

Tables 5a-5c
Source Zone Concentrations for Chemicals of Potential Concern (CoPC) and Source Zone Dimensions

TABLE 5a - SOURCE CONCENTRATIONS					
MODELLED RECEPTOR	Compound	Media	Measured Concentration in Soil (mg/kg)	Distribution used in model	Comments
Sandwith Beck	PCB Aroclor-1254	Soil	18	single	Maximum measured concentrations in soil were input directly into the model.
	TPH (>EC12-16) aromatic		5.5		
	TPH (>EC16-21) aromatic		110		
	TPH (>EC21-35) aromatic		400		
	TPH (>EC12-16) aliphatic		53		
	TPH (>EC16-21) aliphatic		590		
	TPH (>EC21-35) aliphatic		460		

TABLE 1b - SOURCE AREA					
MODELLED RECEPTOR	Compound	Length of source area (m)	Width of source area (m)	Distribution used in model	Comments
Sandwith Beck	PCB Aroclor-1254	20	20	single	A conservative assumption was included in the model, that each of the measured analytes was at the measured concentration across the entire source area (i.e. the entire footprint of Sub Z was considered to be the source area). The defined source area was 20meters long by 20meters wide (giving a 400m ² source area).
	TPH (>EC12-16) aromatic				
	TPH (>EC16-21) aromatic				
	TPH (>EC21-35) aromatic				
	TPH (>EC12-16) aliphatic				
	TPH (>EC16-21) aliphatic				
	TPH (>EC21-35) aliphatic				

TABLE 1C - SOURCE THICKNESS				
MODELLED RECEPTOR	Compound	Thickness of source area (m)	Distribution used in model	Comments
Sandwith Beck	PCB Aroclor-1254	1	single	Remediation of the uppermost 0.5m removed what was expected to be the most impacted area of contamination (given the source infiltrated from the surface). At each location, soil samples were taken at the base of the remediation zone (between 0.1m and 0.5mbgl) and also from the deeper strata (to a maximum depth of 1.2mbgl). In three of the four deep samples, limited detections of TPH were recorded, with the one remaining deep sample (TP1 at 1.2mbgl) returning a relatively elevated concentration of 510mg/kg (Total TPH). It was conservatively assumed in the model that contamination extended to 1.5mbgl, and was therefore 1 meter thick. Only one sample for PCB was taken, so it was conservatively assumed that this analyte was also present between 0.5 and 1.5mbgl. URS understands that the spillage occurred in August 2007 and was remediated in September 2007, and so it was considered conservative to assume the contamination had infiltrated through one meter of strata, especially as the Plot C investigation found this strata was generally found to be dry and of low permeability.
	TPH (>EC12-16) aromatic			
	TPH (>EC16-21) aromatic			
	TPH (>EC21-35) aromatic			
	TPH (>EC12-16) aliphatic			
	TPH (>EC16-21) aliphatic			
	TPH (>EC21-35) aliphatic			

Table 6a-b
Aquifer and Pathway Characteristics

Table 6a: Soil and groundwater pathway model parameters						
Parameters		Parameter Value			Distribution Used	Comment
		Most Likely	Min	Max		
Aquifer Characteristics						Conservatively assumed that a continuous horizon of silt exists between the source and the receptor. Furthermore, the highest hydraulic conductivity for the range for silt in the CONSIM manual has been adopted (this will generate the worst case scenario as it will transport the analyte to the receptor in the shortest time)
	Hydraulic conductivity (m/s)	2.00E-05	-	-	Single	
	Hydraulic gradient	0.014286	-	-	Single	Based on hydraulic gradient calculation used in the Plot C model.
	Effective porosity (fraction)	-	0.05	0.25	Uniform	Adopted range of porosities for silt and more granular zones of Glacial Boulder Clay. Within range of parameters defined in CONSIM manual.
	Aquifer Bulk Density (g/cm³)	-	1.7	2.45	Uniform	Adopted range for weathered and unweathered Glacial Till from CONSIM manual.
	Groundwater flow direction (degrees)	135	-	-	Single	Interpreted from the on-site groundwater contour plot for Plot C which suggests a convergent flow towards Sandwith Beck
	Saturated Aquifer Thickness (m)	2	-	-	Single	A silt horizon has been conservatively assumed to be present, with a thickness of 2 meters. The closest borehole log to sub Z is BH201 (approximately 30m to the north east). This was logged as containing drift deposits (very silty clay) to at least 21m depth in this area, with no continuous groundwater encountered until 49mbgl. Therefore it is conservative to assume that a silt horizon of 2 meters in thickness is present beneath Sub Z (at a depth of 1.5m to 3.5m below ground level), that is saturated, and extends to the receptor 250m away.
Active Processes	Retarded Travel in UZ	NO			It is considered likely that retardation will occur in the aquifer, however it has been assumed no unsaturated zone is present and that the source area extends to the water table.	
	Retarded Travel in Aquifer	YES				
	Biodegradation in UZ	NO			It is considered likely that biodegradation will occur, however it has been assumed no unsaturated zone is present and that the source area extends to the water table.	
	Biodegradation in Aquifer	YES				

