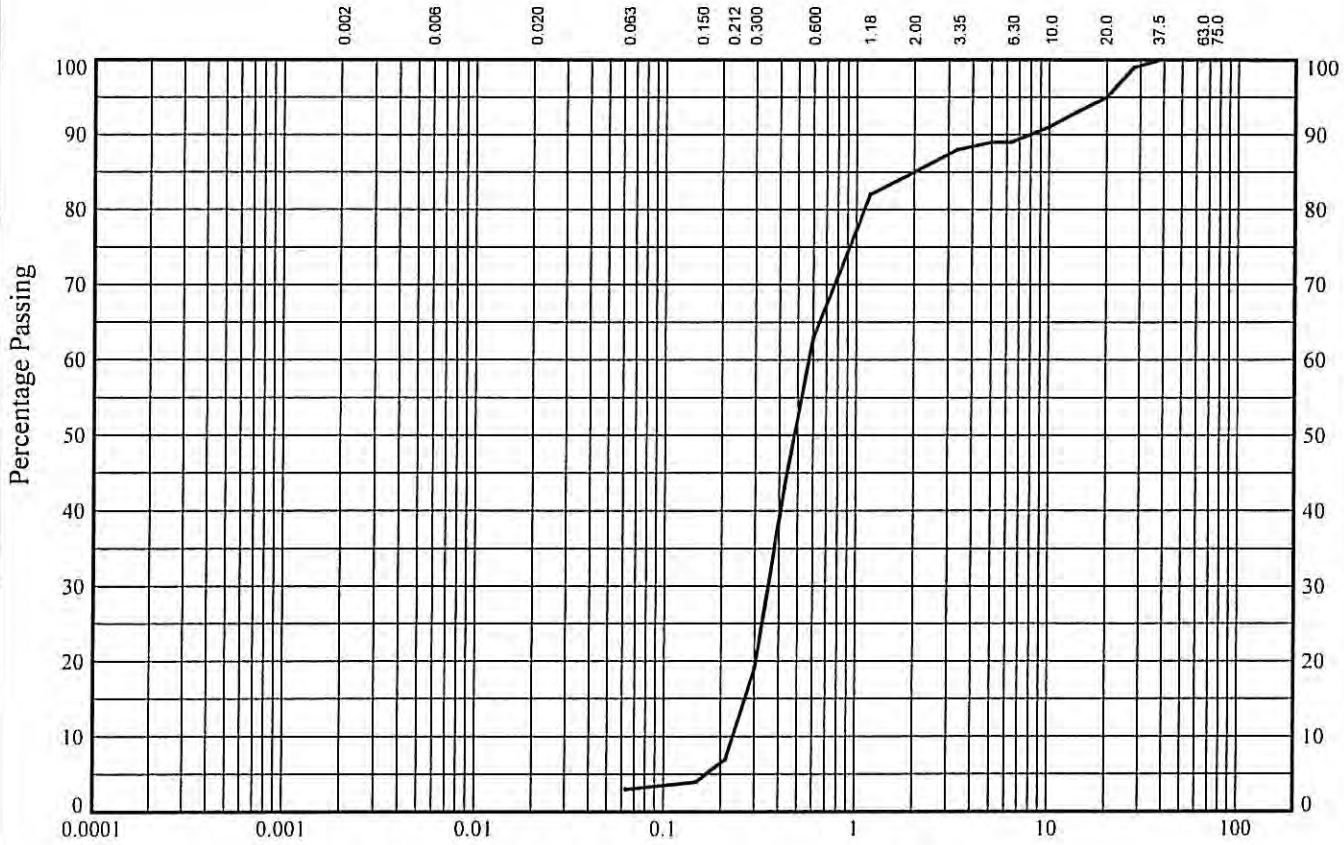
PARTICLE SIZE DISTRIBUTION TEST

In accordance with clauses 9.2,9.5 of BS1377:Part 2:1990

Borehole : **BH1** Sample Ref: Sample Type: **D** Depth (m): **3.50**



CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	SILT			SAND			GRAVEL			

BS Test Sieve (mm)	Percentage Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	99
20	95
14	93
10	91
6.3	89
5	89
3.35	88
2	85
1.18	82
0.6	63
0.425	43
0.3	19
0.212	7
0.15	4
0.063	3

Particle Diameter	Percentage Passing

Soil Fraction	Sieve Percentage
GRAVEL	**15**
SAND	**82**
SILT/CLAY	**3**

Soil Description:

Approved Signatories: P. KENT S. CAIRNS

STRUCTURAL SOILS
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Compiled By	Date
[redacted] PAUL KENT	22/02/11

Contract: **Salisbury Square, Hatfield**

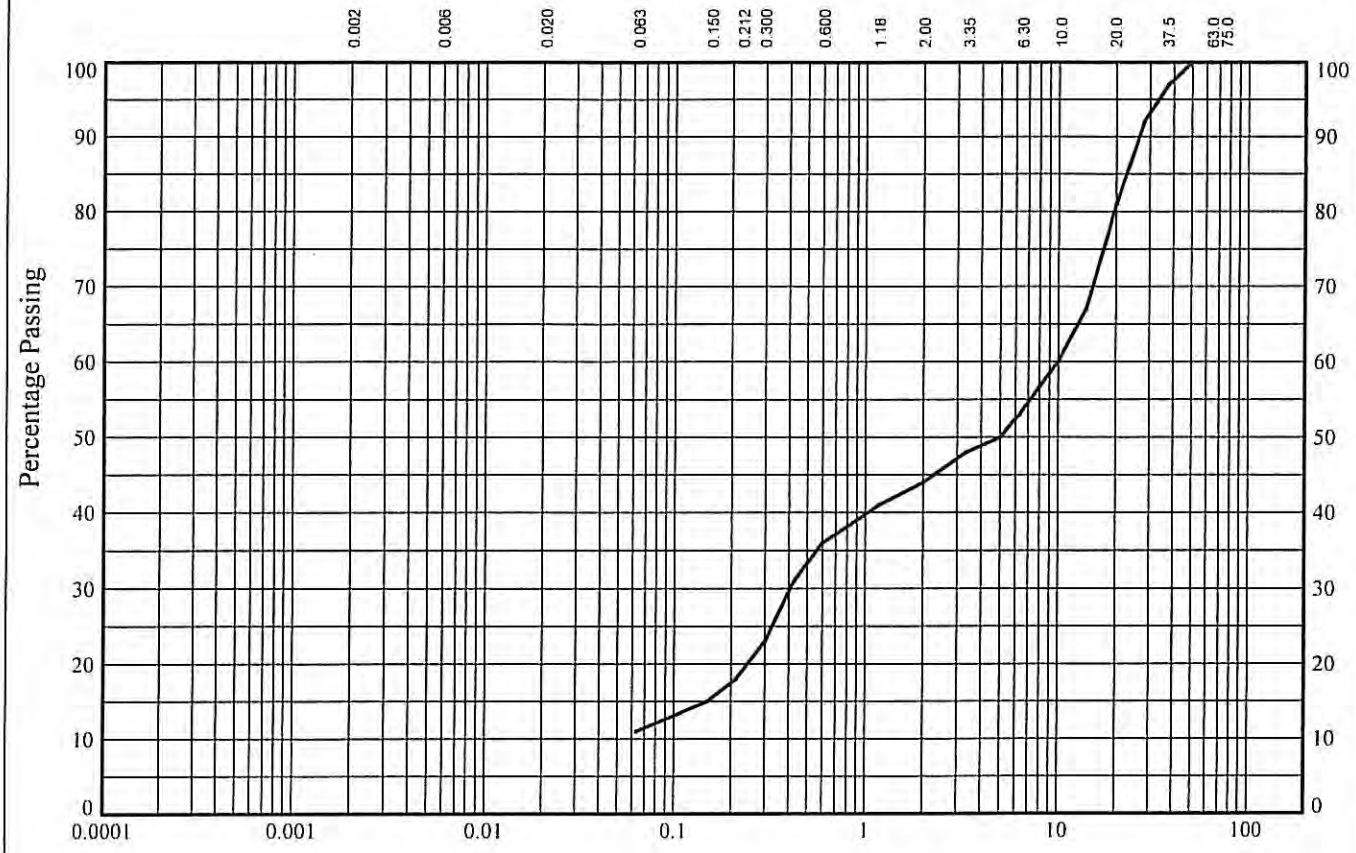
Contract Ref: **581511**

AGS

PARTICLE SIZE DISTRIBUTION TEST

In accordance with clauses 9.2,9.5 of BS1377:Part 2:1990

Borehole : **BH2** Sample Ref: Sample Type: **B** Depth (m): **13.50**



CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	SILT			SAND			GRAVEL			

BS Test Sieve (mm)	Percentage Passing
125	100
90	100
75	100
63	100
50	100
37.5	97
28	92
20	81
14	67
10	60
6.3	53
5	50
3.35	48
2	44
1.18	41
0.6	36
0.425	31
0.3	23
0.212	18
0.15	15
0.063	11

Particle Diameter	Percentage Passing

Soil Fraction	Sieve Percentage
GRAVEL	**56**
SAND	**33**
SILT/CLAY	**11**

Soil Description:

Approved Signatories: P. KENT S. CAIRNS

STRUCTURAL SOILS
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Compiled By	Date
[redacted] PAUL KENT	22/02/11

Contract: **Salisbury Square, Hatfield**

Contract Ref: **581511**

AGS

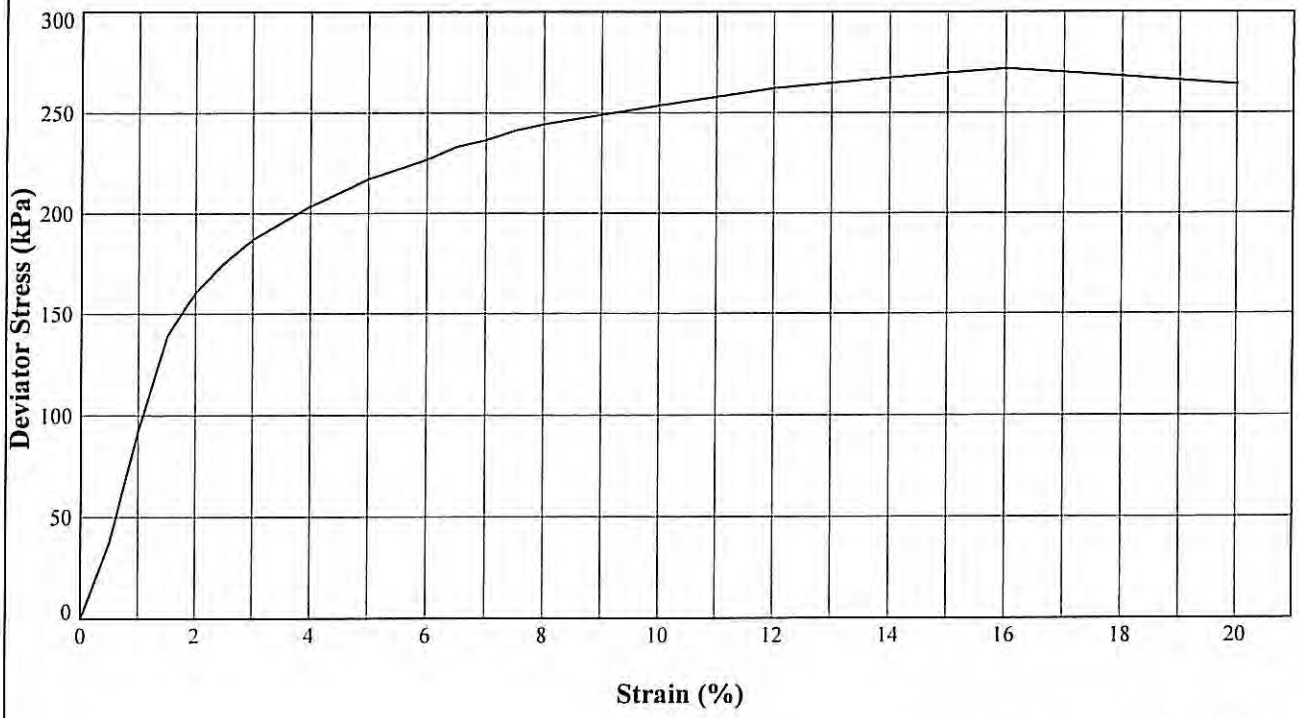
UNCONSOLIDATED QUICK UNDRAINED (SINGLE STAGE) TRIAXIAL COMPRESSION TEST

In accordance with BS1377:Part 7:1990, Clause 8

Borehole : **BH2** Sample Ref: Sample Type: **U** Depth (m): **5.70**

Description : **Very dark grey CLAY with occasional fine to medium chalk fragments**

STAGE NUMBER			1	2	3
SAMPLE DETAILS	Sample Condition		Undisturbed		
	Orientation of sample		Vertical		
	Diameter	(mm)	101.66		
	Height	(mm)	209.80		
	Moisture Content	(%)	19		
	Bulk Density	(Mg/m^3)	2.01		
	Dry Density	(Mg/m^3)	1.69		
TEST DETAILS	Membrane Thickness	(mm)	0.24		
	Rate of Axial Displacement	(%/min)	2.00		
	Cell Pressure	(kPa)	114		
	Membrane Correction	(kPa)	0.76		
	Corrected Deviator Stress	(kPa)	272		
	Undrained Shear Strength	(kPa)	136		
	Strain at Failure	(%)	16.0		
	Mode of Failure		Compound		



Approved Signatories: P. KENT S. CAIRNS

STRUCTURAL SOILS
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Compiled By: [redacted] PAUL KENT — Date: 22/02/11

Contract: **Salisbury Square, Hatfield**

Contract Ref: **581511**

AGS

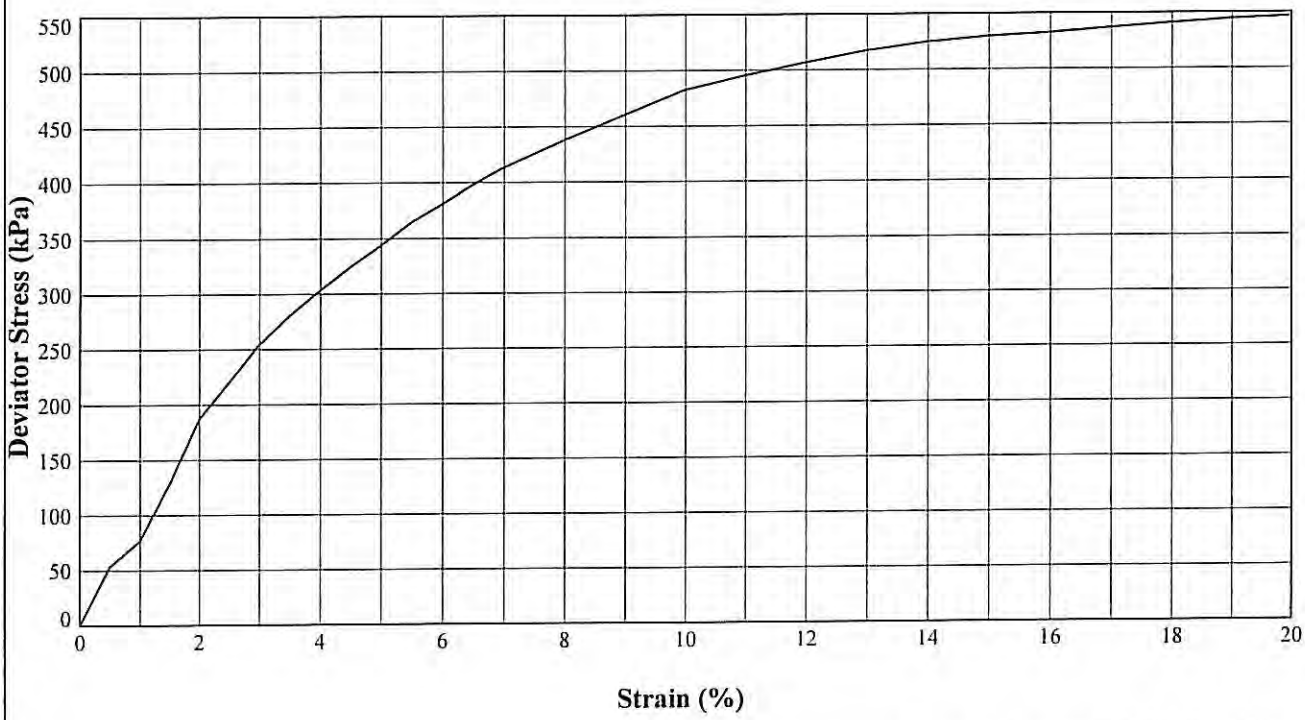
UNCONSOLIDATED QUICK UNDRAINED (SINGLE STAGE) TRIAXIAL COMPRESSION TEST

In accordance with BS1377:Part 7:1990, Clause 8

Borehole : **BH2** Sample Ref: Sample Type: **U** Depth (m): **8.50**

Description : **Very dark grey CLAY with occasional fine to medium chalk fragments**

STAGE NUMBER			1	2	3
SAMPLE DETAILS	Sample Condition		Undisturbed		
	Orientation of sample		Vertical		
	Diameter	(mm)	103.13		
	Height	(mm)	210.55		
	Moisture Content	(%)	16		
	Bulk Density	(Mg/m^3)	2.20		
	Dry Density	(Mg/m^3)	1.91		
TEST DETAILS	Membrane Thickness	(mm)	0.24		
	Rate of Axial Displacement	(%/min)	2.00		
	Cell Pressure	(kPa)	170		
	Membrane Correction	(kPa)	0.89		
	Corrected Deviator Stress	(kPa)	547		
	Undrained Shear Strength	(kPa)	273		
	Strain at Failure	(%)	20.0		
	Mode of Failure		Compound		



Approved Signatories: P. KENT S. CAIRNS

STRUCTURAL SOILS
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Compiled By: [redacted] PAUL KENT — Date: 22/02/11

Contract: **Salisbury Square, Hatfield**

Contract Ref: **581511**

Page 7 of 7

AGS

APPENDIX D

Chemical Laboratory Test Records

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 11/00569
Issue Number: 2 **Date:** 22 March, 2011

Client: RSK STATS Hemel Hempstead
18 Frogmore Road
Hemel Hempstead
Hertfordshire
UK
HP3 9RT

Project Manager: Ben Coulston
Project Name: Salisbury Square, Hatfield
Project Ref: 241882
Order No: Not specified
Date Samples Received: 10/02/11
Date Instructions Received: 17/03/11
Date Analysis Completed: 22/03/11

Prepared by: **Approved by:**

[redacted]

Gill Scott
Laboratory Manager

John Gustafson
Director

Notes - Soil analysis
All results are reported as dry weight (<40℃).
Stones >10mm are removed from the sample prior to analysis and results corrected where appropriate.

