Canadian Environmental Quality Guidelines for Polychlorinated Dibenzo-*p*-dioxins and Polychlorinated Dibenzofurans

Water, Sediment, and Tissue

Volume II: Figures and Tables

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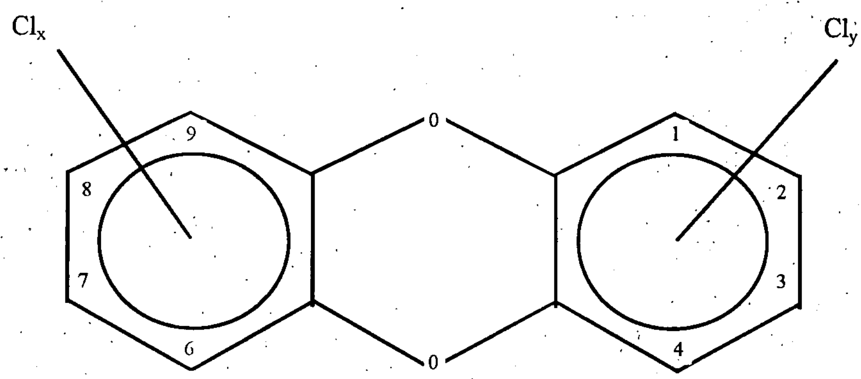
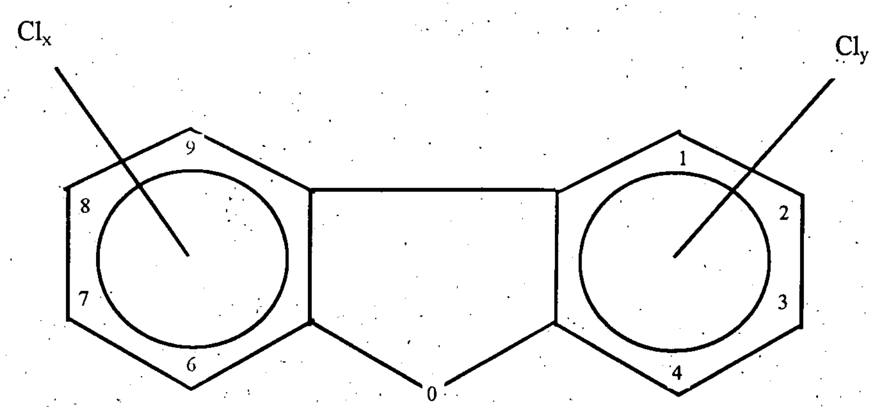


Polychlorinated dibenzo-*p* -dioxins (PCDDs)



Polychlorinated dibenzofurans (PCDFs)

Figure 1. Chemical Structure of PCDDs and PCDFs

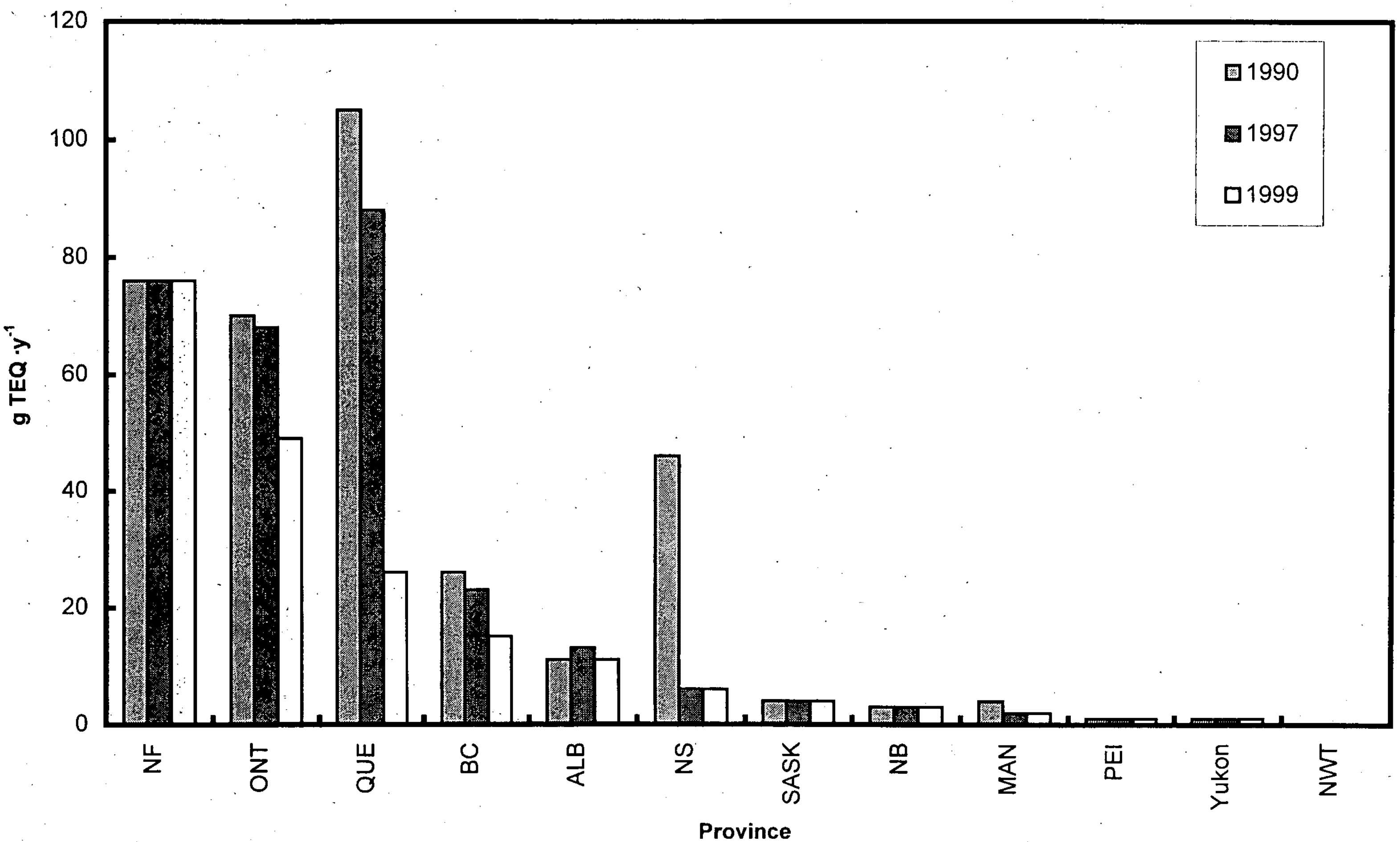


Figure 2. Measured and projected PCDD/F releases by province for 1990, 1997, 1999 in Canada (modified from Environment Canada 1998a)

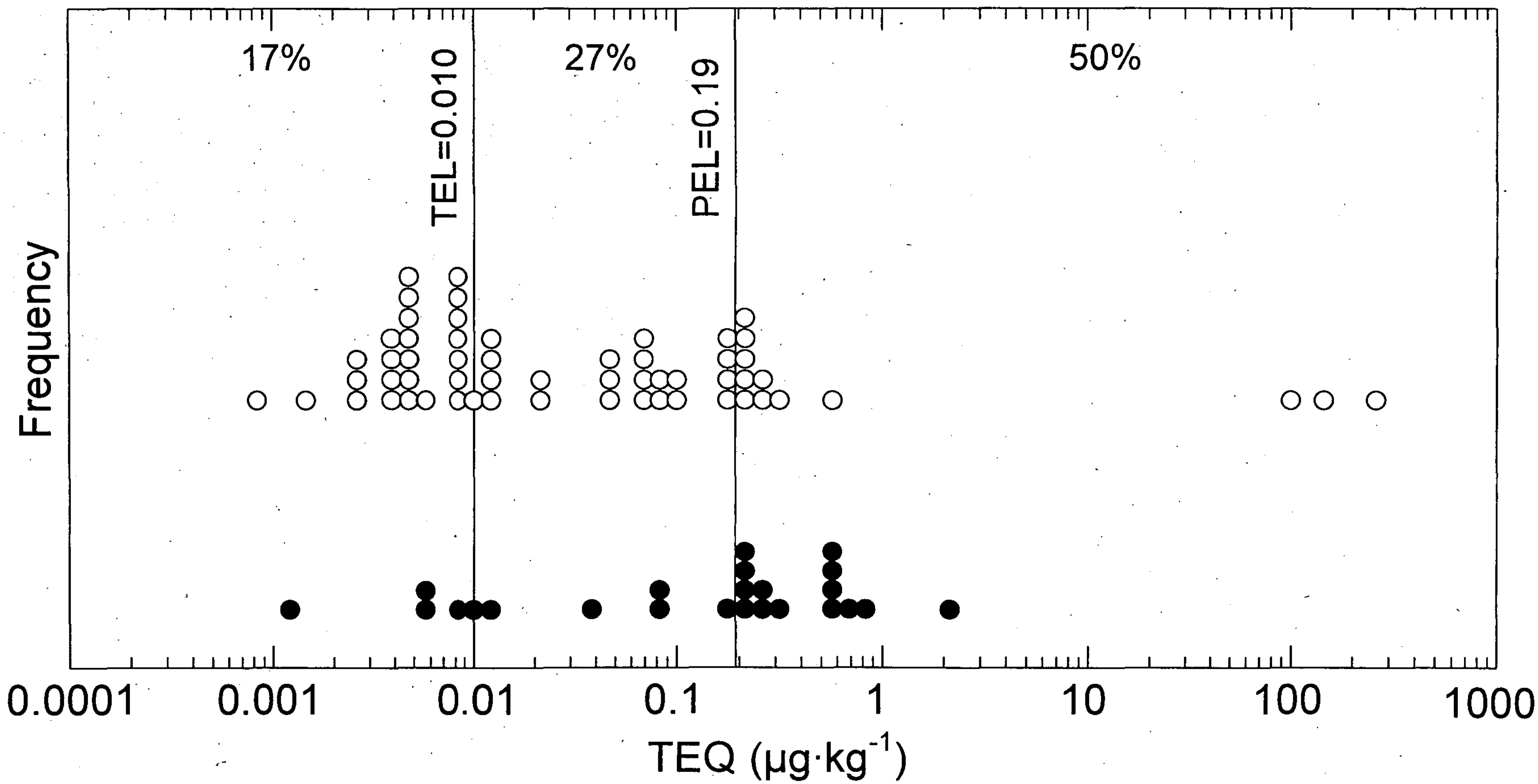


Figure 3. Distribution of PCDD/F TEQ concentrations in freshwater sediments that are associated with adverse biological effects (●) and no adverse biological effects (○). Percentages indicate proportions of concentrations associated with effects in ranges below the Threshold Effect Level (TEL), between the TEL and Probable Effect Level (PEL), and above the PEL.

Table 1. List of PCDD/F congeners, their respective abbreviations, CAS registry numbers, and molecular weights.

Congener	Congener Abbreviation[a]	CAS Registry Number[b]	Molecular Weight[a]
PCDDs			
2,3,7,8-tetrachlorodibenzo-*p* -dioxin	T_4CDD	1746-01-6	322
1,2,3,7,8-pentachlorodibenzo-*p* -dioxin	1,2,3,7,8-PCDD	40321-76-4	356
1,2,3,4,7,8-hexachlorodibenzo-*p* -dioxin	1,2,3,4,7,8-HCDD	39227-28-6	391
1,2,3,6,7,8-hexachlorodibenzo-*p* -dioxin	1,2,3,6,7,8-HCDD	57653-85-7	391
1,2,3,7,8,9-hexachlorodibenzo-*p* -dioxin	1,2,3,7,8,9-HCDD	19408-74-3	391
1,2,3,4,6,7,8-heptachlorodibenzo-*p* -dioxin	1,2,3,4,6,7,8-HCDD	352822-46-9	425
1,2,3,4,5,6,7,8-octachlorodibenzo-*p* -dioxin	OCDD	3268-87-9	460
PCDFs			
2,3,7,8-tetrachlorodibenzofuran	T_4CDF	51207-31-9	306
1,2,3,7,8-pentachlorodibenzofuran	1,2,3,7,8-PCDF	57117-41-6	340
2,3,4,7,8-pentachlorodibenzofuran	2,3,4,7,8-PCDF	57117-31-4	340
1,2,3,4,7,8-hexachlorodibenzofuran	1,2,3,4,7,8-HCDF	70648-26-9	375
1,2,3,6,7,8-hexachlorodibenzofuran	1,2,3,6,7,8-HCDF	577117-44-9	375
1,2,3,7,8,9-hexachlorodibenzofuran	1,2,3,7,8,9-HCDF	72918-21-9	375
2,3,4,6,7,8-hexachlorodibenzofuran	2,3,4,6,7,8-HCDF	60851-34-5	375
1,2,3,4,6,7,8-heptachlorodibenzofuran	1,2,3,4,6,7,8-HCDF	-	409
1,2,3,4,7,8,9-heptachlorodibenzofuran	1,2,3,4,7,8,9-HCDF	58200-70-7	409
1,2,3,4,5,6,7,8-octachlorodibenzofuran	OCDF	-	444

[a]in the text, congener abbreviations may include a subscript to distinguish between hexa-substituted (H_6CDD) and hepta-substituted (H_7CDD) congeners, for example, especially when the chlorine substitution pattern was not provided in the original reference or to refer all congeners within a homologue group.

[b]CAS = Chemical Abstracts Service; from Lupp and McCarty 1989; Shiu et al. 1988; Budavari et al. 1989.

Table 2. Melting and boiling point temperatures for PCDD/Fs.

Congener	Melting Point (°C)	Boiling Point (°C)	Reference
PCDDs			
2,3,7,8-T_4CDD	295	NR	Budavari et al. 1989
	320 - 325	NR	Budavari et al. 1989
	305	421 - 447	Pohjanvirta 1991
	305	446 (est.)	Rordorf 1989
	305 - 306	NR	Pohland and Yang 1972*
	305 - 307	NR	Kende et al. 1974*
	305	412 (est.)	Schroy et al. 1985**
	322	NR	Fiedler et al. 1990
1,2,3,7,8-P_5CDD	240	465 (est.)	Rordorf 1989
1,2,3,4,7,8-H_6CDD	273	488 (est.)	Rordorf 1989
	275	NR	Pohland and Yang 1972*
	273	NR	Shiu et al. 1988
1,2,3,6,7,8-H_6CDD	285	488 (est.)	Rordorf 1989
1,2,3,7,8,9-H_6CDD	243	488 (est.)	Rordorf 1989
1,2,3,4,6,7,8-H_7CDD	264	507 (est.)	Rordorf 1989
	265	NR	Shiu et al. 1988
OCDD	330	510 (est.)	Rordorf 1989
	330	NR	Pohland and Yang 1972*
	332	NR	Shiu et al. 1988
PCDFs			
2,3,7,8-T_4CDF	227	438 (est.)	Rordorf 1989
1,2,3,7,8-P_5CDF	225	465 (est.)	Rordorf 1989
2,3,4,7,8-P_5CDF	196	465 (est.)	Rordorf 1989
1,2,3,4,7,8-H_6CDF	225.5	488 (est.)	Rordorf 1989
1,2,3,6,7,8-H_6CDF	232	488 (est.)	Rordorf 1989
2,3,4,6,7,8-H_6CDF	239	488 (est.)	Rordorf 1989
1,2,3,4,6,7,8-H_7CDF	236	507 (est.)	Rordorf 1989
1,2,3,4,7,8,9-H_7CDF	221	507 (est.)	Rordorf 1989

Boiling Point: est. = estimated; NR = not reported.
Reference: * = as cited in WHO 1989; ** = as cited in SRC 1989a.

Table 3. Solubilities for PCDD/Fs.

Congener	Solvent	Temperature (°C)	Solubility (ng·L^{-1})	Reference
PCDDs				
2,3,7,8-T_4CDD	water	20 - 22	7.91	Adams and Blaine 1986
	water	22	12.5	Marple et al. 1986
	water	4.3	12.9	Lodge 1989
	water	22	19.3	Marple et al. 1986
	water	25	200	Crummett and Stehl 1973*
	water	17.3	483	Lodge 1989
	water	NR	8 - 200	Shiu et al 1988
	acetone	25	110 000 000	Schroy et al. 1985**
	benzene	25	570 000 000	Schroy et al. 1985**
	chlorobenzene	25	720 000 000	Schroy et al. 1985**
	o-dichlorobenzene	25	1 400 000 000	Schroy et al. 1985**
	chloroform	25	370 000 000	Schroy et al. 1985**
	methanol	25	10 000 000	Schroy et al. 1985**
	n-octanol	25	48 000 000	Schroy et al. 1985**
	dimethyl sulphoxide	25	200 000 000	Pohjanvirta 1991
1,2,3,4,7,8,-H_6CDD	water	7	2.22	Friesen and Webster 1990
	water	11.5	2.99	Friesen and Webster 1990
	water	17	4.01	Friesen and Webster 1990
	water	20	4.42	Friesen et al. 1985
	water	21	4.69	Friesen and Webster 1990
	water	26	7.58	Friesen and Webster 1990
1,2,3,4,6,7,8,-H_7CDD	water	7	0.90	Friesen and Webster 1990
	water	11.5	1.1	Friesen and Webster 1990
	water	17	1.24	Friesen and Webster 1990
	water	21	2.21	Friesen and Webster 1990
	water	26	2.47	Friesen and Webster 1990
	water	20	2.4	Friesen et al. 1985
OCDD	water	25	0.074	Shiu et al. 1988
	water	20	0.4	Friesen et al. 1985
	water	20	0.4	Webster et al. 1985
	water	NR	0.4 - 0.97	Fiedler et al. 1990
PCDFs				
2,3,7,8-T_4CDF	water	22.7	419.2	Friesen et al. 1990
2,3,4,7,8-P_5CDF	water	22.7	235.3	Friesen et al. 1990
1,2,3,6,7,8-H_6CDF	water	22.7	17.7	Friesen et al. 1990
1,2,3,4,7,8-H_6CDF	water	22.7	8.25	Friesen et al. 1990
1,2,3,4,6,7,8-H_7CDF	water	22.7	1.35	Friesen et al. 1990
OCDF	water	25	1.16	Friesen et al. 1990

Temperature: NR = not reported.
Reference: * = as cited in Shiu et al. 1988; ** = as cited in Pohjanvirta 1991.

Table 4. Vapour pressures for PCDD/Fs.

Congener	Temperature (°C)	Vapour Pressure (µPa)	Reference
PCDDs			
2,3,7,8-T_4CDD	25	0.098	Podoll et al. 1986*
	25	0.151	Shiu et al. 1988
	25	0.20	Rordorf 1989
	25	0.20	Shiu et al. 1988
	25	0.62	Shiu et al. 1988
1,2,3,7,8-P_5CDD	25	17.5	Eitzer and Hites 1988
	25	0.058 (est.)	Rordorf 1989
1,2,3,4,7,8-H_6CDD	25	0.0051	Shiu et al. 1988
	25	3.96	Eitzer and Hites 1988
	25	0.0051 (est.)	Rordorf 1989
1,2,3,6,7,8-H_6CDD	25	0.0048 (est.)	Rordorf 1989
1,2,3,7,8,9-H_6CDD	25	0.0065 (est.)	Rordorf 1989
1,2,3,4,6,7,8-H_7CDD	25	1.02	Eitzer and Hites 1988
	25	0.00075 (est.)	Rordorf 1989
OCDD	25	0.0001	Rordorf 1989
	25	0.00011	Shiu et al. 1988
	25	0.28	Eitzer and Hites 1988
	20	8.7	Webster et al. 1985
PCDFs			
2,3,7,8-T_4CDF	25	123	Eitzer and Hites 1988
	25	2.0 (est.)	Rordorf 1989
1,2,3,7,8-P_5CDF	25	36.4	Eitzer and Hites 1988
	25	0.23 (est.)	Rordorf 1989
2,3,4,7,8-P_5CDF	25	21.7	Eitzer and Hites 1988
	25	0.35 (est.)	Rordorf 1989
1,2,3,4,7,8-H_6CDF	25	8.09	Eitzer and Hites 1988
	25	0.032 (est.)	Rordorf 1989
1,2,3,6,7,8-H_6CDF	25	8.09	Eitzer and Hites 1988
	25	0.029 (est.)	Rordorf 1989
1,2,3,7,8,9-H_6CDF	25	4.99	Eitzer and Hites 1988
2,3,4,6,7,8-H_6CDF	25	4.99	Eitzer and Hites 1988
	25	0.026 (est.)	Rordorf 1989
1,2,3,4,6,7,8-H_7CDF	25	2.24	Eitzer and Hites 1988
	25	0.0047 (est.)	Rordorf 1989
1,2,3,4,7,8,9-H_7CDF	25	1.3	Eitzer and Hites 1988
	25	0.0062 (est.)	Rordorf 1989

Vapour Pressure: est. = estimated.
Reference: * = as cited in Shiu et al. 1988.

