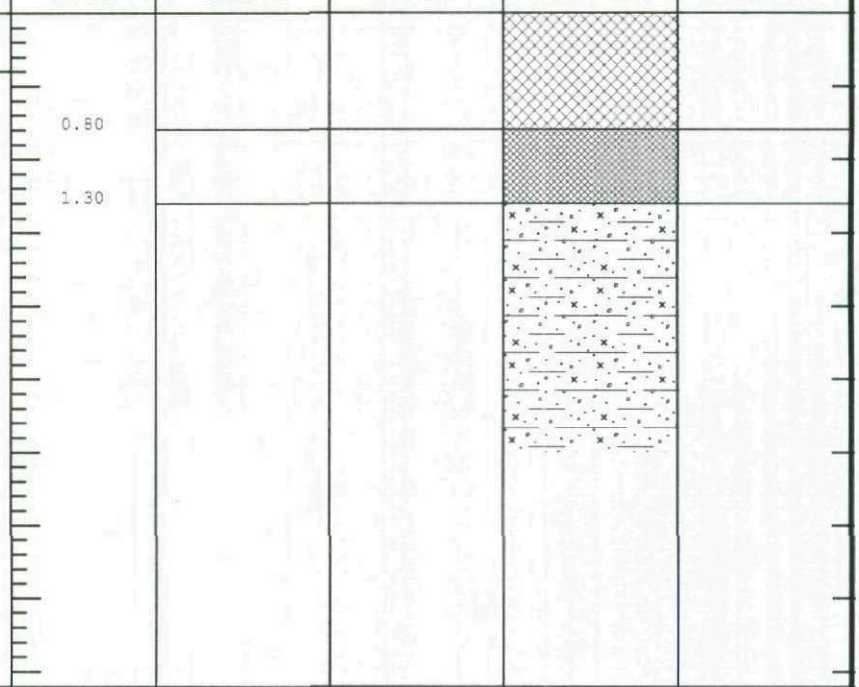
DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
14/08/06-14/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/5

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

ORIENTATION



Orientation



FACE AND POSITION LOGGED ALL

SAMPLE AND TEST RECORD DEPTH	TYPE	RESULT	DEPTH	DESCRIPTION OF STRATUM (thickness)	STRATUM NO.	WATER DEPTH
				MADE GROUND comprising brick, concrete, wire, gravel and occasional timber in sand (0.80)		
0.50	CBR	3%				
0.70	TUB			PID HEADSPACE = 0.0ppm		
1.00	TUB		0.80	MADE GROUND comprising reworked light brown silty sandy gravelly clay with occasional brick and tarmac (0.50)		
			1.30			
1.50	TUB			Dark brown rapidly becoming brown very silty very sandy gravelly CLAY often tending to clayey silty SAND becoming more gravelly and cobbly with depth (weathered SANDSTONE)		
			3.00	TRIAL PIT TERMINATED ON ROCKHEAD		

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

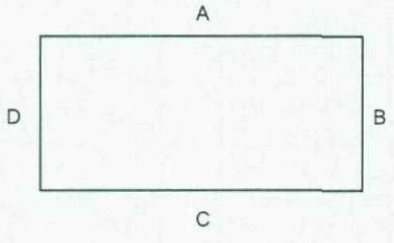
CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	TRIAL PIT LOG	TRIAL PIT NO. TP11 Sheet 1 of 1

CLIENT	SITE
BARNSLEY MBC	PENISTONE HIGH SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
14/08/06-14/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/5

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	3%	0.30	Firm/stiff mottled orange/brown/grey silty sandy CLAY becoming gravelly with depth (dry and crumbly - weathered MUDSTONE) PID HEADSPACE = 0.0ppm		
0.70	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

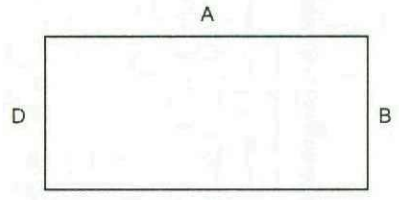
TRIAL PIT NO. TP12
Sheet 1 of 1

CLIENT	SITE
BARNSLEY MBC	PENISTONE HIGH SCHOOL, BARNSLEY

DATE OF FIELDWORK	SCALE	LEVEL/POSITION	LOGGED BY	JOB NO.
14/08/06-14/08/06	1:50	SEE LOCATION PLAN	RR	06/3908/5

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	3%	0.30	Light brown clayey silty gravelly SAND becoming more gravelly and cobbly with depth (weathered SANDSTONE)		
0.70	TUB			PID HEADSPACE = 0.0ppm		
			2.20	TRIAL PIT TERMINATED ON ROCKHEAD		

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



TP2



TP3



TP4



TP5



TP6



TP7



TP8



TP9



TP10



TP11



TP12

APPENDIX D

GROUND GAS MONITORING DATA

GAS MONITORING RESULTS

Job Number:	06/3908/5		Site Name:	Penistone High School, Barnsley

	VISIT NUMBER	1	2	3	4	5	6	7	8	9	10
	DATE	15/09/06	29/09/06	04/10/06	12/10/06	19/10/06	25/10/06				
BH	ATMOSPHERIC PRESSURE (mB)	988	977	983	992	962	999				
	AIR TEMPERATURE (^{U}C)	15	20	15	15	15	15				
	CLOUD COVER	Light	Overcast	Overcast	Light	Overcast	Overcast				
	WIND VELOCITY (MPH)	Light	Light	Moderate	Moderate	Strong	Moderate				
	PRECIPITATION	Nil	Nil	Nil	Nil	Light rain	Nil				
	STATE OF GROUND	Dry	Damp	Dry	Dry	Wet	Damp				
1	CH_4 (%)	Nil	Nil	Nil	Nil	0.1	Nil				
	CO_2 (%)	3.2	3.6	0.7	0.6	0.2	0.5				
	O_2 (%)	16.4	17.8	20.3	20.0	20.6	20.4				
	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)	1.75	Dry	Dry	1.00	0.99	1.00				
2	CH_4 (%)	Nil	Nil	Nil	Nil	0.1	Nil				
	CO_2 (%)	1.1	1.5	1.5	1.3	1.4	1.2				
	O_2 (%)	18.6	18.5	19.5	17.8	18.1	19.3				
	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 (%)	0.3	0.2	0.3	0.3	0.2	0.1				
	O_2 (%)	20.3	20.3	20.2	20.4	20.3	20.3				
	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				
4	CH_4 (%)	Nil	Nil	Nil	Nil	0.1	Nil				
	CO_2 (%)	2.4	3.0	3.2	3.4	3.4	3.3				
	O_2 (%)	17.6	17.5	18.2	16.5	17.3	16.6				
	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

GAS MONITORING RESULTS

Job Number:	06/3908/5		Site Name:	Penistone High School, Barnsley

	VISIT NUMBER	1	2	3	4	5	6	7	8	9	10
	DATE	15/09/06	29/09/06	04/10/06	12/10/06	19/10/06	25/10/06				
BH	ATMOSPHERIC PRESSURE (mB)	988	977	983	992	962	999				
	AIR TEMPERATURE (^{O}C)	15	20	15	15	15	15				
	CLOUD COVER	Light	Overcast	Overcast	Light	Overcast	Overcast				
	WIND VELOCITY (MPH)	Light	Light	Moderate	Moderate	Strong	Moderate				
	PRECIPITATION	Nil	Nil	Nil	Nil	Light rain	Nil				
	STATE OF GROUND	Dry	Damp	Dry	Dry	Wet	Damp				
5	CH_4 (%)	Nil	Nil	Nil	Nil	0.1	Nil				
	CO_2 (%)	0.2	0.1	0.2	0.2	0.6	0.2				
	O_2 (%)	20.1	20.4	20.6	20.3	20.3	20.3				
	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				
	CH_4 (%)										
	CO_2 (%)										
	O_2 (%)										
	H_2S (p.p.m.)										
	CO (p.p.m.)										
	FLOW (l/hr)										
	STANDING WATER LEVEL (m)										
	CH_4 (%)										
	CO_2 (%)										
	O_2 (%)										
	H_2S (p.p.m.)										
	CO (p.p.m.)										
	FLOW (l/hr)										
	STANDING WATER LEVEL (m)										
	CH_4 (%)										
	CO_2 (%)										
	O_2 (%)										
	H_2S (p.p.m.)										
	CO (p.p.m.)										
	FLOW (l/hr)										
	STANDING WATER LEVEL (m)										

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

Tested .....

Approved .....

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: 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	1000 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	31	-	-	-	43	23	20	92	CI	Very sandy gravelly CLAY. (see PSD result sheet)
BH1	BD	1.50	1.50	22	-	-	-	36	22	14	92	CI	
BH2	BD	0.50	0.50	19	-	-	-	-	-	-	-	-	Very silty very sandy GRAVEL. (see PSD result sheet)
BH2	BD	1.50	1.50	16	-	-	-	28	18	10	85	CL	Very sandy very gravelly CLAY. (see PSD result sheet)
BH2	BD	2.50	2.50	13	-	-	-	-	-	-	-	-	
BH3	BD	0.50	0.50	12	-	-	-	-	-	-	-	-	Very gravelly sandy CLAY. (see PSD result sheet)
BH4	BD	0.50	0.50	16	-	-	-	-	-	-	-	NP	Very sandy gravelly SILT. (see PSD result sheet)
BH4	BD	1.50	1.50	13	-	-	-	39	19	20	93	CI	
BH5	BD	0.50	0.50	17	-	-	-	43	22	21	86	CI	Very gravelly sandy CLAY. (see PSD result sheet)
BH5	BD	1.50	1.50	14	-	-	-	38	20	18	90	CI	

SITE: PENISSTONE SCHOOL

CLIENT: BARNSLEY MBC

DATE: Sep-06

SHEET: 1 of 1

CC Geotechnical

Telephone: (0151) 523 0202

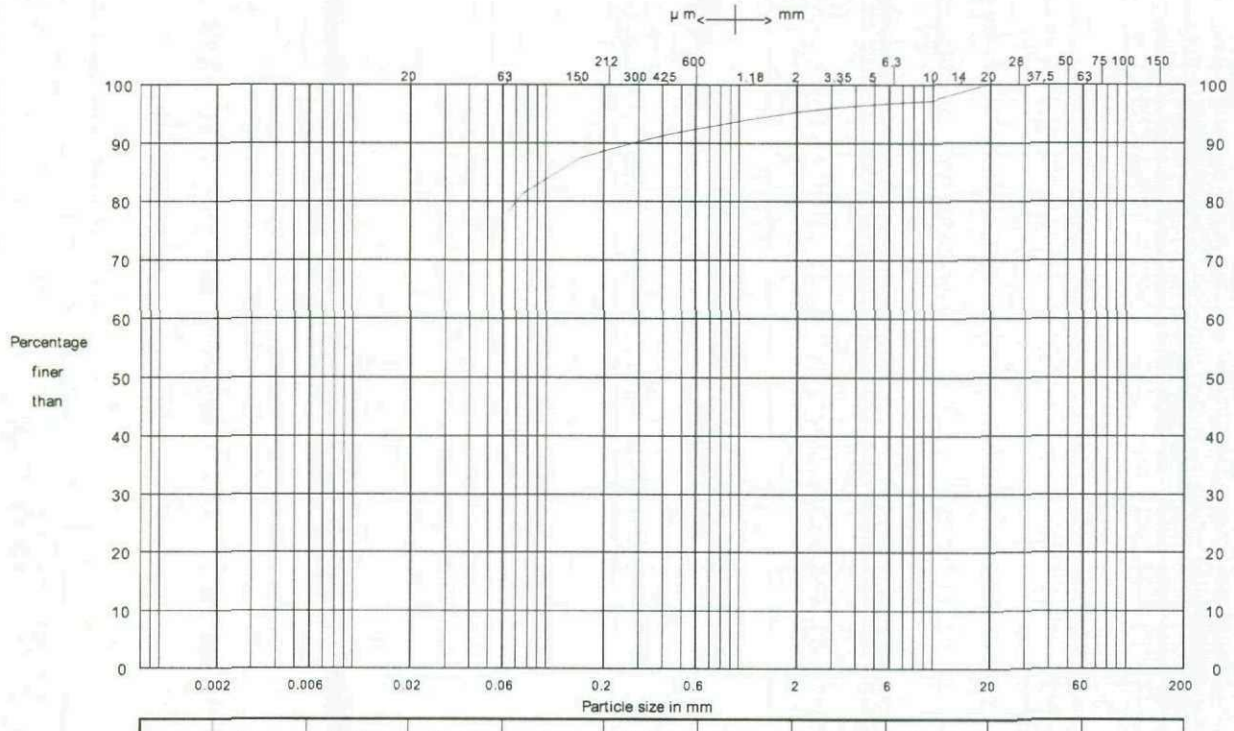
Key:- BD = Bulk Disturbed; SD = Small Disturbed; U100 = Undisturbed 100mm

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

(* Denotes Hand Shear Vane test result)

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH1
CLIENT BARNSLEY MBC		SITE PENISSTONE SCHOOL	
SAMPLE DEPTH 0.50 - 0.50		SAMPLE REF 1	JOB NO. 06/3908/5
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	78	81	87	89	90	91	92	94	95	96	97	97	97	99	100	100	100	100	100	100	100	100

