Chemtech Environmental Limited

SOILS

Lab number			53504-1	53504-2	53504-3	53504-4	53504-5	53504-6
Sample id			TP 1	TP 2	TP 2	TP 2	TP 3	TP 3
Depth (m)			0.10	0.10	0.60	3.50	0.10	5.50-6.00
Date sampled			12/11/2014	12/11/2014	12/11/2014	12/11/2014	12/11/2014	12/11/2014
Test	**Method**	**Units**						
Arsenic (total)	CE127 M	mg/kg As	31	15	15	10	24	32
Cadmium (total)	CE127 M	mg/kg Cd	0.4	0.4	<0.2	0.4	0.4	0.5
Chromium (total)	CE127 M	mg/kg Cr	41	48	24	38	48	51
Chromium (VI)	CE050	mg/kg CrVI	<1	<1	<1	<1	<1	<1
Copper (total)	CE127 M	mg/kg Cu	41	48	24	38	48	51
Lead (total)	CE127 M	mg/kg Pb	72	79	25	21	63	83
Mercury (total)	CE127 M	mg/kg Hg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Nickel (total)	CE127 M	mg/kg Ni	34	39	35	52	36	37
Selenium (total)	CE127 M	mg/kg Se	1.8	1.8	1.2	1.5	1.5	2.1
Zinc (total)	CE127 M	mg/kg Zn	120	140	68	136	129	105
pH	CE004 M	units	6.5	7.0	6.4	7.0	7.0	7.5
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	-	-	238	601	-	700
Sulphate (total)	CE062 M	mg/kg SO_4	-	-	3712	2131	-	3385
Sulphur (total)	CE127	mg/kg S	-	-	1432	<100	-	13846
PAH								
Naphthalene	CE087	mg/kg	0.16	0.22	0.35	<0.01	0.08	0.35
Acenaphthylene	CE087	mg/kg	0.01	0.04	<0.01	<0.01	<0.01	<0.01
Acenaphthene	CE087	mg/kg	0.06	0.15	<0.01	<0.01	0.02	<0.01
Fluorene	CE087	mg/kg	0.09	0.20	0.02	<0.01	0.03	0.06
Phenanthrene	CE087	mg/kg	1.14	3.11	0.42	0.03	0.54	0.41
Anthracene	CE087	mg/kg	0.28	0.94	0.03	<0.01	0.11	0.04
Fluoranthene	CE087	mg/kg	1.70	5.70	0.16	0.03	0.93	0.25
Pyrene	CE087	mg/kg	1.32	4.34	0.15	0.03	0.76	0.20
Benzo(a)anthracene	CE087	mg/kg	0.70	2.46	0.07	<0.01	0.38	0.09
Chrysene	CE087	mg/kg	0.63	2.06	0.07	<0.01	0.33	0.11
Benzo(b)fluoranthene	CE087	mg/kg	0.75	2.37	0.07	<0.01	0.45	0.12
Benzo(k)fluoranthene	CE087	mg/kg	0.36	1.16	0.03	<0.01	0.19	0.03
Benzo(a)pyrene	CE087	mg/kg	0.57	2.02	0.04	<0.01	0.33	<0.01
Indeno(123cd)pyrene	CE087	mg/kg	0.34	1.11	0.04	<0.01	0.21	<0.01
Dibenz(ah)anthracene	CE087	mg/kg	0.06	0.23	<0.01	<0.01	0.04	<0.01
Benzo(ghi)perylene	CE087	mg/kg	0.28	0.92	0.05	<0.01	0.19	<0.01
PAH (total of USEPA 16)	CE087	mg/kg	8.44	27.0	1.49	<0.16	4.59	1.66