Table 5. Log octanol-water partition coefficients (log K_{ow}s) for PCDD/Fs.

Congener	log K_{ow}	Reference
PCDDs		
2,3,7,8-T_4CDD	6.15	Kenaga 1980**
	6.60	Pohjanvirta 1991
	6.60	Gobas and Schrap 1990
	6.64	Marple et al. 1986*
	6.80	Hawker 1990; Shiu et al. 1988
	6.85	Travis & Hattemer-Frey 1987
	7.02	Burkhard and Kuehl 1986**
	7.02	Servos 1988
	7.10	Servos et al. 1992a
	7.10	Broman et al. 1991
	8.93	Sarna et al. 1985**
mean (standard deviation)	*6.85 (0.71)*	
1,2,3,7,8-P_5CDD	7.00	Broman et al. 1991
	7.80	Lupp & McCarty 1989
mean (standard deviation)	*7.40 (0.57)*	
1,2,3,4,7,8-H_6CDD	7.30	Broman et al. 1991
	7.79	Burkhard and Kuehl 1986**
	7.80	Hawker 1990; Shiu et al. 1988
	9.19	Webster et al. 1985
	9.65	Webster et al. 1985
	10.22	Webster et al. 1985
	10.40	Webster et al. 1985
mean (standard deviation)	*8.91 (1.27)*	
1,2,3,6,7,8-H_6CDD	7.60	Lupp and McCarty 1989
	7.80	Broman et al. 1991
mean (standard deviation)	*7.70 (0.14)*	
1,2,3,7,8,9-H_6CDD	6.90	Broman et al. 1991
1,2,3,4,6,7,8-H_7CDD	8.00	Broman et al. 1991
	8.00	Hawker 1990; Shiu et al. 1988
	8.20	Servos 1988
	8.20	Burkhard and Kuehl 1986**
	9.69	Webster et al. 1985
	10.55	Webster et al. 1985
	11.05	Webster et al. 1985
	11.38	Webster et al. 1985
	11.50	Sarna et al. 1985**
mean (standard deviation)	*9.62 (1.53)*	
OCDD	7.53	Doucette 1985**
	8.20	Servos et al. 1992a
	8.20	Broman et al. 1991
	8.20	Gobas and Schrap 1990
	8.20	Hawker 1990; Shiu et al. 1988

Table 5. Log octanol-water partition coefficients (log K_{ow}s) for PCDD/Fs.

Congener	log K_{ow}	Reference
	8.60	Burkhard and Kuehl 1986**
	10.07	Webster et al. 1985
	10.56	Doucette 1985**
	11.16	Sarna et al. 1985**
	11.35	Webster et al. 1985
	11.51	Webster et al. 1983**
	11.76	Webster et al. 1985
	12.26	Webster et al. 1985
	12.72	Sarna et al. 1985**
mean (standard deviation)	*10.02 (1.81)*	
PCDFs		
2,3,7,8-T_4CDF	5.80	Lupp and McCarty 1989
	5.82	Burkhard and Kuehl 1986*
mean (standard deviation)	*5.81 (0.01)*	
1,2,3,7,8-P_5CDF	7.80	Broman et al. 1991
2,3,4,7,8-P_5CDF	7.60	Broman et al. 1991
1,2,3,6,7,8-H_6CDF	7.60	Broman et al. 1991
1,2,3,7,8,9-H_6CDF	7.00	Broman et al. 1991
2,3,4,6,7,8-H_6CDF	7.00	Broman et al. 1991
1,2,3,4,6,7,8-H_7CDF	8.10	Broman et al. 1991
1,2,3,4,7,8,9-H_7CDF	6.90	Broman et al. 1991
OCDF	7.60	Broman et al. 1991
	8.20	Gobas and Schrap 1990
	8.78	Burkhard and Kuehl 1986*
	13.37	Sarna et al. 1984*
	2.63	
mean (standard deviation)	*9.49 (2.63)*	

Reference: * = as cited in WHO 1989; ** = as cited in Shiu et al. 1988.

Table 6. Log organic carbon-water partition coefficients (log K_{oc}s) for PCDD/Fs.

Congener	Medium	log K_{oc}	Reference
PCDDs			
2,3,7,8-T_4CDD	Soil	6.66	Walters et al. 1989
	Soil	7.39 - 7.58	Jackson et al. 1985*
	Alluvial soil	5.96 - 6.09	Marple et al. 1986*
	Red clay soil	6.22 - 6.54	Marple et al. 1986*
	NR	5.67	Kenaga 1980
	NR	6 - 7	Fiedler et al. 1990
	Lake bed sediments	6.74	Corbet et al. 1988
	Lake bed sediments	7.25 - 7.59	Lodge and Cook 1989
	Marine particulates	6.8	Broman et al. 1991
	Soil - pH 4	5.70 - 6.24	Puri et al. 1989
	Soil - pH 7	5.09 - 6.10	Puri et al. 1989
	Soil - pH 8.5	4.76 - 5.10	Puri et al. 1989
1,2,3,7,8-P_5CDD	Marine particulates	6.8	Broman et al. 1991
1,2,3,4,7,8-H_6CDD	Marine particulates	7.1	Broman et al. 1991
1,2,3,4,7,8-H_6CDD	Soil - FA present	5.13 - 5.41	Webster et al. 1986
1,2,3,4,7,8-H_6CDD	Soil - HA present	5.95 - 6.02	Webster et al. 1986
1,2,3,4,7,8-H_6CDD	Soil - A-HA present	6.15 - 6.32	Webster et al. 1986
1,2,3,6,7,8-H_6CDD	Marine particulates	7.6	Broman et al. 1991
1,2,3,7,8,9-H_6CDD	Marine particulates	6.6	Broman et al. 1991
1,2,3,4,6,7,8-H_7CDD	Marine particulates	7.8	Broman et al. 1991
OCDD	Marine particulates	7.9	Broman et al. 1991
PCDFs			
2,3,7,8-T_4CDF	Marine particulates	7.5	Broman et al. 1991
2,3,4,7,8-P_5CDF	Marine particulates	7.4	Broman et al. 1991
1,2,3,6,7,8-H_6CDF	Marine particulates	7.4	Broman et al. 1991
1,2,3,7,8,9-H_6CDF	Marine particulates	6.8	Broman et al. 1991
2,3,4,6,7,8-H_6CDF	Marine particulates	6.8	Broman et al. 1991
1,2,3,4,6,7,8-H_7CDF	Marine particulates	7.9	Broman et al. 1991
1,2,3,4,7,8,9-H_7CDF	Marine particulates	6.7	Broman et al. 1991
OCDF	Marine particulates	7.4	Broman et al. 1991

Medium: FA = fulvic acid; HA = humic acid; A-HA = Aldrich humic acid.
Reference: * = as cited in Lodge and Cook 1989.

Table 7. Toxic Equivalency Factors (TEFs) for PCDD/Fs.

Congener	Toxic Equivalency Factors (TEFs)																			
	Fish								Mammalian										Avian	
												I-TEFs[a]								
	Bol et al. 1989	Clemons et al. 1994	Mehrle et al. 1988	Parrott et al. 1991	Parrott et al. 1992	Tysklind et al. 1994	Walker & Peterson 1991	Zabel et al. 1995	Ahlborg et al. 1992	Elliott et al. 1989	Kutz et al. 1990	NATO/CCMS 1988	Safe et al. 1988	Safe 1990	Safe 1992	Safe 1994	Stahl et al. 1992	Tillitt et al. 1996	van den Heuvel et al. 1995	Bosveld et al. 1992	Bosveld et al. 1993
2,3,7,8-TCDD	1	1	1	1			1	1	1		1	1	1	1	1	1	1	1	1	1	1
1,2,3,7,8-PCDD	0.77	2.6		1			0.73	0.73	0.5	0.0087[b]	0.5	0.5	0.5	0.5	0.5	0.5	0.2	0.42	1.13[e]	1.2	
1,2,3,4,7,8-HCDD		1.1		0.3			0.319	0.319	0.1		0.1	0.1	0.1	0.1	0.1	0.1	0.05	0.083	0.49[e]	0.5	
1,2,3,6,7,8-HCDD		0.2		0.3				0.024	0.1	0.004[c]		0.1		0.1	0.1	0.1		0.024	0.23[e]	0.01	0.01
1,2,3,7,8,9-HCDD									0.1	0.0037[c]		0.1		0.1	0.1			0.034	0.01[f]	0.1	
1,2,3,4,6,7,8-HCDD		0.2		0.5				0.002		0.0028[c]	0.01	0.01		0.01	0.01	0.01	0.007		0.097[f]	<0.001	
1,2,3,4,6,7,9-HCDD									0.01									0.023			
OCDD									0.001		0.001	0.001		0.001	0.001		0.0014	0.000504			
2,3,7,8-TCDF		0.2	0.04		0.54		0.028	0.028	0.1	0.025[d]	0.1	0.1	0.1	0.1	0.1	0.1		0.2	0.03[e]	0.9	
1,2,3,7-TCDF						2.2															
1,2,6,9-TCDF						5.4															
1,2,6,8-TCDF						4.2															
1,3,6,8-TCDF						3.7															
1,4,6,9-TCDF						6.5															
2,3,6,8-TCDF						1.6															
2,4,6,8-TCDF						4.5															
1,2,3,7,8-PCDF		0.2			0.42		0.034	0.034	0.05		0.05	0.05	0.05	0.01/0.05	0.1	0.05		0.2	0.16[e]	0.3	
2,3,4,7,8-PCDF	0.35	1.9			4.4	0.2	0.359	0.359	0.5	0.38[d]	0.5	0.5	0.5	0.5	0.5	0.5		1.4	0.40[e]	1.1	1.1
1,2,6,7,8-PCDF						2.4															
2,3,4,6,7,-PCDF						1.4															
1,2,3,4,6-PCDF						4.1															
1,2,3,4,9-PCDF						3.6															
1,2,4,8,9-PCDF						4															
1,2,3,4,7,8-HCDF		1.1			0.44		0.28	0.28	0.1		0.1	0.1	0.1	0.1	0.1	0.1		0.02	0.33[e]	0.01	0.01
1,2,3,6,7,8-HCDF									0.1			0.1		0.1	0.1			0.06	0.1[f]	0.4	0.4
1,2,3,7,8,9-HCDF	0.006					0.4			0.1			0.1	0.1	0.1	0.1			0.2	0.01[f]		
2,3,4,6,7,8-HCDF									0.1			0.1		0.1	0.1			0.3	0.2[f]		0.14[g]
1,2,4,6,8,9-HCDF						4.4															
1,2,4,6,7,8-HCDF						2.5															
1,2,4,6,7,9-HCDF						3.5															
1,3,4,6,7,8-HCDF						2.3												0.3			
1,2,3,4,6,7,8-HCDF									0.01		0.01	0.01		0.01	0.1				0.01[f]		0.11[g]
1,2,3,4,7,8,9-HCDF						1.1			0.01			0.01		0.01	0.1			0.02			
OCDF									0.001		0.001	0.001		0.001	0.001						

[a]International TEFs

[b,c,d]Mason et al. 1986, Bradlaw et al. 1980, and Bandiera et al. 1984, respectively, as cited in Elliott et al. 1991

[e,f]Clemons et al. 1994 and Safe 1987, respectively, as cited in van den Heuvel et al. 1995

[g]Bandeira et al. 1982 as cited in Bosveld et al. 1993

Table 8. World Health Organization (WHO) Toxic Equivalency Factors (TEFs) for PCDD/Fs.

Congener	Chemical Abstract Number	Toxic Equivalency Factors (TEFs)[a]		
		Fish	Mammalian	Avian
2,3,7,8-T_4CDD	1746-01-6	1	1	1
1,2,3,7,8-P_5CDD	40321-76-4	1	1	1
1,2,3,4,7,8-H_6CDD	39227-28-6	0.5	0.1	0.05
1,2,3,6,7,8-H_6CDD	19408-74-3	0.01	0.1	0.01
1,2,3,7,8,9-H_6CDD	57653-85-7	0.01	0.1	0.1
1,2,3,4,6,7,8-H_7CDD	352822-46-9	0.001	0.01	<0.001
OCDD	3268-87-9	-	0.0001	-
2,3,7,8-T_4CDF	51207-31-9	0.05	0.1	1
1,2,3,7,8-P_5CDF	57117-31-4	0.05	0.05	0.1
2,3,4,7,8-P_5CDF	57117-41-6	0.5	0.5	1
1,2,3,4,7,8-H_6CDF	70648-26-9	0.1	0.1	0.1
1,2,3,6,7,8-H_6CDD	72918-21-9	0.1	0.1	0.1
1,2,3,7,8,9-H_6CDF	57117-44-9	0.1	0.1	0.1
2,3,4,6,7,8-H_6CDF	60851-34-5	0.1	0.1	0.1
1,2,3,4,6,7,8-H_7CDF	67462-39-4	0.01	0.01	0.01
1,2,3,4,7,8,9-H_7CDF	55673-89-7	0.01	0.01	0.01
OCDF	39001-02-0	0.0001	0.0001	0.0001

[a]van den Berg et al. 1998

Table 9. Estimated annual natural and anthropogenic PCDD/F releases into the Canadian environment.

Congener	Source/Sector	Year	Release Pathway	Annual Releases (kg/y)	Reference
	Natural Sources				
Total PCDD	Forest fires	NR	Air emissions	58.7	Sheffield 1985
	Chemical Manufacturing and Use				
Total PCDD	Chlorophenol production	1981	Air emissions	0.9	Sheffield 1985
Total PCDD	Chlorophenol production	NR	Wastewater	0.013	Sheffield 1985
Total PCDD	Use of 2,4-D formulations	1983	Unspecified	0.1	Sheffield 1985
Total PCDD	Use of Dicamba	1983	Unspecified	0.011	Sheffield 1985
Total PCDD	Use of 2,4,5-T	1983	Unspecified	0.001	Sheffield 1985
Total PCDD	Total PCP Use	1983	Unspecified	1400	Sheffield 1985
Total PCDD	Wood Preservation Using PCP	NR	Wastewater	1	Sheffield 1985
Total PCDD	Wood Preservation Using PCP	NR	Waste disposal	> 0.5	Sheffield 1985
Total PCDF	Total PCP Use	1983	Unspecified	800	Sheffield 1985
Total PCDF	Chlorophenol production	1981	Air emissions	0.6	Sheffield 1985
Total PCDF	Chlorophenol production	NR	Wastewater	0.013	Sheffield 1985
Total PCDF	PCB disposal	1982	Unspecified	< 75	Sheffield 1985
Total PCDF	Wood Preservation Using PCP	NR	Wastewater	0.6	Sheffield 1985
Total PCDF	Wood Preservation Using PCP	NR	Waste disposal	> 0.3	Sheffield 1985
	Combustion Sources				
Total PCDD	Municipal incineration	NR	Air emissions	0.25 - 13.7	Sheffield 1985
Total PCDD	Municipal incineration	NR	Fly ash disposal	2.9 - 7.1	Sheffield 1985
Total PCDD	Sewage sludge incineration	NR	Air emissions	1.4 - 3.3	Sheffield 1985
Total PCDD	Used railway tie burning	NR	Air emissions	6	Sheffield 1985
Total PCDD	Slash burning	1980	Air emissions	3.3	Sheffield 1985
Total PCDD	Fuelwood combustion	1980	Air emissions	1.8	Sheffield 1985
Total PCDD	Residential gas combustion	NR	Air emissions	0.9	Sheffield 1985

Table 9. Estimated annual natural and anthropogenic PCDD/F releases into the Canadian environment.

Congener	Source/Sector	Year	Release Pathway	Annual Releases (kg/y)	Reference
	Combustion Sources				
Total PCDD	Coal-fired utility boilers	NR	Air emissions	0.3	Sheffield 1985
Total PCDD	Coal-fired utility boilers	NR	Fly ash disposal	<0.3	Sheffield 1985
Total PCDD	Motor vehicle exhaust	NR	Air emissions	0.2	Sheffield 1985
Total PCDD	Cigarette smoke	NR	Air emissions	0.003	Sheffield 1985
Total PCDD	Residential oil combustion	NR	Air emissions	0.001	Sheffield 1985
Total PCDD	PCP-treated wood disposal	NR	Air emissions	0 - 30.2	Sheffield 1985
Total PCDF	Municipal incineration	NR	Air emissions	0.55 - 21.7	Sheffield 1985
Total PCDF	Municipal incineration	NR	Fly ash disposal	4.9 - 15.6	Sheffield 1985
Total PCDF	Sewage sludge incineration	NR	Air emissions	1.5 - 6.5	Sheffield 1985
Total PCDF	Coal-fired utility boilers	NR	Air emissions	0.7	Sheffield 1985
Total PCDF	Coal-fired utility boilers	NR	Fly ash disposal	0.03 - 1.3	Sheffield 1985
	Pulp and Paper Industry				
2,3,7,8-T4CDD	Pulp and paper mills	NR	Wastewater	0.1 - 0.15	Boddington et al. 1990
2,3,7,8-T_4CDF	Pulp and paper mills	NR	Wastewater	2.0 - 3.0	Boddington et al. 1990

Source/Sector: 2,4-D = (2,4-Dichlorophenoxy)acetic acid; 2,4,5-T = (2,4,5-Trichlorophenoxy)acetic acid; PCP = pentachlorophenol; PCB = Polychlorinated biphenyls

NR = not reported

Table 10. Atmospheric releases of PCDD/Fs into the Canadian environment by sector (g TEQ·y^{-1}).

Sector	TEQ 1990	TEQ 1997	TEQ 1999[a]	Reference
Municipal waste incineration	204	152	85.2	Environment Canada 1998a
Wood combustion (residential)	35.7	35.7	35.7	Environment Canada 1998a
Iron manufacturing: sintering plants	42.9	42.9	23.5	Environment Canada 1998a
Pulp and paper: burning salt laden wood	10.5	10.5	10.5	Environment Canada 1998a
Steel manufacturing: electric arc furnaces	9.1	10.2	10.2	Environment Canada 1998a
Fuel combustion diesel (traffic)	8.7	8.7	8.7	Environment Canada 1998a
Oil combustion (residential)	7	7	7	Environment Canada 1998a
Electric power generation	3.4	4.6	4.6	Environment Canada 1998a
Wood waste combustion (saw mills and pulp & paper mills)	4.4	4.4	4.4	Environment Canada 1998a
Cement kilns	2.8	2.8	2.8	Environment Canada 1998a
Hospital incinerators	8.3	2.5	2.5	Environment Canada 1998a
Chemical production (air releases)	2.2	2	0.3	Environment Canada 1998a
In-service utility poles	1.9	1.9	1.9	Environment Canada 1998a
Wood preserving plants	1.8	1.8	1.8	Environment Canada 1998a
Hazardous waste incinerators	2.1	1.3	0.8	Environment Canada 1998a
Pulp & paper kraft liqour boilers	0.7	0.7	0.7	Environment Canada 1998a
Federal incinerators	1.3	0.6	0.6	Environment Canada 1998a
Steel foundries EAF	0.4	0.5	0.5	Environment Canada 1998a
Sewage sludge incinerators	0.3	0.3	0.3	Environment Canada 1998a
Base metals smelting	0.1	0.1	0.1	Environment Canada 1998a
Secondary lead smelters	0.1	0.1	0.1	Environment Canada 1998a
Biomedical waste incineration	4.9	0	0	Environment Canada 1998a
Total	353	292	199	

[a]1999 projections

Table 11. Levels of T_4CDD and T_4CDF in contaminated beverage containers ($pg \cdot g^{-1}$).