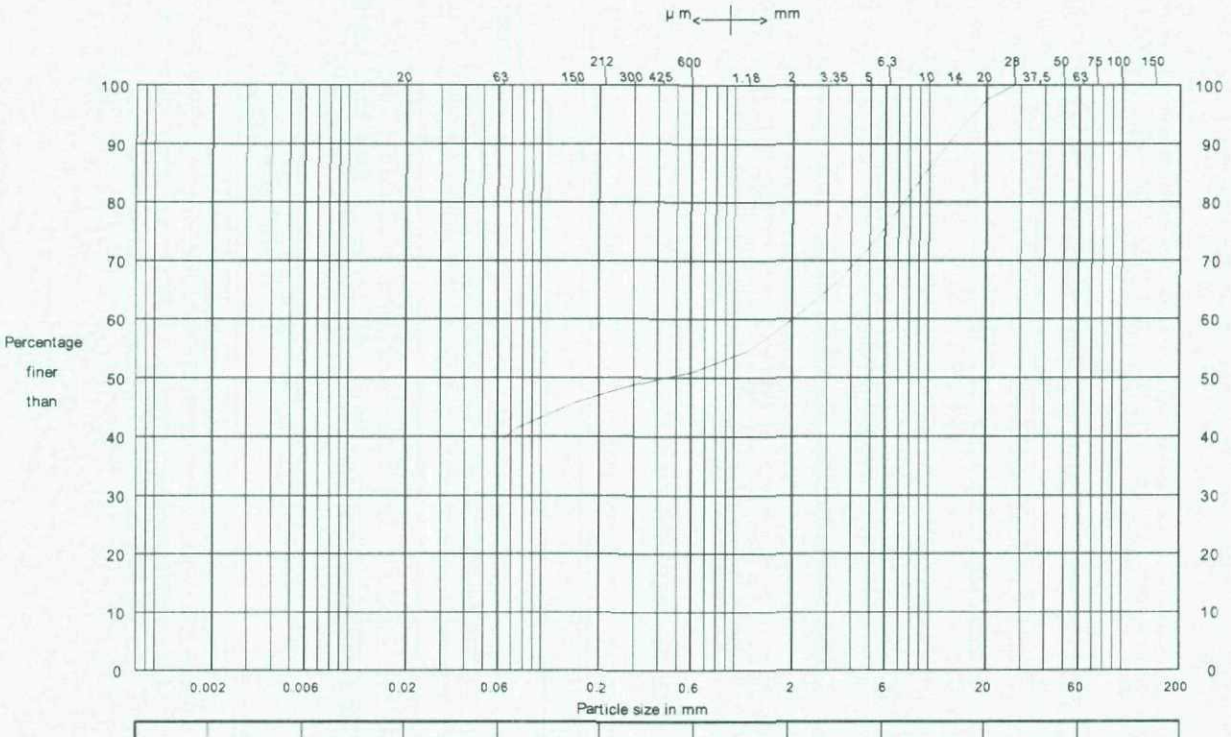


	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			17			5			0

SAMPLE DESCRIPTION	REMARKS
Very sandy gravelly CLAY	

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH2
CLIENT BARNSLEY MBC		SITE PENISSTONE SCHOOL	
SAMPLE DEPTH 0.50 - 0.50		SAMPLE REF 1	JOB NO. 06/3908/5
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	39	41	46	47	49	50	51	54	60	66	72	77	86	92	98	100	100	100	100	100	100	100



	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			21			40			0

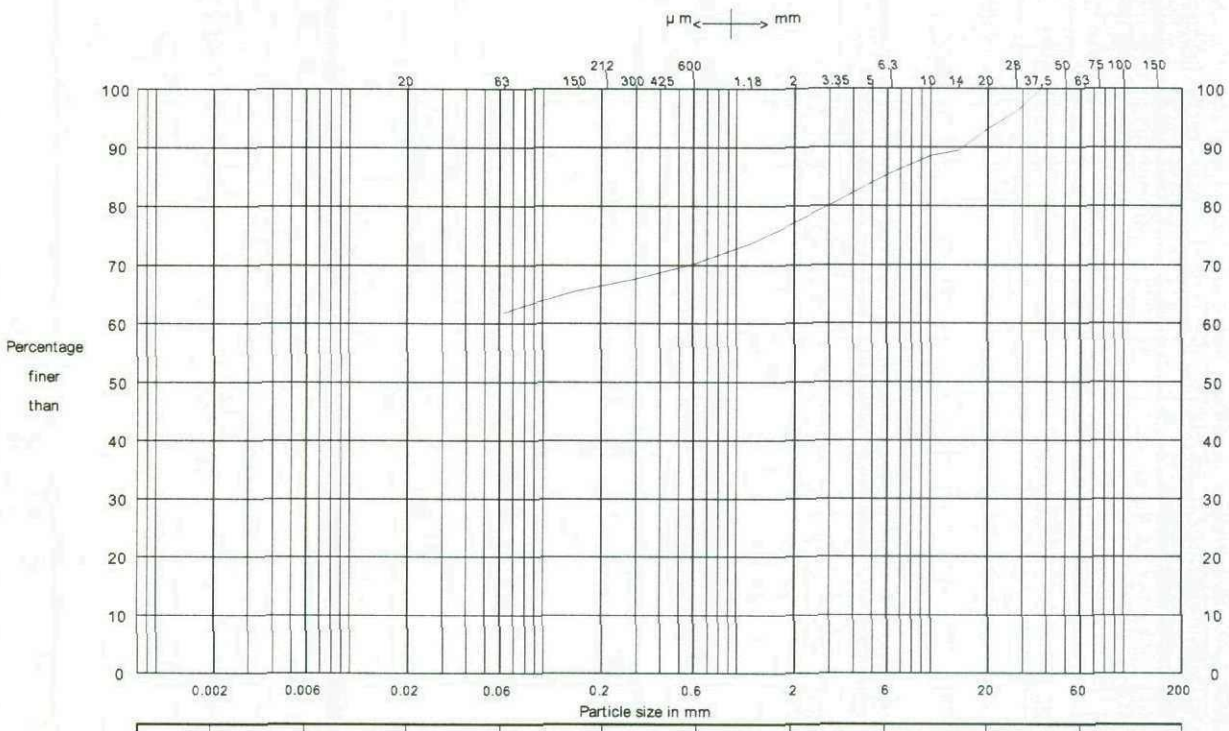
SAMPLE DESCRIPTION

Very silty very sandy GRAVEL

REMARKS

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH2
CLIENT	BARNSLEY MBC	SITE	PENISSTONE SCHOOL
SAMPLE DEPTH	1.50 - 1.50	SAMPLE REF	2
JOB NO.	06/3908/5		
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	62	63	66	67	68	69	70	74	77	81	84	86	88	89	93	96	100	100	100	100	100	100	



	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			15			23			0

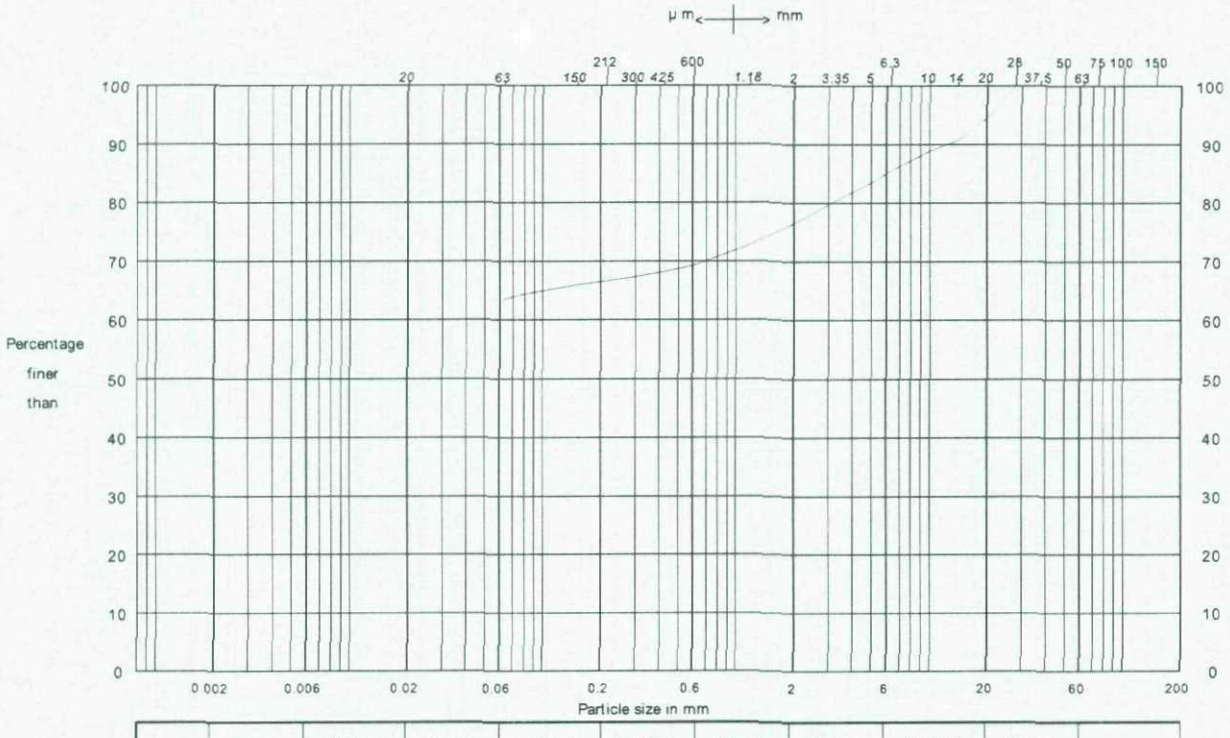
SAMPLE DESCRIPTION

Very sandy very gravelly CLAY

REMARKS

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH3
CLIENT	BARNSLEY MBC	SITE	PENISSTONE SCHOOL
SAMPLE DEPTH	0.50 - 0.50	SAMPLE REF	1
JOB NO.	06/3908/5		
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	63	64	66	67	67	68	69	73	76	80	83	85	89	91	94	100	100	100	100	100	100	100

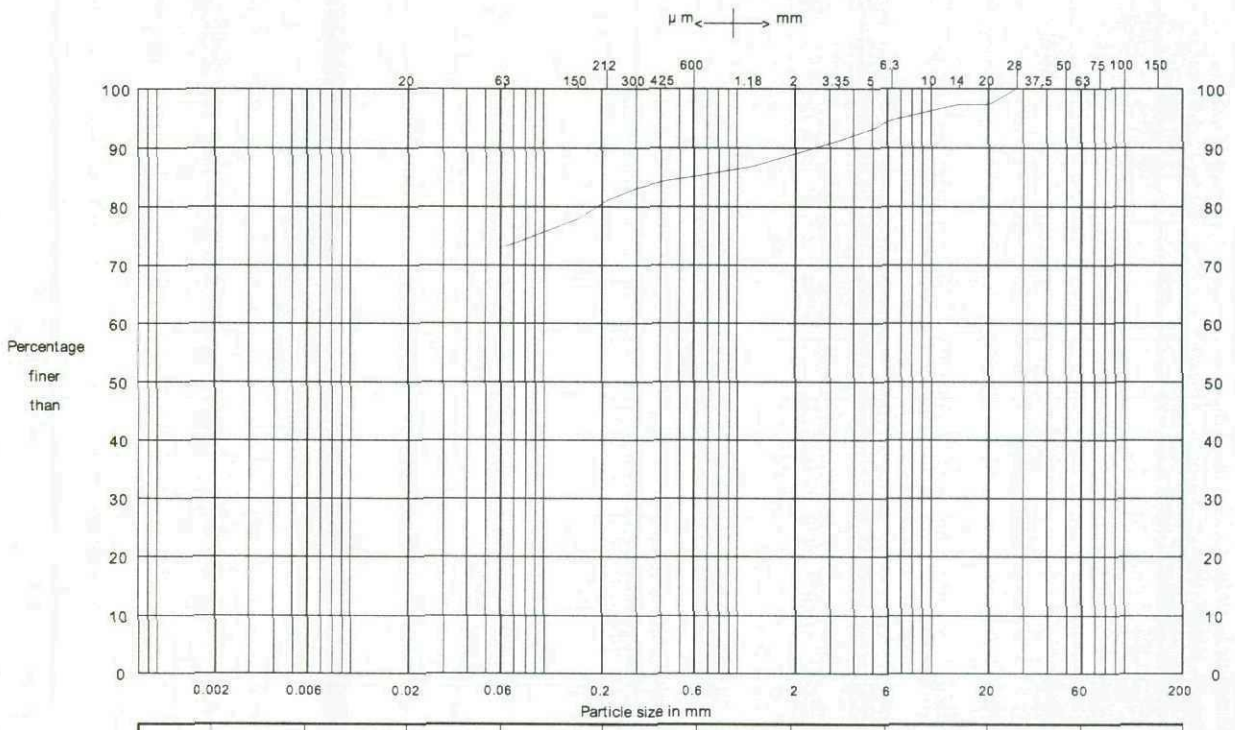


	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			13			24			0

SAMPLE DESCRIPTION	REMARKS
Very gravelly sandy CLAY	

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH4
CLIENT BARNSLEY MBC		SITE PENI$STONE SCHOOL	
SAMPLE DEPTH 0.50 - 0.50		SAMPLE REF 1	JOB NO. 06/3908/5
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	73	74	78	81	83	84	85	87	89	91	93	95	96	97	97	100	100	100	100	100	100	100