Chemtech Environmental Limited

SOILS

Lab number			53504-7	53504-8	53504-9	53504-10	53504-11
Sample Id			TP 4	TP 5	TP 6	TP 6	TP 6
Depth (m)			0.45	0.30	0.30	0.75	4.20
Date sampled			12/11/2014	12/11/2014	12/11/2014	12/11/2014	12/11/2014
Test	**Method**	**Units**					
Arsenic (total)	CE127 M	mg/kg As	40	8.0	7.2	70	6.0
Cadmium (total)	CE127 M	mg/kg Cd	0.3	0.3	0.2	0.2	<0.2
Chromium (total)	CE127 M	mg/kg Cr	27	108	88	32	49
Chromium (VI)	CE050	mg/kg CrVI	<1	<1	<1	<1	<1
Copper (total)	CE127 M	mg/kg Cu	54	27	11	41	15
Lead (total)	CE127 M	mg/kg Pb	55	40	16	75	23
Mercury (total)	CE127 M	mg/kg Hg	<0.5	0.5	0.5	0.5	0.5
Nickel (total)	CE127 M	mg/kg Ni	38	16	11	36	30
Selenium (total)	CE127 M	mg/kg Se	2.1	0.7	0.5	1.9	1.3
Zinc (total)	CE127 M	mg/kg Zn	102	74	45	95	102
pH	CE004 M	units	6.8	9.5	8.3	7.8	6.7
Sulphate (2:1 water soluble)	CE061 M	mg/l SO_4	372	299	129	129	695
Sulphate (total)	CE062 M	mg/kg SO_4	5996	2359	1789	809	1897
Sulphur (total)	CE127	mg/kg S	1923	278	<100	10290	<100
PAH							
Naphthalene	CE087	mg/kg	0.26	0.18	0.10	1.03	<0.01
Acenaphthylene	CE087	mg/kg	<0.01	0.04	<0.01	<0.01	<0.01
Acenaphthene	CE087	mg/kg	<0.01	0.48	<0.01	0.13	<0.01
Fluorene	CE087	mg/kg	<0.01	0.35	<0.01	0.10	<0.01
Phenanthrene	CE087	mg/kg	0.28	2.41	0.26	0.57	<0.01
Anthracene	CE087	mg/kg	0.03	0.70	0.05	0.05	<0.01
Fluoranthene	CE087	mg/kg	0.22	3.35	0.51	0.11	<0.01
Pyrene	CE087	mg/kg	0.19	3.50	0.64	0.10	<0.01
Benzo(a)anthracene	CE087	mg/kg	0.12	1.59	0.36	0.04	<0.01
Chrysene	CE087	mg/kg	0.12	1.63	0.52	0.05	<0.01
Benzo(b)fluoranthene	CE087	mg/kg	0.15	2.00	0.41	0.03	<0.01
Benzo(k)fluoranthene	CE087	mg/kg	0.05	0.94	0.15	0.03	<0.01
Benzo(a)pyrene	CE087	mg/kg	0.09	1.93	0.30	0.04	<0.01
Indeno(123cd)pyrene	CE087	mg/kg	0.05	1.10	0.18	<0.01	<0.01
Dibenz(ah)anthracene	CE087	mg/kg	<0.01	0.20	<0.01	<0.01	<0.01
Benzo(ghi)perylene	CE087	mg/kg	0.06	0.92	0.20	<0.01	<0.01
PAH (total of USEPA 16)	CE087	mg/kg	1.62	21.3	3.68	2.27	<0.16

Chemtech Environmental Limited

METHOD DETAILS

METHOD	SOILS	METHOD SUMMARY	SAMPLE	STATUS	LOD	UNITS
CE127	Arsenic (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg As
CE127	Cadmium (total)	Aqua regia digest, ICP-MS	Dry	M	0.2	mg/kg Cd
CE127	Chromium (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cr
CE050	Chromium (VI)	Acid extraction, Colorimetry	Dry		1	mg/kg CrVI
CE127	Copper (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Cu
CE127	Lead (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Pb
CE127	Mercury (total)	Aqua regia digest, ICP-MS	Dry	M	0.5	mg/kg Hg
CE127	Nickel (total)	Aqua regia digest, ICP-MS	Dry	M	1	mg/kg Ni
CE127	Selenium (total)	Aqua regia digest, ICP-MS	Dry	M	0.3	mg/kg Se
CE127	Zinc (total)	Aqua regia digest, ICP-MS	Dry	M	5	mg/kg Zn
CE004	pH	Based on BS 1377, pH Meter	Wet	M	-	units
CE061	Sulphate (2:1 water soluble)	Aqueous extraction, ICP-OES	Dry	M	10	mg/l SO_4
CE062	Sulphate (total)	Acid extraction, ICP-OES	Dry	M	100	mg/kg SO_4
CE127	Sulphur (total)	Acid extraction, ICP-MS	Dry		100	mg/kg S
CE087	PAH (speciated)	Solvent extraction, GC-MS	Wet		0.01	mg/kg