Notes - General
For soil samples subscript A indicates analysis performed on the sample as received, D indicates analysis performed on dried & crushed sample.
Superscript M indicates method accredited to MCERTS.

Predominant Matrix Codes - 1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER.
Samples with Matrix Code 7 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our MCERTS accreditation.
Secondary Matrix Codes - A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.
IS indicates Insufficient sample for analysis. NDP indicates No Determination Possible. NFI indicates No Fibres Identified.
Superscript # indicates method accredited to ISO 17025.
Accreditation for TPH (C6-C40) applies to the range C6-C36 only.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.

MCERTS
UKAS TESTING 1247

Envirolab Job Number: 11/00569

Client Project Name: Salisbury Square, Hatfield

Client Project Ref: 241882

Lab Sample ID	11/00569/1	11/00569/2	11/00569/3	11/00569/4	11/00569/5	11/00569/6	11/00569/7	11/00569/8	Units	Method ref
Client Sample No										
Client Sample ID	BH1	BH1	BH1	BH1	BH2	BH2	BH2	BH2		
Depth to Top	0.20	0.70	1.50	2.30	0.25	0.50	0.90	1.40		
Depth To Bottom			1.70	2.50						
Date Sampled	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	7	5A	5A	1A	7	5A	7	5A		
ACM Screen$_A$	-	NFI	NFI	-	NFI	NFI	-	-		Visual
pH$_D^{M\#}$	8.1	8.8	9.4	9.0	9.0	8.6	11.6	9.0	pH	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	0.02	0.05	-	0.02	-	0.03	-	-	g/l	A-T-026s
Phenols - Total by HPLC$_A$	<0.2	-	<0.2	-	-	<0.2	-	-	mg/kg	A-T-050s
Total Organic Carbon$_D^{\#}$	-	2.07	-	-	-	-	-	0.83	% w/w	A-T-032s
Arsenic$_D^{M\#}$	26	23	12	7	23	-	23	11	mg/kg	A-T-024
Boron (water soluble)$_D^{M\#}$	<1.0	<1.0	<1.0	<1.0	<1.0	-	<1.0	<1.0	mg/kg	A-T-027s
Cadmium$_D^{M\#}$	0.6	0.6	<0.5	<0.5	0.5	-	<0.5	<0.5	mg/kg	A-T-024
Copper$_D^{M\#}$	17	50	14	3	17	-	16	33	mg/kg	A-T-024
Chromium$_D^{M\#}$	29	29	29	15	23	-	30	30	mg/kg	A-T-024
Lead$_D^{M\#}$	14	278	21	5	14	-	43	46	mg/kg	A-T-024
Mercury$_D$	<0.17	<0.17	<0.17	<0.17	<0.17	-	<0.17	<0.17	mg/kg	A-T-024
Nickel$_D^{M\#}$	43	32	28	9	35	-	35	21	mg/kg	A-T-024
Selenium$_D^{M\#}$	1	2	<1	<1	<1	-	<1	<1	mg/kg	A-T-024
Zinc$_D^{M\#}$	105	177	46	17	87	-	97	62	mg/kg	A-T-024
TPH total (C6-C40)$_A$	-	-	-	-	-	-	-	168	mg/kg	A-T-007s

Envirolab Job Number: 11/00569

Client Project Name: Salisbury Square, Hatfield

Client Project Ref: 241882

Lab Sample ID	11/00569/1	11/00569/2	11/00569/3	11/00569/4	11/00569/5	11/00569/6	11/00569/7	11/00569/8	Units	Method ref
Client Sample No										
Client Sample ID	BH1	BH1	BH1	BH1	BH2	BH2	BH2	BH2		
Depth to Top	0.20	0.70	1.50	2.30	0.25	0.50	0.90	1.40		
Depth To Bottom			1.70	2.50						
Date Sampled	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	7	5A	5A	1A	7	5A	7	5A		
TPH CWG										
Ali >C5-C6$_A$	<0.01	-	-	-	-	-	-	-	mg/kg	A-T-022s
Ali >C6-C8$_A$	<0.01	-	-	-	-	-	-	-	mg/kg	A-T-022s
Ali >C8-C10$_A$	<0.01	-	-	-	-	-	-	-	mg/kg	A-T-022s
Ali >C10-C12$_A^{\#}$	<0.1	-	-	-	-	-	-	-	mg/kg	A-T-023s
Ali >C12-C16$_A^{\#}$	<0.1	-	-	-	-	-	-	-	mg/kg	A-T-023s
Ali >C16-C21$_A^{\#}$	<0.1	-	-	-	-	-	-	-	mg/kg	A-T-023s
Ali >C21-C35$_A^{\#}$	<0.1	-	-	-	-	-	-	-	mg/kg	A-T-023s
Total Aliphatics$_A^{\#}$	<0.1	-	-	-	-	-	-	-	mg/kg	A-T-022+23s
Aro >C5-C7$_A$	<0.01	-	-	-	-	-	-	-	mg/kg	A-T-022s
Aro >C7-C8$_A$	<0.01	-	-	-	-	-	-	-	mg/kg	A-T-022s
Aro >C8-C9$_A$	<0.01	-	-	-	-	-	-	-	mg/kg	A-T-022s
Aro >C9-C10$_A$	<0.01	-	-	-	-	-	-	-	mg/kg	A-T-022s
Aro >C10-C12$_A^{\#}$	<0.1	-	-	-	-	-	-	-	mg/kg	A-T-023s
Aro >C12-C16$_A^{\#}$	<0.1	-	-	-	-	-	-	-	mg/kg	A-T-023s
Aro >C16-C21$_A^{\#}$	<0.1	-	-	-	-	-	-	-	mg/kg	A-T-023s
Aro >C21-C35$_A^{\#}$	<0.1	-	-	-	-	-	-	-	mg/kg	A-T-023s
Total Aromatics$_A^{\#}$	<0.1	-	-	-	-	-	-	-	mg/kg	A-T-022+23s
TPH (Ali & Aro)$_A^{\#}$	<0.1	-	-	-	-	-	-	-	mg/kg	A-T-022+23s
MTBE$_A^{\#}$	<0.01	-	-	-	-	-	-	-	mg/kg	A-T-022s
BTEX										
BTEX - Benzene$_A^{\#}$	<0.01	-	-	-	-	-	-	-	mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	-	-	-	-	-	-	-	mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	-	-	-	-	-	-	-	mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	-	-	-	-	-	-	-	mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	-	-	-	-	-	-	-	mg/kg	A-T-022s

Envirolab Job Number: 11/00569

Client Project Name: Salisbury Square, Hatfield

Client Project Ref: 241882

Lab Sample ID	11/00569/1	11/00569/2	11/00569/3	11/00569/4	11/00569/5	11/00569/6	11/00569/7	11/00569/8	Units	Method ref
Client Sample No										
Client Sample ID	BH1	BH1	BH1	BH1	BH2	BH2	BH2	BH2		
Depth to Top	0.20	0.70	1.50	2.30	0.25	0.50	0.90	1.40		
Depth To Bottom			1.70	2.50						
Date Sampled	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	7	5A	5A	1A	7	5A	7	5A		
PAH 16										
Acenapthene$_A^{M\#}$	<0.01	0.01	0.02	<0.01	<0.01	-	0.04	-	mg/kg	A-T-019s
Acenapthylene$_A^{M\#}$	<0.01	0.05	<0.01	<0.01	<0.01	-	0.14	-	mg/kg	A-T-019s
Anthracene$_A^{M\#}$	<0.01	0.07	<0.01	<0.01	<0.01	-	0.19	-	mg/kg	A-T-019s
Benzo(a)anthracene$_A^{\#}$	<0.01	0.36	0.01	<0.01	<0.01	-	0.67	-	mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	0.02	0.47	<0.01	<0.01	<0.01	-	0.94	-	mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	0.01	0.33	<0.01	<0.01	0.01	-	0.70	-	mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	<0.01	0.71	0.02	<0.01	0.01	-	1.01	-	mg/kg	A-T-019s
Benzo(k)fluoranthene$_A$	0.02	0.48	0.02	<0.01	<0.01	-	0.76	-	mg/kg	A-T-019s
Chrysene$_A^{M\#}$	<0.01	0.70	0.03	<0.01	0.02	-	1.48	-	mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{\#}$	<0.01	0.10	<0.01	<0.01	<0.01	-	0.14	-	mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	0.01	0.78	0.07	<0.01	0.03	-	1.90	-	mg/kg	A-T-019s
Fluorene$_A^{M\#}$	<0.01	<0.01	0.01	<0.01	<0.01	-	0.03	-	mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{\#}$	<0.01	0.27	<0.01	<0.01	<0.01	-	0.58	-	mg/kg	A-T-019s
Napthalene$_A^{M\#}$	<0.01	0.03	0.11	0.02	<0.01	-	0.04	-	mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	0.02	0.17	0.06	<0.01	0.02	-	0.65	-	mg/kg	A-T-019s
Pyrene$_A^{M\#}$	0.01	0.75	0.06	0.02	0.03	-	1.71	-	mg/kg	A-T-019s
Total PAH$_A^{\#}$	0.10	5.28	0.41	0.03	0.13	-	11	-	mg/kg	A-T-019s

Envirolab Job Number: 11/00569

Client Project Name: Salisbury Square, Hatfield

Client Project Ref: 241882

Lab Sample ID	11/00569/9	11/00569/10	11/00569/11	11/00569/12	11/00569/13	11/00569/14	11/00569/15	11/00569/16	Units	Method ref
Client Sample No										
Client Sample ID	BH2	BH2	WS1	WS1	WS2	WS2	WS3	WS3		
Depth to Top	3.00	4.90	0.20	0.50	0.20	0.50	0.20	0.50		
Depth To Bottom			0.30	0.60	0.30	0.60	0.30	0.60		
Date Sampled	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	5A	1A	5AE	5AE	5AE	7	5A			
ACM Screen$_A$	-	-	NFI	-	NFI	NFI	NFI	NFI		Visual
pH$_D$ M#	8.7	8.9	-	8.7	-	7.6	-	-	pH	A-T-031s
Sulphate (water sol 2:1)$_D$ M#	-	0.02	-	<0.01	-	-	-	-	g/l	A-T-026s
Phenols - Total by HPLC$_A$	<0.2	-	<0.2	-	<0.2	-	-	-	mg/kg	A-T-050s
Total Organic Carbon$_D$ #	-	-	-	-	-	0.10	-	-	% w/w	A-T-032s
Arsenic$_D$ M#	11	14	-	12	-	23	-	-	mg/kg	A-T-024
Boron (water soluble)$_D$ M#	<1.0	<1.0	-	<1.0	-	<1.0	-	-	mg/kg	A-T-027s
Cadmium$_D$ M#	<0.5	<0.5	-	<0.5	-	<0.5	-	-	mg/kg	A-T-024
Copper$_D$ M#	18	9	-	26	-	17	-	-	mg/kg	A-T-024
Chromium$_D$ M#	30	18	-	30	-	29	-	-	mg/kg	A-T-024
Lead$_D$ M#	35	16	-	68	-	17	-	-	mg/kg	A-T-024
Mercury$_D$	<0.17	<0.17	-	<0.17	-	<0.17	-	-	mg/kg	A-T-024
Nickel$_D$ M#	21	15	-	21	-	42	-	-	mg/kg	A-T-024
Selenium$_D$ M#	<1	<1	-	<1	-	1	-	-	mg/kg	A-T-024
Zinc$_D$ M#	55	40	-	80	-	95	-	-	mg/kg	A-T-024
TPH total (C6-C40)$_A$	-	-	-	<10	<10	-	<10	-	mg/kg	A-T-007s

Envirolab Job Number: 11/00569

Client Project Name: Salisbury Square, Hatfield

Client Project Ref: 241882

Lab Sample ID	11/00569/9	11/00569/10	11/00569/11	11/00569/12	11/00569/13	11/00569/14	11/00569/15	11/00569/16	Units	Method ref
Client Sample No										
Client Sample ID	BH2	BH2	WS1	WS1	WS2	WS2	WS3	WS3		
Depth to Top	3.00	4.90	0.20	0.50	0.20	0.50	0.20	0.50		
Depth To Bottom			0.30	0.60	0.30	0.60	0.30	0.60		
Date Sampled	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	5A	1A	5AE	5AE	5AE	7	5A			
PAH 16										
Acenapthene$_A^{M\#}$	-	0.02	-	0.02	-	<0.01	-	-	mg/kg	A-T-019s
Acenapthylene$_A^{M\#}$	-	<0.01	-	<0.01	-	<0.01	-	-	mg/kg	A-T-019s
Anthracene$_A^{M\#}$	-	<0.01	-	0.02	-	0.01	-	-	mg/kg	A-T-019s
Benzo(a)anthracene$_A^{\#}$	-	<0.01	-	0.04	-	<0.01	-	-	mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	-	<0.01	-	0.04	-	<0.01	-	-	mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	-	<0.01	-	0.03	-	<0.01	-	-	mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	-	<0.01	-	0.09	-	<0.01	-	-	mg/kg	A-T-019s
Benzo(k)fluoranthene$_A$	-	<0.01	-	0.03	-	<0.01	-	-	mg/kg	A-T-019s
Chrysene$_A^{M\#}$	-	0.02	-	0.13	-	0.01	-	-	mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{\#}$	-	<0.01	-	<0.01	-	<0.01	-	-	mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	-	0.03	-	0.14	-	0.03	-	-	mg/kg	A-T-019s
Fluorene$_A^{M\#}$	-	<0.01	-	<0.01	-	<0.01	-	-	mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{\#}$	-	<0.01	-	0.03	-	<0.01	-	-	mg/kg	A-T-019s
Napthalene$_A^{M\#}$	-	0.02	-	0.02	-	<0.01	-	-	mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	-	0.02	-	0.05	-	0.02	-	-	mg/kg	A-T-019s
Pyrene$_A^{M\#}$	-	0.03	-	0.13	-	0.02	-	-	mg/kg	A-T-019s
Total PAH$_A^{\#}$	-	0.14	-	0.78	-	0.09	-	-	mg/kg	A-T-019s

Envirolab Job Number: 11/00569

Client Project Name: Salisbury Square, Hatfield

Client Project Ref: 241882

Lab Sample ID	11/00569/17	11/00569/18	11/00569/19	11/00569/20	11/00569/23	11/00569/25			Units	Method ref
Client Sample No										
Client Sample ID	WS4	WS4	TP1	TP1	TP2	TP3				
Depth to Top	0.20	0.50	0.10	0.40	0.50	0.10				
Depth To Bottom	0.30	0.60								
Date Sampled	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	7	7	4AE		4AE	4AE				
ACM Screen$_A$	NFI	-	-	NFI	-	-				Visual
pH$_D$ M#	8.4	8.4	8.3	-	8.3	8.2			pH	A-T-031s
Sulphate (water sol 2:1)$_D$ M#	-	0.01	-	-	-	-			g/l	A-T-026s
Total Organic Carbon$_D$ #	0.07	-	-	-	1.08	-			% w/w	A-T-032s
Arsenic$_D$ M#	22	18	10	-	12	22			mg/kg	A-T-024
Boron (water soluble)$_D$ M#	<1.0	<1.0	<1.0	-	<1.0	<1.0			mg/kg	A-T-027s
Cadmium$_D$ M#	<0.5	<0.5	<0.5	-	<0.5	0.9			mg/kg	A-T-024
Copper$_D$ M#	14	11	22	-	37	174			mg/kg	A-T-024
Chromium$_D$ M#	21	20	18	-	20	29			mg/kg	A-T-024
Lead$_D$ M#	39	10	66	-	84	345			mg/kg	A-T-024
Mercury$_D$	<0.17	<0.17	0.17	-	<0.17	1.03			mg/kg	A-T-024
Nickel$_D$ M#	30	33	14	-	18	33			mg/kg	A-T-024
Selenium$_D$ M#	<1	1	<1	-	1	2			mg/kg	A-T-024
Zinc$_D$ M#	73	70	80	-	112	306			mg/kg	A-T-024