	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			16			11			0

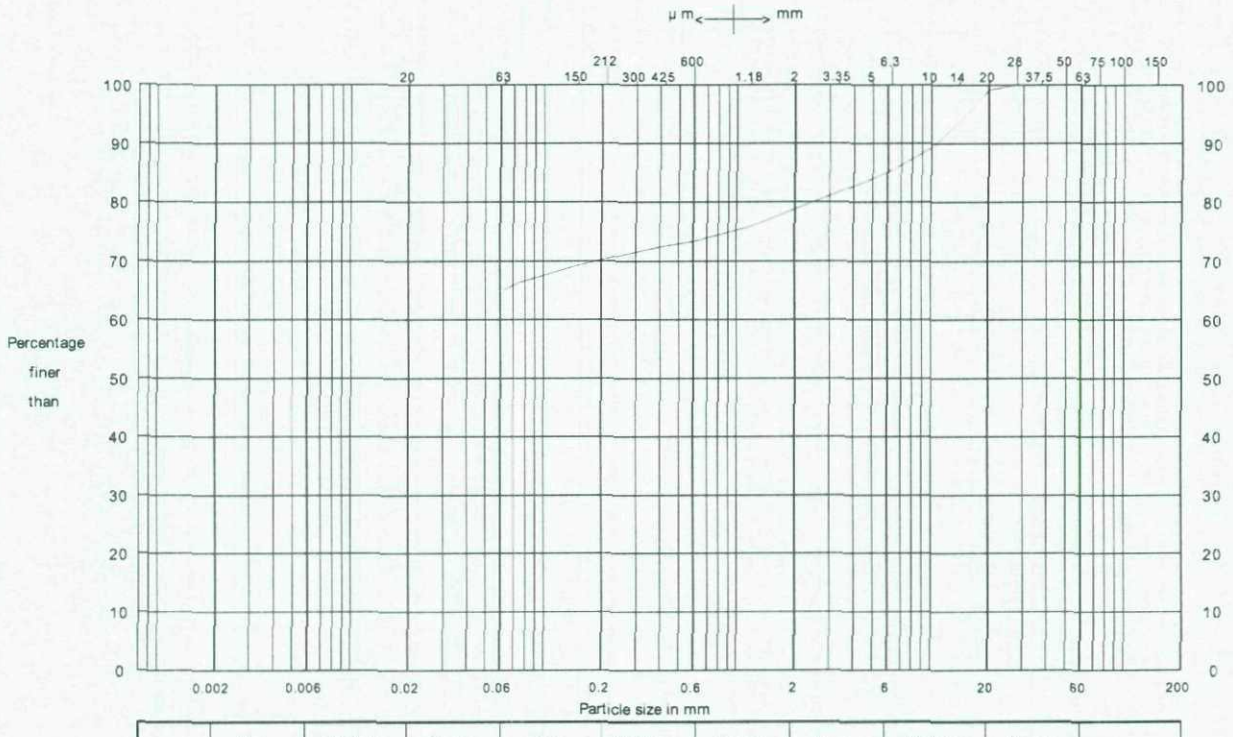
SAMPLE DESCRIPTION

Very sandy gravelly SILT

REMARKS

CC Geotechnical	Tel: 0151-523-0202 Fax: 0151-523-0252	DETERMINATION OF PARTICLE SIZE DISTRIBUTION	HOLE NO. BH5
CLIENT BARNSLEY MBC		SITE PENISSTONE SCHOOL	
SAMPLE DEPTH 0.50 - 0.50		SAMPLE REF 1	JOB NO. 06/3908/5
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	66	69	70	71	72	73	76	79	82	84	85	89	94	99	100	100	100	100	100	100	100



	CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
		SILT			SAND			GRAVEL			
%	-	-			14			21			0

SAMPLE DESCRIPTION	REMARKS
Very gravelly sandy CLAY	

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: R06/1341

Client Project Name:	**Penistone High School, Barnsley**
Client Project Number:	**06/3908/5**
Your Order Number:	**06/3908/5**
Order Receipt Date:	**25/08/06**
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: Penistone High School, Barnsley

Client: CC GEOTECHNICAL

Project Number: 06/3908/5

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: Penistone High School, Barnsley

Client: CC GEOTECHNICAL

Project Number: 06/3908/5

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	04/09/06
Cadmium	ICP-OES	D	0.2 mg/kg	17025	No	04/09/06
Chromium (hexavalent)	ICP-OES	D	1.0 mg/kg	17025	No	07/09/06
Chromium (total)	ICP-OES	D	0.2 mg/kg	17025	No	04/09/06
Lead	ICP-OES	D	0.5 mg/kg	17025	No	04/09/06
Mercury	ICP-OES	D	0.1 mg/kg	17025	No	04/09/06
Selenium	ICP-OES	D	1.0 mg/kg	17025	No	04/09/06
Boron (water soluble)	ICP-OES	D	0.5 mg/kg	17025	No	07/09/06
Copper	ICP-OES	D	0.2 mg/kg	17025	No	04/09/06
Nickel	ICP-OES	D	0.2 mg/kg	17025	No	04/09/06
Zinc	ICP-OES	D	0.2 mg/kg	17025	No	04/09/06
PAH (sum of EPA 16)	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Phenols (monohydric)	Colorimetry	R	2.0 mg/kg	17025	No	31/08/06
Cyanide (free)	Colorimetry	R	2.0 mg/kg	17025	No	01/09/06
Cyanide (total)	Colorimetry	R	2.0 mg/kg	17025	No	01/09/06
Cyanide (complex)	Colorimetry	R	2.0 mg/kg	17025	No	01/09/06
Sulphate (water soluble)	HPLC-IC	D	0.001 g/l SO4	17025	No	06/09/06
Sulphide	Colorimetry	R	2.0 mg/kg	17025	No	01/09/06
Sulphur (free)	HPLC-UV	D	4 mg/kg	17025	No	13/09/06
pH	pH-meter	D	N/A	17025	No	04/09/06
Naphthalene	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Acenaphthylene	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Acenaphthene	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Fluorene	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Phenanthrene	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Anthracene	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Fluoranthene	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Pyrene	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Benzo(a)anthracene	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Chrysene	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Benzo(b)fluoranthene	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Benzo(k)fluoranthene	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Benzo(a)pyrene	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Indeno(1,2,3-cd)pyrene	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Dibenz(a,h)anthracene	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Benzo(g,h,i)perylene	GC-MS	D	0.1 mg/kg	17025	No	06/09/06
Barium	ICP-OES	D	0.2 mg/kg	None	No	04/09/06
Beryllium	ICP-OES	D	0.2 mg/kg	None	No	04/09/06
Vanadium	ICP-OES	D	0.2 mg/kg	None	No	04/09/06
Nitrate	HPLC-IC	D	2.0 mg/kg	None	No	06/09/06
Sulphate (total)	ICP-OES	D	30 mg/kg SO4	17025	No	07/09/06
Chrysotile (white)	Microscopy	D	0.1% w/w	17025	No	30/08/06

Client Project Name: Penistone High School, Barnsley

Client: CC GEOTECHNICAL

Project Number: 06/3908/5

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	30/08/06
Crocidolite (blue)	Microscopy	D	0.1% w/w	17025	No	30/08/06
Anthophyllite	Microscopy	D	0.1% w/w	17025	No	30/08/06
Actinolite	Microscopy	D	0.1% w/w	17025	No	30/08/06
Tremolite	Microscopy	D	0.1% w/w	17025	No	30/08/06
Non-Asbestos fibres	Microscopy	D	0.1% w/w	None	No	30/08/06
Organic Matter	Titration	D	0.1 %	None	No	04/09/06
TPH	GC-FID	D	5.0 mg/kg	17025	No	06/09/06
TPH C10-C12	GC-FID	D	5.0 mg/kg	None	No	06/09/06
TPH C12-C16	GC-FID	D	5.0 mg/kg	None	No	06/09/06
TPH C16-C21	GC-FID	D	5.0 mg/kg	None	No	06/09/06
TPH C21-C35	GC-FID	D	5.0 mg/kg	None	No	06/09/06
TPH C35-C40	GC-FID	D	5.0 mg/kg	None	No	06/09/06
TPH Aromatic EC5-EC7	HS-GC-FID	R	0.02 mg/kg	None	No	15/09/06
TPH Aromatic EC7-EC8	HS-GC-FID	R	0.02 mg/kg	None	No	15/09/06
TPH Aromatic EC8-EC10	HS-GC-FID	R	0.1 mg/kg	None	No	15/09/06
TPH Aromatic EC10-EC12	GC-FID	D	5.0 mg/kg	None	No	14/09/06
TPH Aromatic EC12-EC16	GC-FID	D	5.0 mg/kg	None	No	14/09/06
TPH Aromatic EC16-EC21	GC-FID	D	5.0 mg/kg	None	No	14/09/06
TPH Aromatic EC21-EC35	GC-FID	D	5.0 mg/kg	None	No	14/09/06
TPH Aliphatic EC5-EC6	HS-GC-FID	R	0.1 mg/kg	None	No	15/09/06
TPH Aliphatic EC6-EC8	HS-GC-FID	R	0.1 mg/kg	None	No	15/09/06
TPH Aliphatic EC8-EC10	HS-GC-FID	R	0.1 mg/kg	None	No	15/09/06
TPH Aliphatic EC10-EC12	GC-FID	D	5.0 mg/kg	None	No	14/09/06
TPH Aliphatic EC12-EC16	GC-FID	D	5.0 mg/kg	None	No	14/09/06
TPH Aliphatic EC16-EC35	GC-FID	D	5.0 mg/kg	None	No	14/09/06
Benzene	HS-GC-FID	R	0.02 mg/kg	17025	No	15/09/06
Toluene	HS-GC-FID	R	0.02 mg/kg	17025	No	15/09/06
Ethylbenzene	HS-GC-FID	R	0.02 mg/kg	17025	No	15/09/06
m+p-Xylene	HS-GC-FID	R	0.04 mg/kg	17025	No	15/09/06
o-Xylene	HS-GC-FID	R	0.02 mg/kg	17025	No	15/09/06

Client Project Name: Penistone High School, Barnsley

Client: CC GEOTECHNICAL

Project Number: 06/3908/5

Reporting Date: Friday 15 September 2006

	BH/TP	TP2	TP3	TP5	TP6	TP7
	Top Depth / m	0.70	0.70	0.70	0.70	0.60
	Bottom Depth / m					
	Customer ID					
	Sample Type					
	Date Sampled					
	Receipt Date	25/08/06	25/08/06	25/08/06	25/08/06	25/08/06
	ECõS Sample ID	S0610387	S0610388	S0610389	S0610390	S0610391
	Matrix Type	Soil	Soil	Soil	Soil	Soil
Determinand	Units					
Arsenic	mg/kg	5.7	7.6	6.2	3.8	11.2
Cadmium	mg/kg	<0.2	<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	16.1	20.2	19.1	18.0	106.6
Lead	mg/kg	11.6	8.4	8.2	8.5	21.6
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Selenium	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Boron (water soluble)	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5
Copper	mg/kg	7.6	18.8	12.2	11.6	15.3
Nickel	mg/kg	14.4	20.5	21.7	19.4	15.1
Zinc	mg/kg	41.3	56.1	63.8	43.0	69.5
PAH (sum of EPA 16)	mg/kg	<0.1	<0.1	<0.1	<0.1	411.9
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	0.008	0.008	0.010	0.005	0.514
Sulphide	mg/kg	<2.0	<2.0	<2.0	<2.0	107.1
Sulphur (free)	mg/kg	<4	<4	<4	<4	120
pH	N/A	6.3	5.8	6.7	6.7	10.9
Naphthalene	mg/kg	<0.1	<0.1	<0.1	<0.1	0.2
Acenaphthylene	mg/kg	<0.1	<0.1	<0.1	<0.1	0.3
Acenaphthene	mg/kg	<0.1	<0.1	<0.1	<0.1	4.6
Fluorene	mg/kg	<0.1	<0.1	<0.1	<0.1	4.5
Phenanthrene	mg/kg	<0.1	<0.1	<0.1	<0.1	60.2
Anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	13.7
Fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	85.3
Pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	69.4
Benzo(a)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	30.7
Chrysene	mg/kg	<0.1	<0.1	<0.1	<0.1	29.4
Benzo(b)fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	33.0
Benzo(k)fluoranthene	mg/kg	<0.1	<0.1	<0.1	<0.1	12.9
Benzo(a)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	28.9
Indeno(1,2,3-cd)pyrene	mg/kg	<0.1	<0.1	<0.1	<0.1	17.6
Dibenz(a,h)anthracene	mg/kg	<0.1	<0.1	<0.1	<0.1	3.0

Client Project Name: Penistone High School, Barnsley

Client: CC GEOTECHNICAL

Project Number: 06/3908/5

Reporting Date: Friday 15 September 2006

	BH/TP	TP2	TP3	TP5	TP6	TP7
	Top Depth / m	0.70	0.70	0.70	0.70	0.60
	Bottom Depth / m					
	Customer ID					
	Sample Type					
	Date Sampled					
	Receipt Date	25/08/06	25/08/06	25/08/06	25/08/06	25/08/06
	ECõS Sample ID	S0610387	S0610388	S0610389	S0610390	S0610391
	Matrix Type	Soil	Soil	Soil	Soil	Soil
Determinand	**Units**					
Benzo(g,h,i)perylene	mg/kg	<0.1	<0.1	<0.1	<0.1	18.5
Barium	mg/kg	18.2	24.7	16.5	16.7	124.9
Beryllium	mg/kg	0.5	0.8	0.8	0.6	1.2
Vanadium	mg/kg	24.2	28.7	26.9	25.3	64.6
Nitrate	mg/kg	8.0	<2.0	<2.0	<2.0	37.9
Sulphate (total)	mg/kg SO4	152	40	71	<30	7320
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	P	P	P	P	P
Organic Matter	%	1.0	1.0	1.0	0.5	3.9
TPH	mg/kg	7.3	<5.0	<5.0	<5.0	2554.8
TPH C10-C12	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0
TPH C12-C16	mg/kg	<5.0	<5.0	<5.0	<5.0	52.1
TPH C16-C21	mg/kg	<5.0	<5.0	<5.0	<5.0	527.0
TPH C21-C35	mg/kg	6.2	<5.0	<5.0	<5.0	1531.1
TPH C35-C40	mg/kg	<5.0	<5.0	<5.0	<5.0	442.5
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	#	#	#	#	15.7
TPH Aromatic EC16-EC21	mg/kg	#	#	#	#	219.5
TPH Aromatic EC21-EC35	mg/kg	#	#	#	#	240.6
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
Ethylbenzene	mg/kg	#	#	#	#	<0.02