Chemtech Environmental Limited

DEVIATING SAMPLE INFORMATION

Comments
Sample deviation is determined in accordance with the UKAS note "Guidance on Deviating Samples" and based on reference standards and laboratory trials.
For samples identified as deviating, test result(s) may be compromised and may not be representative of the sample at the time of sampling.
Chemtech Environmental Ltd cannot be held responsible for the integrity of sample(s) received if Chemtech Environmental Ltd did not undertake the sampling. Such samples may be deviating.

Key

N	No (not deviating sample)
Y	Yes (deviating sample)
A	Sampling date not provided
B	Sampling time not provided (waters only)
C	Sample exceeded holding time(s)
D	Sample not received in appropriate containers
E	Headspace present in sample container
F	Sample not chemically fixed (where appropriate)
G	Sample not cooled
H	Other (specify)

Lab ref	Sample id	Depth (m)	Deviating	Tests (Reason for deviation)
53504-1	TP 1	0.10	N	
53504-2	TP 2	0.10	N	
53504-3	TP 2	0.60	N	
53504-4	TP 2	3.50	N	
53504-5	TP 3	0.10	N	
53504-6	TP 3	5.50-6.00	N	
53504-7	TP 4	0.45	N	
53504-8	TP 5	0.30	N	
53504-9	TP 6	0.30	N	
53504-10	TP 6	0.75	N	
53504-11	TP 6	4.20	N	

Contaminant	Intended Land Use: Commercial/Industrial End Use (mg/kg)				
	Human Health	Phytoxicity			
		pH 5.0-5.5	pH 5.5-6.0	pH 6.0-6.5	pH >7.0
Arsenic	640	50			
Cadmium	230	3			
Chromium	5,000	400			
Chromium (VI)	35	-			
Lead	750	300			
Mercury	26	1			
Nickel	1,800	50	60	75	110
Selenium	13,000				
Copper		80	100	135	200
Zinc		200	200	200	300

Notes:

The assessment values are the Soil Guideline Values derived by DEFRA and Environment Agency using the '*Contaminated Land Exposure Assessment*' model. The assessment concentrations for arsenic, cadmium, nickel, mercury and selenium are outlined in the Environment Agency's Science Report series SC050021. These are based on a sandy loam soil and 6% soil organic matter.

The assessment concentrations for the remaining metals/metalloids are described in the Contaminated Land Report Series (CLR), which have now been withdrawn. The SGV threshold value is not intended to be applied to individual sample results where materials are similar, as the levels of contaminants will have a natural variability across the site. The modified mean value should instead be compared with the SGV.

The assessment values for phytotoxicity are levels at which plant growth is thought to be affected. These are taken from the maximum permissible and advisable concentrations in soil after application of soil sludge given in the '*The Code of Good Agricultural Practice for the Protection of Soil*', MAFF, 1998.

The assessment criterion for chromium (VI) have been taken from Nathanail, C. P., McCaffrey, C., Ashmore, M. H., Cheng, Y. Y., Gillett, A., Ogden, R. & Scott, D., 2009 '*The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment 2nd Edition*', Land Quality Press, Nottingham. These are also all based on a sandy loam soil and 6% soil organic matter.