Envirolab Job Number: 11/00569

Client Project Name: Salisbury Square, Hatfield

Client Project Ref: 241882

Lab Sample ID	11/00569/17	11/00569/18	11/00569/19	11/00569/20	11/00569/23	11/00569/25			Units	Method ref
Client Sample No										
Client Sample ID	WS4	WS4	TP1	TP1	TP2	TP3				
Depth to Top	0.20	0.50	0.10	0.40	0.50	0.10				
Depth To Bottom	0.30	0.60								
Date Sampled	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	7	7	4AE		4AE	4AE				
TPH CWG										
Ali >C5-C6$_A$	-	<0.01	-	-	-	-			mg/kg	A-T-022s
Ali >C6-C8$_A$	-	<0.01	-	-	-	-			mg/kg	A-T-022s
Ali >C8-C10$_A$	-	<0.01	-	-	-	-			mg/kg	A-T-022s
Ali >C10-C12$_A^{\#}$	-	<0.1	-	-	-	-			mg/kg	A-T-023s
Ali >C12-C16$_A^{\#}$	-	<0.1	-	-	-	-			mg/kg	A-T-023s
Ali >C16-C21$_A^{\#}$	-	<0.1	-	-	-	-			mg/kg	A-T-023s
Ali >C21-C35$_A^{\#}$	-	<0.1	-	-	-	-			mg/kg	A-T-023s
Total Aliphatics$_A^{\#}$	-	<0.1	-	-	-	-			mg/kg	A-T-022+23s
Aro >C5-C7$_A$	-	<0.01	-	-	-	-			mg/kg	A-T-022s
Aro >C7-C8$_A$	-	<0.01	-	-	-	-			mg/kg	A-T-022s
Aro >C8-C9$_A$	-	<0.01	-	-	-	-			mg/kg	A-T-022s
Aro >C9-C10$_A$	-	<0.01	-	-	-	-			mg/kg	A-T-022s
Aro >C10-C12$_A^{\#}$	-	<0.1	-	-	-	-			mg/kg	A-T-023s
Aro >C12-C16$_A^{\#}$	-	<0.1	-	-	-	-			mg/kg	A-T-023s
Aro >C16-C21$_A^{\#}$	-	<0.1	-	-	-	-			mg/kg	A-T-023s
Aro >C21-C35$_A^{\#}$	-	<0.1	-	-	-	-			mg/kg	A-T-023s
Total Aromatics$_A^{\#}$	-	<0.1	-	-	-	-			mg/kg	A-T-022+23s
TPH (Ali & Aro)$_A^{\#}$	-	<0.1	-	-	-	-			mg/kg	A-T-022+23s
MTBE$_A^{\#}$	-	<0.01	-	-	-	-			mg/kg	A-T-022s
BTEX										
BTEX - Benzene$_A^{\#}$	-	<0.01	-	-	-	-			mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	-	<0.01	-	-	-	-			mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	-	<0.01	-	-	-	-			mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	-	<0.01	-	-	-	-			mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	-	<0.01	-	-	-	-			mg/kg	A-T-022s

Envirolab Job Number: 11/00569

Client Project Name: Salisbury Square, Hatfield

Client Project Ref: 241882

Lab Sample ID	11/00569/17	11/00569/18	11/00569/19	11/00569/20	11/00569/23	11/00569/25			Units	Method ref
Client Sample No										
Client Sample ID	WS4	WS4	TP1	TP1	TP2	TP3				
Depth to Top	0.20	0.50	0.10	0.40	0.50	0.10				
Depth To Bottom	0.30	0.60								
Date Sampled	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	7	7	4AE		4AE	4AE				
PAH 16										
Acenapthene$_A^{M\#}$	<0.01	<0.01	0.02	-	0.13	-			mg/kg	A-T-019s
Acenapthylene$_A^{M\#}$	<0.01	<0.01	0.05	-	0.01	-			mg/kg	A-T-019s
Anthracene$_A^{M\#}$	<0.01	0.01	0.09	-	1.60	-			mg/kg	A-T-019s
Benzo(a)anthracene$_A^{\#}$	<0.01	<0.01	0.33	-	3.24	-			mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	<0.01	<0.01	0.47	-	2.33	-			mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	<0.01	<0.01	0.44	-	2.29	-			mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	<0.01	0.01	0.68	-	1.90	-			mg/kg	A-T-019s
Benzo(k)fluoranthene$_A$	<0.01	<0.01	0.36	-	2.64	-			mg/kg	A-T-019s
Chrysene$_A^{M\#}$	<0.01	0.02	0.71	-	5.27	-			mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{\#}$	<0.01	<0.01	0.05	-	0.42	-			mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	<0.01	0.03	0.84	-	8.88	-			mg/kg	A-T-019s
Fluorene$_A^{M\#}$	<0.01	<0.01	<0.01	-	0.17	-			mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{\#}$	<0.01	<0.01	0.26	-	1.42	-			mg/kg	A-T-019s
Napthalene$_A^{M\#}$	<0.01	0.01	<0.01	-	0.02	-			mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	<0.01	0.03	0.22	-	3.49	-			mg/kg	A-T-019s
Pyrene$_A^{M\#}$	<0.01	0.02	0.79	-	6.11	-			mg/kg	A-T-019s
Total PAH$_A^{\#}$	<0.01	0.14	5.30	-	39.9	-			mg/kg	A-T-019s

Envirolab Job Number: 11/00569

Client Project Name: Salisbury Square, Hatfield

Client Project Ref: 241882

Lab Sample ID	11/00569/17	11/00569/18	11/00569/19	11/00569/20	11/00569/23	11/00569/25			Units	Method ref
Client Sample No										
Client Sample ID	WS4	WS4	TP1	TP1	TP2	TP3				
Depth to Top	0.20	0.50	0.10	0.40	0.50	0.10				
Depth To Bottom	0.30	0.60								
Date Sampled	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11	03-Feb-11				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	7	7	4AE		4AE	4AE				
Spec PCB-WHO12										
PCB BZ 81_D	-	<0.005	-	-	-	-			mg/kg	A-T-004/5s
PCB BZ 105_D	-	<0.005	-	-	-	-			mg/kg	A-T-004/5s
PCB BZ 114_D	-	<0.005	-	-	-	-			mg/kg	A-T-004/5s
PCB BZ $118/123_D$	-	<0.005	-	-	-	-			mg/kg	A-T-004/5s
PCB BZ 126_D	-	<0.005	-	-	-	-			mg/kg	A-T-004/5s
PCB BZ 156_D	-	<0.005	-	-	-	-			mg/kg	A-T-004/5s
PCB BZ 157_D	-	<0.005	-	-	-	-			mg/kg	A-T-004/5s
PCB BZ 167_D	-	<0.005	-	-	-	-			mg/kg	A-T-004/5s
PCB BZ 169_D	-	<0.005	-	-	-	-			mg/kg	A-T-004/5s
PCB BZ 189_D	-	<0.005	-	-	-	-			mg/kg	A-T-004/5s
PCB BZ 77_D	-	<0.005	-	-	-	-			mg/kg	A-T-004/5s

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Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 11/01190
Issue Number: 1 **Date:** 22 March, 2011

Client: RSK STATS Hemel Hempstead
18 Frogmore Road
Hemel Hempstead
Hertfordshire
UK
HP3 9RT

Project Manager: Ben Coulston
Project Name: Salisbury Square, Hatfield
Project Ref: 241882
Order No: Not specified
Date Samples Received: 18/03/11
Date Instructions Received: 18/03/11
Date Analysis Completed: 22/03/11

Prepared by: **Approved by:**

[redacted]

John Gustafson
Director

Gill Scott
Laboratory Manager

Notes - Soil analysis
All results are reported as dry weight (<40°C).
Stones >10mm are removed from the sample prior to analysis and results corrected where appropriate.

Notes - General
For soil samples subscript A indicates analysis performed on the sample as received, D indicates analysis performed on dried & crushed sample.
Superscript M indicates method accredited to MCERTS.

Predominant Matrix Codes - 1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER.
Samples with Matrix Code 7 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our MCERTS accreditation.
Secondary Matrix Codes - A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.
IS indicates Insufficient sample for analysis. NDP indicates No Determination Possible. NFI indicates No Fibres Identified.
Superscript # indicates method accredited to ISO 17025.
Accreditation for TPH (C6-C40) applies to the range C6-C36 only.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.

MCERTS
UKAS TESTING 1247

Envirolab Job Number: 11/01190

Client Project Name: Salisbury Square, Hatfield

Client Project Ref: 241882

Lab Sample ID	11/01190/1	11/01190/2							Units	Method ref
Client Sample No										
Client Sample ID	BH2	BH1								
Depth to Top	12.20	6.80								
Depth To Bottom										
Date Sampled	03-Feb-11	03-Feb-11								
Sample Type	Soil - D	Soil - D								
Sample Matrix Code	5A	5A								
pH_D M#	8.2	8.0							pH	A-T-031s
Sulphate (water sol 2:1)$_D$ M#	0.15	0.28							g/l	A-T-026s

APPENDIX E

CLEA Software Output Reports

Generic Assessment Criteria for Human Health
Residential Scenario – Private Gardens

The human health generic assessment criteria (GAC) have been developed during a period of regulatory review and updating of the Contaminated Land Exposure Assessment (CLEA) project. Hence, the Environment Agency (EA) is in the process of publishing updated reports relating to the CLEA project and the GAC presented in this document may change to reflect these updates. This issue was prepared following the publication of soil guideline value reports and associated publications[1] for mercury, selenium, benzene, toluene, ethylbenzene and xylene in March 2009, arsenic and nickel in May 2009, cadmium and phenol in June 2009, dioxins, furans and dioxin-like PCBs in September 2009. It was also produced following publication of GAC by LQM[6]. Where available, the published soil guideline values (SGV)[1] have been used as GAC.

1. Model Selection

Soil assessment criteria (SAC) were calculated using CLEA v1.06 and the supporting UK guidance [1-6]. Groundwater assessment criteria (GrAC) protective of human health via the inhalation pathway were derived using the RBCA 1.3b model. RSK has updated the inputs within RBCA to reflect the UK guidance[1-5]. The SAC and GrAC collectively are termed GAC.

2. Conceptual Model

In accordance with EA Science Report SC050221/SR3[3], the residential with private garden scenario considers risks to a female child between the ages of 0 and 6 years old. In accordance with Box 3.1, SR3[3], the pathways considered for production of the SAC in the residential with gardens scenario are:

- Direct soil and dust ingestion;
- Consumption of homegrown produce;
- Consumption of soil attached to homegrown produce;
- Dermal contact with soil and indoor dust, and
- Inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

The pathway considered in production of the GrAC is the volatilisation of compounds from groundwater and subsequent vapour inhalation by residents whilst indoors. Figure 2 illustrates this linkage. Although the outdoor air inhalation pathway is also valid, this contributes little to the overall risks owing to the dilution in outdoor air. Within RBCA, the solubility limit of the determinant restricts the extent of volatilisation, which in turn drives the indoor air inhalation pathway. Whilst the same restriction is not built into the CLEA model, the CLEA model output cells are flagged red where the soil saturation limit has been exceeded.

An assumption used in the CLEA model is that of simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase[4]. The upper boundaries of this partitioning are represented by the aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous or vapour based saturation limits. Where model output cells are flagged red the soil or vapour saturation limit has been exceeded and further consideration of the SAC to be used within the assessment is required. One approach that could be adopted is to use the 'modelled' solubility saturation limit or vapour saturation limit of the compound as the SAC. However, as stated within the CLEA Handbook[4] this is likely to not be practical in many cases because of the very low limits

and is in any case highly conservative. Unless free-phase product is present, concentrations of the chemical are unlikely to be present at sufficient concentration to result in an exceedance of the health criteria value (HCV).

RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH[6] whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limit given in brackets. Therefore, when using the SAC's to screen laboratory analysis the assessor should take note if a given SAC has a corresponding solubility or vapour saturation limit (in brackets), and subsequently incorporate this piece of information within the screening analytical discussion. If further assessment is required following this process then an additional approach can be utilised as detailed within Section 4.12 of the CLEA model manual[4] which explains how to calculate an effective assessment criterion manually.

3. Input Selection

Chemical data was obtained from EA Report SC050021/SR7[5] and the health criteria values (HCV) from the UK TOX[1] reports where available. For SAC for total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH) toxicological and chemical specific parameters were obtained from the LQM/CIEH report [6]. Similarly, toxicological and specific chemical parameters for the volatile organic compound 1,2,4-trimethylbenzene were obtained from EIC/AGS/CL:AIRE[7].

For total petroleum hydrocarbons (TPH), aromatic hydrocarbons C_5-C_8 were not modelled since benzene and toluene are being modelled separately. The aromatic C_8-C_9 hydrocarbon fraction comprises ethylbenzene, xylene and styrene. Since ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for this band has been taken from styrene.

Owing to the lack of UK-specific data, default information in the RBCA model was used to evaluate methyl tertiary butyl ether (MTBE). No published UK data was available for 1,3,5-trimethylbenzene, so information was obtained from the US EPA as in the RBCA model. RBCA uses toxicity data for the inhalation pathway in different units to the CLEA model and cannot consider separately the mean daily intake (MDI), occupancy periods or breathing rates. Therefore, the HCV in RBCA was amended to take account of:

- Amendments to the MDI using Table 3.4 of SR2[2];
- A child weighing 13.3kg (average of 0-6 year old female in accordance with Table 4.6 of SR3[3]) and breathing 11.85m^3 (average daily inhalation rate for a 0-6 yr old female in accordance with Table 4.14 of SR3[3]; and
- The 50% rule (for petroleum hydrocarbons, 1,3,5-trimethylbenzene and MTBE)[2] where MDI data is not available but background exposure is considered important in the overall exposure.

4. Physical Parameters

For the residential with private gardens scenario, the CLEA default building is a small two-storey terrace house with concrete ground bearing slab. The house is assumed to have a 100m^2 private garden consisting of lawn, flowerbeds and incorporating a 20m^2 plot for growing fruit and vegetables consumed by the residents. SR3[3] notes this residential building type to be the most conservative in terms of protection from vapour intrusion. The building parameters are outlined in Table 5.

The parameters for a sandy loam soil type were used in line with SR3[3]. This includes a value of 6% for the percentage soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site specific risk assessments for this parameter, RSK has produced an

additional set of SAC for an SOM of 1% and 2.5%. For the GrAC, the depth to groundwater was taken as 2.5m based on RSK's experience of assessing the volatilisation pathway from groundwater.

5. GAC

The SAC were produced using the input parameters in Tables 1 to 5 and the GrAC using input parameters in Table 6. The final selected GAC are presented by pathway in Table 7 and the combined GAC in Table 8.

Figure 1
Conceptual Model for CLEA Residential Scenario – Private Gardens

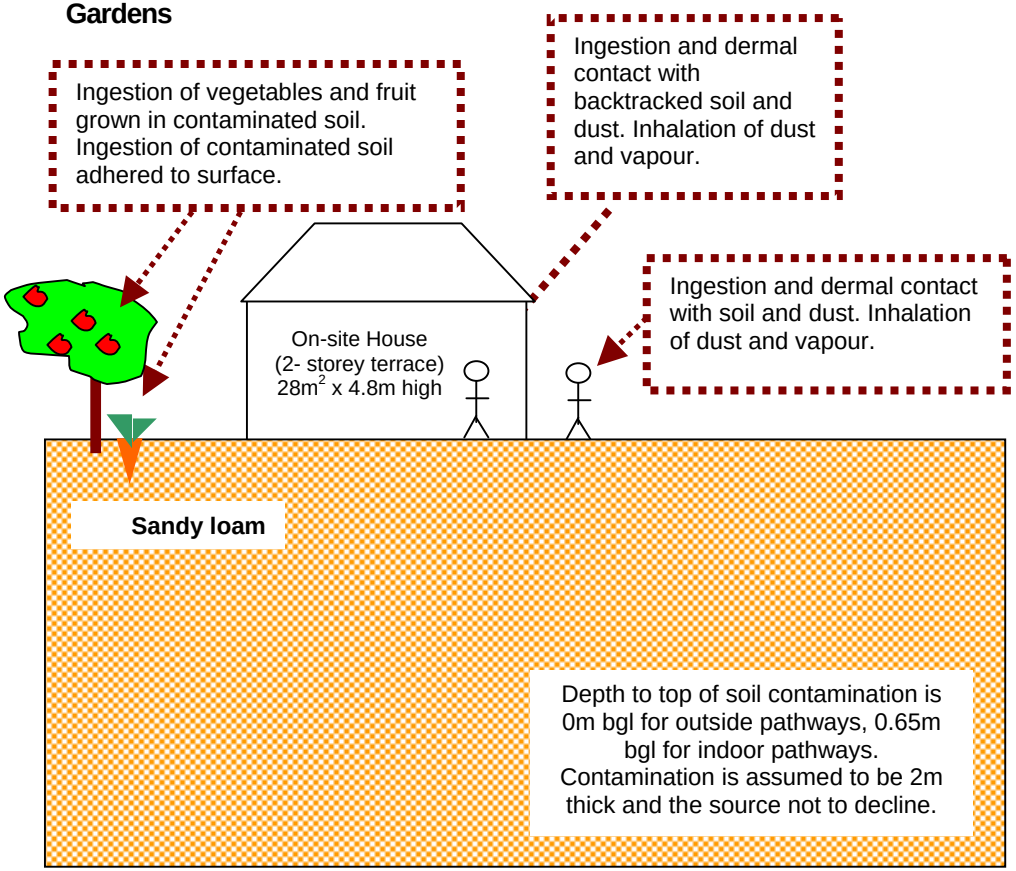

Table 1
Exposure Assessment Parameters for Residential Scenario - Private Gardens – Inputs for CLEA Model

Parameter	Value	Justification
Land use	Residential with homegrown produce	Chosen land use
Receptor	Female child age 1 to 6	Key generic assumption given in Box 3.1, report SC050021/SR3[3]
Building	Small terraced house	Key generic assumption given in Box 3.1, report SC050021/SR3. Two storey small terraced house chosen as it is the most conservative residential building type in terms of protection from vapor intrusion (Section 3.4.6, report SC050021/SR3)[3]
Soil type	Sandy Loam	Most common UK soil type (Section 4.3.1, From Table 3.1, report SC050021/SR3)[3]
Start AC (age class)	1	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged zero to six. From Box 3.1, report SC050021/SR3[3]
End AC (age class)	6	
SOM (%)	6	Representative of sandy loamy soil according to EA Guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[8]
	1	To provide SAC for sites where SOM <6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2
Residential with Private Gardens –Homegrown Produce Data for CLEA Model