Sample	Congener	
	T_4CDD	T_4CDF
Milk carton	5.8	51
Cream carton	ND	107
Orange juice carton	ND	18

Source: Safe 1991

Table 12. Bioconcentration factors (BCFs) of PCDD/Fs in freshwater organisms.

Congener	Species	Life Stage	Test Type	Congener Conc. (ng/L)	DOC (mg/L)	Exposure Period (d)	Dep. Period (d)	Lipid content (%)	Tissue analyzed	BCF	BCF_{lipid}	BCF at steady state?	Reference
PCDDs													
	Fish												
	Salmonidae												
2,3,7,8-T_4CDD	rainbow trout	0.38 g	F,M	0.038	NR	7	0	NR	WB	10 736	214 720[a]	no	Mehrle et al. 1988
	Oncorhynchus mykiss					14	0	NR	WB	20 131	402 620[a]	no	
						21	0	NR	WB	25 947	518 940[a]	no	
						28	0	NR	WB	25 789	515 780[a]	no	
		0.38 g	F,M	0.176	NR	7	0	NR	WB	9 551	191 000[a]	no	Mehrle et al. 1988
						14	0	NR	WB	15 966	319 320[a]	no	
						21	0	NR	WB	21 977	439 540[a]	no	
						28	0	NR	WB	25 670	513 400[a]	no	
		0.38 g	F,M	0.382	NR	7	0	NR	WB	9 005	180 100[a]	no	Mehrle et al. 1988
						14	0	NR	WB	16 282	325 640[a]	no	
						21	0	NR	WB	26 439	528 780[a]	no	
						28	0	NR	WB	28 644	572 880[a]	no	
		0.38 g	F,M	0.789	NR	7	0	NR	WB	8 558	171 200[a]	no	Mehrle et al. 1988
						14	0	NR	WB	14 790	295 800[a]	no	
						21	0	NR	WB	19 510	390 200[a]	no	
		0.38 g	F,M	0.038	NR	28	0	NR	WB	39 000	**780 000**[a]	est .at 90% ss	Mehrle et al. 1988
				0.176	NR	28	0	NR	WB	37 560	**751 200**[a]	est .at 90% ss	
				0.382	NR	28	0	NR	WB	86 000	**1 700 000**[a]	est .at 90% ss	
				0.789	NR	28	0	NR	WB	36 637	**732 740**[a]	est .at 90% ss	
		0.4-1.1 g	F,M	31.8	0.7	5	≤ 48 d	NR	WB	3 675	**73 500**[a]	yes	Servos et al. 1989
				36.6	4.1	10	≤ 48 d	NR	WB	3 315	**66 300**[a]	yes	
				39.7	1.1	10	≤ 48 d	NR	WB	3 348	**66 960**[a]	yes	
				39.9	0.6	5	≤ 48 d	NR	WB	5 017	**100 300**[a]	yes	
				41.1	8.6	10	≤ 48 d	NR	WB	2 565	**51 300**[a]	yes	
				41.7	3.3	10	≤ 48 d	NR	WB	3 493	**69 860**[a]	yes	
				41.9	1.7	10	≤ 48 d	NR	WB	3 255	**65 100**[a]	yes	
				50.7	2.5	10	≤ 48 d	NR	WB	2 545	**50 900**[a]	yes	
				106.0	1.4	4	≤ 48 d	NR	WB	3 025	**60 500**[a]	yes	
				167.2	2.3	4	≤ 48 d	NR	WB	3 025	**60 500**[a]	yes	
		35 g	S,M	320	NR	0.25	139	NR	WB	9 270	**116 000**[b]	yes	Branson et al. 1985
								NR	ML	4635		yes	
	Cyprinidae												
	fathead minnow	0.5 - 1.0 g	SR,M	0.87	NR	28	20	NR	WB	29 200[dw]		no	Adams et al. 1986
	Pimephales promelas									5 800	82 900[c]	no	
										7 900	**113 000**[c]	est .at 90% ss	

Table 12. Bioconcentration factors (BCFs) of PCDD/Fs in freshwater organisms.

Congener	Species	Life Stage	Test Type	Congener Conc. (ng/L)	DOC (mg/L)	Exposure Period (d)	Dep. Period (d)	Lipid content (%)	Tissue analyzed	BCF	BCF_{lipid}	BCF at steady state?	Reference
		1 g	F,M	0.049	NR	71	61	19[ww]	WB	97 000	**510 000**	yes	Cook et al. 1991
				0.067	NR	71	61	19[ww]	WB	159 000	**837 000**	yes	
	carp *Cyprinus carpio*	15 g	F,M	0.062	NR	71	61	9[ww]	WB	66 000	**733 000**	yes	Cook et al. 1991
	Poeciliidae												
	guppy *Poecilia reticulata*	0.70-0.112 g	RC/RN,M	0.08	NR	21	0	9.7[ww]	WB	NR	105 000	est .at ss	Loonen et al. 1994a
		0.67-0.101 g	RC/RN,M	0.08[e]	NR	21	0	8.0[ww]	WB	NR	174 000	no	Loonen et al. 1994b
				0.12[f]	NR	21	0	8.0[ww]	WB	NR	81 000	no	
	Oryziatidae												
	medaka *Oryzias latipes*	175 g	F,M	0.101	NR	12	175	10	WB	510 000	5 100 000	yes	Schmieder et al. 1995
	Aquatic Plants												
	Chlorophyta												
	green algae *Oedogonium cardiacum*	NA	RC,M	3.4	NR	1	0	NR	COM	6		no	Yockim et al. 1978
				2.9	NR	3	0	NR	COM	1 034		no	
				2.4	NR	7	0	NR	COM	2 083		yes	
				2.6	NR	15	0	NR	COM	654		yes	
				4.2	NR	32	0	NR	COM	1 000		yes	
		NA	RC,M	3.44	NR	1	0	NR	COM	380		no	Isensee 1978
				2.93	NR	3	0	NR	COM	1 000		no	
				2.42	NR	7	0	NR	COM	2 075		yes	
				2.58	NR	15	0	NR	COM	660		yes	
				4.15	NR	32	0	NR	COM	1 025		yes	
	Fish												
	Poeciliidae												
1,2,3,7,8-P_5CDD	guppy *Poecilia reticulata*	0.70-0.112 g	RC/RN,M	0.21	NR	21	0	9.7[ww]	WB	NR	331 000	est .at ss	Loonen et al. 1994a
		0.67-0.101 g	RC/RN,M	0.21[e]	NR	21	0	8.0[ww]	WB	NR	186 000	no	Loonen et al. 1994b
				0.29[f]	NR	21	0	8.0[ww]	WB	NR	95 500	no	
	Fish												
	Salmonidae												
1,2,3,4,7,8-H_6CDD	rainbow trout *Oncorhynchus mykiss*	0.4-1.1 g	F,M	13.9	0.3	10	≤ 48 d	NR	WB	2 387	47 740[a]	yes	Servos et al. 1989
				21.6	1.6	10	≤ 48 d	NR	WB	568	11 360[a]	yes	

Table 12. Bioconcentration factors (BCFs) of PCDD/Fs in freshwater organisms.

Congener	Species	Life Stage	Test Type	Congener Conc. (ng/L)	DOC (mg/L)	Exposure Period (d)	Dep. Period (d)	Lipid content (%)	Tissue analyzed	BCF	BCF_{lipid}	BCF at steady state?	Reference
		0.1-0.3 g	F,M	0.047	8.5-9.0	5	12	NR	WB	1 715	34 300[a]	yes	Muir et al. 1985b
				0.010	8.5-9.0	5	48	NR	WB	2 840	56 800[a]	yes	
		fry	F,M	10-47	9.6	4-5	24-28	NR	WB	5 424		yes	Muir et al. 1985c
	Cyprinidae												
	fathead minnow	1.0-2.5 g	F,M	0.018	8.5-9.0	5	24	NR	WB	2 630	13 800[d]	yes	Muir et al. 1985b
	Pimephales promelas			0.007	8.5-9.0	5	48	NR	WB	5 834	30 700[d]	yes	
		NR	F,M	7-18	9.6	4-5	24-28	NR	WB	10 076		yes	Muir et al. 1985c
	Poeciliidae												
	guppy	0.70-0.112 g	RC/RN,M	0.20	NR	21	0	9.7[ww]	WB	NR	138 000	est. at ss	Loonen et al. 1994a
	Poecilia reticulata												
		0.67-0.101 g	RC/RN,M	0.20[e]	NR	21	0	8.0[ww]	WB	NR	102 000	no	Loonen et al. 1994b
				0.18[f]	NR	21	0	8.0[ww]	WB	NR	44 700	no	
	Poeciliidae												
1,2,3,6,7,8-H_6CDD	guppy	0.70-0.112 g	RC/RN,M	0.23	NR	21	0	9.7[ww]	WB	NR	174 000	est. at ss	Loonen et al. 1994a
	Poecilia reticulata												
		0.67-0.101 g	RC/RN,M	0.23[e]	NR	21	0	8.0[ww]	WB	NR	87 100	no	Loonen et al. 1994b
				0.22[f]	NR	21	0	8.0[ww]	WB	NR	50 100	no	
	Poeciliidae												
1,2,3,7,8,9-H_6CDD	guppy	0.70-0.112 g	RC/RN,M	0.28	NR	21	0	9.7[ww]	WB	NR	95 500	est. at ss	Loonen et al. 1994a
	Poecilia reticulata												
		0.67-0.101 g	RC/RN,M	0.28[e]	NR	21	0	8.0[ww]	WB	NR	85 100	no	Loonen et al. 1994b
				0.48[f]	NR	21	0	8.0[ww]	WB	NR	21 900	no	
	Fish												
	Salmonidae												
1,2,3,4,6,7,8-H_7CDD	rainbow trout	0.4-1.1 g	F,M	14.3	2.6	10	≤ 48 d	NR	WB	28 027	560 540[a]	yes	Servos et al. 1989
	Oncorhynchus mykiss			15.2	0.2	10	≤ 48 d	NR	WB	6 594	131 900[a]	yes	
				23.5	1.2	10	≤ 48 d	NR	WB	31 789	635 780[a]	yes	
		0.1-0.3 g	F,M	0.055	8.5-9.0	5	24	NR	WB	1 059	21 180[a]	yes	Muir et al. 1985b
				0.011	8.5-9.0	5	24	NR	WB	1 790	35 800[a]	yes	
		fry	F,M	11-55	9.6	4-5	24-28	NR	WB	5 480		yes	Muir et al. 1985c
	Cyprinidae												
	fathead minnow	1.0-2.5 g	F,M	0.039	8.5-9.0	5	24	NR	WB	513	2 700[d]	yes	Muir et al. 1985b
	Pimephales promelas			0.008	8.5-9.0	5	48	NR	WB	515	2 710[d]	yes	

Table 12. Bioconcentration factors (BCFs) of PCDD/Fs in freshwater organisms.

Congener	Species	Life Stage	Test Type	Congener Conc. (ng/L)	DOC (mg/L)	Exposure Period (d)	Dep. Period (d)	Lipid content (%)	Tissue analyzed	BCF	BCF_{lipid}	BCF at steady state?	Reference
		NR	F,M	8-39	9.6	4-5	24-28	NR	WB	2 081		yes	Muir et al. 1985c
	Poeciliidae												
	guppy	0.70-0.112 g	RC/RN,M	1.31	NR	21	0	9.7[ww]	WB	NR	57 500	est. at ss	Loonen et al. 1994a
	Poecilia reticulata												
		0.67-0.101 g	RC/RN,M	1.31[e]	NR	21	0	8.0[ww]	WB	NR	47 900	no	Loonen et al. 1994b
				0.91[f]	NR	21	0	8.0[ww]	WB	NR	17 000	no	
	Fish												
	Salmonidae												
O_8CDD	rainbow trout	0.4-1.1 g	F,M	57.5	0.7	10	≤ 48 d	NR	WB	705	14 100[a]	yes	Servos et al. 1989
	Oncorhynchus mykiss			65.9	2.0	10	≤ 48 d	NR	WB	1 489	29 780[a]	yes	
				69.6	3.3	10	≤ 48 d	NR	WB	637	12 700[a]	yes	
		fry	F,M	20-245	9.6	4-5	24-28	NR	WB	8 500		yes	Muir et al. 1985c
	Cyprinidae												
	fathead minnow	NR	F,M	9	9.6	4-5	24-28	NR	WB	22 300		yes	Muir et al. 1985c
	Pimephales promelas												
	Poeciliidae												
	guppy	0.079 g	RC,M	640	NR	8,10	2,0	7.5[ww]	WB	708	9 330	yes	Gobas and Schrap 1990
	Poecilia reticulata												
		0.70-0.112 g	RC/RN,M	0.80	NR	21	0	9.7[ww]	WB	NR	24 000	est. at ss	Loonen et al. 1994a
		0.67-0.101 g	RC/RN,M	0.80[e]	NR	21	0	8.0[ww]	WB	NR	13 500	no	Loonen et al. 1994b
				0.76[f]	NR	21	0	8.0[ww]	WB	NR	2 400	no	
PCDFs													
	Fish												
	Salmonidae												
2,3,7,8-T_4CDF	rainbow trout	0.38 g	F,M	0.41	NR	7	0	NR	WB	3 976	79 520[a]	yes	Mehrle et al. 1988
	Oncorhynchus mykiss					14	0	NR	WB	4 390	87 800[a]	yes	
						21	0	NR	WB	2 561	51 220[a]	yes	
						28	0	NR	WB	6 049	120 980[a]	yes	
		0.38 g	F,M	3.93	NR	7	0	NR	WB	3 028	60 560[a]	yes	Mehrle et al. 1988
						14	0	NR	WB	2 366	47 320[a]	yes	
						21	0	NR	WB	2 730	54 600[a]	yes	
						28	0	NR	WB	2 455	49 100[a]	yes	
		0.38 g	F,M	0.41	NR	28	0	NR	WB	4 449	88 980[a]	est. at 90% ss	Mehrle et al. 1988

Table 12. Bioconcentration factors (BCFs) of PCDD/Fs in freshwater organisms.

Congener	Species		Life Stage	Test Type	Congener Conc. (ng/L)	DOC (mg/L)	Exposure Period (d)	Dep. Period (d)	Lipid content (%)	Tissue analyzed	BCF	BCF_{lipid}	BCF at steady state?	Reference
					3.93		28	0	NR	WB	2 640	52 800[a]	est .at 90% ss	
	Poeciliidae guppy	*Poecilia reticulata*	0.70-0.112 g	RC/RN,M	0.12	NR	21	0	9.7[ww]	WB	NR	21 400	est .at ss	Loonen et al. 1994a
			0.67-0.101 g	RC/RN,M	0.12[e]	NR	21	0	8.0[ww]	WB	NR	15 500	no	Loonen et al. 1994b
					0.19[f]	NR	21	0	8.0[ww]	WB	NR	13 200	no	
1,2,3,7,8-P_5CDF/ 1,2,3,4,8,-P_5CDF	**Fish** **Poeciliidae** guppy	*Poecilia reticulata*	0.70-0.112 g	RC/RN,M	0.14	NR	21	0	9.7[ww]	WB	NR	21 400	est .at ss	Loonen et al. 1994a
			0.67-0.101 g	RC/RN,M	0.14[e]	NR	21	0	8.0[ww]	WB	NR	38 900	no	Loonen et al. 1994b
					0.14[f]	NR	21	0	8.0[ww]	WB	NR	1 950	no	
2,3,4,7,8-P_5CDF	**Poeciliidae** guppy	*Poecilia reticulata*	0.70-0.112 g	RC/RN,M	0.16	NR	21	0	9.7[ww]	WB	NR	240 000	est .at ss	Loonen et al. 1994a
			0.67-0.101 g	RC/RN,M	0.16[e]	NR	21	0	8.0[ww]	WB	NR	138 000	no	Loonen et al. 1994b
					0.22[f]	NR	21	0	8.0[ww]	WB	NR	83 200	no	
1,2,3,4,7,8-H_6CDF/ 1,2,3,4,7,9-H_6CDF	**Fish** **Poeciliidae** guppy	*Poecilia reticulata*	0.70-0.112 g	RC/RN,M	0.21	NR	21	0	9.7[ww]	WB	NR	110 000	est .at ss	Loonen et al. 1994a
			0.67-0.101 g	RC/RN,M	0.21[e]	NR	21	0	8.0[ww]	WB	NR	81 300	no	Loonen et al. 1994b
					0.28[f]	NR	21	0	8.0[ww]	WB	NR	25 100	no	
1,2,3,6,7,8-H_6CDF	**Poeciliidae** guppy	*Poecilia reticulata*	0.70-0.112 g	RC/RN,M	0.22	NR	21	0	9.7[ww]	WB	NR	174 000	est .at ss	Loonen et al. 1994a
			0.67-0.101 g	RC/RN,M	0.22[e]	NR	21	0	8.0[ww]	WB	NR	89 100	no	Loonen et al. 1994b
					0.20[f]	NR	21	0	8.0[ww]	WB	NR	30 900	no	
2,3,4,6,7,8-H_6CDF	**Poeciliidae** guppy	*Poecilia reticulata*	0.70-0.112 g	RC/RN,M	0.19	NR	21	0	9.7[ww]	WB	NR	105 000	est .at ss	Loonen et al. 1994a
1,2,3,4,6,7,8-H_7CDF	**Fish** **Poeciliidae** guppy		0.70-0.112 g	RC/RN,M	0.68	NR	21	0	9.7[ww]	WB	NR	42 700	est .at ss	Loonen et al. 1994a

Table 12. Bioconcentration factors (BCFs) of PCDD/Fs in freshwater organisms.

Congener	Species	Life Stage	Test Type	Congener Conc. (ng/L)	DOC (mg/L)	Exposure Period (d)	Dep. Period (d)	Lipid content (%)	Tissue analyzed	BCF	BCF_{lipid}	BCF at steady state?	Reference
	Poecilia reticulata												
		0.67-0.101 g	RC/RN,M	0.68[e]	NR	21	0	8.0[ww]	WB	NR	28 800	no	Loonen et al. 1994b
				0.66[f]	NR	21	0	8.0[ww]	WB	NR	12 000	no	
	Fish												
O_8CDF	**Poeciliidae**												
	guppy	0.079 g	RC,M	960	NR	8,10	2,0	7.5[ww]	WB	589	7 760	yes	Gobas and Schrap 1990
	Poecilia reticulata												
		0.70-0.112 g	RC/RN,M	0.09	NR	21	0	9.7[ww]	WB	NR	12 900	est .at ss	Loonen et al. 1994a

Test type: F - flow-through, RC - re-circulating, RN - renewal, M - measured water concentration
DOC = dissolved organic carbon
Dep. = Depuration
Tissue analyzed: WB - whole-body, ML - muscle, COM - composite of many cells
BCF: ww - wet weight, dw - dry weight
BCF_{lipid}: BCF on a lipid adjusted basis; values in bold font were used to calculate the geometric mean BCF_{lipid}
BCF at steady state?: est. - estimated, ss - steady state
NR = not reported.

[a] BCF_{lipid} was calculated using estimated lipid fraction (0.05 g lipid/g wet weight) cited in Schmieder et al. 1995
[b] BCF_{lipid} was calculated using estimated lipid fraction (0.08 g lipid/g wet weight) cited in Muir et al. 1992
[c] BCF_{lipid} was calculated using estimated lipid fraction (0.07 g lipid/g wet weight) cited in Schmieder et al. 1995
[d] BCF_{lipid} was calculated using lipid fraction (0.19 g lipid/g wet weight) cited in Cook et al. 1991
[e] water concentration based on contamination from generator column (Chromosorb) spiked with fly-ash
[f] water concentration based on contamination from generator column (sediment) spiked with fly-ash

Table 13. Biota-sediment accumulation factors (BSAFs) of PCDD/Fs in freshwater and marine/estuarine organisms.