Prepared	AJK	Typist	AJK	Checked	CAT	Date	1.12.2014	Job No	37688

E&P Eastwood&Partners
CONSULTING ENGINEERS
St Andrew's House
23 Kingfield Road
Sheffield S11 9AS
Tel: (0114) 2554554 Fax: (0114) 2554330

SAFESTYLE UK LTD

GENERIC ASSESSMENT CRITERIA

COMMERCIAL/INDUSTRIAL

Organic Compounds	Intended Land Use Commercial (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Naphthalene	200	480	1100
Acenaphthene	85,000	98,000	100,000
Acenaphthylene	84,000	97,000	100,000
Fluorene	64,000	69,000	71,000
Phenanthrene	22,000	22,000	23,000
Anthracene	530,000	540,000	540,000
Fluoranthene	23,000	23,000	23,000
Pyrene	54,000	54,000	54,000
Benzo(a)anthracene	90	95	97
Chrysene	140	140	140
Benzo(b)fluoranthene	100	100	100
Benzo(k)fluoranthene	140	140	140
Benzo(a)pyrene	14	14	14
Dibenz(a,h)anthracene	13	13	13
Indeno(1,2,3-cd)pyrene	60	61	62
Benzo(g,h,i)perylene	650	660	660
Phenol	1,100,000	1,100,000	3,200
Benzene	~	~	95
Toluene	~	~	4,400
Ethylbenzene	~	~	2,800
o-Xylene	~	~	2,600
m-Xylene	~	~	3,500
p-Xylene	~	~	3,200

The assessment criteria for the sixteen polycyclic aromatic hydrocarbon (PAH) species covered under the USEPA test have been taken from Nathanail, C. P., McCaffrey, C., Ashmore, M. H., Cheng, Y. Y., Gillett, A., Ogden, R. & Scott, D., 2009 *'The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment 2nd Edition'*, Land Quality Press, Nottingham. This is also the case for phenol at 1% and 2.5% SOM. These are also all based on a sandy loam soil.

The assessment values for phenol (6% SOM) and the BTEX compounds are the Soil Guideline Values derived by DEFRA and Environment Agency using the *'Contaminated Land Exposure Assessment'* model. These are outlined in the Environment Agency's Science Report series SC050021. The threshold value is not intended to be applied to individual sample results where materials are similar, as the levels of contaminants will have a natural variability across the site. The modified mean value should instead be compared with the threshold value.

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GENERIC ASSESSMENT CRITERIA

COMMERCIAL/INDUSTRIAL

TPH Fraction	Intended Land Use Commercial (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Aliphatic EC 5-6	3,400	6,200	13,000
Aliphatic EC >6-8	8,300	18,000	42,000
Aliphatic EC >8-10	2,100	5,100	12,000
Aliphatic EC >10-12	10,000	24,000	49,000
Aliphatic EC >12-16	61,000	83,000	91,000
Aliphatic EC >16-35	1,600,000	1,800,000	1,800,000
Aliphatic EC >35-44	1,600,000	1,800,000	1,800,000
Aromatic EC 5-7	28,000	49,000	90,000
Aromatic EC >7-8	59,000	110,000	190,000
Aromatic EC>8-10	3,700	8,600	18,000
Aromatic EC >10-12	17,000	29,000	345,000
Aromatic EC >12-16	36,000	37,000	37,800
Aromatic EC >16-21	28,000	28,000	28,000
Aromatic EC >21-35	28,000	28,000	28,000
Aromatic EC >35-44	28,000	28,000	28,000

The assessment criteria for each of the petroleum hydrocarbon fractions have been taken from Nathanail, C. P., McCaffrey, C., Ashmore, M. H., Cheng, Y. Y., Gillett, A., Ogden, R. & Scott, D., 2009 *'The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment 2nd Edition'*, Land Quality Press, Nottingham. These are also all based on a sandy loam soil.

Within the Environment Agency Science Report P5-080/TR3, Askari, K. & Pollard, S., 2005 *'The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils'* it is stated that the assessment values should not be considered individually; instead the potential additive effects should be calculated. This is achieved by calculating an individual Hazard Quotient (HQ) for each fraction. The HQ is the proportion of the assessment concentration represented by the recorded concentration. The HQs are then added together to form a Hazard Index (HI) and where this exceeds unity a potential significant risk to human health may exist.

Where only a TPH screen is undertaken, the assessment value used should be taken as the most onerous value given for individual carbon bands, as described above. This should be the assessment for Aliphatic band EC>8-10, assuming a SOM value of 1%. The assessment value should therefore be taken as 2,100 mg/kg.

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