Client Project Name: Penistone High School, Barnsley

Client: CC GEOTECHNICAL

Project Number: 06/3908/5

Reporting Date: Friday 15 September 2006

	BH/TP	TP2	TP3	TP5	TP6	TP7
	Top Depth / m	0.70	0.70	0.70	0.70	0.60
	Bottom Depth / m					
	Customer ID					
	Sample Type					
	Date Sampled					
	Receipt Date	25/08/06	25/08/06	25/08/06	25/08/06	25/08/06
	ECõS Sample ID	S0610387	S0610388	S0610389	S0610390	S0610391
	Matrix Type	Soil	Soil	Soil	Soil	Soil
Determinand	**Units**					
m+p-Xylene	mg/kg	#	#	#	#	<0.04
o-Xylene	mg/kg	#	#	#	#	<0.02

Client Project Name: Penistone High School, Barnsley **Client: CC GEOTECHNICAL**

Project Number: 06/3908/5 **Reporting Date: Friday 15 September 2006**

	BH/TP	TP8	TP9	TP10	TP11	TP12
	Top Depth / m	0.40	0.70	0.70	0.70	0.70
	Bottom Depth / m					
	Customer ID					
	Sample Type					
	Date Sampled					
	Receipt Date	25/08/06	25/08/06	25/08/06	25/08/06	25/08/06
	ECõS Sample ID	S0610392	S0610393	S0610394	S0610395	S0610396
	Matrix Type	Soil	Soil	Soil	Soil	Soil
Determinand	**Units**					
Arsenic	mg/kg	9.5	5.0	9.9	3.6	6.4
Cadmium	mg/kg	<0.2	<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	20.0	20.9	41.2	26.1	23.6
Lead	mg/kg	20.2	10.1	40.8	12.1	10.7
Mercury	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
Selenium	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0
Boron (water soluble)	mg/kg	<0.5	<0.5	0.8	<0.5	<0.5
Copper	mg/kg	21.0	14.9	26.0	23.6	21.2
Nickel	mg/kg	13.8	19.2	12.7	28.0	24.4
Zinc	mg/kg	56.9	62.8	92.0	65.9	65.5
PAH (sum of EPA 16)	mg/kg	8.4	<0.1	250.6	<0.1	<0.1
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	0.104	0.013	0.761	0.045	0.008
Sulphide	mg/kg	2.9	4.5	27.2	<2.0	<2.0
Sulphur (free)	mg/kg	<4	<4	54	<4	<4
pH	N/A	8.5	7.2	10.6	6.7	6.9
Naphthalene	mg/kg	<0.1	<0.1	1.0	<0.1	<0.1
Acenaphthylene	mg/kg	<0.1	<0.1	0.3	<0.1	<0.1
Acenaphthene	mg/kg	<0.1	<0.1	4.4	<0.1	<0.1
Fluorene	mg/kg	<0.1	<0.1	4.5	<0.1	<0.1
Phenanthrene	mg/kg	1.0	<0.1	43.2	<0.1	<0.1
Anthracene	mg/kg	0.5	<0.1	8.6	<0.1	<0.1
Fluoranthene	mg/kg	2.1	<0.1	48.7	<0.1	<0.1
Pyrene	mg/kg	2.0	<0.1	41.7	<0.1	<0.1
Benzo(a)anthracene	mg/kg	0.7	<0.1	17.7	<0.1	<0.1
Chrysene	mg/kg	0.6	<0.1	16.5	<0.1	<0.1
Benzo(b)fluoranthene	mg/kg	0.7	<0.1	18.4	<0.1	<0.1
Benzo(k)fluoranthene	mg/kg	0.2	<0.1	7.5	<0.1	<0.1
Benzo(a)pyrene	mg/kg	0.5	<0.1	16.7	<0.1	<0.1
Indeno(1,2,3-cd)pyrene	mg/kg	<0.1	<0.1	9.0	<0.1	<0.1
Dibenz(a,h)anthracene	mg/kg	<0.1	<0.1	1.6	<0.1	<0.1

Client Project Name: Penistone High School, Barnsley

Client: CC GEOTECHNICAL

Project Number: 06/3908/5

Reporting Date: Friday 15 September 2006

	BH/TP	TP8	TP9	TP10	TP11	TP12
	Top Depth / m	0.40	0.70	0.70	0.70	0.70
	Bottom Depth / m					
	Customer ID					
	Sample Type					
	Date Sampled					
	Receipt Date	25/08/06	25/08/06	25/08/06	25/08/06	25/08/06
	ECõS Sample ID	S0610392	S0610393	S0610394	S0610395	S0610396
	Matrix Type	Soil	Soil	Soil	Soil	Soil
Determinand	Units					
Benzo(g,h,i)perylene	mg/kg	0.3	<0.1	11.2	<0.1	<0.1
Barium	mg/kg	68.5	25.6	86.6	46.9	24.5
Beryllium	mg/kg	0.5	0.6	0.7	1.2	0.9
Vanadium	mg/kg	74.1	29.9	54.0	34.2	32.5
Nitrate	mg/kg	<2.0	2.4	39.2	<2.0	2.4
Sulphate (total)	mg/kg SO4	2195	164	9926	69	<30
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	P	P	P	P	P
Organic Matter	%	1.8	1.3	3.9	0.5	0.6
TPH	mg/kg	79.4	<5.0	1741.9	<5.0	<5.0
TPH C10-C12	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0
TPH C12-C16	mg/kg	<5.0	<5.0	39.1	<5.0	<5.0
TPH C16-C21	mg/kg	10.4	<5.0	306.5	<5.0	<5.0
TPH C21-C35	mg/kg	34.3	<5.0	1065.0	<5.0	<5.0
TPH C35-C40	mg/kg	33.8	<5.0	328.8	<5.0	<5.0
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	#	#	19.6	#	#
TPH Aromatic EC16-EC21	mg/kg	#	#	181.6	#	#
TPH Aromatic EC21-EC35	mg/kg	#	#	165.5	#	#
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	#	#
Ethylbenzene	mg/kg	#	#	<0.02	#	#

Client Project Name: Penistone High School, Barnsley **Client: CC GEOTECHNICAL**

Project Number: 06/3908/5 **Reporting Date: Friday 15 September 2006**

	BH/TP	TP8	TP9	TP10	TP11	TP12
	Top Depth / m	0.40	0.70	0.70	0.70	0.70
	Bottom Depth / m					
	Customer ID					
	Sample Type					
	Date Sampled					
	Receipt Date	25/08/06	25/08/06	25/08/06	25/08/06	25/08/06
	ECõS Sample ID	S0610392	S0610393	S0610394	S0610395	S0610396
	Matrix Type	Soil	Soil	Soil	Soil	Soil
Determinand	**Units**					
m+p-Xylene	mg/kg	#	#	<0.04	#	#
o-Xylene	mg/kg	#	#	<0.02	#	#

Client Project Name: Penistone High School, Barnsley

Client: CC GEOTECHNICAL

Project Number: 06/3908/5

Reporting Date: Friday 15 September 2006

Notes and Preservation Details

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.

APPENDIX G

WRAS ASSESSMENT TABLE FOR WATER MAINS SPECIFICATION

CC Geotechnical

WRAS ANALYSIS OF CONTAMINATION DATA

Job Number 06/3908/5 Created by: PB
Name Penistone High School, Barnsl Reviewed by: DH

	Arithmetric Mean (mg/kg)	Geometric Mean (mg/kg)	UCL_{95}	WRAS threshold value (mg/kg)
Arsenic	6.89		8.47	10
Cadmium	0.20		0.20	3
Chromium (hexavalent)	1.00		1.00	25
Chromium (total)	31.18		47.72	600
Lead		13.18	19.38	500
Mercury	0.10		0.10	1
Selenium	1.00		1.00	3
PAH (total)	67.16		154.69	50
Phenols (monohydric)	2.00		2.00	5
Cyanide (free)	2.00		2.00	25
Cyanide (complex)	2.00		2.00	250
Sulphide	15.37		35.56	250
Sulphur (free)	20.60		43.87	5000
pH	7.63		8.69	5<pH>8
TPH	441.34		999.22	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

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

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:

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

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

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

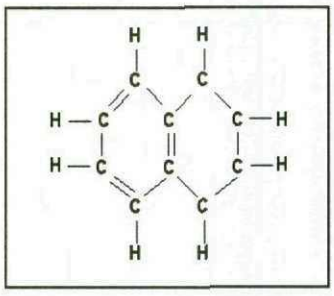
The background exposure data for selenium is presented below:

	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:

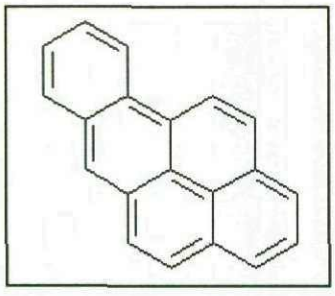
	Value	Source
$MDI_{ingestion}$	7ug/kg bw/day	CLEA CLR TOX 20
$MDI_{inhalation}$	2.8ug/kg bw/day	CLEA CLR TOX 20

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

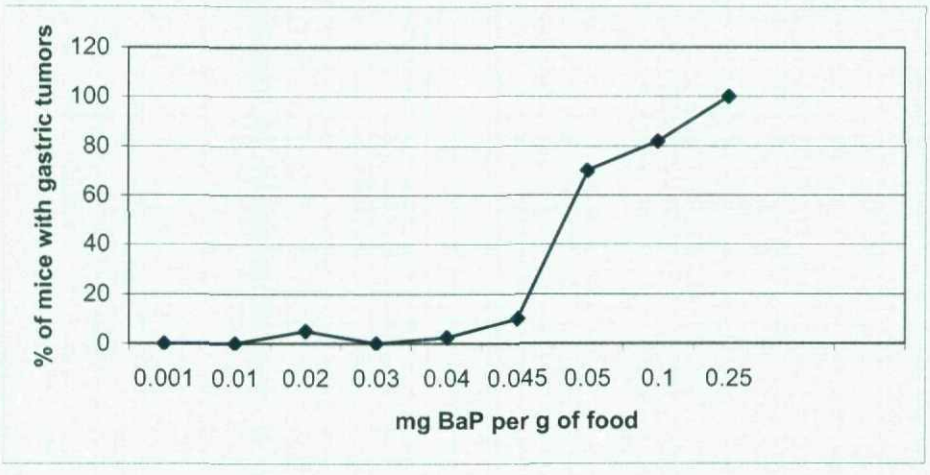
The USEPA classes benzo(a)pyrene as a "probable human carcinogen".

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.

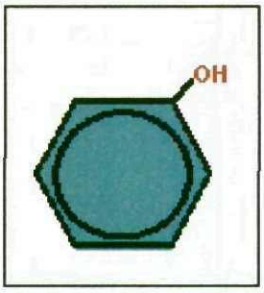
A review of the primary literature (Neal 1967) indicates that benzo(a)pyrene may be a non-threshold substance. A plot of dose versus reaction is presented below:



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;

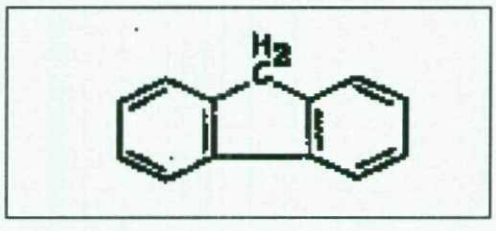
		Description effects	Source
Acute Effects	LD 140mg/kg bw	Nercosis, cardiovascular *effects*, cardiovascular effects, metabolic acidosis and cyanosis	CLEA CLR TOX 9
Ingestion chronic exposure	TDI_{ing}=0.7mg/kg bw/day	Mouth sores, diarrhea and dark urine	CLEA CLR TOX 9

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 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-EC6 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 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)

[ ] 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. (Yor 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_{dring} from this table, depending on your choice of land use

Land Use	SEI_{dring} (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_{dring} = 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_{dring} = SEI_{dring} * *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_{dring} = RI_{ingest}/SEI_{dring}

ASC_{dring} = 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)[a] weight plant per ug per g dry weight soil

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

[a] 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** 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): **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** [b] 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}= **0.023455113** [b] ug per g fresh weight plant per ug per g dry weight soil

[b] 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*HF*CF*DW	TAVCR*HF*CF
Brussel sprouts	5.04750E-03	calc not required	2.60996E-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	3.69474E-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: $ASC_{veg} = RI_{ingest}/SEI_{veg}$

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: $ASC_{indirect} = RI_{ingest}/SEI_{indirect}$

$ASC_{indirect}$ = 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_{vap}=	0.31	unitless	
Water filed porosity	θ_{wat}=	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}=	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_i=	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		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	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= 3.05254E-05 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
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 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: $SEI_{outv} = TAA_{outv} \times CVF \times 1000$

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	$TAAI_{inv}$ 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 $SF=K_{av} \times f_{ov}/H'$

SF= 0.139133498 l air per kg soil

33 **Soil vapour partition coefficient**

The soil vapour partition coefficient (SVPC) is

SVPC= 2.979375121 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}= 4.14697E-02 kg soil/(kg body weight per day)

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

ASC_{inv} = 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
$C_{sat} = (SatVP \times MW \times 10^3)/(760mmHg \times R \times Temp)$

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 $C_{sv} = ASC_{inv} \times SVPC$

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 (SSAC) 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/ 1833.3712	=	5.45443E-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	$1/ASC_{outdv}$=	1/ 473.7714317	=	2.11072E-03	kg soil per mg
inhalation of indoor air	$1/ASC_{indv}$=	1/ 25.3678985	=	3.94199E-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 $SSAC_{other}$ =	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 liphatic 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	$1/ASC_{ding}$=	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

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. 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)

[ ] 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_{dring} from this table, depending on your choice of land use

Land Use	SEI_{dring} (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_{dring} = 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_{dring} = SEI_{dring} * 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_{dring} = RI_{ingest}/SEI_{dring}

ASC_{dring} = 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)[a] weight plant per ug per g dry weight soil

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

[a] 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** [b] 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** [b] ug per g fresh weight plant per ug per g dry weight soil

[b] 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*HF*CF*DW	TAVCR*HF*CF
Brussel sprouts	5.04750E-03	calc not required	7.27306E-04
Cabbage	4.86885E-03	calc not required	6.95340E-04
Carrot	7.38094E-03	calc not required	4.29225E-05
Leafy salads	3.25677E-03	calc not required	1.30097E-04
Onion	3.69474E-03	calc not required	3.06602E-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: $ASC_{veg} = RI_{ingest}/SEI_{veg}$

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: $ASC_{indirect} = RI_{ingest}/SEI_{indirect}$

$ASC_{indirect}$ = 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_{vap}=	0.31	unitless	
Water filled porosity	θ_{wat}=	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_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		1.76555E-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 h= 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	TAAloutv 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: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

1.01227E-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	$TAAI_{inv}$ 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= 0.540543912 l air per kg soil

33 **Soil vapour partition coefficient**

The soil vapour partition coefficient (SVPC) is

SVPC= 1.358239761 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}= 1.89053E-02 kg soil/(kg body weight per day)

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

ASC_{inv} = 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 $C_{sv} = ASC_{inv} \times SVPC$

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 (SSAC) 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/ 5986.428908	=	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	$1/ASC_{outdv}$ =	1/ 1039.244296	=	9.62238E-04	kg soil per mg
inhalation of indoor air	$1/ASC_{inv}$ =	1/ 55.64590863	=	1.79708E-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 $SSAC_{alt}$ = 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 liphatic 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 $SSAC_{rwp}$ = mg per kg soil

For the allotments land use the $SSAC_{alt}$ = 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? (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). 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)

[ ] 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. (Yor 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.