Congener	Species	Test type/location	Tissue analyzed	BSAF	Reference
<u>Derived from laboratory/mesocosm studies</u>					
Freshwater					
PCDDs					
2,3,7,8-T_4CDD	lake trout	sediment and smelt (food source) in flow through aquaria	WB	**0.03**	Batterman et al. 1989
	lake trout	sediment and smelt (food source) in flow through aquaria	WB WB	**0.07** **0.11**	Cook 1990
	carp	sediment in static aquaria	WB-LBHTF (minus liver, bowels, head, tail)	**0.85**	van der Weiden et al. 1989a
	carp	sediment in flow through aquaria	WB-GV	**0.27**	Kuehl et al. 1987b
	guppies	sediment in generator column for recirculating sytem	WB	0.155	Loonen et al. 1994b
1,2,3,7,8-P_5CDD	guppies	sediment in generator column for recirculating sytem	WB	0.080	Loonen et al. 1994b
	carp	sediment in flow through aquaria	WB-GV	0.060	Kuehl et al. 1987b
1,2,3,4,7,8-H_6CDD	guppies	sediment in generator column for recirculating sytem	WB	0.024	Loonen et al. 1994b
1,2,3,6,7,8-H_6CDD	guppies	sediment in generator column for recirculating sytem	WB	0.024	Loonen et al. 1994b
1,2,3,4,7,8-H_6CDD/ 1,2,3,6,7,8-H_6CDD	carp	sediment in flow through aquaria	WB-GV	0.035	Kuehl et al. 1987b

Table 13. Biota-sediment accumulation factors (BSAFs) of PCDD/Fs in freshwater and marine/estuarine organisms.

Congener	Species	Test type/location	Tissue analyzed	BSAF	Reference
1,2,3,7,8,9-H_6CDD	guppies	sediment in generator column for recirculating sytem	WB	0.008	Loonen et al. 1994b
1,2,3,4,6,7,8-H_7CDD	mussels	sediment in lake mesocosms	WB	0.07	Segstro et al. 1995
			WB	0.03	
	crayfish	sediment in lake mesocosms	WB	0.03	Segstro et al. 1995
			WB	0.04	
	guppies	sediment in generator column for recirculating sytem	WB	0.014	Loonen et al. 1994b
	carp	sediment in flow through aquaria	WB-GV	0.0048	Kuehl et al. 1987b
OCDD	mussels	sediment in lake mesocosms	WB	4.73	Muir et al. 1992b
			WB	0.93	
			WB	0.15	
		sediment in lake mesocosms	WB	0.10	Segstro et al. 1995
			WB	0.05	
	crayfish	sediment in lake mesocosms	WB	0.10	Muir et al. 1992b
		sediment in lake mesocosms	WB	0.07	Segstro et al. 1995
			WB	0.09	
	white suckers	sediment in lake mesocosms	WB-GV(carcass)	1.20	Muir et al. 1992b
				0.52	
				0.49	
	guppies	sediment in generator column for recirculating sytem	WB	0.003	Loonen et al. 1994b

Table 13. Biota-sediment accumulation factors (BSAFs) of PCDD/Fs in freshwater and marine/estuarine organisms.

Congener	Species	Test type/location	Tissue analyzed	BSAF	Reference
PCDFs					
2,3,7,8-T_4CDF	mussels	sediment in lake mesocosms	WB	4.7	Muir et al. 1992b
		sediment in lake mesocosms	WB	0.36	
		sediment in lake mesocosms	WB	18.6	Fairchild et al. 1992
	crayfish	sediment in lake mesocosms	WB	2.0	Muir et al. 1992b
			WB	0.18	
		sediment in lake mesocosms	WB	24.60	Fairchid et al. 1992
	Hexagenia nymphs	sediment in lake mesocosms	WB	0.25	Muir et al. 1992b
			WB	0.17	
	Mayfly nymphs	sediment in lake mesocosms	WB	0.31	Fairchid et al. 1992
	chironomids	sediment in lake mesocosms	WB	1.59	Muir et al. 1992b
		sediment in lake mesocosms	WB	1.08	Fairchid et al. 1992
	odonate	sediment in lake mesocosms	WB	1.62	Fairchid et al. 1992
	guppies	sediment in generator column for recirculating sytem	WB	0.014	Loonen et al. 1994b
	carp	sediment in flow through aquaria	WB-GV	0.06	Kuehl et al. 1987b
1,2,3,7,8-P_5CDF	guppies	sediment in generator column for recirculating sytem	WB	0.002	Loonen et al. 1994b
2,3,4,7,8-P_5CDF	guppies	sediment in generator column for recirculating sytem	WB	0.088	Loonen et al. 1994b
	carp	sediment in flow through aquaria	WB-GV	0.28	Kuehl et al. 1987b

Table 13. Biota-sediment accumulation factors (BSAFs) of PCDD/Fs in freshwater and marine/estuarine organisms.

Congener	Species	Test type/location	Tissue analyzed	BSAF	Reference
1,2,3,4,7,8-H_6CDF	guppies	sediment in generator column for recirculating sytem	WB	0.031	Loonen et al. 1994b
1,2,3,6,7,8-H_6CDF	guppies	sediment in generator column for recirculating sytem	WB	0.021	Loonen et al. 1994b
	carp	sediment in flow through aquaria	WB-GV	0.037	Kuehl et al. 1987b
1,2,3,4,6,7,8-H_7CDF	guppies	sediment in generator column for recirculating sytem	WB	0.016	Loonen et al. 1994b
	carp	sediment in flow through aquaria	WB-GV	0.0033	Kuehl et al. 1987b
Estuarine/Marine					
PCDDs					
2,3,7,8-T_4CDD	sandworm, *Nereis virens*	sediment in flow through aquaria	WB	**0.48**	Rubinstein et al. 1990
		sediment in flow through aquaria	WB	**0.14**	Schrock et al. 1997
	clam	sediment in flow through aquaria	WB	**0.93**	Rubinstein et al. 1990
	shrimp	sediment in flow through aquaria	WB	**0.73**	Rubinstein et al. 1990
PCDFs					
2,3,7,8-T_4CDF	sandworm, *Nereis virens*	sediment in flow through aquaria	WB	0.20	Schrock et al. 1997

Derived from field monitoring studies:

Congener	Species	Test type/location	Tissue analyzed	BSAF	Reference
Freshwater					
PCDDs					
2,3,7,8-T_4CDD	lake trout	Lake Ontario (off Grimsby, ON)	WB	2.9[a]	Niimi 1996

Table 13. Biota-sediment accumulation factors (BSAFs) of PCDD/Fs in freshwater and marine/estuarine organisms.

Congener	Species	Test type/location	Tissue analyzed	BSAF	Reference
	lake trout	Lake Ontario (lakewide)	WB	**0.07**	Carey et al. 1990
	brown trout	Lake Ontario (lakewide)	WB	**0.03**	Carey et al. 1990
	smallmouth bass	Lake Ontario (lakewide)	WB	**0.05**	Carey et al. 1990
	white perch	Lake Ontario (lakewide)	WB	**0.21**	Carey et al. 1990
	yellow perch	Lake Ontario (lakewide)	WB	**0.03**	Carey et al. 1990
	largescale/bridgelip suckers	Fraser R., Prince George, BC	M	**0.37**[DL]	Mah et al. 1989
		Fraser R., Quesnel, BC	M	**0.16**[DL]	
		Fraser R., Kamloops, BC	M	**0.33**[DL]	
		Kootenay R., Cranbrook, BC	M	**0.96**[DL]	
		Columbia R., Castlegar, BC	M	**0.32**[DL]	
	longnose suckers	Athabasca R., Hinton, AB	M+WB	**0.52**[DL]	Muir et al. 1992b
	white suckers	Wapiti R., Grand Prairie, AB	M+WB	**0.74**[DL]	Muir et al. 1992b
		Saskatchewan R., Prince Albert, SA	WB	**0.20**[DL]	
		Kaministikwia R., Thunder Bay, ON	M	**0.16**[DL]	
		Spanish R., Espanola, ON	M	**0.14**[DL]	
		Bell R., Quevillon, PQ		**0.24**[DL]	
		Ottawa R., PortageduFort, PQ	M+WB	**0.72**[DL]	
		St. Maurice R., LaTuque, PQ	WB	**0.36**[DL]	
		St. Francois R., Windsor, PQ	WB	**0.67**[DL]	
		Ottawa R., Thurso, PQ	WB	**0.45**[DL]	
		Mistassini R., St. Felicien, PQ		**0.95**[DL]	
		St. John R., Nackawic, NB	M+WB	**0.79**[DL]	
		Mirimachi R., Newcastle, NB	M+WB	**0.20**[DL]	
	mountain whitefish	Fraser R., Prince George, BC	M	**0.98**[DL]	Mah et al. 1989
		Fraser R., Quesnel, BC	M	**1.37**[DL]	
		Fraser R., Kamloops, BC	M	**1.53**[DL]	
		Kootenay R., Cranbrook, BC	M	**0.37**[DL]	

Table 13. Biota-sediment accumulation factors (BSAFs) of PCDD/Fs in freshwater and marine/estuarine organisms.

Congener	Species	Test type/location	Tissue analyzed	BSAF	Reference
		Columbia R., Castlegar, BC	M	**0.28**[DL]	
		Athabasca R., Hinton, AB	M+WB	**1.88**[DL]	Muir et al. 1992b
		Wapiti R., Grand Prairie, AB	M	**0.74**[DL]	
	lake whitefish	Wabigoon R./Clay L., Dryden, ON	M	**0.94**[DL]	Muir et al. 1992b
	eel	Volgermeerpolder, Amsterdam, The Netherlands	L	0.22	van der Oost et al. 1996
1,2,3,7,8-P_5CDD	lake trout	Lake Ontario (off Grimsby, ON)	WB	0.9	Niimi 1996
	eel	Volgermeerpolder, Amsterdam, The Netherlands	L	0.001	van der Oost et al. 1996
1,2,3,4,7,8-H_6CDD	lake trout	Lake Ontario (off Grimsby, ON)	WB	<1	Niimi 1996
1,2,3,6,7,8-H_6CDD	lake trout	Lake Ontario (off Grimsby, ON)	WB	0.3	Niimi 1996
1,2,3,4,7,8-H_6CDD/ 1,2,3,6,7,8-H_6CDD	eel	Volgermeerpolder, Amsterdam, The Netherlands	L	0.02	van der Oost et al. 1996
1,2,3,7,8,9-H_6CDD	lake trout	Lake Ontario (off Grimsby, ON)	WB	<1	Niimi 1996
	eel	Volgermeerpolder, Amsterdam, The Netherlands	L	0.001	van der Oost et al. 1996
1,2,3,4,6,7,8-H_7CDD	lake trout	Lake Ontario (off Grimsby, ON)	WB	<1	Niimi 1996
	eel	Volgermeerpolder, Amsterdam, The Netherlands	L	0.00007	van der Oost et al. 1996

Table 13. Biota-sediment accumulation factors (BSAFs) of PCDD/Fs in freshwater and marine/estuarine organisms.

Congener	Species	Test type/location	Tissue analyzed	BSAF	Reference
OCDD	lake trout	Lake Ontario (off Grimsby, ON)	WB	0.002	Niimi 1996
	eel	Volgermeerpolder, Amsterdam, The Netherlands	L	0.00003	van der Oost et al. 1996
PCDFs					
2,3,7,8-T_4CDF	lake trout	Lake Ontario (off Grimsby, ON)	WB	0.8	Niimi 1996
	eel	Volgermeerpolder, Amsterdam, The Netherlands	L	0.01	van der Oost et al. 1996
1,2,3,7,8-P_5CDF	lake trout	Lake Ontario (off Grimsby, ON)	WB	0.6	Niimi 1996
	eel	Volgermeerpolder, Amsterdam, The Netherlands	L	0.0003	van der Oost et al. 1996
2,3,4,7,8-P_5CDF	lake trout	Lake Ontario (off Grimsby, ON)	WB	1.7	Niimi 1996
	eel	Volgermeerpolder, Amsterdam, The Netherlands	L	0.02	van der Oost et al. 1996
1,2,3,4,7,8-H_6CDF	lake trout	Lake Ontario (off Grimsby, ON)	WB	0.2	Niimi 1996
	eel	Volgermeerpolder, Amsterdam, The Netherlands	L	0.01	van der Oost et al. 1996
1,2,3,6,7,8-H_6CDF	lake trout	Lake Ontario (off Grimsby, ON)	WB	<0.3	Niimi 1996
	eel	Volgermeerpolder, Amsterdam, The Netherlands	L	0.009	van der Oost et al. 1996
2,3,4,6,7,8-H_6CDF	lake trout	Lake Ontario (off Grimsby, ON)	WB	<0.1	Niimi 1996

Table 13. Biota-sediment accumulation factors (BSAFs) of PCDD/Fs in freshwater and marine/estuarine organisms.

Congener	Species	Test type/location	Tissue analyzed	BSAF	Reference
	eel	Volgermeerpolder, Amsterdam, The Netherlands	L	0.01	van der Oost et al. 1996
1,2,3,7,8,9-H_6CDD	lake trout	Lake Ontario (off Grimsby, ON)	WB	<0.1	Niimi 1996
	eel	Volgermeerpolder, Amsterdam, The Netherlands	L	0.09	van der Oost et al. 1996
1,2,3,4,6,7,8-H_7CDF	eel	Volgermeerpolder, Amsterdam, The Netherlands	L	0.004	van der Oost et al. 1996
1,2,3,4,7,8,9-H_7CDF	eel	Volgermeerpolder, Amsterdam, The Netherlands	L	0.003	van der Oost et al. 1996
OCDF	lake trout	Lake Ontario (off Grimsby, ON)	WB	~0.08	Niimi 1996
	eel	Volgermeerpolder, Amsterdam, The Netherlands	L	0.001	van der Oost et al. 1996
Estuarine/Marine					
PCDDs					
2,3,7,8-T_4CDD	Dungeness crab	Strait of Georgia, BC	M	**0.03**	Harding and Pomeroy 1990 (as reported in Muir et al. 1992a)
	blue crab	Rice Cr., northeastern Florida	hepatopancreas	**0.089**	Schell, Jr. et al 1993
	largemouth bass	Rice Cr., northeastern Florida	L	**0.038**	Schell, Jr. et al 1993
			L	**0.100**	
			ovary	**0.096**	
	bowfin	Rice Cr., northeastern Florida	L	**0.180**	Schell, Jr. et al 1993

Table 13. Biota-sediment accumulation factors (BSAFs) of PCDD/Fs in freshwater and marine/estuarine organisms.

Congener	Species	Test type/location	Tissue analyzed	BSAF	Reference
			L	**0.255**	
			ovary	**0.281**	
	catfish	Rice Cr., northeastern Florida	L	**0.043**	Schell, Jr. et al 1993
			L	**0.074**	
			L	**0.073**	

BSAF: freshwater and marine values in bold font were used to calculate geometric mean BSAFs for freshwater or marine environments, respectively

Tissue analyzed: WB - whole-body, WB-GV - whole body minus gills and viscera, L - liver, M+WB - combined muscle and whole body data

[a]organic content of sediments not report and value therefore was not included in geometric mean calculation

[DL] sediment concentrations of congener were non-detectable or near detection limit so BSAF calculated assuming concentrations in sediment at the detection limit

Table 14. Levels of T_4CDD, T_4CDF, and TEQ in marine mammals in Canada.

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ ($ng \cdot kg^{-1}$) (ww)	TEF Source	Reference
Pacific Coast										
Saanich Penn., Vancouver Is.	1988	Dall's Porpoise	Immature	fat	1	<2	16	NR		Jarman et al. 1996
Sooke, Vancouver Is.	1987	Dall's Porpoise	Immature	fat	1	2	21	NR		Jarman et al. 1996
White Rock, BC	1988	Dall's Porpoise	Mature	fat	1	4	69	NR		Jarman et al. 1996
Denman Island, BC	1987	False Killer Whale	Mature	fat	1	8	109	NR		Jarman et al. 1996
Vargas Island, Vancouver Is.	1989	False Killer Whale	Mature (old)	fat	1	<2	2	NR		Jarman et al. 1996
Denman Island, BC	1988	Grey Whale	Calf	fat	1	<2	3	NR		Jarman et al. 1996
Long Beach, Vancouver Is.	1987	Grey Whale	Calf	fat	1	<2	<2	NR		Jarman et al. 1996
Cambell River, Vancouver Is.	1987	Harbour porpoise	Mature	fat	1	2	43	NR		Jarman et al. 1996
Gabriola Island, BC	NR	Harbour porpoise	calf	fat	1	ND	ND	4.4	NR	Burlinson 1991
Gabriola Island, BC	NR	Harbour porpoise	ADT, F	fat	1	ND	4.4	6	NR	Burlinson 1991
Gabriola Island, BC	1987	Harbour porpoise	Calf	fat	1	<2	11	NR		Jarman et al. 1996
Long Beach, Vancouver Is.	1987	Harbour porpoise	Juvenile	fat	1	<2	4	NR		Jarman et al. 1996
Qualicum Beach, Vancouver Is.	NR	Harbour porpoise	ADT, M	fat	1	ND	45	8.2	NR	Burlinson 1991
Qualicum Beach, Vancouver Is.	NR	Harbour porpoise	ADT, F	fat	1	3.3	44	22.2	NR	Burlinson 1991
Qualicum Beach, Vancouver Is.	1989	Harbour porpoise	Mature	fat	1	4	38	NR		Jarman et al. 1996
Sandspit, Moresby Island	1987	Harbour porpoise	Juvenile	fat	1	<2	2	NR		Jarman et al. 1996
Tsawassen, BC	NR	Harbour porpoise	ADT, M	fat	1	ND	19	3.6	NR	Burlinson 1991
Tsawwassen, BC	1987	Harbour porpoise	Juvenile	fat	1	5	31	NR		Jarman et al. 1996
Victoria, BC	NR	Harbour porpoise	ADT, M	fat	1	ND	5.2	1.1	NR	Burlinson 1991
Victoria, Vancouver Is.	1988	Harbour porpoise	Juvenile	fat	1	1	11	NR		Jarman et al. 1996
Quatsino Sd. - Coal Harbour	1991	Harbour seal	F, 8 y	fat	1	0.95	8.38	3.81	WHO 1998	Addison et al. 1996
Quatsino Sd. - Coal Harbour	1992	Harbour seal	F, 9 y	fat	1	NDR (0.86)	3.74	2.08	WHO 1998	Addison et al. 1996
Quatsino Sd. - Coal Harbour	1992	Harbour seal	F, 18 y	fat	1	1	9.85	4.12	WHO 1998	Addison et al. 1996
Quatsino Sd. - Coal Harbour	1992	Harbour seal	M, 2 y	fat	1	NDR (1.45)	7.4	6.35	WHO 1998	Addison et al. 1996
Quatsino Sd. - Coal Harbour	1991	Harbour seal	M, 3 y	fat	1	1.05	6.5	3.84	WHO 1998	Addison et al. 1996
Quatsino Sd. - Coal Harbour	1992	Harbour seal	M, 3 y	fat	1	0.88	7.13	3.43	WHO 1998	Addison et al. 1996
Quatsino Sd. - Coal Harbour	1992	Harbour seal	M, 5 y	fat	1	NDR (1.68)	24.39	11.21	WHO 1998	Addison et al. 1996
Quatsino Sd. - Coal Harbour	1992	Harbour seal	M, 6 y	fat	1	1.38	10.8	4.26	WHO 1998	Addison et al. 1996
Quatsino Sd. - Coal Harbour	1991	Harbour seal	M, 10 y	fat	1	NDR (0.56)	2.68	1.70	WHO 1998	Addison et al. 1996

Table 14. Levels of T_4CDD, T_4CDF, and TEQ in marine mammals in Canada.