	Consumption Rate (g FW kg^{-1} BW day^{-1}) by Age Class						Dry Weight Conversion Factor	Homegrown Fraction (average)	Homegrown Fraction (high end)	Soil loading factor	Preparation correction factor
Name	1	2	3	4	5	6	g DW g^{-1} FW	-	-	g g^{-1} DW	-
Green vegetables	7.12	6.85	6.85	6.85	3.74	3.74	0.096	0.05	0.33	1.00E-03	2.00E-01
Root vegetables	10.69	3.30	3.30	3.30	1.77	1.77	0.103	0.06	0.4	1.00E-03	1.00E+00
Tuber vegetables	16.03	5.46	5.46	5.46	3.38	3.38	0.21	0.02	0.13	1.00E-03	1.00E+00
Herbaceous fruit	1.83	3.96	3.96	3.96	1.85	1.85	0.058	0.06	0.4	1.00E-03	6.00E-01
Shrub fruit	2.23	0.54	0.54	0.54	0.16	0.16	0.166	0.09	0.6	1.00E-03	6.00E-01
Tree fruit	3.82	11.96	11.96	11.96	4.26	4.26	0.157	0.04	0.27	1.00E-03	6.00E-01
Justification	Table 4.17, SR3[3]						Table 6.3, SR3[3]	Table 4.19, SR3[3]		Table 6.3, SR3[3]	

Table 3
Residential with Private Gardens – Land Use Data for CLEA Model

Parameter	Unit	Age Class					
		1	2	3	4	5	6
EF (soil and dust ingestion)	day yr^{-1}	180	365	365	365	365	365
EF (consumption of homegrown produce)	day yr^{-1}	180	365	365	365	365	365
EF (skin contact, indoor)	day yr^{-1}	180	365	365	365	365	365
EF (skin contact, outdoor)	day yr^{-1}	180	365	365	365	365	365
EF (inhalation of dust and vapour, indoor)	day yr^{-1}	365	365	365	365	365	365
EF (inhalation of dust and vapour, outdoor)	day yr^{-1}	365	365	365	365	365	365
Justification		Table 3.1, SR3[3]					
Occupancy period (indoor)	hr day^{-1}	23	23	23	23	19	19
Occupancy period (outdoor)	hr day^{-1}	1	1	1	1	1	1
Justification		Table 3.2, SR3[3]					
Soil to skin adherence factor (indoor)	mg cm^{-2} day^{-1}	6.00E-02	6.00E-02	6.00E-02	6.00E-02	6.00E-02	6.00E-02
Soil to skin adherence factor (outdoor)	mg cm^{-2} day^{-1}	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Justification		Table 8.1, SR3[3]					
Soil and dust ingestion rate	g day^{-1}	1.00E-01	1.00E-01	1.00E-01	1.00E-01	1.00E-01	1.00E-01
Justification		Table 6.2, SR3[3]					

*Of note, for **cadmium**, the exposure assessment for a residential land use is based on estimates representative of lifetime exposure AC1-18. This is because the TDI_{oral} and TDI_{inh} – are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not only in childhood but averaged over a longer time period. See the Environment Agency Science report: SC05002 / TOX 3 [1] and Science Report SC050021 / Cadmium SGV [1] for more information.*

Table 4
Residential with Private Gardens – Receptor Data for CLEA Model

Parameter	Unit	Age Class						Justification
		1	2	3	4	5	6	
Body weight	kg	5.6	9.8	12.7	15.1	16.9	19.7	Table 4.6, SR3[3]
Body height	m	0.7	0.8	0.9	0.9	1	1.1	
Inhalation rate	m^3 day^{-1}	8.5	13.3	12.7	12.2	12.2	12.2	Table 4.14, SR3[3]
Max exposed skin fraction (indoor)	m^2 m^{-2}	0.32	0.33	0.32	0.35	0.35	0.33	Table 4.8, SR3[3]
Max exposed skin fraction (outdoor)	m^2 m^{-2}	0.26	0.26	0.25	0.28	0.28	0.26	

*See **cadmium** note as per Table 3 above.*

Table 5
Residential with Private Gardens – Soil and Building Inputs for CLEA Model

Parameter	Unit	Value	Justification
SOIL PROPERTIES for sandy loam			
Porosity, total	$cm^3\ cm^{-3}$	0.53	Default soil type is sandy loam, section 4.3.1, SR3[3] Parameters for sandy loam from Table 4.4, SR3[3]
Porosity, air filled	$cm^3\ cm^{-3}$	0.20	
Porosity, water filled	$cm^3\ cm^{-3}$	0.33	
Residual soil water content	$cm^3\ cm^{-3}$	0.12	
Saturated hydraulic conductivity	$cm\ s^{-1}$	3.56E-03	
van Genuchten shape parameter (*m*)	-	3.20E-01	
Bulk density	$g\ cm^{-3}$	1.21	
Threshold value of wind speed at 10m	$m\ s^{-1}$	7.20	Default value taken from Section 9.2.2, SR3[3]
Empirical function (F_x) for dust model	-	1.22	Value taken from Section 9.2.2, SR3[3]
Ambient soil temperature	K	283	Annual average soil temperature representative of UK surface soils. Section 4.3.1, SR3[3]
AIR DISPERSION MODEL			
Mean annual wind speed (10 m)	$m\ s^{-1}$	5.00	Default value taken from Section 9.2.2, SR3[3]
Air dispersion factor at height of 0.8 m	$g\ m^{-2}\ s^{-1}$ per $kg\ m^{-3}$	2400	Values for a 0.01 ha site, appropriate to a residential land use in Newcastle (most representative city for UK). (from Table 9.1, SR3)[3] Assumed child of 6 is not tall enough to reach 1.6m
Air dispersion factor at height of 1.6 m	$g\ m^{-2}\ s^{-1}$ per $kg\ m^{-3}$	0	
Fraction of site with hard or vegetative cover	$m^2\ m^{-2}$	0.75	Section 3.2.6, SR3 [3] based on residential land use
BUILDING PROPERTIES for small terrace house with ground-bearing floor slab			
Building footprint	m^2	28	From Table 3.3 and 4.21, SR3[3]
Living space air exchange rate	hr^{-1}	0.50	
Living space height (above ground)	m	4.8	
Living space height (below ground)	m	0.0	Assumed no basement
Pressure difference (soil to enclosed space)	Pa	3.1	From Table 3.3, SR3[3]
Foundation thickness	m	0.15	
Floor crack area	cm^2	423	
Dust loading factor	$\mu g\ m^{-3}$	50	Default value for a residential site taken from Section 9.3, SR3[3]
VAPOUR MODEL			
Default soil gas ingress rate	$cm^3\ s^{-1}$	25	Generic flow rate, Section 10.3, SR3[3]
Depth to top of source (beneath building)	cm	50	Section 3.2.6, SR3 [3] states source is 50cm below building or 65cm below ground surface
Depth to top of source (no building)	cm	0	Section 10.2, SR3 [3] assumes impact from 0-1m for outdoor inhalation pathway
Thickness of contaminant layer	cm	200	Model default for indoor air, Section 4.9, SR4[4]
Time average period for surface emissions	years	6	Time period of a 0 to 6 year old, Box 3.5, SR3[3]
User-defined effective air permeability	cm^2	3.05E-08	Calculated for sandy loam using equations in Appendix 1, SR3[3]

Figure 2
GrAC Conceptual Model for RBCA Residential with Private Gardens Scenario

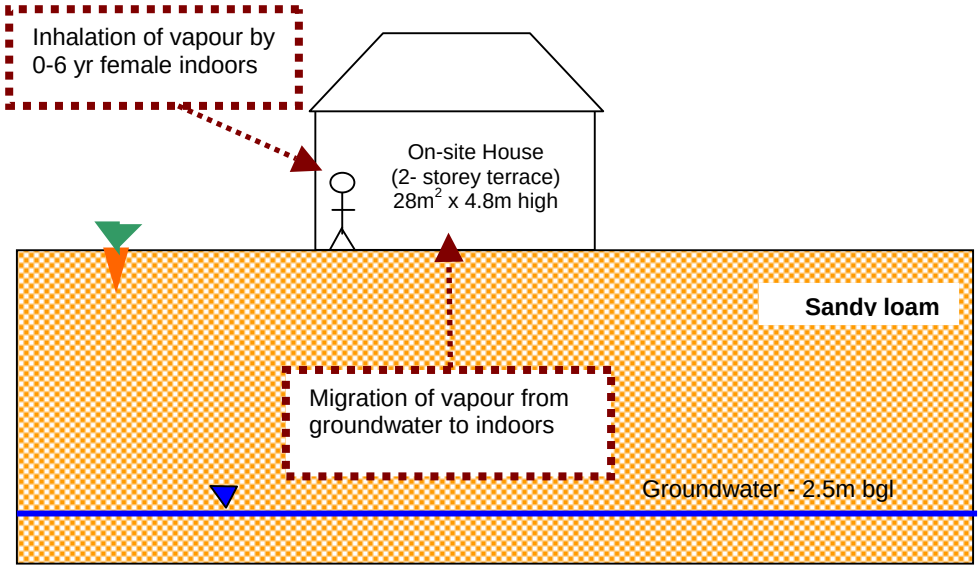

Table 6
Residential with Private Gardens RBCA Inputs

Parameter	Unit	Value	Justification
RECEPTOR			
Averaging time	Years	6	From Box 3.1, SR3[3]
Receptor weight	kg	13.3	Average of CLEA 0-6 year old female data, Table 4.6, SR3[3]
Exposure duration	Years	6	From Box 3.1, report , SR3[3]
Exposure frequency	Days/yr	350	Weighted using occupancy period of 23 hours per day for 365 days of the year
SOIL TYPE – SANDY LOAM			
Total porosity	-	0.53	CLEA value for sandy loam. Parameters for sandy loam from Table 4.4, SR3[3]
Volumetric water content	-	0.33	
Volumetric air content	-	0.20	
Dry bulk density	g cm^{-3}	1.21	
Vertical hydraulic conductivity	cm s^{-1}	3.56E-3	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3[3]
Vapour permeability	m^2	3.05E-12	Calculated for sandy loam using equations in Appendix 1, SR3[3]
Capillary zone thickness	m	0.1	Professional judgement
Fraction organic carbon	%	(i) 0.0348	Representative of sandy loam according to EA Guidance note dated January 2009 entitled Changes We Have Made to the CLEA Framework Documents (ref)
		(ii) 0.0058	To provide SAC for site's where SOM < 6% as often observed by RSK
BUILDING			
Building volume/area ratio	m	4.8	Table 3.3, SR3[3]
Foundation area	m^2	28	
Foundation perimeter	m	22	Calculated assuming building measures 7m x 4m to give 28m^2 foundation area
Building air exchange rate	d^{-1}	12	Table 3.3, SR3[3]
Depth to bottom of foundation slab	m	0.15	
Foundation thickness	m	0.15	
Foundation crack fraction	-	0.0151	Calculated from floor crack area of 423 cm^2 and building footprint of 28m^2 in Table 4.21, SR3[3]
Volumetric water content of cracks	-	0.33	Assumed equal to underlying soil type in assumption that cracks become filled with soil over time. Parameters for sandy loam from Table 4.4, SR3[3]
Volumetric air content of cracks	-	0.2	
Indoor/outdoor differential pressure	Pa	3.1	From Table 3.3, SR3[3]

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH PRIVATE GARDENS

Table 7

Human Health Generic Assessment Criteria by Pathway for Residential Scenario - Private Gardens

Compound	Notes	GrAC (mg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals														
Arsenic	(b)(c)	-	3.24E+01	8.50E+01	-	NR	3.24E+01	8.50E+01	-	NR	3.24E+01	8.50E+01	-	NR
Cadmium	(b)	-	1.12E+01	1.85E+02	1.10E+01	NR	1.12E+01	1.85E+02	1.10E+01	NR	1.12E+01	1.85E+02	1.10E+01	NR
Chromium (III) - oxide		-	1.84E+04	3.55E+03	2.98E+03	NR	1.84E+04	3.55E+03	2.98E+03	NR	1.84E+04	3.55E+03	2.98E+03	NR
Chromium (VI) - hexavalent		-	1.02E+01	4.25E+00	3.21E+00	NR	1.02E+01	4.25E+00	3.21E+00	NR	1.02E+01	4.25E+00	3.21E+00	NR
Copper		-	2.66E+03	1.04E+04	2.33E+03	NR	2.66E+03	1.04E+04	2.33E+03	NR	2.66E+03	1.04E+04	2.33E+03	NR
Lead	(a)	-	4.50E+02	-	-	NR	4.50E+02	-	-	NR	4.50E+02	-	-	NR
Elemental Mercury (Hg^0)	(b)(d)	9.40E-03	-	1.70E-01	-	4.31E+00	-	4.24E-01	-	1.07E+01	-	1.02E+00	-	2.58E+01
Inorganic Mercury (Hg^{2+})	(b)	-	1.81E+02	2.55E+03	1.69E+02	NR	1.81E+02	2.55E+03	1.69E+02	NR	1.81E+02	2.55E+03	1.69E+02	NR
Methyl Mercury (Hg^{4+})	(b)	2.00E+01	1.39E+01	1.59E+01	7.40E+00	7.33E+01	1.39E+01	3.08E+01	9.55E+00	1.42E+02	1.39E+01	6.53E+01	1.14E+01	3.04E+02
Nickel	(b)(d)	-	5.31E+02	1.27E+02	-	NR	5.31E+02	1.27E+02	-	NR	5.31E+02	1.27E+02	-	NR
Selenium	(b)(c)	-	3.50E+02	-	-	NR	3.50E+02	NR	-	NR	3.50E+02	-	-	NR
Zinc	(c)	-	3.75E+03	2.55E+07	-	NR	3.75E+03	2.55E+07	-	NR	3.75E+03	2.55E+07	-	NR
Cyanide		-	2.66E+01	3.97E+00	3.68E+00	NR	2.66E+01	3.97E+00	3.68E+00	NR	2.66E+01	3.97E+00	3.68E+00	NR
Volatile Organic Compounds														
Benzene	(b)	7.20E+00	1.12E-01	2.69E-01	7.92E-02	1.22E+03	2.28E-01	4.99E-01	1.57E-01	2.26E+03	4.89E-01	1.04E+00	3.32E-01	4.71E+03
Toluene	(b)	1.90E+03	1.47E+02	6.26E+02	1.19E+02	8.69E+02	3.35E+02	1.38E+03	2.70E+02	1.92E+03	7.59E+02	3.14E+03	6.11E+02	4.36E+03
Ethylbenzene	(b)	2.60E+02	1.06E+02	1.70E+02	6.52E+01	5.18E+02	2.51E+02	3.98E+02	1.54E+02	1.22E+03	5.70E+02	9.32E+02	3.54E+02	2.84E+03
Xylene - m	(b)	8.40E+01	2.02E+02	5.56E+01	4.36E+01	6.25E+02	4.80E+02	1.31E+02	1.03E+02	1.47E+03	1.09E+03	3.07E+02	2.40E+02	3.46E+03
Xylene - o		1.00E+02	1.85E+02	5.98E+01	4.52E+01	4.78E+02	4.38E+02	1.40E+02	1.06E+02	1.12E+03	9.96E+02	3.27E+02	2.46E+02	2.62E+03
Xylene - p		8.70E+01	1.91E+02	5.34E+01	4.17E+01	5.76E+02	4.51E+02	1.26E+02	9.82E+01	1.35E+03	1.02E+03	2.94E+02	2.28E+02	3.17E+03
Total xylene		8.40E+01	2.02E+02	5.56E+01	4.36E+01	6.25E+02	4.80E+02	1.31E+02	1.03E+02	1.47E+03	1.09E+03	3.07E+02	2.40E+02	3.46E+03
Methyl t-Butyl ether		2.20E+03	1.75E+00	1.84E+02	1.75E+00	1.66E+04	3.68E+00	2.40E+02	3.67E+00	2.16E+04	7.41E+00	3.70E+02	7.37E+00	3.34E+04
Trichloroethene		1.80E+00	2.83E+00	1.10E-01	1.06E-01	1.54E+03	6.25E+00	2.30E-01	2.22E-01	3.22E+03	1.40E+01	5.11E-01	4.93E-01	7.14E+03
Tetrachloroethene		3.60E+00	1.06E+01	1.03E+00	9.36E-01	4.24E+02	2.44E+01	2.30E+00	2.10E+00	9.51E+02	5.55E+01	5.28E+00	4.82E+00	2.18E+03
1,1,1-Trichloroethane		2.60E+01	3.20E+02	6.33E+00	6.21E+00	1.43E+03	6.97E+02	1.29E+01	1.27E+01	2.92E+03	1.55E+03	2.84E+01	2.79E+01	6.39E+03
1,1,1,2 Tetrachloroethane		1.40E+01	5.19E+00	1.08E+00	8.93E-01	2.60E+03	1.22E+01	2.50E+00	2.08E+00	6.02E+03	2.78E+01	5.83E+00	4.82E+00	1.40E+04
1,1,2,2-Tetrachloroethane		1.40E+01	2.70E+00	2.76E+00	1.37E+00	2.67E+03	5.85E+00	5.65E+00	2.87E+00	5.46E+03	1.30E+01	1.24E+01	6.34E+00	1.20E+04
Carbon Tetrachloride		5.50E-02	1.05E+00	1.81E-02	1.79E-02	1.52E+03	2.41E+00	3.97E-02	3.93E-02	3.32E+03	5.44E+00	8.99E-02	8.92E-02	7.54E+03
1,2-Dichloroethane		3.00E-01	3.06E-02	6.46E-03	5.34E-03	3.41E+03	5.53E-02	9.32E-03	7.98E-03	4.91E+03	1.05E-01	1.60E-02	1.39E-02	8.43E+03
Vinyl Chloride		1.90E-02	3.69E-03	5.43E-04	4.73E-04	1.36E+03	6.64E-03	7.02E-04	6.35E-04	1.76E+03	1.21E-02	1.07E-03	9.86E-04	2.69E+03
1,2,4-Trimethylbenzene		7.50E-02	-	3.51E-01	-	5.57E+02	-	8.55E-01	-	1.36E+03	-	2.10E+00	-	3.25E+03
1,3,5-Trimethylbenzene		4.70E-02	1.45E+01	4.60E-01	4.56E-01	9.47E+01	3.47E+01	1.10E+00	1.09E+00	2.26E+02	7.94E+01	2.59E+00	2.56E+00	5.33E+02
Semi-Volatile Organic Compounds														
Acenaphthene		3.20E+00	2.18E+02	3.46E+03	2.05E+02	5.70E+01	5.08E+02	8.54E+03	4.79E+02	1.41E+02	1.06E+03	2.03E+04	1.01E+03	3.36E+02
Acenaphthylene		4.20E+00	1.78E+02	3.27E+03	1.68E+02	8.61E+01	4.17E+02	8.03E+03	3.97E+02	2.12E+02	8.90E+02	1.91E+04	8.51E+02	5.06E+02
Anthracene		2.10E-02	2.31E+03	1.08E+05	2.26E+03	1.17E+00	5.03E+03	2.65E+05	4.93E+03	2.91E+00	9.33E+03	6.15E+05	9.19E+03	6.96E+00
Benzo(a)anthracene		3.80E-03	7.00E+00	5.55E+00	3.10E+00	1.71E+00	8.98E+00	9.83E+00	4.69E+00	4.28E+00	1.01E+01	1.41E+01	5.88E+00	1.03E+01
Benzo(b)fluoranthene		2.00E-03	8.06E+00	1.79E+01	5.56E+00	1.22E+00	9.78E+00	1.97E+01	6.53E+00	3.04E+00	1.07E+01	2.05E+01	7.02E+00	7.29E+00
Benzo(g,h,i)perylene		2.60E-04	6.68E+01	1.27E+02	4.38E+01	1.54E-02	7.04E+01	1.32E+02	4.59E+01	3.85E-02	7.19E+01	1.34E+02	4.68E+01	9.23E-02
Benzo(k)fluoranthene		8.00E-04	1.25E+01	2.66E+01	8.51E+00	6.87E-01	1.44E+01	2.83E+01	9.56E+00	1.72E+00	1.53E+01	2.91E+01	1.00E+01	4.12E+00
Chrysene		2.00E-03	8.76E+00	1.95E+01	6.00E+00	4.40E-01	1.20E+01	2.45E+01	8.04E+00	1.10E+00	1.41E+01	2.72E+01	9.27E+00	2.64E+00
Dibenzo(a,h)anthracene		6.00E-04	1.19E+00	2.13E+00	7.62E-01	3.93E-03	1.33E+00	2.42E+00	8.58E-01	9.82E-03	1.39E+00	2.56E+00	9.03E-01	2.36E-02
Fluoranthene		2.30E-01	2.59E+02	2.69E+04	2.57E+02	1.89E+01	4.67E+02	6.23E+04	4.63E+02	4.73E+01	6.78E+02	1.28E+05	6.74E+02	1.13E+02
Fluorene		1.90E+00	1.70E+02	4.35E+03	1.63E+02	3.09E+01	3.91E+02	1.07E+04	3.77E+02	7.65E+01	8.00E+02	2.54E+04	7.76E+02	1.83E+02
Indeno(1,2,3-cd)pyrene		2.00E-04	4.58E+00	1.04E+01	3.18E+00	6.13E-02	5.74E+00	1.17E+01	3.85E+00	1.53E-01	6.37E+00	1.22E+01	4.19E+00	3.68E-01
Phenanthrene		5.30E-01	9.35E+01	5.04E+03	9.18E+01	3.60E+01	2.04E+02	1.23E+04	2.01E+02	8.96E+01	3.81E+02	2.86E+04	3.76E+02	2.14E+02
Pyrene		1.30E-01	5.69E+02	6.18E+04	5.63E+02	2.20E+00	1.05E+03	1.44E+05	1.04E+03	5.49E+00	1.56E+03	2.97E+05	1.56E+03	1.32E+01
Benzo(a)pyrene		3.80E-03	1.21E+00	2.62E+00	8.26E-01	9.11E-01	1.42E+00	2.81E+00	9.43E-01	2.28E+00	1.52E+00	2.90E+00	9.98E-01	5.46E+00
Naphthalene		1.90E+01	2.68E+01	1.64E+00	1.54E+00	7.64E+01	6.36E+01	3.93E+00	3.70E+00	1.83E+02	1.43E+02	9.27E+00	8.71E+00	4.32E+02
Phenol	(b)	-	4.51E+02	3.11E+02	1.84E+02	4.16E+04	9.38E+02	4.20E+02	2.90E+02	8.15E+04	2.04E+03	5.21E+02	4.15E+02	1.74E+05