Y

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)

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-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)[a] weight plant per ug per g dry weight soil

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

[a] 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	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):	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}= 0.031661696 [b] 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 [b] ug per g fresh weight plant per ug per g dry weight soil

[b] 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*HF*CF*DW	TAVCR*HF*CF
Brussel sprouts	5.04750E-03	calc not required	1.00901E-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: $ASC_{veg} = RI_{ingest}/SEI_{veg}$

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: $ASC_{indirect} = RI_{ingest}/SEI_{indirect}$

$ASC_{indirect}$ = 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_{vap}=	0.31	unitless	
Water filed porosity	θ_{wat}=	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}=	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		8.47465E-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 h= 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	TAAloutv 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: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

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: $ASC_{outv} = RI_{outv}/SEI_{outv}$

ASC_{outv} = 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 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= 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	$1/ASC_{ding}$ =	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	$1/ASC_{outv}$ =	1/ 197.0224539	=	5.07556E-03	kg soil per mg
inhalation of indoor air	$1/ASC_{inv}$ =	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 $SSAC_{rwp}$ =		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 $SSAC_{other}$ =	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 **iphatic 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	$1/ASC_{ding}$ =	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

The Level 1 Site Specific Assessment Criterion for **liphatic 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? (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). 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. (Yor 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.

Y

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)

[ ]

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-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)[a] weight plant per ug per g dry weight soil

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

[a] 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) | 398107.1706 | 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 [b] 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 [b] ug per g fresh weight *plant per ug per g dry weight* soil

[b] 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*HF*CF*DW	TAVCR*HF*CF
Brussel sprouts	5.04750E-03	calc not required	7.89014E-06
Cabbage	4.86885E-03	calc not required	7.54335E-06
Carrot	7.38094E-03	calc not required	1.24723E-05
Leafy salads	3.25677E-03	calc not required	1.41135E-06
Onion	3.69474E-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: $ASC_{veg} = RI_{ingest}/SEI_{veg}$

ASC_{veg} = 2.00000E-02 mg per kg body weight per day / 9.58449E-06 kg soil per kg body weight per day = 2086.705472 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: $ASC_{indirect} = RI_{ingest}/SEI_{indirect}$

$ASC_{indirect}$ = 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_{vac}=	0.31	unitless	
Water filed porosity	θ_{wat}=	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}=	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	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		8.47465E-03	unitless
Air term		9.52847E-07	m^2 per s
Water term		6.51896E-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=	160	g per mol
Saturated vapour pressure	SatVP	0.49	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= 8.74949E-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 = 911.2963863 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= 11.51543068 l air per kg soil

33 **Soil vapour partition coefficient**

The soil vapour partition coefficient (SVPC) is

SVPC= 0.085397812 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}= 1.18865E-03 kg soil/(kg body weight per day)

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

ASC_{inv} = 5.80000E-02 mg per kg body weight per day / 1.18865E-03 kg soil per kg body weight per day = 48.7949847 mg per kg soil

36 **Saturated vapour concentration**

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^9)/(760mmHg \times R \times Temp)$

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 $C_{sv} = ASC_{inv} \times SVPC$

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}= 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	$1/ASC_{ding}$=	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	$1/ASC_{vedirect}$=	1/ *17742.63367*	=	*5.63614E-05*	*kg soil per mg*
inhalation of outdoor air	$1/ASC_{outdv}$=	1/ 911.2963863	=	1.09734E-03	kg soil per mg
inhalation of indoor air	$1/ASC_{indv}$=	1/ 48.7949847	=	2.04939E-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 $SSAC_{other}$ = 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	$1/ASC_{ding}$=	1/	=		kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/	=		kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{vedirect}$=	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 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. (Yor 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)[a]

[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.

[ ] 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

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_{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)

[ ]

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-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? (Yor N)

N

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

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

[a] 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) 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-05 [b] 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 [b] ug per g fresh weight plant per ug per g dry weight soil

[b] 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*HF*CF*DW	TAVCR*HF*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. $ASC_{veg} = RI_{ingest}/SEI_{veg}$

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: $ASC_{indirect} = RI_{ingest}/SEI_{indirect}$

$ASC_{indirect}$ = 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_z=	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=	1.6	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_i=	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= 1.84145E-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: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

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	$TAAI_{inv}$ 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= 55.44466622 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: $SEI_{inv} = (TAAI_{inv} \times 1000 \times SVPC)/DR$

SEI_{inv}= 2.50167E-04 kg soil/(kg body weight per day)

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

ASC_{inv} = 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 $C_{sv} = ASC_{inv} \times SVPC$

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}= 1.02868E-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/ 5884.825504	=	1.69929E-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	$1/ASC_{outdv}$=	1/ 4329.946503	=	2.30960E-04	kg soil per mg
inhalation of indoor air	$1/ASC_{inv}$=	1/ 231.8451665	=	4.31322E-03	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 $SSAC_{alt}$ = 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 $SSAC_{rwp}$ = mg per kg soil

For the allotments land use the $SSAC_{alt}$ = 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 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 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. 2.00E+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)

[ ] 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_{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} = 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? (Yor N)

N

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

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

[a] 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) 794328234.7 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

[b] 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*HF*CF*DW	TAVCR*HF*CF
Brussel sprouts	5.04750E-03	calc not required	1.01962E-12
Cabbage	4.86885E-03	calc not required	9.74808E-13
Carrot	7.38094E-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: $ASC_{indirect} = RI_{ingest}/SEI_{indirect}$

$ASC_{indirect}$ = 4.00000E-01 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 354852.6733 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=	1.6	kg soil per l soil

Contaminant

Organic carbon/water partition coefficient	K_{oc}=	10000000000	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	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		8.47465E-03	unitless
Air term		9.52847E-07	m^2 per s
Water term		1.32416E-15	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=	270	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 — 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	TAAloutv 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: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

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: $ASC_{outv} = RI_{outv}/SEI_{outv}$

ASC_{outv} = 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 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= 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	$1/ASC_{outv}$ =	1/	=	kg soil per mg
inhalation of indoor air	$1/ASC_{inv}$ =	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 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 $SSAC_{rwp}$ = 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 $SSAC_{other}$ = 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? (Yor 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. (Yor 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_{dreg} from this table, depending on your choice of land use

Land Use	SEI_{dreg} (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_{dreg} = 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_{dreg} = SEI_{dreg} * 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_{dreg} = RI_{ingest}/SEI_{dreg}

ASC_{dreg} = 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)[a] weight plant per ug per g dry weight soil

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

[a] 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) **59** 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 $CF_{leafy} = (0.784 * 10^{0.434*(logKow-1.78)^2/2.44} + (10^{0.95logKow-2.05} + 0.82) * (\phi/(\theta+\phi K_{ow} f_{oc}))$

CF_{leafy}= **1.278848457** ug per g fresh weight plant per ug per g dry weight soil

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

CF_{root}= **0.02070259** [b] ug per g fresh weight plant per ug per g dry weight soil

[b] Note - If the soil correction factor $(\phi/(\theta+\phi K_{ow} f_{oc}))$ 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*HF*CF*DW	TAVCR*HF*CF
Brussel sprouts	5.04750E-03	calc not required	4.07550E-03
Cabbage	4.86885E-03	calc not required	3.89637E-03
Carrot	7.38094E-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: $ASC_{veg} = RI_{ingest}/SEI_{veg}$

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_{ingest}/$SEI_{indirect}$

$ASC_{indirect}$ = 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 filed porosity	θ_{water}=	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	m^2 per s
Diffusion coefficient in soil air	D_s=	8.80E-06	m^2 per s
Air in soil		9.52847E-02	unitless
Water in soil		8.47465E-03	unitless
Air term		8.38506E-07	m^2 per s
Water term		3.64261E-11	m^2 per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	8.38542E-07	m^2 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	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: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

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: $ASC_{outv} = RI_{outv}/SEI_{outv}$

ASC_{outv} = 9.10000E-04 mg per kg body weight per day / 3.04427E-04 kg soil per kg body weight per day = 2.989217672 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= 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}= 4.16896E+08 mm Hg.g per mol

37 **Equilibrium contaminant concentration in soil vapour**

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

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 (SSAC) 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	=	2.82997E+00	kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{inderect}$=	1/ 257.2681881	=	3.88699E-03	kg soil per mg
inhalation of outdoor air	$1/ASC_{outv}$=	1/ 2.989217672	=	3.34536E-01	kg soil per mg
inhalation of indoor air	$1/ASC_{inv}$=	1/ 0.140855926	=	7.09945E+00	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 $SSAC_{other}$ =	0.133905287	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 romatic EC5-EC 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/	=		kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/	=		kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{inderect}$=	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 Aromatic 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 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)

[ ] 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. (Yor 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_{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)

[ ]

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} = 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) **5.98602E-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*HF*CF*DW	TAVCR*HF*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	4.41616E-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: $ASC_{veg} = RI_{vegetables}/SEI_{veg}$

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=	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		8.47465E-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 h= 0.93 /2 = 0.465 m

26 **Contaminant Volatilisation Factor (CVF)**

CVF= 5.13886E-07 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
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	$TAAI_{inv}$ 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= 19.55273127 l 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: $SEI_{inv} = (TAAI_{inv} \times 1000 \times SVPC)/DR$

SEI_{inv}= 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: $ASC_{inv} = RI_{inv}/SEI_{inv}$

ASC_{inv} = 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 $C_{sv} = ASC_{inv} \times SVPC$

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}= 2.66037E-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	$1/ASC_{ding}$ =	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	$1/ASC_{outv}$ =	1/ 321.0178624	=	3.11509E-03	kg soil per mg
inhalation of indoor air	$1/ASC_{inv}$ =	1/ 17.18907829	=	5.81765E-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 $SSAC_{other}$ = 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	$1/ASC_{ding}$ =	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

The Level 1 Site Specific Assessment Criterion for **uromaric 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? (Y or 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: $RI_{ingest}=(TDI-((MDI/70x46.4)xCF)/TABW)^a$

[ ] mg per kg body weight per day

[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.