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng\cdot kg^{-1}$) (ww)	T_4CDF ($ng\cdot kg^{-1}$) (ww)	TEQ ($ng\cdot kg^{-1}$) (ww)	TEF Source	Reference
Quatsino Sd. - Coal Harbour	1992	Harbour seal	M, 10 y	fat	1	1.78	7.23	6.56	WHO 1998	Addison et al. 1996
Strait of Georgia - Crofton	1992	Harbour seal	F, 3 y	fat	1	4.4	35.23	24.42	WHO 1998	Addison et al. 1996
Strait of Georgia - Crofton	1992	Harbour seal	F, 3 y	fat	1	4.68	35.98	26.05	WHO 1998	Addison et al. 1996
Strait of Georgia - Danger River	1992	Harbour seal	F, 0 y	fat	1	5.55	46.79	21.80	WHO 1998	Addison et al. 1996
Strait of Georgia - Danger River	NR	Harbour seal	F, 5 y	fat	1	3.41	42.42	14.80	WHO 1998	Addison et al. 1996
Strait of Georgia - Danger River	1992	Harbour seal	M, 8 y	fat	1	7.3	56.19	25.18	WHO 1998	Addison et al. 1996
Strait of Georgia - Escape Reef	1992	Harbour seal	M, 11 y	fat	1	6.87	50.12	22.86	WHO 1998	Addison et al. 1996
Strait of Georgia - Miami Island	NR	Harbour seal	F, 4 y	fat	1	334	52.49	20.27	WHO 1998	Addison et al. 1996
Strait of Georgia - Miami Island	1992	Harbour seal	F, 11 y	fat	1	3.62	70.21	24.05	WHO 1998	Addison et al. 1996
Strait of Georgia - Miami Island	1992	Harbour seal	M, 4 y	fat	1	3.67	41.7	20.97	WHO 1998	Addison et al. 1996
Strait of Georgia - N Stuart Chan	1992	Harbour seal	F, 1 y	fat	1	6.19	68.2	36.04	WHO 1998	Addison et al. 1996
Strait of Georgia - N Stuart Chan	1992	Harbour seal	F, 2 y	fat	1	4.06	58.05	22.82	WHO 1998	Addison et al. 1996
Strait of Georgia - Nanaimo	1992	Harbour seal	F, 0 y	fat	1	3.39	24.75	18.56	WHO 1998	Addison et al. 1996
Strait of Georgia - North Reef	1992	Harbour seal	M, 4 y	fat	1	5.74	61.76	34.96	WHO 1998	Addison et al. 1996
Strait of Georgia - North Reef	1992	Harbour seal	M, 4 y	fat	1	5.81	59.52	32.96	WHO 1998	Addison et al. 1996
Strait of Georgia - Snake Island	1992	Harbour seal	F, 0 y	fat	1	2.55	12.39	12.13	WHO 1998	Addison et al. 1996
Strait of Georgia - Snake Island	1992	Harbour seal	F, 0 y	fat	1	3.39	60.12	20.25	WHO 1998	Addison et al. 1996
Strait of Georgia - Snake Island	1992	Harbour seal	F, 0 y	fat	1	3.41	66.29	22.58	WHO 1998	Addison et al. 1996
Strait of Georgia - Snake Island	1992	Harbour seal	F, 1 y	fat	1	3.82	63.32	21.21	WHO 1998	Addison et al. 1996
Strait of Georgia - Thetis Island	1992	Harbour seal	M, 16 y	fat	1	5.73	54.55	35.91	WHO 1998	Addison et al. 1996
Johnstone Strait	NR	Killer whale	56 y, F	fat	1	2.3	68	19.7	NR	Burlinson 1991
Namu, BC	1989	Killer Whale	8 yrs	fat	1	<2	6	NR		Jarman et al. 1996
Port Renfrew, Vancouver Is.	NR	Killer Whale	Mature	fat	1	<2	23	NR		Jarman et al. 1996
Radar Beach, Vancouver Is.	1989	Killer Whale	17 yrs	fat	1	<2	13	NR		Jarman et al. 1996
Tsawwassen, BC	1986	Killer Whale	Neonate	fat	1	<2	39	NR		Jarman et al. 1996
Ucluelet, Vancouver Is.	1987	Killer Whale	Calf	fat	1	<2	13	NR		Jarman et al. 1996
Queen Charlotte Island, BC	1988	Risso's dolphin	Mature	fat	1	<2	4	NR		Jarman et al. 1996
Atlantic Coast										
St. Lawrence estuary	NR	Beluga	M	oil	11	< 2	2	NR		Muir & Norstrom 1990

Table 14. Levels of T_4CDD, T_4CDF, and TEQ in marine mammals in Canada.

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ ($ng \cdot kg^{-1}$) (ww)	TEF Source	Reference
Newfoundland - south coast	NR	Pilot whale	M	fat	5	ND	ND	NR		Muir & Norstrom 1990
Gulf of St. Lawrence	NR	White-beaked dolphin	M	fat	9	ND	ND	NR		Muir & Norstrom 1990
Arctic Coast										
Beaufort Sea	1983	Beluga	M + F	blubber	5	<2	<2	NR		Norstrom et al. 1990
Cumberland Sound	NR	Beluga	M	fat	6	<2	< 2	NR		Muir & Norstrom 1990
Cumberland Sound	1983	Beluga	M + F	blubber	8	<2	<2	NR		Norstrom et al. 1990
Jones Sound	NR	Beluga	M	fat	8	ND	ND	NR		Muir & Norstrom 1990
West Hudson Bay	1984	Beluga	M + F	blubber	19	<2	3	NR		Norstrom et al. 1990
Baffin Bay	NR	Narwhal	M	fat	16	ND	ND	NR		Muir & Norstrom 1990
Amundsen Gulf	1982	Polar bear	M + F	liver	4	2.5	<2	NR		Norstrom et al. 1990
Barrow Strait	1982	Polar bear	M + F	liver	20	20.5	<2	NR		Norstrom et al. 1990
Beaufort Sea	1982	Polar bear	M + F	liver	5	2	<2	NR		Norstrom et al. 1990
Cornwallis Island	NR	Polar bear	M/F	liver	18	20	< 2	NR		Muir & Norstrom 1990
Cumberland Sound	1984	Polar bear	M + F	fat	10	<2	<2	NR		Norstrom et al. 1990
Hadley Bay	1982	Polar bear	M	liver	6	4	<2	NR		Norstrom et al. 1990
Larsen Strait	1982	Polar bear	M + F	fat	10	23	<2	NR		Norstrom et al. 1990
M'Clure Strait	1982	Polar bear	M + F	fat	8	18	<4	NR		Norstrom et al. 1990
North Baffin Island	NR	Polar bear	M/F	fat	10	4	< 2	NR		Muir & Norstrom 1990
North Hudson Bay	1983	Polar bear	M + F	fat	10	2	<2	NR		Norstrom et al. 1990
Pond Inlet	1984	Polar bear	M + F	liver	10	4	<2	NR		Norstrom et al. 1990
South Baffin Island	NR	Polar bear	M/F	fat	20	5	< 2	NR		Muir & Norstrom 1990
West Baffin Bay	1984	Polar bear	M + F	fat	10	5	<2	NR		Norstrom et al. 1990
West Davis Strait	NR	Polar bear	M/F	fat	10	3	< 2	NR		Muir & Norstrom 1990
West Davis Strait	1984	Polar bear	M + F	fat	10	3	<2	NR		Norstrom et al. 1990
West Hudson Bay	NR	Polar bear	M/F	fat	9	2	< 2	NR		Muir & Norstrom 1990
West Hudson Bay		Polar bear	M + F	fat	10	2	<2	NR		Norstrom et al. 1990
Admiralty Inlet	1983	Ringed seal	M	fat	11	35	5	NR		Norstrom et al. 1990
Barrow Strait	NR	Ringed seal	M	fat	16	37	4	NR		Muir & Norstrom 1990
Barrow Strait	1984	Ringed seal	F	fat	7	33[a]	4.5[a]	NR		Norstrom et al. 1990

Table 14. Levels of T_4CDD, T_4CDF, and TEQ in marine mammals in Canada.

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ ($ng \cdot kg^{-1}$) (ww)	TEF Source	Reference
Beaufort Sea	1985-86	Ringed seal	M + F	fat	4	4	2	NR		Norstrom et al. 1990
Cumberland Sound	NR	Ringed seal	M	fat	10	8	4	NR		Muir & Norstrom 1990
Cumberland Sound	1985-86	Ringed seal	M	fat	4	8	4	NR		Norstrom et al. 1990
North Hudson Bay	1985-86	Ringed seal	M	fat	4	3	7	NR		Norstrom et al. 1990
Queen Maude Sound	1985-86	Ringed seal	M	fat	4	12	4	NR		Norstrom et al. 1990
Spence Bay	1985-86	Ringed seal	M	fat	4	15	3	NR		Norstrom et al. 1990
West Davis Strait	NR	Ringed seal	M	fat	8	11	3	NR		Muir & Norstrom 1990
West Davis Strait	1985-86	Ringed seal	M	fat	3	11	3	NR		Norstrom et al. 1990
West Hudson Bay	1985-86	Ringed seal	M	fat	4	2	4	NR		Norstrom et al. 1990
Eastern Hudson Bay (Akulivik)	NR	Walrus	M + F	fat	7	7.3	<0.9	12.98	Safe 1990	Muir et al. 1995
Eastern Hudson Bay (Inukjuak)	NR	Walrus	F	fat	7	2.3	0.7	3.82	Safe 1990	Muir et al. 1995
North Sea										
North Sea	NR	Harbour porpoise	F, > 1 yr	fat	1	<0.5	4.7	1.8	WHO 1998	Beck et al. 1990
North Sea	NR	Harbour seal	F, ~ 1 yr	fat	1	3.9	5.2	12.1	WHO 1998	Beck et al. 1990
North Sea	NR	Harbour seal	M, ~ 1 yr	fat	1	2.6	5	10.3	WHO 1998	Beck et al. 1990
North Sea	NR	Harbour seal	M, ~ 1 yr	fat	1	3.6	6.7	12.3	WHO 1998	Beck et al. 1990
North Sea	NR	Harbour seal	M, ~ 1 yr	fat	1	3.7	4.5	9.6	WHO 1998	Beck et al. 1990
North Sea	NR	Harbour seal	F, > 1 yr	fat	1	2.7	10.5	8.1	WHO 1998	Beck et al. 1990

NDR values used half of detection limit
FHO - Federal Health Office
oil - PCDD/PCDF results based on mean of 10 oil samples (M + F) assuming undetectable levels are one-half of the detection limit
ND - not detected
NR - not reported
[a]mean of duplicate analysis

Table 15. Levels of PCDD/F in ambient air in Canada ($pg \cdot m^{-3}$).

Location	Date	Sample Type	T_4CDD	T_4CDF	Reference
Alberta					
Edmonton	1994-1997	total	0.07	0.03	Dann 1998
Edmonton	1994-1997	total	0.01	0.007	Dann 1998
Fort McMurray	1994-1997	total	0.01	0.01	Dann 1998
Fort Saskatchewan	1994-1997	total	0.05	0.02	Dann 1998
British Columbia					
Chilliwack	1994-1997	total	0.03	0.003	Dann 1998
Powell River	1994-1997	total	0.05	0.01	Dann 1998
Trail	1994-1997	total	0.07	0.007	Dann 1998
Vancouver	1994-1997	total	0.02	0.01	Dann 1998
Vancouver	1994-1997	total	0.02	0.006	Dann 1998
Vancouver	1994-1997	total	0.04	0.02	Dann 1998
Vancouver	1994-1997	total	0.06	0.001	Dann 1998
Victoria	1994-1997	total	0.05	0.007	Dann 1998
Manitoba					
Winnipeg	1994-1997	total	0.04	0.01	Dann 1998
Winnipeg	1994-1997	total	0.03	0.003	Dann 1998
New Brunswick					
Kejimkujik National Park	1994-1997	total	0.005	0.005	Dann 1998
St. Andrews	1994-1997	total	0.007	0.005	Dann 1998
St. John	1994-1997	total	0.02	0.007	Dann 1998
Northwest Territories					
Whitehorse	1994-1997	total	0.09	0.009	Dann 1998
Nova Scotia					
Halifax	1994-1997	total	0.13	0.02	Dann 1998
Ontario					
Dorset	88/09/14	total	0.2	0.2	Steer et al. 1990
Dorset	88/10/12	total	0.1	0.02	Steer et al. 1990
Dorset	88/11/10	total	0.08	0.1	Steer et al. 1990
Dorset	88/12/07	total	0.1	0.2	Steer et al. 1990
Dorset	89/01/18	total	0.1	0.3	Steer et al. 1990
Hamilton	1994-1997	total	0.08	0.03	Dann 1998
Point Petre	1994-1997	total	0.04	0.02	Dann 1998
Simcoe	1994-1997	total	0.02	0.007	Dann 1998
Toronto	1994-1997	total	0.13	0.05	Dann 1998
Toronto Island	88/09/14	total	0.1	0.2	Steer et al. 1990
Toronto Island	88/10/12	total	0.05	0.02	Steer et al. 1990
Toronto Island	88/11/10	total	0.1	0.3	Steer et al. 1990
Toronto Island	88/12/07	total	0.5	1	Steer et al. 1990
Toronto Island	89/01/18	total	0.1	0.5	Steer et al. 1990
Walpole Island	1987-88	total	<0.7[a]	<0.05 - 0.12[a]	Bobet et al. 1990

Table 15. Levels of PCDD/F in ambient air in Canada ($pg \cdot m^{-3}$).

Location	Date	Sample Type	T_4CDD	T_4CDF	Reference
Walpole Island	1994-1997	total	0.03	0.01	Dann 1998
Windsor	1987-88	total	0.03[b]	0.15 - < 0.16[b]	Bobet et al. 1990
Windsor	88/08/25	total	0.09	0.3	Steer et al. 1990
Windsor	88/09/18	total	1	0.6	Steer et al. 1990
Windsor	88/10/12	total	0.4	1	Steer et al. 1990
Windsor	88/11/05	total	0.5	1	Steer et al. 1990
Windsor	88/12/23	total	0.3	0.9	Steer et al. 1990
Windsor	89/03/06	total	0.9	0.6	Steer et al. 1990
Windsor	1994-1997	total	0.17	0.04	Dann 1998
Windsor	1994-1997	total	0.13	0.04	Dann 1998
Prince Edward Island					
Charlottetown	1994-1997	total	0.03	0.004	Dann 1998
Quebec					
Jonquiere	1994-1997	total	0.19	0.05	Dann 1998
Montreal	1994-1997	total	0.06	0.02	Dann 1998
Saskatchewan					
Estevan	1994-1997	total	0.01	0.005	Dann 1998
Gray	1994-1997	total	0.004	0.004	Dann 1998
Prince Albert	1994-1997	total	0.01	0.003	Dann 1998
Regina	1994-1997	total	0.008	0.002	Dann 1998
Regina	1994-1997	total	0.03	0.009	Dann 1998

NR - not reported
Sample type: total = particulate + vapour
[a]number of samples = 8
[b] maximum limit detetced was below the detection limit.

Table 16. Levels of PCDD/Fs in Canadian soil

Location	Year	N	Sample Type	Homologue	Conc. (μg·kg^{-1} dw) Mean (Range)	TEQ (μg·kg^{-1} dw) Mean (Range)	TEF Source	Reference
Nova Scotia								
Truro (on wood preserving plant property)	NR		0-15 cm	T_4CDD	NR	NR		Baker & Matheson 1981[b]
Truro (on wood preserving plant property)	NR		0-15 cm	P_5CDD	NR	NR		Baker & Matheson 1981[b]
Truro (on wood preserving plant property)	NR		0-15 cm	H_6CDD	10[a]	NR		Baker & Matheson 1981[b]
Truro (on wood preserving plant property)	NR		0-15 cm	H_7CDD	100[a]	NR		Baker & Matheson 1981[b]
Truro (on wood preserving plant property)	NR		0-15 cm	OCDD	567	NR		Baker & Matheson 1981[b]
Truro (near wood preserving plant)	NR		0-15 cm	T_4CDD	NR	NR		Baker & Matheson 1981[b]
Truro (near wood preserving plant)	NR		0-15 cm	P_5CDD	NR	NR		Baker & Matheson 1981[b]
Truro (near wood preserving plant)	NR		0-15 cm	H_6CDD	NR	NR		Baker & Matheson 1981[b]
Truro (near wood preserving plant)	NR		0-15 cm	H_7CDD	NR	NR		Baker & Matheson 1981[b]
Truro (near wood preserving plant)	NR		0-15 cm	OCDD	<0.01	NR		Baker & Matheson 1981[b]
Truro (on wood preserving plant property)	NR		0-15 cm	T_4CDF	NR	NR		Baker & Matheson 1981[b]
Truro (near wood preserving plant)	NR		0-15 cm	T_4CDF	NR	NR		Baker & Matheson 1981[b]
New Brunswick								
Newcastle (on wood preserving plant property)	NR		0-15 cm	T_4CDD	NR	NR		Baker & Matheson 1981[b]
Newcastle (on wood preserving plant property)	NR		0-15 cm	P_5CDD	NR	NR		Baker & Matheson 1981[b]
Newcastle (on wood preserving plant property)	NR		0-15 cm	H_6CDD	100[a]	NR		Baker & Matheson 1981[b]
Newcastle (on wood preserving plant property)	NR		0-15 cm	H_7CDD	1000[a]	NR		Baker & Matheson 1981[b]
Newcastle (on wood preserving plant property)	NR		0-15 cm	OCDD	1500	NR		Baker & Matheson 1981[b]
Newcastle (near wood preserving plant)	NR		0-15 cm	T_4CDD	NR	NR		Baker & Matheson 1981[b]
Newcastle (near wood preserving plant)	NR		0-15 cm	P_5CDD	NR	NR		Baker & Matheson 1981[b]
Newcastle (near wood preserving plant)	NR		0-15 cm	H_6CDD	NR	NR		Baker & Matheson 1981[b]
Newcastle (near wood preserving plant)	NR		0-15 cm	H_7CDD	NR	NR		Baker & Matheson 1981[b]
Newcastle (near wood preserving plant)	NR		0-15 cm	OCDD	280	NR		Baker & Matheson 1981[b]
Newcastle (on wood preserving plant property)	NR		0-15 cm	T_4CDF	NR	NR		Baker & Matheson 1981[b]
Newcastle (near wood preserving plant)	NR		0-15 cm	T_4CDF	NR	NR		Baker & Matheson 1981[b]
Ontario								
Hamilton (70 m W of municipal incinerator)	1983		0 - 5 cm	T_4CDD	< 0.0003	NR		McLaughlin et al. 1989
Hamilton (70 m W of municipal incinerator)	1983		0 - 5 cm	P_5CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (70 m W of municipal incinerator)	1983		0 - 5 cm	H_6CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (70 m W of municipal incinerator)	1983		0 - 5 cm	H_7CDD	0.096	NR		McLaughlin et al. 1989
Hamilton (70 m W of municipal incinerator)	1983		0 - 5 cm	OCDD	0.11	NR		McLaughlin et al. 1989