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH PRIVATE GARDENS

Table 7

Human Health Generic Assessment Criteria by Pathway for Residential Scenario - Private Gardens

Compound	Notes	GrAC (mg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Total Petroleum Hydrocarbons														
Aliphatic hydrocarbons EC_5-EC_6		1.00E+01	4.79E+03	2.98E+01	2.97E+01	3.04E+02	1.08E+04	5.47E+01	5.46E+01	5.58E+02	2.35E+04	1.13E+02	1.13E+02	1.15E+03
Aliphatic hydrocarbons >EC_6-EC_8		5.40E+00	1.43E+04	7.27E+01	7.26E+01	1.44E+02	3.21E+04	1.62E+02	1.62E+02	3.22E+02	6.36E+04	3.72E+02	3.71E+02	7.36E+02
Aliphatic hydrocarbons >EC_8-EC_{10}		2.30E-01	1.46E+03	1.89E+01	1.88E+01	7.77E+01	2.44E+03	4.60E+01	4.58E+01	1.90E+02	3.30E+03	1.09E+02	1.08E+02	4.51E+02
Aliphatic hydrocarbons >EC_{10}-EC_{12}		3.40E-02	3.52E+03	9.34E+01	9.28E+01	4.75E+01	4.01E+03	2.32E+02	2.29E+02	1.18E+02	4.24E+03	5.57E+02	5.37E+02	2.83E+02
Aliphatic hydrocarbons >EC_{12}-EC_{16}		7.60E-04	4.37E+03	7.82E+02	7.44E+02	2.37E+01	4.40E+03	1.95E+03	1.69E+03	5.91E+01	4.41E+03	4.68E+03	3.03E+03	1.42E+00
Aliphatic hydrocarbons >EC_{16}-EC_{35}	(c)	-	4.51E+04	-	-	8.48E+00	6.38E+04	-	-	2.12E+01	7.61E+04	-	-	5.09E+01
Aliphatic hydrocarbons >EC_{35}-EC_{44}	(c)	-	4.51E+04	-	-	8.48E+00	6.38E+04	-	-	2.12E+01	7.61E+04	-	-	5.09E+01
Aromatic hydrocarbons >EC_8-EC_9 (styrene)		7.40E+00	1.66E+02	2.65E+02	1.33E+02	6.20E+02	3.92E+02	6.47E+02	3.16E+02	1.52E+03	8.50E+02	1.54E+03	7.02E+02	3.61E+03
Aromatic hydrocarbons >EC_9-EC_{10}		7.40E+00	5.55E+01	3.33E+01	2.69E+01	6.13E+02	1.31E+02	8.16E+01	6.54E+01	1.50E+03	2.84E+02	1.94E+02	1.51E+02	3.58E+02
Aromatic hydrocarbons >EC_{10}-EC_{12}		2.50E+01	7.97E+01	1.82E+02	6.91E+01	3.64E+02	1.86E+02	4.48E+02	1.62E+02	8.99E+02	3.87E+02	1.07E+03	3.46E+02	2.15E+03
Aromatic hydrocarbons >EC_{12}-EC_{16}		5.80E+00	1.40E+02	2.00E+03	1.38E+02	1.69E+02	3.13E+02	4.96E+03	3.08E+02	4.19E+02	6.01E+02	1.18E+04	5.93E+02	1.00E+03
Aromatic hydrocarbons >EC_{16}-EC_{21}	(c)	-	2.47E+02	-	-	5.37E+01	4.82E+02	-	-	1.34E+02	7.66E+02	-	-	3.21E+02
Aromatic hydrocarbons >EC_{21}-EC_{35}	(c)	-	8.88E+02	-	-	4.83E+00	1.11E+03	-	-	1.21E+01	1.22E+03	-	-	2.90E+01
Aromatic hydrocarbons >EC_{35}-EC_{44}	(c)	-	8.88E+02	-	-	4.83E+00	1.11E+03	-	-	1.21E+01	1.22E+03	-	-	2.90E+01

Notes:

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

NR - the compound is not volatile and therefore a soil saturation limit not calculated within CLEA

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

Calculated SAC exceeds soil saturation limit and may significantly effect the interpretation of any exceedances since the contribution of the indoor and outdoor vapour pathway to total exposure is >10%. This shading has also been used for the RBCA output where the theoretical solubility limit has been exceeded. The SAC has been set as the model calculated SAC with the saturation limits shown in brackets.

Calculated SAC exceeds soil saturation limit but will not effect the SSV significantly since the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.

Calculated SAC does not exceed the soil saturation limit.

For consistency where the theoretical solubility limit within RBCA has been exceeded in production of the GrAC, these cellls have also been hatched red.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, polycyclic aromatic hydrocarbons, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3

(a) GAC taken as former Soil Guideline Value owing to uncertainty regarding toxicological approach to be adopted by the Environment Agency.

(b) GAC taken from the Environment Agency SGV reports published 2009.

(c) SAC for selenium, aliphatic and aromatic hydrocarbons >EC16 does not include inhalation pathway owing to absence of toxicity data. SAC for arsenic is only based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The same approach has been adopted for zinc.

(d) SAC for elemental mercury, chromium VI and nickel is based on the inhalation pathway only owing to an absence of toxicity for elemental mercury, in accordance with the SGV report for nickel and LQM report for chromium VI.

Table 8
Human Health Generic Assessment Criteria for Residential Scenario - Private Gardens

Compound	GrAC for Groundwater (mg/l)	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals				
Arsenic	-	32	32	32
Cadmium	-	10	10	10
Chormium (III) - oxide	-	3,000	3,000	3,000
Chromium (VI) - hexavalent	-	4.3	4.3	4.3
Copper	-	2,300	2,300	2,300
Lead	-	450	450	450
Elemental Mercury (Hg^0)	0.009	0.17	0.42	1.0
Inorganic Mercury (Hg^{2+})	-	170	170	170
Methyl Mercury (Hg^{4+})	20	7.4	9.6	11
Nickel	-	130	130	130
Selenium	-	350	350	350
Zinc	-	3,800	3,800	3,800
Cyanide	-	3.7	3.7	3.7
Volatile Organic Compounds				
Benzene	7	0.079	0.157	0.33
Toluene	1,900	120	270	610
Ethylbenzene	260	65	154	350
Xylene - m	100	44	103	240
Xylene - o	87	45	106	250
Xylene - p	84	42	98	230
Total xylene	84	44	103	240
Methyl tertiary butyl ether (MTBE)	2,200	1.8	3.7	7.4
Trichloroethene	1.8	0.11	0.2	0.49
Tetrachloroethene	3.6	0.94	2.1	4.8
1,1,1-Trichloroethane	26	6.2	12.7	28
1,1,1,2Tetrachloroethane	14	0.89	2.1	4.8
1,1,2,2-Tetrachloroethane	14	1.4	2.87	6.3
Carbon Tetrachloride	0.055	0.018	0.039	0.089
1,2-Dichloroethane	0.30	0.0053	0.0080	0.014
Vinyl Chloride	0.019	0.00047	0.0006	0.001
1,2,4-Trimethylbenzene	0.075	0.35	0.85	2.1
1,3,5-Trimethylbenzene	0.047	0.46	1.1	2.6
Semi-Volatile Organic Compounds				
Acenaphthene	3.2	210	480	1,000
Acenaphthylene	4.2	170	400	850
Anthracene	0.021	2,300	4,900	9,200
Benzo(a)anthracene	0.0038	3.1	4.7	5.9
Benzo(b)fluoranthene	0.0020	5.6	6.5	7.0
Benzo(g,h,i)perylene	0.00026	44	46	47
Benzo(k)fluoranthene	0.00080	8.5	9.6	10
Chrysene	0.0020	6.0	8.0	9.3
Dibenzo(a,h)anthracene	0.00060	0.76	0.86	0.90
Fluoranthene	0.23	260	460	670
Fluorene	1.9	160	380	780
Indeno(1,2,3-cd)pyrene	0.0002	3.2	3.8	4.2
Phenanthrene	0.53	92	200	380
Pyrene	0.13	560	1,000	1,600
Benzo(a)pyrene	0.0038	0.83	0.94	1.0
Naphthalene	19	1.5	3.7	8.7
Phenol	-	180	290	420
Total Petroleum Hydrocarbons				
Aliphatic hydrocarbons EC_5-EC_6	10	30	55	110
Aliphatic hydrocarbons >EC_6-EC_8	5.4	73	160	370
Aliphatic hydrocarbons >EC_8-EC_{10}	0.23	19	46	110
Aliphatic hydrocarbons >EC_{10}-EC_{12}	0.034	93 (48)	230 (118)	540 (283)
Aliphatic hydrocarbons >EC_{12}-EC_{16}	0.00076	744 (24)	1,700 (59)	3,000 (142)
Aliphatic hydrocarbons >EC_{16}-EC_{35}	-	45,100 (8.48)	64,000 (21)	76,000
Aliphatic hydrocarbons >EC_{35}-EC_{44}	-	45,100 (8.48)	64,000 (21)	76,000
Aromatic hydrocarbons >EC_8-EC_9 (styrene)	7.4	130	316	700
Aromatic hydrocarbons >EC_9-EC_{10}	7.4	27	65	150
Aromatic hydrocarbons >EC_{10}-EC_{12}	25	69	160	346
Aromatic hydrocarbons >EC_{12}-EC_{16}	5.8	140	310	593
Aromatic hydrocarbons >EC_{16}-EC_{21}	-	250	480	770
Aromatic hydrocarbons >EC_{21}-EC_{35}	-	890	1,100	1,230
Aromatic hydrocarbons >EC_{35}-EC_{44}	-	890	1,100	1,230

Notes:

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58.
1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, polycyclic aromatic hydrocarbons, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

The SAC has been set as the model calculated SAC with the saturation limit shown in brackets. For consistency where the GrAC exceeds the solubility limit, GrAC has been set at the solubility limit. The GrAC conservative since concentrations of the chemical are very unlikely to be at sufficient concentration to result in an exceedance of the health criteria value at the point of exposure (i.e. indoor air) provided free-phase product is absent.

REFERENCES

1) Environment Agency, 31 March 2009, May 2009 and September 2009. Science Report SC050021 / benzene SGV, toluene SGV, ethylbenzene SGV, xylene SGV, mercury SGV, selenium SGV, nickel SGV, arsenic SGV, cadmium SGV, phenol SGV, dioxins, furans and dioxinlike PCBs SGVs. Supplementary information for the derivation of SGV for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs. Contaminants in soil: updated collation of toxicological data and intake values for humans: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs.

2) Environment Agency, January 2009. Science Report SC050021/SR2 Human Health Toxicological Assessment of Contaminants in Soil.

3) Environment Agency, January 2009. Science Report SC050021/SR3 Updated Technical Background to the CLEA Model.

4) Environment Agency, September 2009. Science Report SC050021/SR4 CLEA Software (Version 1.05) Handbook.

5) Environment Agency. 2008. Science Report SC050021/SR7. Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values.

6) Land Quality Management (LQM) and Chartered Institute of Environmental Health (CIEH) 2009. The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment. 2nd Edition.

7) The Soil Generic Assessment Criteria for Human Health Risk Assessment, Report ref. ISBN 978-1-905046-20-1, December 2009, published by CL:AIRE

8) Changes made to the CLEA framework documents after the 3 month evaluation period in 2008, released January 2009 by the Environment Agency.

Generic Assessment Criteria (GAC) for Human Health
Residential Scenario – Without Gardens

The human health generic assessment criteria (GAC) have been developed during a period of regulatory review and updating of the Contaminated Land Exposure Assessment (CLEA) project. Hence, the Environment Agency (EA) is in the process of publishing updated reports relating to the CLEA project and the GAC presented in this document may change to reflect these updates. This issue was prepared following the publication of soil guideline value reports and associated publications[1] for mercury, selenium, benzene, toluene, ethylbenzene and xylene in March 2009 plus arsenic and nickel in May 2009, cadmium and phenol in June 2009, dioxins, furans and dioxin-like PCB's in September 2009. It was also produced following publication of GAC by LQM[6]. Where available, the published soil guideline values (SGV)[1] were used as the GAC.

1. Model Selection

Soil assessment criteria (SAC) were calculated using CLEA v1.06 and the supporting UK guidance[1-6]. Groundwater assessment criteria (GrAC) protective of human health via the inhalation pathway were derived using the RBCA 1.3b model. RSK has updated the inputs within RBCA to reflect the UK guidance[1-5]. The SAC and GrAC collectively are termed GAC.

2. Conceptual Model

In accordance with EA Science Report SC050021/SR3[3], the residential without gardens scenario considers risks to a female child between the ages of 0 and 6 years old. In accordance with Box 3.1, SR3, the pathways considered for production of the SAC in the residential without gardens scenario are:

- Direct soil and dust ingestion;
- Dermal contact with soil and indoor dust, and
- Inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

The pathway considered in production of the GrAC is the volatilisation of compounds from groundwater and subsequent vapour inhalation by residents whilst indoors. Figure 2 illustrates this linkage. Although the outdoor air inhalation pathway is also valid, this contributes little to the overall risks owing to the dilution in outdoor air. Within RBCA, the solubility limit of the determinant restricts the extent of volatilisation, which in turn drives the indoor air inhalation pathway. Whilst the same restriction is not built into the CLEA model, the CLEA model output cells are flagged red where the soil saturation limit has been exceeded.

An assumption used in the CLEA model is that of simple linear partitioning of a chemical in the soil, between the sorbed, dissolved and vapour phase[4]. The upper boundaries of this partitioning are represented by the aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous or vapour based saturation limits. Where model output cells are flagged red the soil or vapour saturation has been exceeded and further consideration of the SAC to be used within the assessment is required. One approach that could be adopted is to use the 'modelled' solubility saturation limit or vapour saturation limit of the compound as the SAC. However, as stated within the CLEA Handbook[4] this is likely not to be practical in many cases because of the subsequent very low solubility/vapour saturation limits and is in any case highly conservative and unless free-phase product is present, concentrations of the chemical are unlikely to be present at sufficient concentration to result in an exceedance of the health criteria value (HCV).

RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH[6] whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limits given in brackets. Therefore, when using the SAC to screen laboratory analysis the assessor should take note if a given SAC has a corresponding solubility or vapour saturation limit (in brackets) and subsequently incorporate this information within the screening analytical discussion. If further assessment is required following this process then an additional approach can be utilised as detailed within Section 4.12 of the CLEA model Handbook[4] which explains how to calculate an effective assessment criterion manually.

3. Input Selection

Chemical data was obtained from EA Report SC050021/SR7[5] and the health criteria values (HCV) from the UK TOX[1] reports where available. For total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH) toxicological and chemical specific parameters were obtained from the LQM/CIEH report[6]. Similarly, toxicological and specific chemical parameters for the volatile organic compound 1,2,4-trimethylbenzene were obtained from EIC/AGS/CL:AIRE[7].

For total petroleum hydrocarbons (TPH), aromatic hydrocarbons C_5-C_8 were not modelled since benzene and toluene are being modelled separately. The aromatic C_8-C_9 hydrocarbon fraction comprises ethylbenzene, xylene and styrene. Since ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for this band has been taken from styrene.

Owing to the lack of UK-specific data, default information in the RBCA model was used to evaluate methyl tertiary butyl ether (MTBE). No published UK data was available for 1,3,5-trimethylbenzene, so information was obtained from the RBCA model. RBCA uses toxicity data for the inhalation pathway in different units to the CLEA model and cannot consider separately the mean daily intake (MDI), occupancy periods or breathing rates. Therefore, the HCV in RBCA was amended to take account of:

- Amendments to the MDI using Table 3.4 of SR2[2];
- A child weighing 13.3kg (average of 0-6 year old female in accordance with Table 4.6 of SR3[3]) and breathing 11.85m^3 (average daily inhalation rate for a 0-6yr old female in accordance with Table 4.14 of SR3[3]; and
- The 50% rule (for petroleum hydrocarbons, trimethylbenzenes and MTBE)[2] where MDI data is not available but background exposure is considered important in the overall exposure.

4. Physical Parameters

For the residential without gardens scenario, the CLEA default building is a small two-storey terrace house with concrete ground bearing slab. SR3[3] notes this residential building type to be the most conservative in terms of protection from vapour intrusion. The building parameters are outlined in Table 3.

The parameters for a sandy loam soil type were used in line with SR3[3]. This includes a value of 6% for the percentage soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for this parameter, RSK has produced an additional set of SAC for an SOM of 1% and 2.5%.

For the GrAC, the depth to groundwater was taken as 2.5m based on RSK's experience of assessing the volatilisation pathway from groundwater.

5. GAC

The SAC were produced using the input parameters in Tables 1 to 3 and the GrAC using the input parameters in Table 4. The GAC by pathway are presented in Table 5 with the combined GAC presented in Table 6.

Figure 1
Conceptual Model for CLEA Residential Scenario – without Gardens

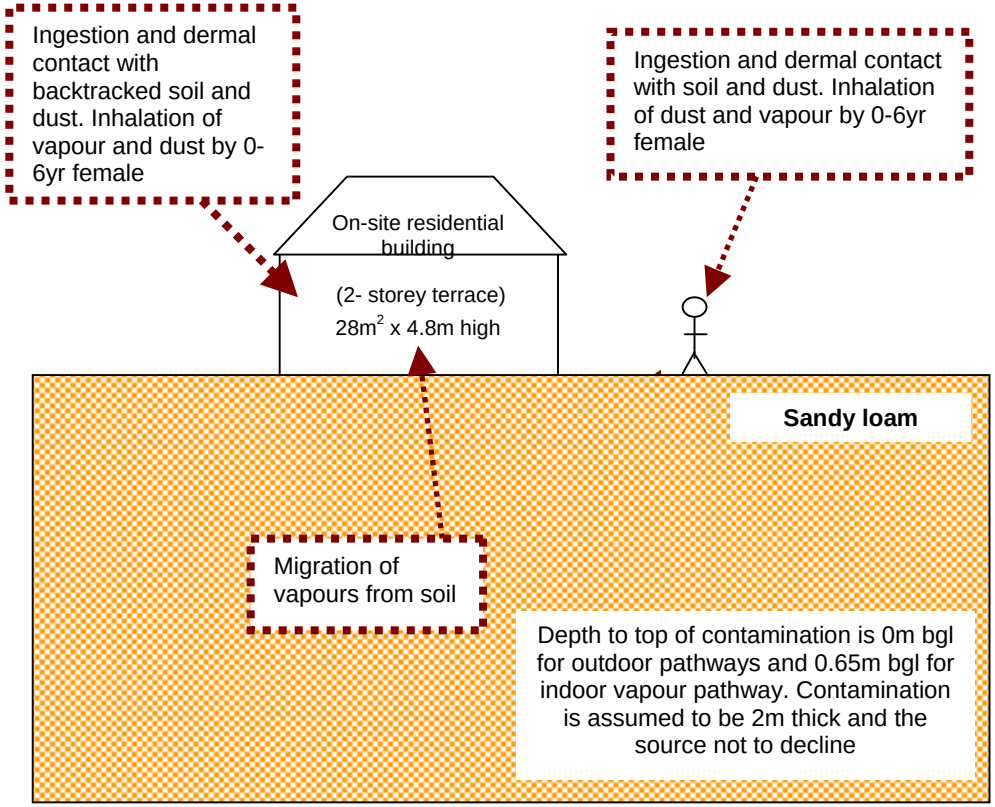

Table 1
Exposure Assessment Parameters for Residential Scenario – without Gardens – Inputs for CLEA model.

Parameter	Value	Justification
Land use	Residential without homegrown produce	Chosen land use
Receptor	Female Child	Taken as female child exposed over 6 years from 0-6 years, Box 3.1, SR3[3]
Building	Small terraced house	Key generic assumption given in Box 3.1, SR3[3]. Two storey small terraced house chosen as it is the most conservative residential building type in terms of protection from vapour intrusion (Section 3.2.6, report SC050021/SR3[3]). Table 3 presents building specific input data
Soil type	Sandy loam	Most common UK soil type (Section 4.3.1, Table 4.4, SR3[3]). Table 4 presents soil-specific input data
Start age class (AC)	1	Range of AC corresponding to key generic assumption that the critical receptor is a young female child aged zero to six. From Box 3.1, SR3[3]. Data specific to the receptor is presented in Table 2
End AC	6	
SOM (%)	6	Representative of sandy loam according to EA Guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[8]
	1	To provide SAC for site's where SOM < 6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2
Residential without Gardens – Land use and Receptor Data for CLEA Model

Parameter	Unit	Age Class					
		1	2	3	4	5	6
Exposure frequency (EF) (soil and dust ingestion)	day yr^{-1}	180	365	365	365	365	365
EF (skin contact, indoor)	day yr^{-1}	180	365	365	365	365	365
EF (skin contact, outdoor)	day yr^{-1}	180	365	365	365	365	365
EF (inhalation of dust and vapour, indoor)	day yr^{-1}	365	365	365	365	365	365
EF (inhalation of dust and vapour, outdoor)	day yr^{-1}	365	365	365	365	365	365
Justification		Table 3.1, SR3[3]					
Occupancy period (indoor)	hr day^{-1}	23	23	23	23	19	19
Occupancy period (outdoor)	hr day^{-1}	1	1	1	1	1	1
Justification		Table 3.2, SR3[3]					
Soil ingestion rate	g/day	0.1	0.1	0.1	0.1	0.1	0.1
Justification		Table 6.2, SR3[3]					
Soil to skin adherence factor – (indoor)	mg soil/cm^2 skin	0.06	0.06	0.06	0.06	0.06	0.06
Soil to skin adherence factor – (outdoor)	mg soil/cm^2 skin	1	1	1	1	1	1
Justification		Table 8.1, SR3[3]					
Body Weight	kg	5.6	9.8	12.7	15.1	16.9	19.7
Body height	m	0.7	0.8	0.9	0.9	1	1.1
Justification		Table 4.6, SR3[3]					
Inhalation Rate	m^3 day^{-1}	8.5	13.3	12.7	12.2	12.2	12.2
Justification		Table 4.14, SR3[3]					
Max exposed skin fraction (indoor)	m^2 m^{-2}	0.32	0.33	0.32	0.35	0.35	0.33
Max exposed skin fraction (outdoor)	m^2 m^{-2}	0.26	0.26	0.25	0.28	0.28	0.26
Justification		Table 4.8, SR3[3]					

*Note: for **cadmium**, the exposure assessment for a residential land use is based on estimates representative of lifetime exposure AC1-18. This is because the TDI_{oral} and TDI_{inh} are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not only in childhood but averaged over a longer time period. See the Environment Agency Science report: SC050021 / TOX 3[1] and Science Report SC050021 / Cadmium SGV[1] for the full AC1-18 Land use Data suite.*

Table 3
Residential without Gardens – Soil, Air and Building Specific Inputs for CLEA Model

Parameter	Unit	Value	Justification
SOIL PROPERTIES for sandy loam			
Porosity, total	$cm^3\ cm^{-3}$	0.53	Default soil type is sandy loam, section 4.3.1, SR3[3] Parameters for sandy loam from Table 4.4, SR3[3]
Porosity, air filled	$cm^3\ cm^{-3}$	0.20	
Porosity, water filled	$cm^3\ cm^{-3}$	0.33	
Residual soil water content	$cm^3\ cm^{-3}$	0.12	
Saturated hydraulic conductivity	$cm\ s^{-1}$	0.00356	
Van Genuchten shape parameter (*m*)	-	0.3201	
Bulk density	$g\ cm^{-3}$	1.21	
Threshold value of wind speed at 10m	$m\ s^{-1}$	7.2	Default value taken from Section 9.2.2, SR3[3]
Empirical function (F_x) for dust model	-	1.22	Value taken from Section 9.2.2, SR3[3]
Ambient soil temperature	K	283	Annual average soil temperature of UK surface soils. Section 4.3.1, SR3[3]
AIR DISPERSION MODEL			
Mean annual wind speed (10 m)	$m\ s^{-1}$	5.0	Default value taken from Section 9.2.2, SR3[3]
Air dispersion factor at height of 0.8 m	$g\ m^{-2}\ s^{-1}$ per $kg\ m^{-3}$	2400	From Table 9.1, SR3[3]. Values for a 0.01 ha site, appropriate to a residential land use in Newcastle (representative city for UK, section 9.2.1, SR3[3])
Fraction of site with hard or vegetative cover	$m^2\ m^{-2}$	0.75	Section 3.2.6, SR3[3] for residential land use
BUILDING PROPERTIES for house with ground-bearing floor slab			
Building footprint	m^2	28	From Table 3.3 and 4.21, SR3[3]
Living space air exchange rate	hr^{-1}	0.50	
Living space height (above ground)	m	4.8	
Living space height (below ground)	m	0.0	Assumed no basement
Pressure difference (soil to enclosed space)	Pa	3.1	From Table 3.3 and 4.21, SR3[3]
Foundation thickness	m	0.15	
Floor crack area	cm^2	423	
Dust loading factor	$\mu g\ m^{-3}$	50	Default value for a residential site taken from Section 9.3, SR3[3]
VAPOUR MODEL			
Default soil gas ingress rate	$cm^3\ s^{-1}$	25	Generic flow rate, Section 10.3, SR3[3]
Depth to top of source (beneath building for indoor exposure)	cm	50	Section 3.2.6, SR3[3] states source is 50cm below building or 65cm below ground surface
Depth to top of source (outdoors)	cm	0	Section 10.2, SR3[3] assumes impact from 0-1m for outdoor inhalation pathway
Thickness of contaminant layer	cm	200	Model default for indoor air, Section 4.9, SR4[4]
Time average period for surface emissions	years	6	Time period of a 0–6 year old, Box 3.5, SR3[3]
User-defined effective air permeability	cm^2	3.05E-08	Calculated for sandy loam using equations in Appendix 1, SR3[3]

Figure 2
GrAC Conceptual Model for RBCA Residential without Gardens Scenario

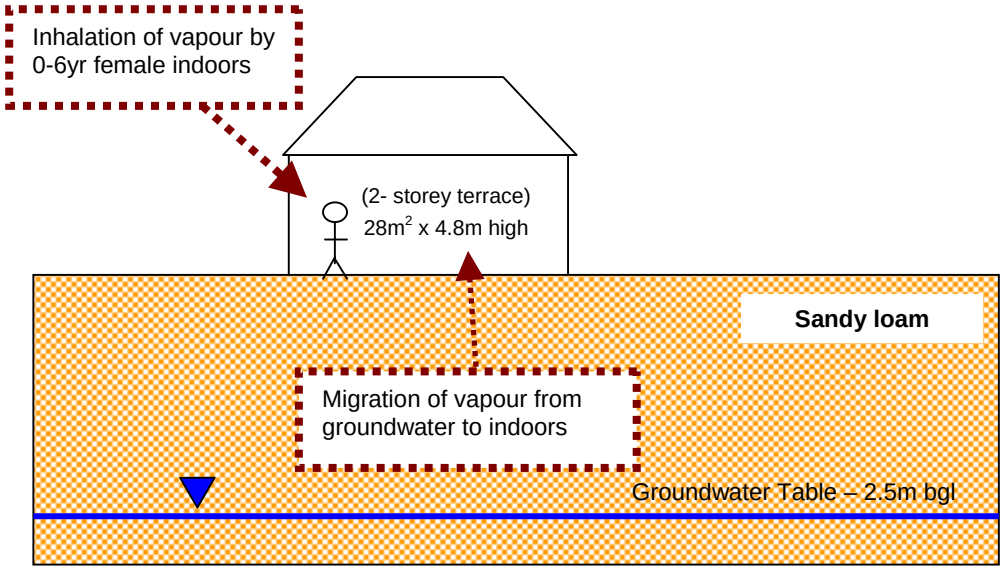

Table 4
Residential without Gardens RBCA Inputs

Parameter	Unit	Value	Justification
RECEPTOR			
Averaging time	Years	6	From Box 3.1, SR3[3]
Receptor weight	kg	13.3	Average of CLEA 0-6 year old female data, Table 4.6, SR3[3]
Exposure duration	Years	6	From Box 3.1, report , SR3[3]
Exposure frequency	Days/yr	350	Weighted using occupancy period of 23 hours per day for 365 days of the year
SOIL TYPE – SANDY LOAM			
Total porosity	-	0.53	CLEA value for sandy loam. Parameters for sandy loam from Table 4.4, SR3[3]
Volumetric water content	-	0.33	
Volumetric air content	-	0.20	
Dry bulk density	g cm^{-3}	1.21	
Vertical hydraulic conductivity	cm s^{-1}	3.56E-3	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3[3]
Vapour permeability	m^2	3.05E-12	Calculated for sandy loam using equations in Appendix 1, $SR3_{(3)}$
Capillary zone thickness	m	0.1	Professional judgement
BUILDING			
Building volume/area ratio	m	4.8	Table 3.3, SR3[3]
Foundation area	m^2	28	
Foundation perimeter	m	22	Calculated assuming building measures 7m x 4m to give 28m^2 foundation area
Building air exchange rate	d^{-1}	12	Table 3.3, SR3[3]
Depth to bottom of foundation slab	m	0.15	
Foundation thickness	m	0.15	
Foundation crack fraction	-	0.0151	Calculated from floor crack area of 423 cm^2 and building footprint of 28m^2 in Table 4.21, SR3[3]
Volumetric water content of cracks	-	0.33	Assumed equal to underlying soil type in assumption that cracks become filled with soil over time. Parameters for sandy loam from Table 4.4, SR3[3]
Volumetric air content of cracks	-	0.2	
Indoor/outdoor differential pressure	Pa	3.1	From Table 3.3, SR3[3]

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT GARDENS

Table 5

Human Health Generic Assessment Criteria by Pathway for Residential Scenario Without Gardens