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_{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)

[ ]

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} = 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)[a] weight plant per ug per g dry weight soil

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

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

CF_{leafy}= 0.304565014 [b] 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}= 0.010477002 [b] ug per g fresh weight plant per ug per g dry weight soil

[b] 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*HF*CF*DW	TAVCR*HF*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: $ASC_{veg} = RI_{mgmet}/SEI_{veg}$

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: $ASC_{indirect}$ = $RI_{ingest}/SEI_{indirect}$

$ASC_{indirect}$ = 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_{air}=	0.31	unitless
Water filed porosity	θ_{wat}=	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}=	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		8.47465E-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	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= 9.50551E-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 = 1735.482331 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= 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: $SEI_{inv} = (TAAI_{inv} \times 1000 \times SVPC)/DR$

SEI_{inv}= 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: $ASC_{inv} = RI_{inv}/SEI_{inv}$

ASC_{inv} = 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
$C_{sat} = (SatVP \times MW \times 10^6)/(760mmHg \times R \times Temp)$

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 $C_{sv} = ASC_{inv} \times SVPC$

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}= 2.45573E-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/ 38.78581768	=	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	$1/ASC_{outh}$=	1/ 1735.482331	=	5.76209E-04	kg soil per mg
inhalation of indoor air	$1/ASC_{inh}$=	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 $SSAC_{nep}$ = 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 $SSAC_{other}$ = 79.56422841 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 $SSAC_{nep}$ = 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 **romatic 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 compatibitility 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? (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_{vgest}=ID

mg per kg body weight per day

For threshold substances the Reference Intake (RI) for ingestion pathways is calculated using the formula: RI_{vgest}=(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_{vgest}=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. (Yor 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_{dring} from this table, depending on your choice of land use

Land Use	SEI_{dring} (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_{dring} = 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_{dring} = SEI_{dring} * 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_{dring} = RI_{ingest}/SEI_{dring}

ASC_{dring} = 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)[a] weight plant per ug per g dry weight soil

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

[a] 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 $CF_{leafy} = \{0.784 * 10^{-0.434*(\log Kow - 1.78)^2/2.44} + (10^{0.95\log Kow - 2.05} + 0.82) * (\phi/(\theta + \phi K_{oc} f_{oc}))$

CF_{leafy}= **0.190590674** [b] 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}= **0.010397878** [b] ug per g fresh weight plant per ug per g dry weight soil

[b] 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*HF*CF*DW	TAVCR*HF*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: $ASC_{veg} = RI_{ingest}/SEI_{veg}$

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: $ASC_{indirect}$ = $RI_{ingest}/SEI_{indirect}$

$ASC_{indirect}$ = 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_{air}=	0.31	unitless	
Water filed porosity	θ_{water}=	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_{water}=	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		8.47465E-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= 1.84178E-08 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
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: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

1.33975E-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: $ASC_{outv} = RI_{outv}/SEI_{outv}$

ASC_{outv} = 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 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= 554.4466622 l 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 = 479.6715723 mg per kg soil

36 **Saturated vapour concentration**

Saturated vapour concentration is calculated using the formula
$C_{sat} = (SatVP \times MW \times 10^9)/(760mmHg \times R \times Temp)$

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	$1/ASC_{ding}$=	1/ 811.9201995	=	1.23165E-03	kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/ 58.5822401	=	1.70700E-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	$1/ASC_{outv}$=	1/ 8956.883984	=	1.11646E-04	kg soil per mg
inhalation of indoor air	$1/ASC_{inv}$=	1/ 479.6715723	=	2.08476E-03	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 $SSAC_{other}$ = 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	$1/ASC_{ding}$=	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

The Level 1 Site Specific Assessment Criterion for **romatic 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
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. (Yor 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_{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} = 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)[a] weight plant per ug per g dry weight soil

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

[a] 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 [b] 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 [b] ug per g fresh weight plant per ug per g dry weight soil

[b] 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*HF*CF*DW	TAVCR*HF*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	3.69986E-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: $ASC_{veg} = RI_{ingest}/SEI_{veg}$

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

$SEI_{indirect}$= 1.1272E-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: $ASC_{indirect}$ = $RI_{ingest}/SEI_{indirect}$

$ASC_{indirect}$ = 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=	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_i=	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		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	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= 1.38975E-09 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
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	$TAAI_{inv}$ 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= 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: $SEI_{inv} = (TAAI_{inv} \times 1000 \times SVPC)/DR$

SEI_{inv}= 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: $ASC_{inv} = RI_{inv}/SEI_{inv}$

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 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	$1/ASC_{outv}$=	1/		=	kg soil per mg
inhalation of indoor air	$1/ASC_{inv}$=	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 $SSAC_{alt}$ = 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 omatic 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/	608.9401496	=	0.001642198 kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/	91.89281415	=	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 $SSAC_{alt}$ = 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 romatic 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? (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). 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. (Yor 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}? (Yor 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} = 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)[a] weight plant per ug per g dry weight soil

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

[a] 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 [b] 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 [b] ug per g fresh weight plant per ug per g dry weight soil

[b] 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*HF*CF*DW	TAVCR*HF*CF
Brussel sprouts	5.04750E-03	calc not required	8.55072E-06
Cabbage	4.86885E-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: $ASC_{veg} = RI_{ingest}/SEI_{veg}$

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) 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: $ASC_{indirect}$ = $RI_{ingest}/SEI_{indirect}$

$ASC_{indirect}$ = 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 filled porosity	θ_{wat}=	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}=	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_i=	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= 9.06586E-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
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: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

6.59469E-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/		=	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	$1/ASC_{outdv}$ =	1/		=	kg soil per mg
inhalation of indoor air	$1/ASC_{indv}$ =	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 $SSAC_{alt}$ = 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 omatic 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 kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$ =	1/	152.7403895	=	0.006547057 kg soil per mg
ingestion of soil attached to vegetables	$1/ASC_{indirect}$ =	1/	5322.7901	=	0.00018787 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 $SSAC_{alt}$ = 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 omatic 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? (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-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)

7.00E-03 mg per day

Is the MDI equal to or greater than 80% 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)*

1.97982E-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 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)

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]

[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_{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} = 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)[a] weight plant per ug per g dry weight soil

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

[a] 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 | 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) | 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 [b] 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 [b] ug per g fresh weight plant per ug per g dry weight soil

[b] 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*HF*CF*DW	TAVCR*HF*CF
Brussel sprouts	5.04750E-03	calc not required	1.12731E-03
Cabbage	4.86885E-03	calc not required	1.07776E-03
Carrot	7.38094E-03	calc not required	3.32921E-05
Leafy salads	3.25677E-03	calc not required	2.01647E-04
Onion	3.69474E-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: $ASC_{veg} = RI_{ingest}/SEI_{veg}$

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: $ASC_{indirect}$ = $RI_{ingest}/SEI_{indirect}$

$ASC_{indirect}$ = 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_{vap}=	0.31 unitless	
Water filed porosity	θ_{wat}=	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}=	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_i=	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 h= 0.93 /2 = 0.465 m

26 **Contaminant Volatilisation Factor (CVF)**

CVF= 9.91893E-09 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
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: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

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 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= 604.8509043 l 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} = 7.99742E-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	$1/ASC_{outv}$=	1/ 1108.407959	=	9.02195E-04	kg soil per mg
inhalation of indoor air	$1/ASC_{inv}$=	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

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 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 Anthracene 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). 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. (Yor 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)[a]

[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.

[ ] 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

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_{oing} from this table, depending on your choice of land use

Land Use	SEI_{oing} (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_{oing} = 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_{oing} = SEI_{oing} * 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_{oing} = RI_{ingest}/SEI_{oing}

ASC_{oing} = 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)[a] weight plant per ug per g dry weight soil

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

[a] 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 uplake 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 $CF_{leafy} = (0.784*10^{-0.434*(logKow-1.78)^2/2.44}+(10^{0.95logKow-2.05}+0.82)*(\phi/(0+\phi K_{oc}f_{oc}))$

CF_{leafy}= 0.03522914 [b] ug per g fresh weight plant per ug per g dry weight soil

For root vegetables $CF_{root}=(10^{0.77logKow-1.52}+0.82)*(\phi/(0+\phi K_{oc}f_{oc}))*0.01$

CF_{root}= 0.005898408 [b] ug per g fresh weight plant per ug per g dry weight soil

[b] Note - If the soil correction factor ($\phi/(0+\phi K_{oc}f_{oc})$) 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*HF*CF*DW	TAVCR*HF*CF
Brussel sprouts	5.04750E-03	calc not required	1.12270E-04
Cabbage	4.86885E-03	calc not required	1.07335E-04
Carrot	7.38094E-03	calc not required	1.77566E-05
Leafy salads	3.25677E-03	calc not required	2.00823E-05
Onion	3.69474E-03	calc not required	1.26838E-05
Potato	4.41616E-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: $ASC_{veg} = RI_{ingest}/SEI_{veg}$

ASC_{veg} = 6.00000E-02 mg per kg body weight per day / 3.29910E-05 kg soil per kg body weight per day = 1818.675551 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: $ASC_{indirect} = RI_{ingest}/SEI_{indirect}$

$ASC_{indirect}$ = 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_z=	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=	1.6	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	m^2 per s
Diffusion coefficient in soil air	D_i=	3.20E-06	m^2 per s
Air in soil		9.52847E-02	unitless
Water in soil		8.47465E-03	unitless
Air term		3.04911E-07	m^2 per s
Water term		2.44400E-09	m^2 per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	3.07355E-07	m^2 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 TAH= 0.93 m

Height of mixing zone h= 0.93 /2 = 0.465 m

26 **Contaminant Volatilisation Factor (CVF)**

CVF= 4.90947E-11 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: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

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: $ASC_{outv} = RI_{outv}/SEI_{outv}$

ASC_{outv} = 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	$TAAI_{inv}$ 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= 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: $SEI_{inv} = (TAAI_{inv} \times 1000 \times SVPC)/DR$

SEI_{inv}= 2.06769E-07 kg soil/(kg body weight per day)

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

ASC_{inv} = 0.00000E+00 mg per kg body weight per day / 2.06769E-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
$C_{sat} = (SatVP \times MW \times 10^9)/(760mmHg \times R \times Temp)$

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 $C_{sv} = ASC_{inv} \times SVPC$

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	$1/ASC_{outv}$=	1/		=	kg soil per mg
inhalation of indoor air	$1/ASC_{inv}$=	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 **Anthracene** 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/	6089.401496	=	0.00016422 kg soil per mg
homegrown vegetable consumption pathway	$1/ASC_{veg}$=	1/	1818.675551	=	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 $SSAC_{rep}$ =		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 $SSAC_{other}$ =	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 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 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. (Yor 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_{oing} from this table, depending on your choice of land use

Land Use	SEI_{oing} (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_{oing} = 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_{oing} = SEI_{oing} * 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_{oing} = RI_{ingest}/SEI_{oing}

ASC_{oing} = 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)[a] weight plant per ug per g dry weight soil

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

[a] 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 [b] 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}= 0.003887348 [b] ug per g fresh weight plant per ug per g dry weight soil

[b] 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*HF*CF*DW	TAVCR*HF*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	4.41616E-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: $ASC_{veg} = RI_{ingest}/SEI_{veg}$

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: $ASC_{indirect} = RI_{ingest}/SEI_{indirect}$

$ASC_{indirect}$ = 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_{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}=	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	m^2 per s
Diffusion coefficient in soil air	D_a=	3.00E-06	m^2 per s
Air in soil		9.52847E-02	unitless
Water in soil		8.47465E-03	unitless
Air term		2.85854E-07	m^2 per s
Water term		2.03138E-09	m^2 per s per (l water per l air)
Effective diffusion coefficient	D_{eff}=	2.87886E-07	m^2 per s
Molecular weight	MW=	202.3	g per mol
Saturated vapour pressure	SatVP	1.20E-08	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= 1.25461E-11 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: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

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 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= 246697.616 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}= 5.64130E-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 / 5.64130E-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}= 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 (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	$1/ASC_{outv}$=	1/		=	kg soil per mg
inhalation of indoor air	$1/ASC_{inv}$=	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 **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	$1/ASC_{ding}$=	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 $SSAC_{rwp}$ = 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 $SSAC_{other}$ = 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? (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. (Yor 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_{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)

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

CF_{leafy}= 0.074613187 ** ug per g fresh weight plant per ug per g dry weight soil

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

CF_{root}= 0.006254839 ** 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*HF*CF*DW	TAVCR*HF*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: $ASC_{veg} = RI_{ingest}/SEI_{veg}$

ASC_{veg} = 8.00000E-03 mg per kg body weight per day / 5.77371E-05 kg soil per kg body weight per day = 138.5591475 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: $ASC_{indirect} = RI_{oral}/SEI_{indirect}$

$ASC_{indirect}$ = 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_{water}=	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}=	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_i=	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=	166.2	g per mol
Saturated vapour pressure	SatVP	0.0084	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= 1.14785E-09 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
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: $SEI_{outv} = TAAI_{outv} \times CVF \times 1000$

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: $ASC_{outv} = RI_{out}/SEI_{outv}$

ASC_{outv} = 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 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= 3211.966871 l air per kg soil

33 **Soil vapour partition coefficient**

The soil vapour partition coefficient (SVPC) is

SVPC= 0.000310969 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
$C_{sat} = (SatVP \times MW \times 10^6)/(760mmHg \times R \times Temp)$

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	$1/ASC_{ding}$=	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	$1/ASC_{outh}$=	1/		=	kg soil per mg
inhalation of indoor air	$1/ASC_{inh}$=	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 $SSAC_{alt}$ = 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^{-3}

soil ingestion pathway	$1/ASC_{ding}$=	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/	7097.053466	=	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 $SSAC_{alt}$ = 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? (Yor 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)[a]

mg per kg body weight per day

[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.