Table 16. Levels of PCDD/Fs in Canadian soil

Location	Year	N	Sample Type	Homologue	Conc. ($\mu g \cdot kg^{-1}$ dw) Mean (Range)	TEQ ($\mu g \cdot kg^{-1}$ dw) Mean (Range)	TEF Source	Reference
Hamilton (880 m SE of municipal incinerator)	1983		0 - 5 cm	T_4CDD	< 0.0003	NR		McLaughlin et al. 1989
Hamilton (880 m SE of municipal incinerator)	1983		0 - 5 cm	P_5CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (880 m SE of municipal incinerator)	1983		0 - 5 cm	H_6CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (880 m SE of municipal incinerator)	1983		0 - 5 cm	H_7CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (880 m SE of municipal incinerator)	1983		0 - 5 cm	OCDD	0.12	NR		McLaughlin et al. 1989
Hamilton (1100 m SW of municipal incinerator)	1983		0 - 5 cm	T_4CDD	< 0.0003	NR		McLaughlin et al. 1989
Hamilton (1100 m SW of municipal incinerator)	1983		0 - 5 cm	P_5CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (1100 m SW of municipal incinerator)	1983		0 - 5 cm	H_6CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (1100 m SW of municipal incinerator)	1983		0 - 5 cm	H_7CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (1100 m SW of municipal incinerator)	1983		0 - 5 cm	OCDD	0.31	NR		McLaughlin et al. 1989
Hamilton (1260 m NE of municipal incinerator)	1983		0 - 5 cm	T_4CDD	< 0.0003	NR		McLaughlin et al. 1989
Hamilton (1260 m NE of municipal incinerator)	1983		0 - 5 cm	P_5CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (1260 m NE of municipal incinerator)	1983		0 - 5 cm	H_6CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (1260 m NE of municipal incinerator)	1983		0 - 5 cm	H_7CDD	0.15	NR		McLaughlin et al. 1989
Hamilton (1260 m NE of municipal incinerator)	1983		0 - 5 cm	OCDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (1260 m SW of municipal incinerator)	1983		0 - 5 cm	T_4CDD	< 0.0003	NR		McLaughlin et al. 1989
Hamilton (1260 m SW of municipal incinerator)	1983		0 - 5 cm	P_5CDD	0.58	NR		McLaughlin et al. 1989
Hamilton (1260 m SW of municipal incinerator)	1983		0 - 5 cm	H_6CDD	0.17	NR		McLaughlin et al. 1989
Hamilton (1260 m SW of municipal incinerator)	1983		0 - 5 cm	H_7CDD	0.39	NR		McLaughlin et al. 1989
Hamilton (1260 m SW of municipal incinerator)	1983		0 - 5 cm	OCDD	3.5	NR		McLaughlin et al. 1989
Hamilton (1570 m SSE of municipal incinerator)	1983		0 - 5 cm	T_4CDD	0.007	NR		McLaughlin et al. 1989
Hamilton (1570 m SSE of municipal incinerator)	1983		0 - 5 cm	P_5CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (1570 m SSE of municipal incinerator)	1983		0 - 5 cm	H_6CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (1570 m SSE of municipal incinerator)	1983		0 - 5 cm	H_7CDD	0.042	NR		McLaughlin et al. 1989
Hamilton (1570 m SSE of municipal incinerator)	1983		0 - 5 cm	OCDD	0.14	NR		McLaughlin et al. 1989
Hamilton (2020 m SSE of municipal incinerator)	1983		0 - 5 cm	T_4CDD	< 0.0003	NR		McLaughlin et al. 1989
Hamilton (2020 m SSE of municipal incinerator)	1983		0 - 5 cm	P_5CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (2020 m SSE of municipal incinerator)	1983		0 - 5 cm	H_6CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (2020 m SSE of municipal incinerator)	1983		0 - 5 cm	H_7CDD	0.042	NR		McLaughlin et al. 1989
Hamilton (2020 m SSE of municipal incinerator)	1983		0 - 5 cm	OCDD	1.3	NR		McLaughlin et al. 1989
Hamilton (2100 m SW of municipal incinerator)	1983		0 - 5 cm	T_4CDD	< 0.0003	NR		McLaughlin et al. 1989
Hamilton (2100 m SW of municipal incinerator)	1983		0 - 5 cm	P_5CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (2100 m SW of municipal incinerator)	1983		0 - 5 cm	H_6CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (2100 m SW of municipal incinerator)	1983		0 - 5 cm	H_7CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (2100 m SW of municipal incinerator)	1983		0 - 5 cm	OCDD	0.075	NR		McLaughlin et al. 1989
Hamilton (2140 m NE of municipal incinerator)	1983		0 - 5 cm	T_4CDD	< 0.0003	NR		McLaughlin et al. 1989
Hamilton (2140 m NE of municipal incinerator)	1983		0 - 5 cm	P_5CDD	< 0.0013	NR		McLaughlin et al. 1989

Table 16. Levels of PCDD/Fs in Canadian soil

Location	Year	N	Sample Type	Homologue	Conc. ($\mu g \cdot kg^{-1}$ dw) Mean (Range)	TEQ ($\mu g \cdot kg^{-1}$ dw) Mean (Range)	TEF Source	Reference
Hamilton (2140 m NE of municipal incinerator)	1983		0 - 5 cm	H_6CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (2140 m NE of municipal incinerator)	1983		0 - 5 cm	H_7CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (2140 m NE of municipal incinerator)	1983		0 - 5 cm	OCDD	0.05	NR		McLaughlin et al. 1989
Hamilton (2380 m E of municipal incinerator)	1983		0 - 5 cm	T_4CDD	< 0.0003	NR		McLaughlin et al. 1989
Hamilton (2380 m E of municipal incinerator)	1983		0 - 5 cm	P_5CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (2380 m E of municipal incinerator)	1983		0 - 5 cm	H_6CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (2380 m E of municipal incinerator)	1983		0 - 5 cm	H_7CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (2380 m E of municipal incinerator)	1983		0 - 5 cm	OCDD	1	NR		McLaughlin et al. 1989
Hamilton (2480 m SW of municipal incinerator)	1983		0 - 5 cm	T_4CDD	< 0.0003	NR		McLaughlin et al. 1989
Hamilton (2480 m SW of municipal incinerator)	1983		0 - 5 cm	P_5CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (2480 m SW of municipal incinerator)	1983		0 - 5 cm	H_6CDD	< 0.0013	NR		McLaughlin et al. 1989
Hamilton (2480 m SW of municipal incinerator)	1983		0 - 5 cm	H_7CDD	0.27	NR		McLaughlin et al. 1989
Hamilton (2480 m SW of municipal incinerator)	1983		0 - 5 cm	OCDD	0.69	NR		McLaughlin et al. 1989
Hamilton (70 m W of municipal incinerator)	1983		0 - 5 cm	T_4CDF	0.071	NR		McLaughlin et al. 1989
Hamilton (70 m W of municipal incinerator)	1983		0 - 5 cm	P_5CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (70 m W of municipal incinerator)	1983		0 - 5 cm	H_6CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (70 m W of municipal incinerator)	1983		0 - 5 cm	H_7CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (70 m W of municipal incinerator)	1983		0 - 5 cm	OCDF	0.009	NR		McLaughlin et al. 1989
Hamilton (880 m SE of municipal incinerator)	1983		0 - 5 cm	T_4CDF	0.043	NR		McLaughlin et al. 1989
Hamilton (880 m SE of municipal incinerator)	1983		0 - 5 cm	P_5CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (880 m SE of municipal incinerator)	1983		0 - 5 cm	H_6CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (880 m SE of municipal incinerator)	1983		0 - 5 cm	H_7CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (880 m SE of municipal incinerator)	1983		0 - 5 cm	OCDF	<0.008	NR		McLaughlin et al. 1989
Hamilton (1100 m SW of municipal incinerator)	1983		0 - 5 cm	T_4CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (1100 m SW of municipal incinerator)	1983		0 - 5 cm	P_5CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (1100 m SW of municipal incinerator)	1983		0 - 5 cm	H_6CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (1100 m SW of municipal incinerator)	1983		0 - 5 cm	H_7CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (1100 m SW of municipal incinerator)	1983		0 - 5 cm	OCDF	<0.008	NR		McLaughlin et al. 1989
Hamilton (1260 m NE of municipal incinerator)	1983		0 - 5 cm	T_4CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (1260 m SW of municipal incinerator)	1983		0 - 5 cm	P_5CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (1260 m SW of municipal incinerator)	1983		0 - 5 cm	H_6CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (1260 m SW of municipal incinerator)	1983		0 - 5 cm	H_7CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (1260 m SW of municipal incinerator)	1983		0 - 5 cm	OCDF	<0.008	NR		McLaughlin et al. 1989
Hamilton (1570 m SSE of municipal incinerator)	1983		0 - 5 cm	T_4CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (1570 m SSE of municipal incinerator)	1983		0 - 5 cm	P_5CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (1570 m SSE of municipal incinerator)	1983		0 - 5 cm	H_6CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (1570 m SSE of municipal incinerator)	1983		0 - 5 cm	H_7CDF	<0.0013	NR		McLaughlin et al. 1989

Table 16. Levels of PCDD/Fs in Canadian soil

Location	Year	N	Sample Type	Homologue	Conc. ($\mu g \cdot kg^{-1}$ dw) Mean (Range)	TEQ ($\mu g \cdot kg^{-1}$ dw) Mean (Range)	TEF Source	Reference
Hamilton (1570 m SSE of municipal incinerator)	1983		0 - 5 cm	OCDF	<0.008	NR		McLaughlin et al. 1989
Hamilton (2020 m SSE of municipal incinerator)	1983		0 - 5 cm	T_4CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2020 m SSE of municipal incinerator)	1983		0 - 5 cm	P_5CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2020 m SSE of municipal incinerator)	1983		0 - 5 cm	H_6CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2020 m SSE of municipal incinerator)	1983		0 - 5 cm	H_7CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2020 m SSE of municipal incinerator)	1983		0 - 5 cm	OCDF	0.005	NR		McLaughlin et al. 1989
Hamilton (2100 m SW of municipal incinerator)	1983		0 - 5 cm	T_4CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2100 m SW of municipal incinerator)	1983		0 - 5 cm	P_5CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2100 m SW of municipal incinerator)	1983		0 - 5 cm	H_6CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2100 m SW of municipal incinerator)	1983		0 - 5 cm	H_7CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2100 m SW of municipal incinerator)	1983		0 - 5 cm	OCDF	<0.008	NR		McLaughlin et al. 1989
Hamilton (2140 m NE of municipal incinerator)	1983		0 - 5 cm	T_4CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2140 m NE of municipal incinerator)	1983		0 - 5 cm	P_5CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2140 m NE of municipal incinerator)	1983		0 - 5 cm	H_6CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2140 m NE of municipal incinerator)	1983		0 - 5 cm	H_7CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2140 m NE of municipal incinerator)	1983		0 - 5 cm	OCDF	<0.008	NR		McLaughlin et al. 1989
Hamilton (2380 m E of municipal incinerator)	1983		0 - 5 cm	T_4CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2380 m E of municipal incinerator)	1983		0 - 5 cm	P_5CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2380 m E of municipal incinerator)	1983		0 - 5 cm	H_6CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2380 m E of municipal incinerator)	1983		0 - 5 cm	H_7CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2380 m E of municipal incinerator)	1983		0 - 5 cm	OCDF	0.033	NR		McLaughlin et al. 1989
Hamilton (2480 m SW of municipal incinerator)	1983		0 - 5 cm	T_4CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2480 m SW of municipal incinerator)	1983		0 - 5 cm	P_5CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2480 m SW of municipal incinerator)	1983		0 - 5 cm	H_6CDF	<0.0013	NR		McLaughlin et al. 1989
Hamilton (2480 m SW of municipal incinerator)	1983		0 - 5 cm	H_7CDF	0.15	NR		McLaughlin et al. 1989
Hamilton (2480 m SW of municipal incinerator)	1983		0 - 5 cm	OCDF	<0.008	NR		McLaughlin et al. 1989
Urban control (4450 m SW of municipal incinerator)	1983		0 - 5 cm	T_4CDD	< 0.0003	NR		McLaughlin et al. 1989
Urban control (4450 m SW of municipal incinerator)	1983		0 - 5 cm	P_5CDD	< 0.0013	NR		McLaughlin et al. 1989
Urban control (4450 m SW of municipal incinerator)	1983		0 - 5 cm	H_6CDD	< 0.0013	NR		McLaughlin et al. 1989
Urban control (4450 m SW of municipal incinerator)	1983		0 - 5 cm	H_7CDD	0.005	NR		McLaughlin et al. 1989
Urban control (4450 m SW of municipal incinerator)	1983		0 - 5 cm	OCDD	0.94	NR		McLaughlin et al. 1989
Urban control (5570 m ESE of municipal incinerator)	1983		0 - 5 cm	T_4CDD	< 0.0003	NR		McLaughlin et al. 1989
Urban control (5570 m ESE of municipal incinerator)	1983		0 - 5 cm	P_5CDD	< 0.0013	NR		McLaughlin et al. 1989
Urban control (5570 m ESE of municipal incinerator)	1983		0 - 5 cm	H_6CDD	< 0.0013	NR		McLaughlin et al. 1989
Urban control (5570 m ESE of municipal incinerator)	1983		0 - 5 cm	H_7CDD	0.097	NR		McLaughlin et al. 1989
Urban control (5570 m ESE of municipal incinerator)	1983		0 - 5 cm	OCDD	3.2	NR		McLaughlin et al. 1989
Urban control (4450 m SW of municipal incinerator)	1983		0 - 5 cm	T_4CDF	0.009	NR		McLaughlin et al. 1989

Table 16. Levels of PCDD/Fs in Canadian soil

Location	Year	N	Sample Type	Homologue	Conc. ($\mu g \cdot kg^{-1}$ dw) Mean (Range)	TEQ ($\mu g \cdot kg^{-1}$ dw) Mean (Range)	TEF Source	Reference
Urban control (4450 m SW of municipal incinerator)	1983		0 - 5 cm	P_5CDF	0.006	NR		McLaughlin et al. 1989
Urban control (4450 m SW of municipal incinerator)	1983		0 - 5 cm	H_6CDF	<0.0013	NR		McLaughlin et al. 1989
Urban control (4450 m SW of municipal incinerator)	1983		0 - 5 cm	H_7CDF	<0.0013	NR		McLaughlin et al. 1989
Urban control (4450 m SW of municipal incinerator)	1983		0 - 5 cm	OCDF	<0.008	NR		McLaughlin et al. 1989
Urban control (5570 m ESE of municipal incinerator)	1983		0 - 5 cm	T_4CDF	0.068	NR		McLaughlin et al. 1989
Urban control (5570 m ESE of municipal incinerator)	1983		0 - 5 cm	P_5CDF	<0.0013	NR		McLaughlin et al. 1989
Urban control (5570 m ESE of municipal incinerator)	1983		0 - 5 cm	H_6CDF	<0.0013	NR		McLaughlin et al. 1989
Urban control (5570 m ESE of municipal incinerator)	1983		0 - 5 cm	H_7CDF	<0.0013	NR		McLaughlin et al. 1989
Urban control (5570 m ESE of municipal incinerator)	1983		0 - 5 cm	OCDF	0.081	NR		McLaughlin et al. 1989
Rural control (22000 m N of municipal incinerator)	1983		0 - 5 cm	T_4CDD	< 0.0003	NR		McLaughlin et al. 1989
Rural control (22000 m N of municipal incinerator)	1983		0 - 5 cm	P_5CDD	< 0.0013	NR		McLaughlin et al. 1989
Rural control (22000 m N of municipal incinerator)	1983		0 - 5 cm	H_6CDD	< 0.0013	NR		McLaughlin et al. 1989
Rural control (22000 m N of municipal incinerator)	1983		0 - 5 cm	H_7CDD	< 0.0013	NR		McLaughlin et al. 1989
Rural control (22000 m N of municipal incinerator)	1983		0 - 5 cm	OCDD	0.81	NR		McLaughlin et al. 1989
Rural control (22000 m N of municipal incinerator)	1983		0 - 5 cm	T_4CDF	<0.0013	NR		McLaughlin et al. 1989
Rural control (22000 m N of municipal incinerator)	1983		0 - 5 cm	P_5CDF	<0.0013	NR		McLaughlin et al. 1989
Rural control (22000 m N of municipal incinerator)	1983		0 - 5 cm	H_6CDF	<0.0013	NR		McLaughlin et al. 1989
Rural control (22000 m N of municipal incinerator)	1983		0 - 5 cm	H_7CDF	<0.0013	NR		McLaughlin et al. 1989
Rural control (22000 m N of municipal incinerator)	1983		0 - 5 cm	OCDF	<0.008	NR		McLaughlin et al. 1989
British Columbia[c]								
Background soil	NR	53		T_4CDD	ND	0.005 (0.0 - 0.057)	I-TEF	Van Oostdam & Ward 1995
Background soil	NR	53		T_4CDF	0.003 (ND - 0.032)	NR	I-TEF	Van Oostdam & Ward 1995
Primary soil (all sources)	NR	31		T_4CDD	0.005 (ND - 0.085)	0.252 (0.0 - 2.58)	I-TEF	Van Oostdam & Ward 1995
Primary soil (all sources)	NR	31		T_4CDF	0.048 (ND - 0.52)	NR	I-TEF	Van Oostdam & Ward 1995
Primary soil (chemical sources)	NR	18		T_4CDD	0.0084 (ND - 0.085)	0.419 (0.0 - 2.58)	I-TEF	Van Oostdam & Ward 1995
Primary soil (chemical sources)	NR	18		T_4CDF	0.006 (ND - 0.52)	NR	I-TEF	Van Oostdam & Ward 1995
Primary soil (combustion sources)	NR	13		T_4CDD	0.0008 (ND - 0.0035)	0.22 (0.0 - 0.126)	I-TEF	Van Oostdam & Ward 1995
Primary soil (combustion sources)	NR	13		T_4CDF	0.031 (ND - 0.16)	NR	I-TEF	Van Oostdam & Ward 1995
Secondary soil (all sources)	NR	137		T_4CDD	0.0054 (ND - 0.55)	0.242 (0.0 - 18.7)	I-TEF	Van Oostdam & Ward 1995
Secondary soil (all sources)	NR	137		T_4CDF	0.025 (ND - 0.055)	NR	I-TEF	Van Oostdam & Ward 1995
Secondary soil (chemical sources)	NR	47		T_4CDD	0.015 (ND - 0.055)	0.669 (0.0 - 18.7)	I-TEF	Van Oostdam & Ward 1995
Secondary soil (chemical sources)	NR	47		T_4CDF	0.061 (ND - 0.055)	NR	I-TEF	Van Oostdam & Ward 1995
Secondary soil (combustion sources)	NR	90		T_4CDD	0.00009 (ND - 0.0056)	0.0187 (0.0 - 0.473)	I-TEF	Van Oostdam & Ward 1995
Secondary soil (combustion sources)	NR	90		T_4CDF	0.0065 (ND - 0.18)	NR	I-TEF	Van Oostdam & Ward 1995

Note: With the exception of Van Oostdam and Ward (1995) measurements for each class represent the sum of several congeners,

Table 16. Levels of PCDD/Fs in Canadian soil

Location	Year	N	Sample Type	Homologue	Conc. ($\mu g \cdot kg^{-1}$ dw) Mean (Range)	TEQ ($\mu g \cdot kg^{-1}$ dw) Mean (Range)	TEF Source	Reference

some of which are not chlorinated in all 2, 3, 7 and 8 positions.
ND - not detected
NR - not reported
[a]estimated concentration
[b]as cited in OMOE 1985
[c]background samples are believed to be indicative of ambient levels of PCDD/F. Primary samples are collected immediately at a potential source of contamination. Secondary samples were collected from areas directly impacted by the primary source.