Table 2b: Soil and groundwater pathway model parameters					
Parameters		Distance to Receptor (m)*	Longitudinal Dispersivity (m)**	Lateral Dispersivity (m)***	Comment
Pathway to Sandwith Beck	PCB Aroclor-1254	250	25	8.3	*Distance to receptor (m): This is the distance from the closest point of the source area to the receptor
	TPH (>EC12-16) aromatic				**Longitudinal Dispersivity (m): Assumed 1/10th travel distance to receptor (this is the minimum distance between closest part of contaminant source and identified receptor) as defined in ConSim manual. This is different for each individual contaminant.
	TPH (>EC16-21) aromatic				
	TPH (>EC21-35) aromatic				
	TPH (>EC12-16) aliphatic				
	TPH (>EC16-21) aliphatic				
	TPH (>EC21-35) aliphatic				
***Lateral Dispersivity (m):Assumed 1/3rd longitudinal dispersivity: defined in ConSim manual. 1/3 of each individual compounds longitudinal dispersivity.					

Table 7
Physical-Chemical and Half Life Parameters

Analytical Suite	Contaminant	Partition Coefficient, K_{oc} or K_d (ml/g)	Ref.	Maximum Solubility (mg/l)	Ref.	Henry's Law Constant, H (unitless)	Ref.	Half-life (years)			
								Most Likely	Minimum	Maximum	Ref.
PCB	PCB Aroclor-1254	2.75E+05	a	0.01-0.3	a	0.0081-0.105	a	1000	-	-	c
TPH	TPH (>EC12-16) aromatic	5.01E+03	b	5.80E+00	b	5.30E-02	b	19.0	9.5	28.5	c
	TPH (>EC16-21) aromatic	1.58E+04	b	6.50E-01	b	1.30E-02	b	38.1	19.0	57.1	c
	TPH (>EC21-35) aromatic	1.26E+05	b	6.60E-04	b	6.70E-04	b	75.0	37.5	112.5	c
	TPH (>EC12-16) aliphatic	5.01E+06	b	7.60E-04	b	5.20E+02	b	1.9	1.0	2.8	c
	TPH (>EC16-21) aliphatic	6.31E+08	b	2.50E-06	b	4.90E+03	b	3.8	1.9	5.7	c
	TPH (>EC21-35) aliphatic	7.59E+09	b	8.91E-08	b	2.00E+04	b	19.0	9.5	28.5	c

Literature Sources:

- a** Mackay, D., Wan-Ying, S., Kuo-Ching, M. 1997. Illustrated Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals. CRC Press LLC, Florida.
- b** TPH Criteria Working Group, Fate and Transport Technical Action Group. 1997. Selection of Representative TPH Fractions Based on Fate and Transport Considerations.
- c** URS derived conservative degradation rates (References below)

References:

Environment Agency (2002) The effects of Contaminant Concentration on the Potential for Natural Attenuation. (Authored by Noble, P. & Morgan, P.) Environment Agency R&D Technical Report P2-228/TR, Environment Agency, Bristol.

Aronson, D., & Howard, P.H. (1997) Anaerobic Biodegradation of Organic Chemicals in Groundwater: A Summary of Field and Laboratory Studies, Final Report. Prepared for the American Petroleum Institute, Chemical Manufacturer's Association, National Council of the Paper Industry for Air and Stream Improvement, Edison Electric Institute, American Forest and Paper Association, Washington DC, USA.

Howard, P.H., Boethling, R.S., Jarvis, W.F., Meylan, W.M. & Michalenko, E.M. (1991) Handbook of Environmental Degradation Rates. Lewis Publishers Inc., Chelsea, MI, USA.

Wild, S.R., Waterhouse, K.S., McGrath, S., & Jones, K. (1990) Organic contaminants in an agricultural soil with a known history of sewage sludge amendments: polynuclear aromatic hydrocarbons. Environ. Sci. Technol., 24:1706-1711.

Wild, S.R. & Jones, K.C. (1995) Polynuclear aromatic hydrocarbons in the United Kingdom environment: a preliminary source inventory and budget. Environ. Pollut., 88: 91-108.

Table 8

Approximate Time for Simulated Contaminant Concentration to Exceed Controlled Waters EQS at Receptor From Source at Sub Z

MODELLED RECEPTOR	Individual Compounds	Stage 2 Controlled Waters Screening Criteria (ug/l)	Source	SIMULATED TIME TO EXCEED DWS	Maximum Simulated Concentrations at Receptor (ug/l)	
					50th PERCENTILE (Years)	95th PERCENTILE (Years)
Sandwith Beck	PCB Aroclor-1254	0.1	UK DWS (2000)	IR	IR	IR
	TPH (>EC12-16) aromatic	10	UK DWS (2000)	IR	IR	IR
	TPH (>EC16-21) aromatic	10	UK DWS (2000)	IR	IR	IR
	TPH (>EC21-35) aromatic	10	UK DWS (2000)	IR	IR	IR
	TPH (>EC12-16) aliphatic	10	UK DWS (2000)	IR	IR	IR
	TPH (>EC16-21) aliphatic	10	UK DWS (2000)	IR	IR	IR
	TPH (>EC21-35) aliphatic	10	UK DWS (2000)	IR	IR	IR

Key

UK DWS - UK Drinking Water Standards