Compound	Notes	GrAC (mg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals														
Arsenic	(c)	-	3.50E+01	8.50E+01	-	NR	3.50E+01	8.50E+01	-	NR	3.50E+01	8.50E+01	-	NR
Cadmium		-	1.21E+02	1.85E+02	8.49E+01	NR	1.21E+02	1.85E+02	8.49E+01	NR	1.21E+02	1.85E+02	8.49E+01	NR
Chromium (III) -oxide		-	1.98E+04	3.55E+03	3.01E+03	NR	1.98E+04	3.55E+03	3.01E+03	NR	1.98E+04	3.55E+03	3.01E+03	NR
Chromium (VI) - hexavalent		-	8.40E+01	4.25E+00	4.12E+00	NR	8.40E+01	4.25E+00	4.12E+00	NR	8.40E+01	4.25E+00	4.12E+00	NR
Copper		-	1.08E+04	1.04E+04	6.20E+03	NR	1.08E+04	1.04E+04	6.20E+03	NR	1.08E+04	1.04E+04	6.20E+03	NR
Lead	(a)	-	4.50E+02	-	-	NR	4.50E+02	-	-		4.50E+02	-	-	NR
Elemental Mercury (Hg^0)	(d)	9.40E-03	-	1.70E-01	-	4.31E+00	-	4.24E-01	-	1.07E+01	-	1.02E+00	-	2.58E+01
Inorganic Mercury (Hg^{2+})		-	2.62E+02	2.55E+03	2.38E+02	NR	2.62E+02	2.55E+03	2.38E+02	NR	2.62E+02	2.55E+03	2.38E+02	NR
Methyl Mercury (Hg^{4+})		2.00E+01	1.80E+01	1.59E+01	8.43E+00	7.33E+01	1.80E+01	1.59E+01	1.13E+01	1.42E+02	1.80E+01	6.53E+01	1.41E+01	3.04E+02
Nickel	(d)	-	7.86E+02	1.27E+02	-	NR	7.86E+02	1.27E+02	-	NR	7.86E+02	1.27E+02	-	NR
Selenium	(c)	-	5.95E+02	-	-	NR	5.95E+02	-	-	NR	5.95E+02	-	-	NR
Zinc	(c)	-	4.05E+04	2.55E+07	-	NR	4.05E+04	2.55E+07	-	NR	4.05E+04	2.55E+07	-	NR
Cyanide		-	7.69E+02	1.15E+02	1.06E+02	NR	7.69E+02	1.15E+02	1.06E+02	NR	7.69E+02	1.15E+02	1.06E+02	NR
Volatile Organic Compounds														
Benzene		7.00E+00	2.58E+01	2.69E-01	2.66E-01	1.22E+03	2.58E+01	4.99E-01	4.90E-01	2.26E+03	2.58E+01	1.04E+00	9.98E-01	4.71E+03
Toluene		1.90E+03	1.98E+04	6.26E+02	6.07E+02	8.69E+02	1.98E+04	1.38E+03	1.29E+03	1.92E+03	1.98E+04	3.14E+03	2.71E+03	4.36E+03
Ethylbenzene		2.60E+02	8.88E+03	1.70E+02	1.67E+02	5.18E+02	8.88E+03	3.98E+02	3.81E+02	1.22E+03	8.88E+03	9.32E+02	8.43E+02	2.84E+03
Xylene - m		8.40E+01	1.60E+04	5.56E+01	5.54E+01	6.25E+02	1.60E+04	1.31E+02	1.30E+02	1.47E+03	1.60E+04	3.07E+02	3.02E+02	3.46E+03
Xylene - o		1.00E+02	1.60E+04	5.98E+01	5.95E+01	4.78E+02	1.60E+04	1.40E+02	1.39E+02	1.12E+03	1.60E+04	3.27E+02	3.21E+02	2.62E+03
Xylene - p		8.70E+01	1.60E+04	5.34E+01	5.33E+01	5.76E+02	1.60E+04	1.26E+02	1.25E+02	1.35E+03	1.60E+04	2.94E+02	2.88E+02	3.17E+03
Total xylene		8.40E+01	1.60E+04	5.56E+01	5.54E+01	6.25E+02	1.60E+04	1.31E+02	1.30E+02	1.47E+03	1.60E+04	3.07E+02	3.02E+02	3.46E+03
Methyl tertiary butyl ether (MTBE)		2.20E+03	4.45E+02	1.84E+02	1.61E+02	1.66E+04	4.45E+02	2.40E+02	2.00E+02	2.16E+04	4.45E+02	3.70E+02	2.68E+02	3.34E+04
Trichloroethene		1.80E+00	4.63E+02	1.10E-01	1.10E-01	1.54E+03	4.63E+02	2.30E-01	2.30E-01	3.22E+03	4.63E+02	5.11E-01	5.11E-01	7.14E+03
Tetrachloroethene		3.60E+00	1.20E+03	1.03E+00	1.03E+00	4.24E+02	1.20E+03	2.30E+00	2.30E+00	9.51E+02	1.20E+03	5.28E+00	5.26E+00	2.18E+03
1,1,1-Trichloroethane		2.60E+01	5.34E+04	6.33E+00	6.33E+00	1.43E+03	5.34E+04	1.29E+01	1.29E+01	2.92E+03	5.34E+04	2.84E+01	2.84E+01	6.39E+03
1,1,1,2-Tetrachloroethane		1.40E+01	5.07E+02	1.08E+00	1.08E+00	2.60E+03	5.07E+02	2.50E+00	2.49E+00	6.02E+03	5.07E+02	5.83E+00	5.76E+00	1.40E+04
1,1,2,2-Tetrachloroethane		1.40E+01	5.07E+02	2.76E+00	2.74E+00	2.67E+03	5.07E+02	5.65E+00	5.58E+00	5.46E+03	5.07E+02	1.24E+01	1.21E+01	1.20E+04
Carbon tetrachloride		5.50E-02	1.25E+02	1.81E-02	1.81E-02	1.52E+03	1.25E+02	3.97E-02	3.96E-02	3.32E+03	1.25E+02	8.99E-02	8.99E-02	7.54E+03
1,2-Dichloroethane		3.00E-01	1.07E+01	6.46E-03	6.46E-03	3.41E+03	1.07E+01	9.32E-03	9.31E-03	4.91E+03	1.07E+01	1.60E-02	1.60E-02	8.43E+03
Vinyl chloride		1.90E-02	1.25E+00	5.43E-04	5.43E-04	1.36E+03	1.25E+00	7.02E-04	7.02E-04	1.76E+03	1.25E+00	1.07E-03	1.07E-03	2.69E+03
1,2,4-Trimethylbenzene		7.50E-02	-	4.08E-01	-	5.57E+02	-	9.91E-01	-	1.36E+03	-	2.33E+00	-	3.25E+03
1,3,5-Trimethylbenzene		4.70E-02	1.28E+03	4.60E-01	4.60E-01	9.47E+01	1.28E+03	1.10E+00	1.10E+00	2.26E+02	1.28E+03	2.59E+00	2.58E+00	5.33E+02
Semi-Volatile Organic Compounds														
Acenaphthene		3.20E+00	4.85E+03	3.46E+03	2.02E+03	5.70E+01	4.85E+03	8.54E+03	3.09E+03	1.41E+02	4.85E+03	2.30E+04	3.91E+03	3.36E+02
Acenaphthylene		4.20E+00	4.85E+03	3.27E+03	1.95E+03	8.61E+01	4.85E+03	8.03E+03	3.02E+03	2.12E+02	4.85E+03	1.91E+04	3.87E+03	5.06E+02
Anthracene		2.10E-02	2.43E+04	1.08E+05	1.98E+04	1.17E+00	2.43E+04	2.65E+05	2.22E+04	2.91E+00	2.43E+04	6.15E+05	2.33E+04	6.96E+00
Benzo(a)anthracene		3.80E-03	1.12E+01	5.55E+00	3.71E+00	1.71E+00	1.12E+01	9.83E+00	5.23E+00	4.28E+00	1.12E+01	1.41E+01	6.22E+00	1.03E+01
Benzo(b)fluoranthene		2.00E-03	1.15E+00	1.79E+01	6.99E+00	1.22E+00	1.15E+01	1.97E+01	7.25E+00	3.04E+00	1.15E+01	2.05E+01	7.36E+00	7.29E+00
Benzo(g,h,i)perylene		2.60E-04	7.35E+01	1.27E+02	4.66E+01	1.54E-02	7.35E+01	1.32E+02	4.72E+01	3.85E-02	7.35E+01	1.34E+02	4.75E+01	9.23E-02
Benzo(k)fluoranthene		8.00E-04	1.62E+01	2.66E+01	1.01E+01	6.87E-01	1.62E+01	2.83E+01	1.03E+01	1.72E+00	1.62E+01	2.91E+01	1.04E+01	4.12E+00
Chrysene		2.00E-03	1.62E+01	1.95E+01	8.84E+00	4.40E-01	1.62E+01	2.45E+01	9.74E+00	1.10E+00	1.62E+01	2.72E+01	1.01E+01	2.64E+00
Dibenzo(a,h)anthracene		6.00E-04	1.46E+00	2.13E+00	8.65E-01	3.93E-03	1.46E+00	2.42E+00	9.09E-01	9.82E-03	1.46E+00	2.56E+00	9.28E-01	2.36E-02
Fluoranthene		2.30E-01	1.01E+03	2.69E+04	9.72E+02	1.89E+01	1.01E+03	6.23E+04	9.93E+02	4.73E+01	1.01E+03	1.28E+05	1.00E+03	1.13E+02
Fluorene		1.90E+00	3.23E+03	4.35E+03	1.85E+03	3.09E+01	3.23E+03	1.07E+04	2.48E+03	7.65E+01	3.23E+03	2.54E+04	2.87E+03	1.83E+02
Indeno(1,2,3-cd)pyrene		2.00E-04	6.95E+00	1.04E+01	4.17E+00	6.13E-02	6.95E+00	1.17E+01	4.35E+00	1.53E-01	6.95E+00	1.22E+01	4.43E+00	3.68E-01
Phenanthrene		5.30E-01	1.00E+03	5.04E+03	8.37E+02	3.60E+01	1.00E+03	1.23E+04	9.28E+02	8.96E+01	1.00E+03	2.86E+04	9.70E+02	2.14E+02
Pyrene		1.30E-01	2.42E+03	6.18E+04	2.33E+03	2.20E+00	2.42E+03	1.44E+05	2.38E+03	5.49E+00	2.42E+03	2.97E+05	2.40E+03	1.32E+01
Benzo(a)pyrene		3.80E-03	1.62E+00	2.62E+00	1.00E+00	9.11E-01	1.62E+00	2.81E+00	1.03E+00	2.28E+00	1.62E+00	2.90E+00	1.04E+00	5.46E+00
Naphthalene		1.90E+01	1.58E+03	1.64E+00	1.64E+00	7.64E+01	1.58E+03	3.93E+00	3.92E+00	1.83E+02	1.58E+03	9.27E+00	9.22E+00	4.32E+02
Phenol		-	9.17E+04	3.11E+02	3.10E+02	4.16E+04	9.17E+04	4.20E+02	4.18E+02	8.15E+04	9.17E+04	5.21E+02	5.19E+02	1.74E+05

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT GARDENS

Table 5

Human Health Generic Assessment Criteria by Pathway for Residential Scenario Without Gardens

Compound	Notes	GrAC (mg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Total Petroleum Hydrocarbons														
Aliphatic hydrocarbons EC_5-EC_6		1.00E+01	2.23E+05	2.98E+01	2.98E+01	3.04E+02	2.23E+05	5.47E+01	5.47E+01	5.58E+02	2.23E+05	1.13E+02	1.13E+02	1.15E+03
Aliphatic hydrocarbons >EC_6-EC_8		5.40E+00	2.23E+05	7.27E+01	7.27E+01	1.44E+02	2.23E+05	1.62E+02	1.62E+02	3.22E+02	2.23E+05	3.72E+02	3.71E+02	7.36E+02
Aliphatic hydrocarbons >EC_8-EC_{10}		2.30E-01	4.45E+03	1.89E+01	1.88E+01	7.77E+01	4.45E+03	4.60E+01	4.59E+01	1.90E+02	4.45E+03	1.09E+02	1.09E+02	4.51E+02
Aliphatic hydrocarbons >EC_{10}-EC_{12}		3.00E-02	4.45E+03	9.34E+01	9.29E+01	4.75E+01	4.45E+03	2.32E+02	2.29E+02	1.18E+02	4.45E+03	5.57E+02	5.38E+02	2.83E+02
Aliphatic hydrocarbons >EC_{12}-EC_{16}		8.00E-04	4.45E+03	7.82E+02	7.45E+02	2.37E+01	4.45E+03	1.95E+03	1.69E+03	5.91E+01	4.45E+03	4.68E+03	3.04E+03	1.42E+02
Aliphatic hydrocarbons >EC_{16}-EC_{35}	(c)	-	4.53E+04	-	-	8.48E+00	6.41E+04	-	-	2.12E+01	7.66E+04	-	-	5.09E+01
Aliphatic hydrocarbons >EC_{35}-EC_{44}	(c)	-	4.53E+04	-	-	8.48E+00	6.41E+04	-	-	2.12E+01	7.66E+04	-	-	5.09E+01
Aromatic hydrocarbons >EC_5-EC_7		-	1.98E+04	2.66E+02	2.63E+02	1.22E+03	1.98E+04	4.95E+02	4.83E+02	2.26E+03	1.98E+04	1.03E+03	9.78E+02	4.71E+03
Aromatic hydrocarbons >EC_7-EC_8		-	1.98E+04	6.26E+02	6.07E+02	8.69E+02	1.98E+04	1.38E+03	1.29E+03	1.92E+03	1.98E+04	3.14E+03	2.71E+03	4.36E+03
Aromatic hydrocarbons >EC_8-EC_9 (styrene)		7.40E+00	5.34E+03	2.65E+02	2.61E+02	6.20E+02	5.34E+03	6.47E+02	6.27E+02	1.52E+03	5.34E+03	1.54E+03	1.41E+03	3.61E+03
Aromatic hydrocarbons >EC_9-EC_{10}		7.40E+00	1.78E+03	3.33E+01	3.32E+01	6.13E+02	1.78E+03	8.16E+01	8.07E+01	1.50E+03	1.78E+03	1.94E+02	1.89E+02	3.58E+03
Aromatic hydrocarbons >EC_{10}-EC_{12}		2.50E+01	1.78E+03	1.82E+02	1.77E+02	3.64E+02	1.78E+03	4.48E+02	4.17E+02	8.99E+02	1.78E+03	1.07E+03	8.66E+02	2.15E+03
Aromatic hydrocarbons >EC_{12}-EC_{16}		5.80E+00	1.78E+03	2.00E+03	1.25E+03	1.69E+02	1.78E+03	4.96E+03	1.59E+03	4.19E+02	1.78E+03	1.18E+04	1.71E+03	1.00E+03
Aromatic hydrocarbons >EC_{16}-EC_{21}	(c)	-	1.29E+03	-	-	5.37E+01	1.31E+03	-	-	1.34E+02	1.32E+03	-	-	3.21E+02
Aromatic hydrocarbons >EC_{21}-EC_{35}	(c)	-	1.33E+03	-	-	4.83E+00	1.33E+03	-	-	1.21E+01	1.33E+03	-	-	2.90E+01
Aromatic hydrocarbons >EC_{35}-EC_{44}	(c)	-	1.33E+03	-	-	4.83E+00	1.33E+03	-	-	1.21E+01	1.33E+03	-	-	2.90E+01

Notes:

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

NR - the compound is not volatile and therefore a soil saturation limit not calculated within CLEA

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

Calculated SAC exceeds soil saturation limit and may significantly effect the interpretation of any exceedances since the contribution of the indoor and outdoor vapour pathway to total exposure is >10%. This shading has also been used for the RBCA output where the theoretical solubility limit has been exceeded. The SAC has been set as the model calculated SAC with the saturation limits shown in brackets.

Calculated SAC exceeds soil saturation limit but will not effect the SAC significantly since the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.

Calculated SAC does not exceed the soil saturation limit.

For consistency where the theoretical solubility limit within RBCA has been exceeded in production of the GrAC, these cellls have also been hatched red.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, polycyclic aromatic hydrocarbons, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3

(a) GAC taken as former Soil Guideline Value owing to uncertainty regarding toxicological approach to be adopted by the Environment Agency.

(b) GAC taken from the Environment Agency SGV reports published 2009.

(c) SAC for selenium, aliphatic and aromatic hydrocarbons >EC16 do not include inhalation pathway owing to absence of toxicity data. SAC for arsenic is only based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report.

(d) SAC for elemental mercury, chromium VI and nickel are based on the inhalation pathway only owing to an absence of toxicity for elemental mercury, in accordance with the SGV report for nickel and LQM report for chromium VI.

Table 6
Human Health Generic Assessment Criteria for Residential Without Gardens

Compound	GrAC for Groundwater (mg/l)	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals				
Arsenic	-	35	35	35
Cadmium	-	85	85	85
Chromium (III) - oxide	-	3,000	3,000	3,000
Chromium (VI) - hexavalent	-	4.3	4.3	4.3
Copper	-	6,200	6,200	6,200
Lead	-	450	450	450
Elemental Mercury (Hg0)	0.0094	0.17	0.42	1.0
Inorganic Mercury (Hg2+)	-	240	240	240
Methyl Mercury (Hg4+)	20	8.4	11	14
Nickel	-	130	130	130
Selenium	-	600	600	600
Zinc	-	41,000	41,000	41,000
Cyanide	-	110	110	110
Volatile Organic Compounds				
Benzene	7	0.27	0.49	1.0
Toluene	1,900	610	1,289	2,700
Ethylbenzene	260	170	381	840
Xylene - m	84	55	130	300
Xylene - o	100	60	139	320
Xylene - p	87	53	125	290
Total xylene	84	55	130	300
Methyl tertiary butyl ether (MTBE)	2,200	160	199.55	270
Trichloroethene	1.8	0.11	0.2	0.51
Tetrachloroethene	3.6	1.0	2.3	5.3
1,1,1-Trichloroethane	26	6.3	12.9	28
1,1,1,2-Tetrachloroethane	14	1.1	2.5	5.8
1,1,2,2-Tetrachloroethane	14	2.7	5.58	12
Carbon tetrachloride	0.055	0.02	0.040	0.09
1,2-Dichloroethane	0.30	0.006	0.0093	0.02
Vinyl chloride	0.019	0.0005	0.0007	0.001
1,2,4-Trimethylbenzene	0.075	0.4	0.99	2.3
1,3,5-Trimethylbenzene	0.047	0.5	1.10	2.6
Semi-Volatile Organic Compounds				
Acenaphthene	3.2	2,000 (57)	3,100 (141)	3,900 (340)
Acenaphthylene	4.2	2,000 (86)	3,000 (212)	3,900 (510)
Anthracene	0.021	20,000 (1.2)	22,000	23,000
Benzo(a)anthracene	0.004	3.7	5.2	6.2
Benzo(b)fluoranthene	0.002	7.0	7.3	7.4
Benzo(g,h,i)perylene	0.0003	47	47	48
Benzo(k)fluoranthene	0.0008	10	10	10
Chrysene	0.002	8.8	9.7	10
Dibenzo(a,h)anthracene	0.0006	0.87	0.91	0.93
Fluoranthene	0.23	970	993	1,000
Fluorene	1.9	1,900 (31)	2,500 (77)	2,900 (180)
Indeno(1,2,3-cd)pyrene	0.0002	4.2	4.4	4.4
Phenanthrene	0.53	840 (36)	930	970
Pyrene	0.13	2,300	2,400	2,400
Benzo(a)pyrene	0.004	1.0	1.0	1.0
Naphthalene	19	1.6	3.9	9.2
Phenol	-	310	420	520
Total Petroleum Hydrocarbons				
Aliphatic hydrocarbons EC_5-EC_6	10	30	55	110
Aliphatic hydrocarbons >EC_6-EC_8	5.4	73	160	370
Aliphatic hydrocarbons >EC_8-EC_{10}	0.23	19	46	110
Aliphatic hydrocarbons >EC_{10}-EC_{12}	0.03	93 (48)	230 (118)	540 (280)
Aliphatic hydrocarbons >EC_{12}-EC_{16}	0.0008	746 (24)	1,700 (59)	3,000 (140)
Aliphatic hydrocarbons >EC_{16}-EC_{35}	-	45,000	64,000 (21)	77,000
Aliphatic hydrocarbons >EC_{35}-EC_{44}	-	45,000	64,000 (21)	77,000
Aromatic hydrocarbons >EC_8-EC_9 (styrene)	7.4	260	627	1,400
Aromatic hydrocarbons >EC_9-EC_{10}	7.4	33	81	190
Aromatic hydrocarbons >EC_{10}-EC_{12}	25	180	417	870
Aromatic hydrocarbons >EC_{12}-EC_{16}	5.8	1,300 (170)	1,600 (419)	1,700
Aromatic hydrocarbons >EC_{16}-EC_{21}	-	1,300	1,300	1,300
Aromatic hydrocarbons >EC_{21}-EC_{35}	-	1,300	1,300	1,300
Aromatic hydrocarbons >EC_{35}-EC_{44}	-	1,300	1,300	1,300

Notes:

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58.
1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, polycyclic aromatic hydrocarbons, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

The SAC has been set as the model calculated SAC with the saturation limit shown in brackets.
For consistency where the GrAC exceeds the solubility limit, GrSV has been set at the solubility limit. These are highly conservative since concentrations of the chemical are very unlikely to be at sufficient concentration to result in an exceedance of the health criteria value at the point of exposure (i.e. indoor air) provided free-phase product is absent.