Table 17. Levels of PCDD/Fs in ditch water of railway right-of-way and other land use in the lower Mainland of British Columbia

			Concentration [mean [a] $\mu g \cdot kg^{-1}$ dw (f/n; range)[b]]					
			Railway					
Homologue	Parkland Ditches	Farm Ditches	Ballasts	Ditches	4 m upstream of pole	Adjacent (0 - 0.3 m) to pole	4 m downstream of pole	Reference
T_4CDD	ND (0/3)	ND (0/5)	ND (0/5)	ND (0/5)	ND (0/5)	ND (0/5)	ND (0/5)	Wan & Van Oostdam 1995
P_5CDD	ND (0/3)	ND (0/5)	ND (0/5)	ND (0/5)	ND (0/5)	0.5 (5/15; 0.05 - 1.1)	ND (0/5)	Wan & Van Oostdam 1995
H_6CDD	ND (0/3)	ND (0/5)	0.4 (1/5)	ND (0/5)	ND (0/5)	1.8 (9/15; 0.15 - 4.3)	ND (0/5)	Wan & Van Oostdam 1995
H_6CDD	ND (0/3)	ND (0/5)	0.8 (2/5; 0.15 - 1.3)	0.1 (2/5; 0.05 - 0.22)	ND (0/5)	19.1 (9/15; 0.41 - 58.9)	0.1 (2/5; 0.05 - 0.17)	Wan & Van Oostdam 1995
H_6CDD	ND (0/3)	ND (0/5)	0.6 (1/5)	ND	ND (0/5)	3.6 (9/15; 0.18 - 11.4)	0.1 (1/5)	Wan & Van Oostdam 1995
H_7CDD	ND (0/3)	0.4 (3/5; 0.05 - 0.76)	16.4 (5/5; 0.09 - 66)	1.5 (5/5; 0.05 - 5.2)	ND (0/5)	208 (15/15; 0.08 - 769)	1.2 (5/5; 0.41 - 1.93)	Wan & Van Oostdam 1995
OCDD	ND (0/3)	1.6 (4/5; 0.15 - 3.7)	217.7 (5/5; 0.47 - 866)	12.4 (5/5; 0.43 - 48)	ND (0/5)	1754 (15/15; 0.08 - 10236)	10.1 (5/5; 2.2 - 13.4)	Wan & Van Oostdam 1995
Total	ND	2	236	14	ND	1987	11.5	Wan & Van Oostdam 1995
CD[c]	ND	3.7	277	18.8	ND	2576	14	Wan & Van Oostdam 1995
Furans								
T_4CDF	ND (0/3)	ND (0/5)	ND (0/5)	ND (0/5)	ND (0/5)	2 (3/15; 0.52 - 2.38)	ND (0/5)	Wan & Van Oostdam 1995
P_5CDF	ND (0/3)	ND (0/5)	0.2 (1/5)	0.1 (1/5)	ND (0/5)	2 (2/15; 1.8 - 2.1)	0.1 (1/5)	Wan & Van Oostdam 1995
H_6CDF	ND (0/3)	ND (0/5)	0.4 (2/5; 0.12 - 0.47)	0.1 (1/5)	ND (0/5)	2.7 (10/15; 0.24 - 6.61)	ND (0/5)	Wan & Van Oostdam 1995
H_6CDF	ND (0/3)	ND (0/5)	0.3 (1/5)	0.1 (1/5)	ND (0/5)	1 (7/15; 0.31 - 2.22)	ND (0/5)	Wan & Van Oostdam 1995
H_6CDF	ND (0/3)	ND (0/5)	0.2 (2/5; 0.05 - 0.41)	0.2 (1/5)	ND (0/5)	1 (6/15; 0.18 - 2.07)	ND (0/5)	Wan & Van Oostdam 1995
H_6CDF	ND (0/3)	ND (0/5)	ND (0/5)	ND (0/5)	ND (0/5)	0.4 (2/15; 0.21 - 0.42)	ND (0/5)	Wan & Van Oostdam 1995
H_7CDF	ND (0/3)	ND (0/5)	0.5 (3/5; 0.18 - 1.2)	0.1 (1/5)	ND (0/5)	94 (15/15; 0.08 - 679)	0.3 (5/5; 0.16 - 0.43)	Wan & Van Oostdam 1995
OCDF	ND (0/3)	0.3 (3/5; 0.06 - 061)	42.5 (5/5; 0.05 - 171	1.9 (5/5; 0.11 - 7.81)	ND (0/5)	732 (15/15; 1.95 - 5000)	1.5 (5/5; 0.08 - 1.71)	Wan & Van Oostdam 1995
Total	ND	0.3	44.1	2.5	ND	835	1.9	Wan & Van Oostdam 1995
CF[c]	ND	0.7	93.4	6.5	ND	1278	3.2	Wan & Van Oostdam 1995

ND - not detected

[a]Mean concentration of positive occurrence, and adjusted for recovery efficiency

[b]f = Frequency of occurrence, / =out of, n = no. of sampling sites; range of concentrations

[c]Mean total CD (chlorinated dibenzo-p-dioxins) or CF (chlorinated dibenzofurans), including isomers not listed, and adjusted for recovery efficiency

Table 18. Levels of T_4CDD, T_4CDF, and TEQ in surface water and groundwater in Canada.

Location	Sample Type	Year	N	T_4CDD ($pg \cdot L^{-1}$) Mean (Range)	T_4CDF ($pg \cdot L^{-1}$) Mean (Range)	TEQ ($pg \cdot L^{-1}$) Mean (Range)	TEF Source	Reference
Surface Water								
British Columbia								
British Columbia, background surface runoff[a]	DW	NR	5	0.4 (ND - 1)	ND	2.1 (0 - 6.4)	I-TEFs	Van Oostdam & Ward 1995
British Columbia, background surface runoff (filtrate)[a]	DW	NR	2	ND	ND	0	I-TEFs	Van Oostdam & Ward 1995
British Columbia, background surface runoff (particulate)[a]	DW	NR	2	ND	ND	0	I-TEFs	Van Oostdam & Ward 1995
British Columbia, secondary surface runoff	DW	NR	10	7.5 (ND - 70)	174.1 (ND - 1700)	1072 (0.03 - 10482	I-TEFs	Van Oostdam & Ward 1995
British Columbia, background water[a]	DW	NR	1	ND	ND	0	I-TEFs	Van Oostdam & Ward 1995
British Columbia, background water (filtrate)[a]	PF	NR	1	ND	ND	0	I-TEFs	Van Oostdam & Ward 1995
British Columbia, secondary water	DW	NR	3	ND	4.3 (ND - 8.6)	25.8 (0.1 - 40.1)	I-TEFs	Van Oostdam & Ward 1995
British Columbia, secondary water (filtrate)	DW	NR	5	ND	ND	0.4 (0.1 - 1.2)	I-TEFs	Van Oostdam & Ward 1995
Fraser River at Prince George	PC	1989	1	< 3	< 2	0.1	I-TEFs	BCMOE 1989
Fraser River at Quesnel	DW	1989	1	< 5	< 4	2	I-TEFs	BCMOE 1989
Peace River at Hudson Hope	DW	1989	1	< 3	< 3	0.52	I-TEFs	BCMOE 1989
Thompson River at Ashcroft	PC	1989	1	< 8	< 6	0.08	I-TEFs	BCMOE 1989
Thompson River at Savona	PC	1989	1	< 8	< 5	0.05	I-TEFs	BCMOE 1989
Thompson River at Walhachin	DW	1989	1	< 10	< 7	0.05	I-TEFs	BCMOE 1989
Columbia River at Warfield	DW	1989	1	< 5	< 4	0.12	I-TEFs	BCMOE 1989
Columbia River at Warfield	PC	1989	1	< 6	< 5	0.18	I-TEFs	BCMOE 1989
Columbia River at Warfield	PC,PF	1989	1	< 5	< 4	0.1	I-TEFs	BCMOE 1989
Alberta								
Elbow River at Calgary (Glenmore)	PC,PF	1989	1	< 7.4	< 4.5	NR		Alberta Environment 1991
Elbow River at Calgary (Glenmore)	DW	1989	1	< 7	< 5.7	NR		Alberta Environment 1991
Bow River at Calgary (Bearspaw)	PC,PF	1989	1	< 7.2	< 2.6	NR		Alberta Environment 1991
Bow River at Calgary (Bearspaw)	DW	1989	1	< 7.1	< 4.3	NR		Alberta Environment 1991
Bow River at Morley	DW	1989	1	< 8.1	< 4.7	NR		Alberta Environment 1991
South Saskatchewan River at Medicine Hat	PC,PF	1989	1	< 8.2	< 5.5	NR		Alberta Environment 1991
South Saskatchewan River at Medicine Hat	DW	1989	1	< 8.6	< 6.0	NR		Alberta Environment 1991
South Saskatchewan River at Redcliffe	DW	1989	1	< 5.2	< 3.5	NR		Alberta Environment 1991
South Saskatchewan River at Redcliffe	PC,PF	1989	1	< 4.6	< 3.6	NR		Alberta Environment 1991
South Saskatchewan River at Ralston	DW	1989	1	< 8.3	< 6.0	NR		Alberta Environment 1991

Table 18. Levels of T_4CDD, T_4CDF, and TEQ in surface water and groundwater in Canada.

Location	Sample Type	Year	N	T_4CDD ($pg \cdot L^{-1}$) Mean (Range)	T_4CDF ($pg \cdot L^{-1}$) Mean (Range)	TEQ ($pg \cdot L^{-1}$) Mean (Range)	TEF Source	Reference
South Saskatchewan River at Ralston	PC,PF	1989	1	< 5.1	< 6.5	NR		Alberta Environment 1991
Irrigation/Bow River at Brooks	DW	1989	1	< 9.4	< 6	NR		Alberta Environment 1991
Irrigation/Bow River at Brooks	PC,PF	1989	1	< 6.7	< 5.3	NR		Alberta Environment 1991
Irrigation/Bow River at Strathmore	DW	1989	1	< 11.5	< 7.5	NR		Alberta Environment 1991
Irrigation/Bow River at Strathmore	PC,PF	1989	1	< 12.5	< 2.1	NR		Alberta Environment 1991
Irrigation/Bow River at Milo	PC,PF	1989	1	< 9.1	< 4.3	NR		Alberta Environment 1991
Athabasca River at Jasper	DW	1989	1	ND	ND	NR		Milos 1990
Athabasca River at Hinton	DW	1989	1	ND	ND	NR		Milos 1990
Athabasca River at Hinton	DW	1989	1	ND	ND	NR		Milos 1990
Athabasca River at Hinton	PC,PF	1989	1	ND	ND	NR		Milos 1990
Athabasca River at Smith	DW	1989	1	ND	ND	NR		Milos 1990
Athabasca River at Smith	PC,PF	1989	1	ND	ND	NR		Milos 1990
Athabasca River at Athabasca	DW	1989	1	ND	ND	NR		Milos 1990
Athabasca River at Athabasca	PC,PF	1989	1	ND	ND	NR		Milos 1990
Wapiti River at Grand Prairie	DW	1989	1	ND	ND	NR		Milos 1990
Wapiti River at Grand Prairie	PC,PF	1989	1	ND	ND	NR		Milos 1990
Peace River at Peace River	DW	1989	1	ND	ND	NR		Milos 1990
Peace River at Peace River	PC,PF	1989	1	ND	ND	NR		Milos 1990
Peace River at Fort Vermillion	DW	1989	1	ND	ND	NR		Milos 1990
Peace River at Fort Vermillion	PC,PF	1989	1	ND	ND	NR		Milos 1990
Ontario								
13 Municipal water supplies	DW	1980-81	20	<1000	NR	NR		OMOE 1985
Lake Ontario (Niagara Falls)	DW	1980-81	14	< 1000	NR	NR		OMOE 1985
Lake Ontario (Niagara Falls)	DW	1981-82	9	<250	NR	NR		OMOE 1985
Lake Ontario (Niagara-on-the-Lake)	DW	1980-81	13	< 1000	NR	NR		OMOE 1985
Lake Ontario (Niagara-on-the-Lake)	DW	1981-82	10	<250	NR	NR		OMOE 1985
Lake Ontario (St. Catherines)	DW	1980-81	13	< 1000	NR	NR		OMOE 1985
Lake Ontario (St. Catherines)	DW	1981-82	3	<250	NR	NR		OMOE 1985
Lake Ontario (Fort Erie)	DW	1980-81	14	< 1000	NR	NR		OMOE 1985
Lake Ontario (Fort Erie)	DW	1981-82	7	<250	NR	NR		OMOE 1985
Lake Ontario (Grimsby)	NR	1981-82	1	< 250	NR	NR		OMOE 1985
Lake Ontario (Port Colborne)	NR	1981-82	1	< 250	NR	NR		OMOE 1985
Lake Ontario (Lincoln/Vineland)	DW	1980-81	1	< 1000	NR	NR		OMOE 1985

Table 18. Levels of T_4CDD, T_4CDF, and TEQ in surface water and groundwater in Canada.

Location	Sample Type	Year	N	T_4CDD ($pg \cdot L^{-1}$) Mean (Range)	T_4CDF ($pg \cdot L^{-1}$) Mean (Range)	TEQ ($pg \cdot L^{-1}$) Mean (Range)	TEF Source	Reference
Lake Ontario (Lincoln/Beamsville)	NR	1981-82	1	< 250	NR	NR		OMOE 1985
Lake Ontario (Niagara Falls)	PC,PF	1980-81	12	< 1000	NR	NR		OMOE 1985
Lake Ontario (Niagara Falls)	PC,PF	1981-82	9	< 250	NR	NR		OMOE 1985
Lake Ontario (Niagara-on-the-Lake)	PC,PF	1980-81	11	< 1000	NR	NR		OMOE 1985
Lake Ontario (Niagara-on-the-Lake)	PC,PF	1981-82	8	< 250	NR	NR		OMOE 1985
Lake Ontario (St. Catherines)	PC,PF	1980-81	13	< 1000	NR	NR		OMOE 1985
Lake Ontario (St. Catherines)	PC,PF	1981-82	3	< 250	NR	NR		OMOE 1985
Hinton combined effluent		1993	NR	0.35	0.78	NR		Crosley 1993
Groundwater								
British Columbia								
Prince George (College Heights)	DW	1989	1	< 3	< 3	NR		BCMOE 1989
Skookumchuk (near pulpmill)	DW	1989	1	< 10	< 7	NR		BCMOE 1989
Castlegar (near Brilliant)	DW	1989	1	< 10	< 7	NR		BCMOE 1989

Sample Type: DW = raw water; PC = post chlorination; PF = post filtration.

NR = not reported; ND = not detected.

[a]background samples are believed to be indicative of ambient levels of dioxins and furans in the environment

secondary samples were collected from areas directly impacted by the primary source, and could be used to indicate movement of contaminants

Table 19. Levels of PCDD/Fs in precipitation in Ontario, Canada ($pg \cdot L^{-1}$)

Year	Congener	Dorset	Toronto Island	Reference
1986	T_4CDD	NR		Tashiro & Clement 1989
1986	P_5CDD	NR		Tashiro & Clement 1989
1986	H_6CDD	NR		Tashiro & Clement 1989
1986	H_7CDD	70		Tashiro & Clement 1989
1986	OCDD	120 - 620		Tashiro & Clement 1989
1987	T_4CDD	NR		Tashiro & Clement 1989
1987	P_5CDD	NR		Tashiro & Clement 1989
1987	H_6CDD	NR		Tashiro & Clement 1989
1987	H_7CDD	NR		Tashiro & Clement 1989
1987	OCDD	60 - 1200		Tashiro & Clement 1989
1987-88	T_4CDD	NR	<3	Reid et al. 1990
1987-88	P_5CDD	NR	<20	Reid et al. 1990
1987-88	H_6CDD	NR	<9	Reid et al. 1990
1987-88	H_7CDD	NR	<8	Reid et al. 1990
1987-88	OCDD	<20 - 180	<20	Reid et al. 1990
1988	T_4CDD	<3	0.7 - <3	Reid et al. 1990
1988	P_5CDD	<20	7 - <20	Reid et al. 1990
1988	H_6CDD	2.7 - <9	1.2 - <9	Reid et al. 1990
1988	H_7CDD	5.0 - <8	0.8 - <8	Reid et al. 1990
1988	OCDD	17.1 - <20	<20	Reid et al. 1990
1986	T_4CDF	NR		Tashiro & Clement 1989
1986	P_5CDF	NR		Tashiro & Clement 1989
1986	H_6CDF	NR		Tashiro & Clement 1989
1986	H_7CDF	9		Tashiro & Clement 1989
1986	OCDF	17		Tashiro & Clement 1989
1987	T_4CDF	NR		Tashiro & Clement 1989
1987	P_5CDF	NR		Tashiro & Clement 1989
1987	H_6CDF	16		Tashiro & Clement 1989
1987	H_7CDF	NR		Tashiro & Clement 1989
1987	OCDF	NR		Tashiro & Clement 1989
1988	T_4CDF	<3	< 3 - 5	Reid et al. 1990
1988	P_5CDF	0.2 - 0.6	< 6 - 6	Reid et al. 1990
1988	H_6CDF	2 - <5	0.7 - 6	Reid et al. 1990
1988	H_7CDF	1.4 - <6	0.8 - <6	Reid et al. 1990
1988	OCDF	0.8 - <10	<10	Reid et al. 1990

Note: Except for the octa congener, measurements for each class represent the sum of several congeners, some of which are not chlorinated in all 2, 3, 7 and 8 positions.
NR = not reported.

Table 20. Levels of T_4CDD, T_4CDF, and TEQ in freshwater sediments in Canada.

Location	Year	N	Sample Depth (cm)	TOC (% dw)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	T_4CDD ($ng \cdot kg^{-1}$) Mean (Range)	T_4CDF ($ng \cdot kg^{-1}$) Mean (Range)	TEQ ($ng \cdot kg^{-1}$) Mean (Range)	TEF Source	Reference
British Columbia													
British Columbia (background sediment)[a]	NR	12							ND	1.4 (ND - 17)	3.9 (0.0 - 24.4)	I-TEFs	Van Oostam & Ward 1995
British Columbia (secondary sediment (all sources))	NR	21							0.2 (ND - 2.7)	3.5 (ND - 33)	32.5 (0.0 - 172.0)	I-TEFs	Van Oostam & Ward 1995
British Columbia (secondary sediment (chemical sources))	NR	14							0.2 (ND - 2.7)	3.8 (ND - 33)	42.1 (0.0 - 172)	I-TEFs	Van Oostam & Ward 1995
British Columbia (secondary sediment (combustion	NR	7							0.2 (ND - 1.1)	3.0 (ND -12)	13.2 (0.0 - 63.6)	I-TEFs	Van Oostam & Ward 1995
Thompson River at Kamloops (U/S)	1988		1 - 4	0.7	5.4	13.3	73.1	8.2	< 15	< 10	NR		Mah et al. 1989
Thompson River at Kamloops (U/S)	1988		1 - 4	0.27	3.3	7.3	88.2	1.2	< 15	< 10	NR		Mah et al. 1989
Thompson River at Kamloops (U/S)	1988		1 - 4	0.37	4.8	25.4	67.9	1.9	< 15	< 10	NR		Mah et al. 1989
North Thompson River (U/S)	1990		0 - 3	1.9[c]	4.9	23.8	71.3	0	< 2.9	< 1.4	3.6	I-TEFs	Dwernychuk et al. 1991b
Thompson River at Kamloops (D/S)	1988		1 - 4	1.2	-	2.5[b]	97.1	0.4	< 15	3168	NR		Mah et al. 1989
Thompson River at Kamloops (D/S)	1988		1 - 4	1.1	-	3.4[b]	96.1	0.5	< 15	2445	NR		Mah et al. 1989
Thompson River at Kamloops (D/S)	1988		1 - 4	0.28	-	10.4[b]	86.6	0	< 15	68.5	NR		Mah et al. 1989
Lower Thompson River at Walhachin	1990		0 - 3	3.5[c]	9	8.5	72.2	10.3	< 2.9	42	8.4	I-TEFs	Dwernychuk et al. 1991b
Lower Thompson River at Spences Bridge	1990		0 - 3	4.4[c]	8.7	25.9	65.4	0	< 2.1	8.9	3.8	I-TEFs	Dwernychuk et al. 1991b
Kamloops Lake	1990		0 - 3	1.6[c]	2.9	23.4	73.7	0	< 2.7	< 3.5	2.1	I-TEFs	Dwernychuk et al. 1991b
Kitimat River (U/S)	NR		1 - 4	0.66	5.3	23.6	71.1	0	< 4	< 4	18.3	I-TEFs	Trudel 1991
Kitimat River (U/S)	NR		1 - 4	0.77	7	36.9	55.9	0.2	< 4	< 4	16.3	I-TEFs	Trudel 1991
Kitimat River (U/S)	NR		1 - 4	0.39	4.2	11.3	84.3	0.2	< 2	< 2	16.3	I-TEFs	Trudel 1991
Kitimat River (D/S)	NR		1 - 4	0.55	5.3	31.1	63.6	0	< 2	< 2	17.8	I-TEFs	Trudel 1991
Kitimat River (D/S)	NR		1 - 4	0.25	5.4	16.9	77.6	0.1	< 2	< 2	19.6	I-TEFs	Trudel 1991
Kitimat River (D/S)	NR		1 - 4	1.86	12	62.6	25.4	0	< 1	< 1	70.4	I-TEFs	Trudel 1991

Table 20. Levels of T_4CDD, T_4CDF, and TEQ in freshwater sediments in Canada.