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	0.362
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

0.000007 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)[a]

[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

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)[a] weight plant per ug per g dry weight soil

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

[a] 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)	1.6	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 [b] 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 [b] ug per g fresh weight plant per ug per g dry weight soil

[b] 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*HF*CF*DW	TAVCR*HF*CF
Brussel sprouts	5.04750E-03	calc not required	1.11171E-06
Cabbage	4.86885E-03	calc not required	1.06285E-06
Carrot	7.38094E-03	calc not required	7.56085E-06
Leafy salads	3.25677E-03	calc not required	1.98857E-07
Onion	3.69474E-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: $ASC_{veg} = RI_{vegair}/SEI_{veg}$

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: $ASC_{indirect}$ = $RI_{ingest}/SEI_{indirect}$

$ASC_{indirect}$ = 2.00000E-05 mg per kg body weight per day / 1.12723E-06 kg soil per kg body weight per day = 17.74263367 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_z=	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=	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_i=	4.30E-06	m^2 per s
Air in soil		9.52847E-02	unitless
Water in soil		8.47465E-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	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= 4.77599E-14 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
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} = 7.00000E-06 mg per kg body weight per day / 3.47416E-12 kg soil per kg body *weight per day* = 2014878.081 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 $SF=K_{oc} \times f_{ov}/H'$

SF= 129330970.9 l air per kg soil

33 **Soil vapour partition coefficient**

The soil vapour partition coefficient (SVPC) is

SVPC= 7.73198E-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
$C_{sat} = (SatVP \times MW \times 10^6)/(760mmHg \times R \times Temp)$

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	$1/ASC_{ding}$=	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	$1/ASC_{outv}$=	1/	=	kg soil per mg
inhalation of indoor air	$1/ASC_{inv}$=	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 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/ 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 06/3908/5 — Created by: RR
Site Name Penistone High School, Barnsley — Reviewed by: PB
All results in mg/kg unless stated otherwise

Position	TP2	TP3	TP5	TP6	TP7	TP8	TP9	TP10	TP11	TP12	SGV /
Depth (m)	0.70m	0.70m	0.70m	0.70m	0.60m	0.40m	0.70m	0.70m	0.70m	0.70m	GAC
Arsenic	5.7	7.6	6.2	3.8	11.2	9.5	5	9.9	3.6	6.4	20
Cadmium	0.2	0.2	0.2	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	1	1	200
Chromium (total)	16.1	20.2	19.1	18	106.6	20	20.9	41.2	26.1	23.6	200
Lead	11.6	8.4	8.2	8.5	21.6	20.2	10.1	40.8	12.1	10.7	450
Mercury	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	15
Selenium	1	1	1	1	1	1	1	1	1	1	260
Boron (water soluble)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.8	0.5	0.5	
Copper	7.6	18.8	12.2	11.6	15.3	21	14.9	26	23.6	21.2	
Nickel	14.4	20.5	21.7	19.4	15.1	13.8	19.2	12.7	28	24.4	75
Zinc	41.3	56.1	63.8	43	69.5	56.9	62.8	92	65.9	65.5	
Phenols (monohydric)	2	2	2	2	2	2	2	2	2	2	21900
Cyanide (free)	2	2	2	2	2	2	2	2	2	2	53
Cyanide (total)	2	2	2	2	2	2	2	2	2	2	53
Cyanide (complex)	2	2	2	2	2	2	2	2	2	2	53
Sulphate (water soluble) g/l SO4	0.008	0.008	0.01	0.005	0.514	0.104	0.013	0.761	0.045	0.008	
Sulphide	2	2	2	2	107.1	2.9	4.5	27.2	2	2	
Sulphur (free)	4	4	4	4	120	4	4	54	4	4	
pH	6.3	5.8	6.7	6.7	10.9	8.5	7.2	10.6	6.7	6.9	
TPH	7.3	5	5	5	2554.8	79.4	5	1741.9	5	5	
PAH (total)	0.1	0.1	0.1	0.1	411.9	8.4	0.1	250.6	0.1	0.1	
Naphthalene	0.1	0.1	0.1	0.1	0.2	0.1	0.1	1	0.1	0.1	1904
Acenaphthylene	0.1	0.1	0.1	0.1	0.3	0.1	0.1	0.3	0.1	0.1	2030
Acenaphthene	0.1	0.1	0.1	0.1	4.6	0.1	0.1	4.4	0.1	0.1	2030
Fluorene	0.1	0.1	0.1	0.1	4.5	0.1	0.1	4.5	0.1	0.1	811
Phenanthrene	0.1	0.1	0.1	0.1	60.2	1	0.1	43.2	0.1	0.1	2030
Anthracene	0.1	0.1	0.1	0.1	13.7	0.5	0.1	8.6	0.1	0.1	6089
Fluoranthene	0.1	0.1	0.1	0.1	85.3	2.1	0.1	48.7	0.1	0.1	2550
Pyrene	0.1	0.1	0.1	0.1	69.4	2	0.1	41.7	0.1	0.1	255
Benzo(a)anthracene	0.1	0.1	0.1	0.1	30.7	0.7	0.1	17.7	0.1	0.1	20.3
Chrysene	0.1	0.1	0.1	0.1	29.4	0.6	0.1	16.5	0.1	0.1	20.3
Benzo(b)fluoranthene	0.1	0.1	0.1	0.1	33	0.7	0.1	18.4	0.1	0.1	20.3
Benzo(k)fluoranthene	0.1	0.1	0.1	0.1	12.9	0.2	0.1	7.5	0.1	0.1	20.3
Benzo(a)pyrene	0.1	0.1	0.1	0.1	28.9	0.5	0.1	16.7	0.1	0.1	2.03
Indeno(1,2,3-cd)pyrene	0.1	0.1	0.1	0.1	17.6	0.1	0.1	9	0.1	0.1	20.3
Dibenz(a,h)anthracene	0.1	0.1	0.1	0.1	3	0.1	0.1	1.6	0.1	0.1	2.03
Benzo(g,h,i)perylene	0.1	0.1	0.1	0.1	18.5	0.3	0.1	11.2	0.1	0.1	20.3
Barium	18.2	24.7	16.5	16.7	124.9	68.5	25.6	86.6	46.9	24.5	
Beryllium	0.5	0.8	0.8	0.6	1.2	0.5	0.6	0.7	1.2	0.9	
Vanadium	24.2	28.7	26.9	25.3	64.6	74.1	29.9	54	34.2	32.5	
Nitrate	8	2	2	2	37.9	2	2.4	39.2	2	2.4	
Sulphate (total)	152	40	71	30	7320	2195	164	9926	69	30	
Chrysotile (white)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Amosite (brown)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Crocidolite (blue)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Anthophyllite	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Actinolite	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Tremolite	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Non-Asbestos fibres	P	P	P	P	P	P	P	P	P	P	
Test sample weight (g)	1	1	1	0.5	3.9	1.8	1.3	3.9	0.5	0.6	
Est. weight asbestos material (g)											
Estimated % (w/w) of asbestos											
Organic Matter	1	1	1	0.5	3.9	1.8	1.3	3.9	0.5	0.6	
TPH C10-C12	5	5	5	5	5	5	5	5	5	5	79.6
TPH C12-C16	5	5	5	5	52.1	5	5	39.1	5	5	291.7
TPH C16-C21	5	5	5	5	527	10.4	5	306.5	5	5	608
TPH C21-C35	6.2	5	5	5	1531.1	34.3	5	1065	5	5	608
TPH C35-C40	5	5	5	5	442.5	33.8	5	328.8	5	5	608
TPH Aromatic EC5-EC7					0.02			0.02			0.134
TPH Aromatic EC7-EC8					0.02			0.02			3
TPH Aromatic EC8-EC10					0.1			0.1			15.99
TPH Aromatic EC10-EC12					5			5			79.6
TPH Aromatic EC12-EC16					15.7			19.6			291.7
TPH Aromatic EC16-EC21					219.5			181.6			608
TPH Aromatic EC21-EC35					240.6			165.5			608
TPH Aliphatic EC5-EC6					0.1			0.1			24.07
TPH Aliphatic EC6-EC8					0.1			0.1			52.79
TPH Aliphatic EC8-EC10					0.1			0.1			9.96
TPH Aliphatic EC10-EC12					5			5			45.28
TPH Aliphatic EC12-EC16					5			5			198.54
TPH Aliphatic EC16-EC21					5			5			40596
TPH Aliphatic EC21-EC34					5			5			40596
Benzene					0.02			0.02			0.134
Toluene					0.02			0.02			3
Ethyl Benzene					0.02			0.02			6
m+p-Xylene					0.04			0.04			22.91
o-Xylene					0.02			0.02			22.91

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TABLE 2 - MAXIMUM VALUE TEST AS DESCRIBED IN CLEA CLR 7 APPENDIX A

Job Number 06/3908/5 Created by: RR

Name Penistone High 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	6.890	11.200	2.604	1.655	10	2.04	NO	11.2	20.0
Cadmium	0.200	0.200	0.000	0.000	10	2.04	NO	0.2	30.0
Chromium (hexavalent)	1.000	1.000	0.000	0.000	10	2.04	NO	1.0	200.0
Chromium (total)	31.180	106.600	27.427	2.750	10	2.04	YES	106.6	200.0
Lead	15.220	40.800	10.167	2.516	10	2.04	YES	40.8	450.0
Mercury	0.100	0.100	0.000	0.000	10	2.04	NO	0.1	15.0
Selenium	1.000	1.000	0.000	0.000	10	2.04	NO	1.0	260.0
Boron (water soluble)	0.530	0.800	0.095	2.846	10	2.04	YES	0.8	
Copper	17.220	26.000	5.858	1.499	10	2.04	NO	26.0	
Nickel	18.920	28.000	4.977	1.824	10	2.04	NO	28.0	75.0
Zinc	61.680	92.000	14.286	2.122	10	2.04	YES	92.0	
Phenols (monohydric)	2.000	2.000	0.000	0.000	10	2.04	NO	2.0	21900.0
Cyanide (free)	2.000	2.000	0.000	0.000	10	2.04	NO	2.0	53.0
Cyanide (total)	2.000	2.000	0.000	0.000	10	2.04	NO	2.0	53.0
Cyanide (complex)	2.000	2.000	0.000	0.000	10	2.04	NO	2.0	53.0
Sulphate (water soluble) g/l SO4	0.148	0.761	0.266	2.302	10	2.04	YES	0.8	
Sulphide	15.370	107.100	33.167	2.766	10	2.04	YES	107.1	
Sulphur (free)	20.600	120.000	38.298	2.595	10	2.04	YES	120.0	
pH	7.630	10.900	1.786	1.831	10	2.04	NO	10.9	
TPH	441.340	2554.800	920.140	2.297	10	2.04	YES	2554.8	
PAH (total)	67.160	411.900	144.310	2.389	10	2.04	YES	411.9	
Naphthalene	0.200	1.000	0.283	2.828	10	2.04	YES	1.0	1904.0
Acenaphthylene	0.140	0.300	0.084	1.897	10	2.04	NO	0.3	2030.0
Acenaphthene	0.980	4.600	1.856	1.951	10	2.04	NO	4.6	2030.0
Fluorene	0.980	4.500	1.855	1.897	10	2.04	NO	4.5	811.0
Phenanthrene	10.510	60.200	22.078	2.251	10	2.04	YES	60.2	2030.0
Anthracene	2.350	13.700	4.793	2.368	10	2.04	YES	13.7	6089.0
Fluoranthene	13.680	85.300	29.403	2.436	10	2.04	YES	85.3	2550.0
Pyrene	11.380	69.400	24.185	2.399	10	2.04	YES	69.4	255.0
Benzo(a)anthracene	4.980	30.700	10.585	2.430	10	2.04	YES	30.7	20.3
Chrysene	4.720	29.400	10.079	2.449	10	2.04	YES	29.4	20.3
Benzo(b)fluoranthene	5.280	33.000	11.301	2.453	10	2.04	YES	33.0	20.3
Benzo(k)fluoranthene	2.130	12.900	4.440	2.426	10	2.04	YES	12.9	20.3
Benzo(a)pyrene	4.680	28.900	9.974	2.428	10	2.04	YES	28.9	2.0
Indeno(1,2,3-cd)pyrene	2.740	17.600	5.923	2.509	10	2.04	YES	17.6	20.3
Dibenz(a,h)anthracene	0.540	3.000	0.985	2.499	10	2.04	YES	3.0	2.0
Benzo(g,h,i)perylene	3.070	18.500	6.443	2.395	10	2.04	YES	18.5	20.3
Barium	45.310	124.900	36.832	2.161	10	2.04	YES	124.9	
Beryllium	0.780	1.200	0.257	1.632	10	2.04	NO	1.2	
Vanadium	39.440	74.100	18.005	1.925	10	2.04	NO	74.1	
Nitrate	9.990	39.200	15.168	1.926	10	2.04	NO	39.2	
Sulphate (total)	1999.700	9926.000	3605.568	2.198	10	2.04	YES	9926.0	
Organic Matter	1.550	3.900	1.299	1.809	10	2.04	NO	3.9	
TPH C10-C12	5.000	5.000	0.000	0.000	10	2.04	NO	5.0	79.6
TPH C12-C16	13.120	52.100	17.391	2.241	10	2.04	YES	52.1	291.7
TPH C16-C21	87.890	527.000	180.957	2.427	10	2.04	YES	527.0	608.0
TPH C21-C35	266.660	1531.100	554.655	2.280	10	2.04	YES	1531.1	608.0
TPH C35-C40	84.010	442.500	161.471	2.220	10	2.04	YES	442.5	608.0
TPH Aromatic EC5-EC7	0.020	0.020	0.000	0.000	2	#N/A	#N/A	0.0	0.1
TPH Aromatic EC7-EC8	0.020	0.020	0.000	0.000	2	#N/A	#N/A	0.0	3.0
TPH Aromatic EC8-EC10	0.100	0.100	0.000	0.000	2	#N/A	#N/A	0.1	16.0
TPH Aromatic EC10-EC12	5.000	5.000	0.000	0.000	2	#N/A	#N/A	5.0	79.6
TPH Aromatic EC12-EC16	17.650	19.600	2.758	0.707	2	#N/A	#N/A	19.6	291.7
TPH Aromatic EC16-EC21	200.550	219.500	26.799	0.707	2	#N/A	#N/A	219.5	608.0
TPH Aromatic EC21-EC35	203.050	240.600	53.104	0.707	2	#N/A	#N/A	240.6	608.0
TPH Aliphatic EC5-EC6	0.100	0.100	0.000	0.000	2	#N/A	#N/A	0.1	24.1
TPH Aliphatic EC6-EC8	0.100	0.100	0.000	0.000	2	#N/A	#N/A	0.1	52.8
TPH Aliphatic EC8-EC10	0.100	0.100	0.000	0.000	2	#N/A	#N/A	0.1	10.0
TPH Aliphatic EC10-EC12	5.000	5.000	0.000	0.000	2	#N/A	#N/A	5.0	45.3
TPH Aliphatic EC12-EC16	5.000	5.000	0.000	0.000	2	#N/A	#N/A	5.0	198.5
TPH Aliphatic EC16-EC21	5.000	5.000	0.000	0.000	2	#N/A	#N/A	5.0	40596.0
TPH Aliphatic EC21-EC34	5.000	5.000	0.000	0.000	2	#N/A	#N/A	5.0	40596.0
Benzene	0.020	0.020	0.000	0.000	2	#N/A	#N/A	0.02	0.134
Toluene	0.020	0.020	0.000	0.000	2	#N/A	#N/A	0.02	3
Ethyl Benzene	0.020	0.020	0.000	0.000	2	#N/A	#N/A	0.02	6
m+p-Xylene	0.040	0.040	0.000	0.000	2	#N/A	#N/A	0.04	22.91