REFERENCES

1) Environment Agency, 31 March 2009, May 2009 and September 2009. Science Report SC050021 / benzene SGV, toluene SGV, ethylbenzene SGV, xylene SGV, mercury SGV, selenium SGV, nickel SGV, arsenic SGV, cadmium SGV, phenol SGV, dioxins, furans and dioxinlike PCBs SGVs. Supplementary information for the derivation of SGV for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs. Contaminants in soil: updated collation of toxicological data and intake values for humans: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs.

2) Environment Agency, January 2009. Science Report SC050021/SR2 Human Health Toxicological Assessment of Contaminants in Soil.

3) Environment Agency, January 2009. Science Report SC050021/SR3 Updated Technical Background to the CLEA Model.

4) Environment Agency, January 2009. Science Report SC050021/SR4 CLEA Software (Version 1.04) Handbook.

5) Environment Agency. 2008. Science Report SC050021/SR7. Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values.

6) Land Quality Management (LQM) and Chartered Institute of Environmental Health (CIEH) 2009. The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment. 2nd Edition.

7) The Soil Generic Assessment Criteria for Human Health Risk Assessment, Report ref. ISBN 978-1-905046-20-1, December 2009, published by CL:AIRE

8) Changes made to the CLEA framework documents after the 3 month evaluation period in 2008, released January 2009 by the Environment Agency.

APPENDIX F

HAS-WASTE Assessment

As cmpds (AsS), Cd (CdO), CrVI cmpds ($FeCrO_4$), Cu (Cu_2O), Inorg Hg cmpds (HgO), Pb cmpds ($PbSO_4$), Ni ($NiCO_3$), Se cmpds (SeS) and Zn as ZnO. Also Ba ($BaCO_3$), Be cmpds ($BeSO_4$), Co (CoO), Mn (MnO_2) and Mo (MoO_3).

HASWASTE v4. Envirolab's Contaminated Land Soil Hazardous Waste Assessment Tool.

Envirolab, Sandpits Business Park, Mottram Road, Hyde, Cheshire SK14 3AR.

Site Code and Name: 241882 - Salisbury Square, Old Hatfileld

TP/WS/BH		BH1	BH1	BH1	BH1	BH2	BH2	BH2	BH2	BH2	BH2	WS1	WS1	WS2	WS2
Depth (m)		0.20	0.70	1.5-1.7	2.3-2.5	0.25	0.50	0.90	1.40	3.00	4.90	0.2-0.3	0.5-0.6	0.2-0.3	0.5-0.6
Envirolab reference															
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic		26	23	12	7	23		23	11	11	14		12		23
CrVI or Chromium		29	29	29	15	23		30	30	30	18		30		29
Copper		17	50	14	3	17		16	33	18	9		26		17
Lead		14	278	21	5	14		43	46	35	16		68		17
Nickel		43	32	28	9	35		35	21	21	15		21		42
Zinc		105	177	46	17	87		97	62	55	40		80		95
Cadmium		0.6	0.6	0.5	0.5	0.5		0.5	0.5	0.5	0.5		0.5		0.5
Mercury		0.2	0.2	0.2	0.2	0.2		0.2	0.2	0.2	0.2		0.2		0.2
Selenium		1	2	1	1	1		1	1	1	1		1		1
Barium															
Beryllium															
Cobalt															
Manganese															
Molybdenum															
Total USEPA 16 PAHs															
Acenaphthene		0.01	0.01	0.02	0.01	0.01		0.04			0.02		0.02		0.01
Acenaphthylene		0.01	0.05	0.01	0.01	0.01		0.14			0.01		0.01		0.01
Anthracene		0.01	0.07	0.01	0.01	0.01		0.19			0.01		0.02		0.01
Benzo(a)anthracene		0.01	0.36	0.01	0.01	0.01		0.67			0.01		0.04		0.01
Benzo(a)pyrene		0.02	0.47	0.01	0.01	0.01		0.94			0.01		0.04		0.01
Benzo(b)fluoranthene		0.01	0.33	0.01	0.01	0.01		0.70			0.01		0.03		0.01
Benzo(ghi)perylene		0.01	0.71	0.02	0.01	0.01		1.01			0.01		0.09		0.01
Benzo(k)fluoranthene		0.02	0.48	0.02	0.01	0.01		0.76			0.01		0.03		0.01
Chrysene		0.01	0.70	0.03	0.01	0.02		1.48			0.02		0.13		0.01
Dibenzo(ah)anthracene		0.01	0.10	0.01	0.01	0.01		0.14			0.01		0.01		0.01
Fluoranthene		0.01	0.78	0.07	0.01	0.03		1.90			0.03		0.14		0.03
Fluorene		0.01	0.01	0.01	0.01	0.01		0.03			0.01		0.01		0.01
Indeno(123cd)pyrene		0.01	0.27	0.01	0.01	0.01		0.58			0.01		0.03		0.01
Naphthalene		0.01	0.03	0.11	0.02	0.01		0.04			0.02		0.02		0.01
Phenanthrene		0.02	0.17	0.06	0.01	0.02		0.65			0.02		0.05		0.02
Pyrene		0.01	0.75	0.06	0.02	0.03		1.71			0.03		0.13		0.02
Benzo(j)fluoranthene															
Benzene		0.01													
Toluene		0.01													
Ethylbenzene		0.01													
Xylenes		0.01													
Trimethylbenzenes															
Chlorobenzene															
1,2-Dichlorobenzene															
1,3-Dichlorobenzene															
1,4-Dichlorobenzene															
1,2,4-Trichlorobenzene															
2-Chlorotoluene															
4-Chlorotoluene															
Trichloroethene (TCE)															
Oil in Waste Carcinogenic H7															
Total TPH	≥1,000mg/kg	0.1											10.0	10.0	
Petrol or (C6-C10)	≥1,000mg/kg														
Diesel or (C10-C25) or (conservative C10-C35)	≥10,000mg/kg														
Lube Oil or (C25+) or (conservative C21+)	≥1,000mg/kg														
8 IARC H7 Carcinogenic PAHs marker test (applicable to LRO only)	≥1%														
Kerosene															
Kerosene															
Creosote															
Creosote															
pH Corrosive H8 (Irritant H4)															
pH (soil)	≤2 H8 ≥11.5														
pH (leachate)	≤2 H8 ≥11.5														
Alkali Reserve (gNaOH/100g)															
H4 Alkali Reserve test	≥13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H8 Alkali Reserve test	≥14.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases H12															
Total Sulphide	≥1,400mg/kg														
Free Cyanide	≥1,200mg/kg														
Thiocyanate	≥2,600mg/kg														
Elemental/Free Sulphur															
PCBs Total															
Phenols Total by HPLC															
Phenol		0.2		0.2			0.2			0.2		0.2		0.2	
Cresols															
Xylenols															
1-Naphthol															
Resourcinol															
2,3,5,6-Tetrachlorophenol															
2,4,5-Trichlorophenol															
2,4,6-Trichlorophenol															
2,4-Dichlorophenol															
4-Chloro-3-methylphenol															
Pentachlorophenol															
Bis(2-ethylhexyl)phthalate															
Butylbenzylphthalate															
Di-n-butylphthalate															
Visual Fibre Screen or Asbestos ID (enter Y or N)	H7≥0.1%; H5≥3%; H6≥25%														

Hazard Codes	Thresholds	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Irritant H4	≥10%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Irritant H4	≥20%	0.009	0.006	0.006	0.002	0.007	0.000	0.007	0.004	0.004	0.003	0.000	0.004	0.000	0.008
Harmful H5	≥25%	0.013	0.053	0.010	0.003	0.011	0.000	0.015	0.015	0.011	0.006	0.000	0.018	0.001	0.013
Toxic H6 (Harmful H5)	≥0.1%H5<7%; H6≥7%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Toxic H6 (Harmful H5)	≥3%H5<25%; H6≥25%	0.013	0.010	0.008	0.003	0.011	0.000	0.011	0.006	0.006	0.005	0.000	0.006	0.000	0.012
Carcinogenic H7	≥0.1%	0.010	0.010	0.010	0.005	0.008	0.000	0.010	0.010	0.010	0.006	0.000	0.010	0.000	0.010
Carcinogenic H7	≥1%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Corrosive H8 (Irritant H4)	≥5%H4<10%; H8≥10%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Toxic for Reproduction H10	≥0.5%	0.009	0.041	0.006	0.002	0.007	0.000	0.007	0.007	0.005	0.003	0.000	0.010	0.000	0.008
Toxic for Reproduction H10	≥5%	0.002	0.041	0.003	0.001	0.002	0.000	0.006	0.007	0.005	0.002	0.000	0.010	0.000	0.002
Mutagenic H11	≥0.1%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mutagenic H11	≥1%	0.009	0.006	0.006	0.002	0.007	0.000	0.007	0.004	0.004	0.003	0.000	0.004	0.000	0.008
Ecotoxic H14	≥1.0	0.150	0.298	0.104	0.043	0.126	0.000	0.153	0.126	0.112	0.073	0.000	0.142	0.000	0.144
New Ecotoxic H14 individual substance specific thresholds	≥0.0025%	0.00000	0.00004	0.00000	0.00000	0.00000	0.00000	0.00007	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
New Ecotoxic H14 individual substance specific thresholds	≥0.025%	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Consider other individual contaminants on a case by case basis.

Table 3.2 of Annex VI of the CLP Regulation including 1st ATP (sometimes called ATSP1).

As cmpds (AsS), Cd (CdO), CrVI cmpds ($FeCrO_4$), Cu (Cu_2O), Inorg Hg cmpds (HgO), Pb cmpds ($PbSO_4$), Ni ($NiCO_3$), Se cmpds (SeS) and Zn as ZnO. Also Ba ($BaCO_3$), Be cmpds ($BeSO_4$), Co (CoO), Mn (MnO_2) and Mo (MoO_3).

HASWASTE v4. Envirolab's Contaminated Land Soil Hazardous Waste Assessment Tool.

Envirolab, Sandpits Business Park, Mottram Road, Hyde, Cheshire SK14 3AR.

envirolab

Site Code and Name 241882 - Salisbury Square, Old Hatfileld

TP/WS/BH		WS3	WS3	WS4	WS4	TP1	TP1	TP2	TP3						
Depth (m)		0.2-0.3	0.5-0.6	0.2-0.3	0.5-0.6	0.10	0.40	0.50	0.10						
Envirolab reference															
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic				22	18	10		12	22						
CrVI or Chromium				21	20	18		20	29						
Copper				14	11	22		37	174						
Lead				39	10	66		84	345						
Nickel				30	33	14		18	33						
Zinc				73	70	80		112	306						
Cadmium				0.5	0.5	0.5		0.5	0.9						
Mercury				0.2	0.2	0.2		0.2	1.0						
Selenium				1	1	1		1	2						
Barium															
Beryllium															
Cobalt															
Manganese															
Molybdenum															
Total USEPA 16 PAHs															
Acenaphthene				0.01	0.01	0.02		0.13							
Acenaphthylene				0.01	0.01	0.05		0.01							
Anthracene				0.01	0.01	0.09		1.60							
Benzo(a)anthracene				0.01	0.01	0.33		3.24							
Benzo(a)pyrene				0.01	0.01	0.47		2.33							
Benzo(b)fluoranthene				0.01	0.01	0.44		2.29							
Benzo(ghi)perylene				0.01	0.01	0.68		1.90							
Benzo(k)fluoranthene				0.01	0.01	0.36		2.64							
Chrysene				0.01	0.02	0.71		5.27							
Dibenzo(ah)anthracene				0.01	0.01	0.05		0.42							
Fluoranthene				0.01	0.03	0.84		8.88							
Fluorene				0.01	0.01	0.01		0.17							
Indeno(123cd)pyrene				0.01	0.01	0.26		1.42							
Naphthalene				0.00	0.01	0.01		0.02							
Phenanthrene				0.01	0.03	0.22		3.49							
Pyrene				0.01	0.02	0.79		6.11							
Benzo(j)fluoranthene															
Benzene		0.01													
Toluene		0.01													
Ethylbenzene		0.01													
Xylenes		0.01													
Trimethylbenzenes															
Chlorobenzene															
1,2-Dichlorobenzene															
1,3-Dichlorobenzene															
1,4-Dichlorobenzene															
1,2,4-Trichlorobenzene															
2-Chlorotoluene															
4-Chlorotoluene															
Trichloroethene (TCE)															
Oil in Waste Carcinogenic H7															
Total TPH	≥1,000mg/kg	10.0			0.0										
Petrol or (C6-C10)	≥1,000mg/kg														
Diesel or (C10-C25) or (conservative C10-C35)	≥10,000mg/kg														
Lube Oil or (C25+) or (conservative C21+)	≥1,000mg/kg														
8 IARC H7 Carcinogenic PAHs marker test (applicable to LRO only)	≥1%	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Kerosene															
Kerosene															
Creosote															
Creosote															
pH Corrosive H8 (Irritant H4)															
pH (soil)	≤2 H8 ≥11.5														
pH (leachate)	≤2 H8 ≥11.5														
Alkali Reserve (gNaOH/100g)															
H4 Alkali Reserve test	≥13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H8 Alkali Reserve test	≥14.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases H12															
Total Sulphide	≥1,400mg/kg														
Free Cyanide	≥1,200mg/kg														
Thiocyanate	≥2,600mg/kg														
Elemental/Free Sulphur															
PCBs Total					0.005										
Phenols Total by HPLC															
Phenol															
Cresols															
Xylenols															
1-Naphthol															
Resourcinol															
2,3,5,6-Tetrachlorophenol															
2,4,5-Trichlorophenol															
2,4,6-Trichlorophenol															
2,4-Dichlorophenol															
4-Chloro-3-methylphenol															
Pentachlorophenol															
Bis(2-ethylhexyl)phthalate															
Butylbenzylphthalate															
Di-n-butylphthalate															
Visual Fibre Screen or Asbestos ID (enter Y or N)	H7≥0.1%; H5≥3%; H6≥25%														

Hazard Codes	Thresholds	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Irritant H4	≥10%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Irritant H4	≥20%	0.000	0.000	0.006	0.007	0.003	0.000	0.004	0.007	0.000	0.000	0.000	0.000	0.000	0.000
Harmful H5	≥25%	0.001	0.000	0.013	0.009	0.015	0.000	0.020	0.077	0.000	0.000	0.000	0.000	0.000	0.000
Toxic H6 (Harmful H5)	≥0.1%H5<7%; H6≥7%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Toxic H6 (Harmful H5)	≥3%H5<25%; H6≥25%	0.000	0.000	0.009	0.009	0.004	0.000	0.006	0.010	0.000	0.000	0.000	0.000	0.000	0.000
Carcinogenic H7	≥0.1%	0.000	0.000	0.007	0.007	0.006	0.000	0.007	0.010	0.000	0.000	0.000	0.000	0.000	0.000
Carcinogenic H7	≥1%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Corrosive H8 (Irritant H4)	≥5%H4<10%; H8≥10%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Toxic for Reproduction H10	≥0.5%	0.000	0.000	0.006	0.007	0.010	0.000	0.012	0.050	0.000	0.000	0.000	0.000	0.000	0.000
Toxic for Reproduction H10	≥5%	0.000	0.000	0.006	0.001	0.010	0.000	0.012	0.050	0.000	0.000	0.000	0.000	0.000	0.000
Mutagenic H11	≥0.1%	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mutagenic H11	≥1%	0.000	0.000	0.006	0.007	0.003	0.000	0.004	0.007	0.000	0.000	0.000	0.000	0.000	0.000
Ecotoxic H14	≥1.0	0.000	0.000	0.120	0.105	0.117	0.000	0.159	0.445	0.000	0.000	0.000	0.000	0.000	0.000
New Ecotoxic H14 individual substance specific thresholds	≥0.0025%	0.00000	0.00000	0.00000	0.00000	0.00003	0.00000	0.00032	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
New Ecotoxic H14 individual substance specific thresholds	≥0.025%	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Consider other individual contaminants on a case by case basis.

Table 3.2 of Annex VI of the CLP Regulation including 1st ATP (sometimes called ATSP1).