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TABLE 3 - MEAN VALUE TEST AS DISCUSSED IN CLEA CLR 7 APPENDIX A

Job Number 06/3908/5 Created by: RR
Name Penistone High School, Barnsle 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	6.9		11.2	10.0	1.8	2.7	8.5
Cadmium	0.2		0.2	10.0	1.8	0.0	0.2
Chromium (hexavalent)	1.0		1.0	10.0	1.8	0.0	1.0
Chromium (total)	31.2		106.6	10.0	1.8	28.5	47.7
Lead		13.2	40.8	10.0	1.8	10.7	19.4
Mercury	0.1		0.1	10.0	1.8	0.0	0.1
Selenium	1.0		1.0	10.0	1.8	0.0	1.0
Boron (water soluble)	0.5		0.8	10.0	1.8	0.1	0.6
Copper	17.2		26.0	10.0	1.8	5.1	20.2
Nickel	18.9		28.0	10.0	1.8	5.0	21.8
Zinc	61.7		92.0	10.0	1.8	13.1	69.3
Phenols (monohydric)	2.0		2.0	10.0	1.8	0.0	2.0
Cyanide (free)	2.0		2.0	10.0	1.8	0.0	2.0
Cyanide (total)	2.0		2.0	10.0	1.8	0.0	2.0
Cyanide (complex)	2.0		2.0	10.0	1.8	0.0	2.0
Sulphate (water soluble) g/l SO4	0.1		0.8	10.0	1.8	0.3	0.3
Sulphide	15.4		107.1	10.0	1.8	34.8	35.6
Sulphur (free)	20.6		120.0	10.0	1.8	40.1	43.9
pH	7.6		10.9	10.0	1.8	1.8	8.7
TPH	441.3		2554.8	10.0	1.8	962.5	999.2
PAH (total)	67.2		411.9	10.0	1.8	151.0	154.7
Naphthalene	0.2		1.0	10.0	1.8	0.3	0.4
Acenaphthylene	0.1		0.3	10.0	1.8	0.1	0.2
Acenaphthene	1.0		4.6	10.0	1.8	1.9	2.1
Fluorene	1.0		4.5	10.0	1.8	1.9	2.1
Phenanthrene	10.5		60.2	10.0	1.8	23.1	23.9
Anthracene	2.4		13.7	10.0	1.8	5.0	5.3
Fluoranthene	13.7		85.3	10.0	1.8	30.8	31.5
Pyrene	11.4		69.4	10.0	1.8	25.3	26.0
Benzo(a)anthracene	5.0		30.7	10.0	1.8	11.1	11.4
Chrysene	4.7		29.4	10.0	1.8	10.6	10.8
Benzo(b)fluoranthene	5.3		33.0	10.0	1.8	11.8	12.1
Benzo(k)fluoranthene	2.1		12.9	10.0	1.8	4.6	4.8
Benzo(a)pyrene	4.7		28.9	10.0	1.8	10.4	10.7
Indeno(1,2,3-cd)pyrene	2.7		17.6	10.0	1.8	6.2	6.3
Dibenz(a,h)anthracene	0.5		3.0	10.0	1.8	1.0	1.1
Benzo(g,h,i)perylene	3.1		18.5	10.0	1.8	6.7	7.0
Barium	45.3		124.9	10.0	1.8	37.7	67.2
Beryllium	0.8		1.2	10.0	1.8	0.3	0.9
Vanadium	39.4		74.1	10.0	1.8	18.2	50.0
Nitrate	10.0		39.2	10.0	1.8	16.1	19.3
Sulphate (total)	1999.7		9926.0	10.0	1.8	3761.8	4180.2
Organic Matter	1.550		3.90	10.0	1.8	1.36	2.34
TPH C10-C12	5.000		5.00	10.0	1.8	0.00	5.00
TPH C12-C16	13.120		52.10	10.0	1.8	18.20	23.67
TPH C16-C21	87.890		527.00	10.0	1.8	189.43	197.69
TPH C21-C35	266.660		1531.10	10.0	1.8	580.24	602.99
TPH C35-C40	84.010		442.50	10.0	1.8	168.72	181.81
TPH Aromatic EC5-EC7	0.0		0.02	2.0	6.3	0.00	0.02
TPH Aromatic EC7-EC8	0.0		0.0	2.0	6.3	0.0	0.0
TPH Aromatic EC8-EC10	0.1		0.1	2.0	6.3	0.0	0.1
TPH Aromatic EC10-EC12	5.0		5.0	2.0	6.3	0.0	5.0
TPH Aromatic EC12-EC16	17.650		19.6	2.0	6.3	2.8	30.0
TPH Aromatic EC16-EC21	200.550		219.50	2.0	6.3	26.80	320.20
TPH Aromatic EC21-EC35	203.050		240.60	2.0	6.3	53.10	440.14
TPH Aliphatic EC5-EC6	0.100		0.10	2.0	6.3	0.00	0.10
TPH Aliphatic EC8-EC10	0.1		0.1	2.0	6.3	0.0	0.1
TPH Aliphatic EC10-EC12	5.0		5.0	2.0	6.3	0.0	5.0
TPH Aliphatic EC12-EC16	5.0		5.0	2.0	6.3	0.0	5.0
TPH Aliphatic EC16-EC21	5.0		5.0	2.0	6.3	0.0	5.0
TPH Aliphatic EC21-EC34	5.0		5.0	2.0	6.3	0.0	5.0
Benzene	0.020		0.020	2.0	6.3	0.000	0.020
Toluene	0.020		0.020	2.0	6.3	0.000	0.020
Ethyl Benzene	0.020		0.020	2.0	6.3	0.000	0.020
m+p-Xylene	0.040		0.040	2.0	6.3	0.000	0.040
o-Xylene	0.020		0.020	2.0	6.3	0.000	0.020

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TABLE 4 - COMPARISON OF 95th UCL TO TIER 1 GAC's

Job Number 06/3908/5 Created by: RR
Name Penistone High School, Barns Reviewed by: PB

	MEAN VALUE TEST			Residential Without Plant Uptake HCV (mg/kg)			HQ	Methodology
	Arithmetric Mean (mg/kg)	Geometric Mean (mg/kg)	UCL_{95}	SGV	Tier 1 GAC	SSAC	HQ = UCL_{95}/HCV	Used
Arsenic	6.9		8.5	20.0				1
Cadmium	0.2		0.2	30.0				1
Chromium (hexavalent)	1.0		1.0	200.0				1
Chromium (total)	31.2		47.7	200.0				1
Lead		13.2	19.4	450.0				1
Mercury	0.1		0.1	15.0				1
Selenium	1.0		1.0	260.0				1
Boron (water soluble)	0.5		0.6					
Copper	17.2		20.2					
Nickel	18.9		21.8	75.0				1
Zinc	61.7		69.3					
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	0.1		0.3					
Sulphide	15.4		35.6					
Sulphur (free)	20.6		43.9					
pH	7.6		8.7					
TPH	441.3		999.2					
PAH (total)	67.2		154.7					
Naphthalene	0.2		0.4		1904.0		0.0002	4
Acenaphthylene	0.1		0.2		2030.0		0.0001	5
Acenaphthene	1.0		2.1		2030.0		0.0010	5
Fluorene	1.0		2.1		811.0		0.0026	4
Phenanthrene	10.5		23.9		2030.0		0.0118	5
Anthracene	2.4		5.3		6089.0		0.0009	4
Fluoranthene	13.7		31.5		2550.0		0.0124	4
Pyrene	11.4		26.0		255.0		0.1021	4
Benzo(a)anthracene	5.0		11.4		20.3		0.5617	5
Chrysene	4.7		10.8		20.3		0.5336	5
Benzo(b)fluoranthene	5.3		12.1		20.3		0.5979	5
Benzo(k)fluoranthene	2.1		4.8		20.3		0.2376	5
Benzo(a)pyrene	4.7		10.7		2.0		5.2667	4
Indeno(1,2,3-cd)pyrene	2.7		6.3		20.3		0.3122	5
Dibenz(a,h)anthracene	0.5		1.1		2.0		0.5605	5
Benzo(g,h,i)perylene	3.1		7.0		20.3		0.3438	5
Sum of PAH's							8.5651	
Barium	45.3		67.2					
Beryllium	0.8		0.9					2
Vanadium	39.4		50.0					2
Nitrate	10.0		19.3					
Sulphate (total)	1999.7		4180.2					
Organic Matter	1.6		2.3					
TPH C10-C12	5.0		5.0		79.6			4
TPH C12-C16	13.1		23.7		291.7			4
TPH C16-C21	87.9		197.7		608.0			4
TPH C21-C35	266.7		603.0		608.0			4
TPH C35-C40	84.0		181.8		608.0			4
TPH Aromatic EC5-EC7	0.020		0.020		0.13		0.1493	4
TPH Aromatic EC7-EC8	0.020		0.020	3.0			0.0067	1
TPH Aromatic EC8-EC10	0.1		0.1		16.0		0.0063	4
TPH Aromatic EC10-EC12	5.0		5.0		79.6		0.0628	4
TPH Aromatic EC12-EC16	17.7		30.0		291.7		0.1027	4
TPH Aromatic EC16-EC21	200.6		320.2		608.0		0.5266	4
TPH Aromatic EC21-EC35	203.1		440.1		608.0		0.7239	4
TPH Aliphatic EC5-EC6	0.1		0.1		24.1		0.0042	4
TPH Aliphatic EC6-EC8	0.1		0.1		52.8		0.0019	4
TPH Aliphatic EC8-EC10	0.1		0.1		10.0		0.0100	4
TPH Aliphatic EC10-EC12	5.0		5.0		45.3		0.1104	4
TPH Aliphatic EC12-EC16	5.0		5.0		198.5		0.0252	4
TPH Aliphatic EC16-EC21	5.0		5.0		40596.0		0.0001	4
TPH Aliphatic EC21-EC34	5.0		5.0		40596.0		0.0001	4
Total TPH's							1.7302	
Benzene	0.0		0.0		0.13			4
Toluene	0.020		0.020	3.0				1
Ethyl Benzene	0.020		0.020	6.0				1
m+p-Xylene	0.04		0.04		22.9			4
o-Xylene	0.02		0.02		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	6.9	0.00	Carc Cat 1: R45	H7	0.1	Non Hazardous
			0.00	R23/R25	H6 (H5)	3	Non Hazardous
			0.00	R50,53	H14	25	Non Hazardous
	Arsenic Pentoxide	6.9	0.00	Carc Cat 1: R45	H7	0.1	Non Hazardous
			0.00	R23/R25	H6 (H5)	3	Non Hazardous
			0.00	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
			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	31.2	0.01	Carc Cat 1: R49	H7	0.1	Non Hazardous
			0.01	R48/23/25	H6 (H5)	3	Non Hazardous
			0.01	R22	H5	1	Non Hazardous
			0.01	R50/53	H14	25	Non Hazardous
Lead	Lead Sulphate	13.2	0.00	R61	H10	0.5	Non Hazardous
			0.00	R63	N/A	5	Non Hazardous
			0.00	R20/22	H5	25	Non Hazardous
			0.00	R50-53	H14	0.25	Non Hazardous
Mercury	Inorganic Mercury	0.1	0.00001	T:R23	H6 (H5)	3	Non Hazardous
			0.00001	T+:R26/27/28	H6 (H5)	0.1	Non Hazardous
			0.00001	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	0.5	0.00	T+: R26/28	H6 (H5)	0.1	Non Hazardous
			0.00	C: R34	H8(H4)	5	Non Hazardous
	Boron Trichloride	0.5	0.00	T+: R26/28	H6 (H5)	0.1	Non Hazardous
			0.00	C: R34	H8(H4)	5	Non Hazardous
Copper	Copper Chloride	17.2	0.00	R22	H5	25	Non Hazardous
	Copper Oxide	17.2	0.00	R22	H5	25	Non Hazardous
	Copper Sulphate	17.2	0.00	R22	H5	25	Non Hazardous
Nickel	Nickel Carbonate	18.9	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		0.2	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Acenaphthylene		0.1	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Acenaphthene		1.0	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Fluorene		1.0	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Phenanthrene		10.5	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Anthracene		2.4	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Fluoranthene		13.7	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Pyrene		11.4	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Benzo(a)anthracene		5.0	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Chrysene		4.7	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Benzo(b)fluoranthene		5.3	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Benzo(k)fluoranthene		2.1	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Benzo(a)pyrene		4.7	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Indeno(1,2,3-cd)pyrene		2.7	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Dibenz(a,h)anthracene		0.5	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous
Benzo(g,h,i)perylene		3.1	0.00	Cart Cat2:R45	H7	0.1	Non Hazardous

ASSESSMENT OF TPH'S IN SOIL

TOTAL TPH		441.3	0.04	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	4.68	mg/kg					
Total oil content (w/w)	0.044%						
Benzo(a)pyrene threshold is	0.022	mg/kg					Non Hazardous

HIGHEST BANDED TPH		266.7	0.03	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	4.68	mg/kg					
Total oil content (w/w)	0.027%						
Benzo(a)pyrene threshold is	0.013	mg/kg					Non Hazardous

TOTAL TPHCWG		446.7	0.04	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	4.68	mg/kg					
Total oil content (w/w)	0.045%						
Benzo(a)pyrene threshold is	0.022	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.

CC GEOTECHNICAL accepts no responsibility or liability for:

1. the consequences of this document being used for any purpose or project other than for which it was commissioned

and/or

2. the consequences of use of this document by any party with whom an agreement has not been executed.

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.