Location	Year	N	Sample Depth (cm)	TOC (% dw)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	T_4CDD ($ng \cdot kg^{-1}$) Mean (Range)	T_4CDF ($ng \cdot kg^{-1}$) Mean (Range)	TEQ ($ng \cdot kg^{-1}$) Mean (Range)	TEF Source	Reference
Tudyah Lake (near MacKenzie - U/S)	1988		1 - 4	0.42	3.2	4.2	91.6	1	< 15	< 10	NR		Mah et al. 1989
Tudyah Lake (near MacKenzie - U/S)	1988		1 - 4	0.4	4.3	8.6	86.7	0.4	< 15	< 10	NR		Mah et al. 1989
Tudyah Lake (near MacKenzie - U/S)	1988		1 - 4	0.51	3.9	5.4	90.4	0.3	< 15	< 10	NR		Mah et al. 1989
Williston Lake (D/S)	1988		1 - 4	10.6	20	51.8	27.4	0.8	< 15	2077	NR		Mah et al. 1989
Williston Lake (D/S)	1988		1 - 4	5.8	19.7	77.4	2.9	0	< 15	982	NR		Mah et al. 1989
Williston Lake (D/S)	1988		1 - 4	4.4	21.9	69.2	8.9	0	< 15	1081	NR		Mah et al. 1989
Williston Lake (D/S)	1988		1 - 4	24	1.5	5.8	92.7	0	< 15	< 10	NR		Mah et al. 1989
Williston Lake (D/S)	1988		1 - 4	16.7	7.4	21	76.6	0	< 15	< 10	NR		Mah et al. 1989
Williston Lake (D/S)	1988		1 - 4	5.9	30.3	66.7	3	0	< 15	286	NR		Mah et al. 1989
Fraser River at Hansard (U/S)	1988		1 - 4	0.52	8.1	46.7	45.2	0	< 15	< 10	NR		Mah et al. 1989
Fraser River at Hansard (U/S)	1988		1 - 4	0.97	8.3	56.2	33.6	1.9	< 15	< 10	NR		Mah et al. 1989
Fraser River at Hansard (U/S)	1988		1 - 4	0.87	37.2	54.8	5.8	2.2	< 15	< 10	NR		Mah et al. 1989
Fraser River at Northwood mill (D/S)	1988		1 - 4	12	5.7	60.9	33.2	0.2	< 15	274	NR		Mah et al. 1989
Fraser River at Northwood mill (D/S)	1988		1 - 4	6.8	5	34.8	60.2	0	< 15	69.9	NR		Mah et al. 1989
Fraser River at Northwood mill (D/S)	1988		1 - 4	6.4	5.5	38.5	55.9	0	< 15	44.6	NR		Mah et al. 1989
Fraser River at Prince George (D/S)	1988		1 - 4	0.42	5.8	40.4	53.6	0.2	< 15	50.7	NR		Mah et al. 1989
Fraser River at Prince George (D/S)	1988		1 - 4	0.47	5.2	27	67.3	0.5	< 15	63.7	NR		Mah et al. 1989
Fraser River at Prince George (D/S)	1988		1 - 4	0.15	4	9.1	86.9	0	< 15	< 10	NR		Mah et al. 1989
Fraser River at Prince George (D/S)	1990		0 - 3	2^c	5.6	39.4	55	0	< 2.3	< 0.9	3.9	I-TEFs	Dwernychuk et al. 1991b
Fraser River at Prince George (D/S)	1990		0 - 3	2^c	6.6	38.4	55	0	< 2.8	< 2.1	5	I-TEFs	Dwernychuk et al. 1991b
Fraser River at Quesnel (U/S)	1988		1 - 4	NR	NR	NR	NR	NR	< 15	134	NR		Mah et al. 1989
Fraser River at Quesnel (U/S)	1988		1 - 4	0.59	9.2	46.5	44	0.3	< 15	< 10	NR		Mah et al. 1989
Fraser River at Quesnel (U/S)	1988		1 - 4	0.76	9.7	42.3	47.2	0.8	< 15	36.8	NR		Mah et al. 1989
Fraser River at Quesnel (D/S)	1988		1 - 4	0.67	10.8	28.3	59.5	1.4	< 15	195	NR		Mah et al. 1989

Table 20. Levels of T_4CDD, T_4CDF, and TEQ in freshwater sediments in Canada.

Location	Year	N	Sample Depth (cm)	TOC (% dw)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	T_4CDD ($ng \cdot kg^{-1}$) Mean (Range)	T_4CDF ($ng \cdot kg^{-1}$) Mean (Range)	TEQ ($ng \cdot kg^{-1}$) Mean (Range)	TEF Source	Reference
Fraser River at Quesnel (D/S)	1988		1 - 4	0.22	7.5	33.2	57.9	1.4	< 15	159	NR		Mah et al. 1989
Fraser River at Quesnel (D/S)	1988		1 - 4	0.15	12	14.3	46.5	27.2	< 15	120	NR		Mah et al. 1989
Fraser River at Quesnel (D/S)	1988		1 - 4	2.4	7.5	33.5	49.2	9.8	< 15	238	NR		Mah et al. 1989
Fraser River at Quesnel (D/S)	1988		1 - 4	0.22	3.4	5.8	89.9	0.9	< 15	36.6	NR		Mah et al. 1989
Fraser River at Quesnel (D/S)	1988		1 - 4	2.5	11.4	61.7	26.6	0.3	< 15	213	NR		Mah et al. 1989
Fraser River at Quesnel (U/S)	1990		0 - 3	2.2[b]	11.8	42.8	45.4	0	< 1.8	< 1.4	2.2	I-TEFs	Dwernychuk et al. 1991b
Fraser River at Quesnel (D/S)	1990		0 - 3	2.6[c]	9.8	41.8	48.4	0	< 2.9	2	4.5	I-TEFs	Dwernychuk et al. 1991b
Fraser River at Hansard	1990		0 - 3	2.3[c]	26.3	48.6	25.1	0	< 1	< 0.9	2.3	I-TEFs	Dwernychuk et al. 1991b
Fraser River at Stoner	1990		0 - 3	2.4[b]	5.8	34.8	59.4	0	< 1.4	< 1	2.5	I-TEFs	Dwernychuk et al. 1991b
Fraser River at Dog Creek	1990		0 - 3	2.3[c]	9	56	35	0	< 2.5	2	3.7	I-TEFs	Dwernychuk et al. 1991b
Fraser River at Hope	1990		0 - 3	3.3[c]	9.6	59.5	30.9	0	< 2.2	4.4	4.2	I-TEFs	Dwernychuk et al. 1991b
Fraser River at Mission	1990		0 - 3	4.1[c]	14.2	65.1	20.7	0	< 2	3.6	3.4	I-TEFs	Dwernychuk et al. 1991b
Fraser River at Mission (D/S)	1990		0 - 3	2.1[c]	6.9	41.6	51.5	0	< 1.3	3.9	6.3	I-TEFs	Dwernychuk et al. 1991b
North Arm of the Fraser River	1990		0 - 3	1.1[c]	2.4	7.4	90.2	0	< 1.1	< 0.9	6.3	I-TEFs	Dwernychuk et al. 1991b
South Arm of the Fraser River	1990		0 - 3	4.6[c]	17.2	75.8	7	0	< 1.8	7.8	3.8	I-TEFs	Dwernychuk et al. 1991b
Kootenay River at Cranbrook (U/S)	1988		1 - 4	5.4	6.2	27.9	65.9	0	< 15	< 10	NR		Mah et al. 1989
Kootenay River at Cranbrook (U/S)	1988		1 - 4	4.7	5.4	21.4	73.2	0	< 15	< 10	NR		Mah et al. 1989
Kootenay River at Cranbrook (D/S)	1988		1 - 4	13	8.5	54	37.5	0	< 15	2217	NR		Mah et al. 1989
Kootenay River at Cranbrook (D/S)	1988		1 - 4	4.2	5.9	20.9	73.2	0	< 15	77.9	NR		Mah et al. 1989

Table 20. Levels of T_4CDD, T_4CDF, and TEQ in freshwater sediments in Canada.

Location	Year	N	Sample Depth (cm)	TOC (% dw)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	T_4CDD ($ng \cdot kg^{-1}$) Mean (Range)	T_4CDF ($ng \cdot kg^{-1}$) Mean (Range)	TEQ ($ng \cdot kg^{-1}$) Mean (Range)	TEF Source	Reference
Kootenay River at Cranbrook (D/S)	1988		1 - 4	4.2	2	34.7	63.3	0	< 15	27.4	NR		Mah et al. 1989
Kootenay River at Cranbrook (D/S)	1988		1 - 4	4.2	12.4	28.2	59.4	0	< 15	< 10	NR		Mah et al. 1989
Kootenay River 29 km from Crestbrook (U/S)	Apr-90		0 - 2	1.2[c]	3.1	9.5	87.4	0	< 2.1	< 1.4	3.3	I-TEFs	Dwernychuk et al. 1991a
Kootenay River 5 km from Crestbrook (U/S)	Apr-90		0 - 2	1.6[c]	6.1	35.9	58	0	< 1.6	< 1.1	2.6	I-TEFs	Dwernychuk et al. 1991a
Kootenay River 5 km from Crestbrook (U/S)	Nov-90		0 - 2	1.8[c]	7.6	37.1	55.3	0	< 3.3	< 2.2	6.6	I-TEFs	Dwernychuk et al. 1991a
Kootenay River 800 m from Crestbrook (D/S)	Apr-90		0 - 2	1.9[c]	5.2	26	59	0	< 1.6	23	4.5	I-TEFs	Dwernychuk et al. 1991a
Kootenay River 800 m from Crestbrook (D/S)	Nov-90		0 - 2	1.8[c]	4.8	29.8	65.4	0	< 2.3	19	5.8	I-TEFs	Dwernychuk et al. 1991a
Kootenay River 3 km from Crestbrook (D/S)	Apr-90		0 - 2	1.4[c]	3.2	18.5	78.3	0	< 1.7	< 1.5	2.6	I-TEFs	Dwernychuk et al. 1991a
Kootenay River 3 km from Crestbrook (D/S)	Nov-90		0 - 2	1.0[c]	3	21.1	75.9	0	< 2.2	< 1.6	3.6	I-TEFs	Dwernychuk et al. 1991a
Kootenay River 3.9 km from Crestbrook (D/S)	Nov-90		0 - 2	0.8[c]	2.6	28.9	68.5	0	< 1.9	< 1.6	3.7	I-TEFs	Dwernychuk et al. 1991a
Kootenay River 4.8 km from Crestbrook (D/S)	Nov-90		0 - 2	1.4[c]	4.9	49.6	45.5	0	< 2.1	9.2	4.6	I-TEFs	Dwernychuk et al. 1991a
Kootenay River 15.8 km from Crestbrook (D/S)	Apr-90		0 - 2	1.7[c]	4.4	29.7	65.9	0	< 2	4.6	3.8	I-TEFs	Dwernychuk et al. 1991a
Kootenay River 15.8 km from Crestbrook (D/S)	Nov-90		0 - 2	0.9[c]	3.3	14.6	82.1	0	< 1.1	8.7	2.8	I-TEFs	Dwernychuk et al. 1991a
Kootenay River 30.3 km from Crestbrook (D/S)	Apr-90		0 - 2	1.9[c]	6.5	40.1	53.4	0	< 2.2	10	4.4	I-TEFs	Dwernychuk et al. 1991a
Kootenay River 50 km from Crestbrook (D/S)	Nov-90		0 - 2	0.5[c]	1.2	3	45.3	50.5	< 2.4	14.5	5.8	I-TEFs	Dwernychuk et al. 1991a
Kootenay River 86.5 km from Crestbrook (D/S)	Apr-90		0 - 2	1.6[c]	6.2	23.5	70.3	0	< 1.5	7.6	3.1	I-TEFs	Dwernychuk et al. 1991a
Kootenay River 86.5 km from Crestbrook (D/S)	Nov-90		0 - 2	0.7[c]	6.3	55	38.7	0	< 1.0	16	3.7	I-TEFs	Dwernychuk et al. 1991a

Table 20. Levels of T_4CDD, T_4CDF, and TEQ in freshwater sediments in Canada.

Location	Year	N	Sample Depth (cm)	TOC (% dw)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	T_4CDD ($ng \cdot kg^{-1}$) Mean (Range)	T_4CDF ($ng \cdot kg^{-1}$) Mean (Range)	TEQ ($ng \cdot kg^{-1}$) Mean (Range)	TEF Source	Reference
Kootenay River 119.5 km from Crestbrook (D/S)	Apr-90		0 - 2	2.4[c]	6	44.5	49.5	0	< 1.4	< 1.0	3.1	I-TEFs	Dwernychuk et al. 1991a
Kootenay River 167 km from Crestbrook (D/S)	Apr-90		0 - 2	4.4[c]	22.3	39.2	38.5	0	< 1.7	15.5	4.6	I-TEFs	Dwernychuk et al. 1991a
Kootenay River 167 km from Crestbrook (D/S)	Nov-90		0 - 2	0.8[c]	6.6	53.6	39.8	0	< 1.1	22	4.1	I-TEFs	Dwernychuk et al. 1991a
Skookumchuck Creek 6 km from Crestbrook (U/S)	Nov-90		0 - 2	0.7[c]	1.1	2.9	89.9	6.1	< 1.9	< 1.4	4.6	I-TEFs	Dwernychuk et al. 1991a
Skookumchuck Creek 2.6 km from Crestbrook (U/S)	Nov-90		0 - 2	2.0[c]	2.9	14	80.9	2.2	< 2.7	< 1.7	4.1	I-TEFs	Dwernychuk et al. 1991a
Columbia River at Arrow Lake	1988		1 - 4	0.29	-	4.1[b]	95	0.9	< 15	< 10	NR		Mah et al. 1989
Columbia River at Arrow Lake	1988		1 - 4	0.14	-	3.3[b]	95.2	1.5	< 15	< 10	NR		Mah et al. 1989
Columbia River at Arrow Lake	1988		1 - 4	0.92	6.7	39.2	52.5	1.6	< 15	< 10	NR		Mah et al. 1989
Columbia River at Castlegar	1988		1 - 4	21	3.2	37.3	59.5	0	< 15	642	NR		Mah et al. 1989
Columbia River at Castlegar	1988		1 - 4	4.7	5.4	55	39.6	0	< 15	298	NR		Mah et al. 1989
Columbia River at Castlegar	1988		1 - 4	1.1	3.8	37.2	58.9	0.1	< 15	100	NR		Mah et al. 1989
Fibrelco Pulp Inc. Peace River (U/S)	1989		bed sediment	1.34	15	27.8	57.2	0	<4	<4	NR		Tuominen & Sekela 1992
Fibrelco Pulp Inc. Peace River (U/S)	1989		bed sediment	1.35	8.6	19.1	72.1	0.2	<2	<2	NR		Tuominen & Sekela 1992
Fibrelco Pulp Inc. Peace River (U/S)	1989		bed sediment	1.18	11	40	49	0	<15	<15	NR		Tuominen & Sekela 1992
Fibrelco Pulp Inc. Peace River (U/S)	1989		bed sediment	1.08	7	38.8	54.2	0	<2	<2	NR		Tuominen & Sekela 1992
Fibrelco Pulp Inc. Peace River (U/S)	1989		bed sediment	1.15	12	24	64	0	<9	<9	NR		Tuominen & Sekela 1992
Fibrelco Pulp Inc. Peace River (U/S)	1989		bed sediment	0.88	9	32.2	58.8	0	<40	<40	NR		Tuominen & Sekela 1992
Petro-Canada Products (D/S)	1989		bed sediment	1.67	10.5	53.8	35.7	0	<20	<20	NR		Tuominen & Sekela 1992
Petro-Canada Products (D/S)	1989		bed sediment	1.26	9.2	41.7	49.1	0	<19	<19	NR		Tuominen & Sekela 1992
Petro-Canada Products (D/S)	1989		bed sediment	2.43	10.3	52.4	37.3	0	<14	<14	NR		Tuominen & Sekela 1992

Table 20. Levels of T_4CDD, T_4CDF, and TEQ in freshwater sediments in Canada.

Location	Year	N	Sample Depth (cm)	TOC (% dw)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	T_4CDD ($ng \cdot kg^{-1}$) Mean (Range)	T_4CDF ($ng \cdot kg^{-1}$) Mean (Range)	TEQ ($ng \cdot kg^{-1}$) Mean (Range)	TEF Source	Reference
Fibrelco Pulp Inc. (D/S)	1989		bed sediment	0.64	7.3	31.3	61.4	0	<12	<12	NR		Tuominen & Sekela 1992
Fibrelco Pulp Inc. (D/S)	1989		bed sediment	1.94	14.5	61.9	23.6	0	<7	<7	NR		Tuominen & Sekela 1992
Fibrelco Pulp Inc. (D/S)	1989		bed sediment	1.92	15.5	71.6	12.9	0	<6	<6	NR		Tuominen & Sekela 1992
Eurocan Pulp & Paper Co. (U/S)	1989		bed sediment	0.39	5.3	23.6	71.1	0	<4	<4	NR		Tuominen & Sekela 1992
Eurocan Pulp & Paper Co. (U/S)	1989		bed sediment	0.6	7	36.9	55.9	0.2	<4	<4	NR		Tuominen & Sekela 1992
Eurocan Pulp & Paper Co. (U/S)	1989		bed sediment	0.22	4.2	11.3	94.3	0.2	<2	<2	NR		Tuominen & Sekela 1992
Eurocan Pulp & Paper Co. (D/S)	1989		bed sediment	0.2	5.3	31.1	63.6	0	<2	<2	NR		Tuominen & Sekela 1992
Eurocan Pulp & Paper Co. (D/S)	1989		bed sediment	0.24	5.4	16.9	77.6	0.1	<2	<2	NR		Tuominen & Sekela 1992
Eurocan Pulp & Paper Co. (D/S)	1989		bed sediment	1.71	12	62.6	25.4	0	<1	<1	NR		Tuominen & Sekela 1992
Lower Fraser River Mills (U/S)	1989		bed sediment	0.24	6.2	25.3	68.5	0	<44	<44	NR		Tuominen & Sekela 1992
Lower Fraser River Mills (U/S)	1989		bed sediment	0.3	6.6	34.9	58.5	0	<23	<23	NR		Tuominen & Sekela 1992
Lower Fraser River Mills (U/S)	1989		bed sediment	0.64	10.3	77.7	12	0	<23	<23	NR		Tuominen & Sekela 1992
Scott Paper Ltd. (D/S)	1989		bed sediment	1.88	6.2	30.8	59.4	3.6	<13	24	NR		Tuominen & Sekela 1992
Scott Paper Ltd. (D/S)	1989		bed sediment	1.57	10.2	43.8	46	0	<15	19	NR		Tuominen & Sekela 1992
Scott Paper Ltd. (D/S)	1989		bed sediment	1.51	6.8	36.5	54.9	1.8	<10	<10	NR		Tuominen & Sekela 1992
Paperboard Industries Corp. (D/S)	1989		bed sediment	0.61	6.4	36.4	56	1.2	<6	22	NR		Tuominen & Sekela 1992
Paperboard Industries Corp. (D/S)	1989		bed sediment	1.02	14.3	53	32.7	0	<7	<7	NR		Tuominen & Sekela 1992
Paperboard Industries Corp. (D/S)	1989		bed sediment	1.91	10	55.9	34.1	0	<19	<19	NR		Tuominen & Sekela 1992

Table 20. Levels of T_4CDD, T_4CDF, and TEQ in freshwater sediments in Canada.

Location	Year	N	Sample Depth (cm)	TOC (% dw)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	T_4CDD ($ng \cdot kg^{-1}$) Mean (Range)	T_4CDF ($ng \cdot kg^{-1}$) Mean (Range)	TEQ ($ng \cdot kg^{-1}$) Mean (Range)	TEF Source	Reference
Alberta													
Wapiti River at Grand Prairie (U/S)	NR		1 - 4	1.24	24	43	33	0	< 2	< 2	16.3	I-TEFs	Trudel 1991
Wapiti River at Grand Prairie (D/S)	NR		1 - 4	1.17	24	43	33	0	< 6	36	19.4	I-TEFs	Trudel 1991
Athabasca River at Hinton	NR		1 - 4	0.75	8	88	4	0	< 1	< 1	16.3	I-TEFs	Trudel 1991
Athabasca River at Hinton	NR		1 - 4	5.87	11.9	45.8	42.3	0	< 2	7	16.4	I-TEFs	Trudel 1991
Athabasca River at Hinton	NR		1 - 4	2.04	11	77	12	0	< 5	< 5	16.3	I-TEFs	Trudel 1991
Maskuta Creek (U/S)	1992		suspended sediment	NR	NR	NR	NR	NR	0.2	NR	NR		Crosley 1996
Hinton Combined Effluent	1992		suspended sediment	NR	NR	NR	NR	NR	11	NR	NR		Crosley 1996
Weldwood Haul Bridge	1992	2	suspended sediment	NR	NR	NR	NR	NR	0.3	NR	NR		Crosley 1996
Obed Bridge	1992		suspended sediment	NR	NR	NR	NR	NR	0.8	NR	NR		Crosley 1996
Emerson Lakes Bridge	1992		suspended sediment	NR	NR	NR	NR	NR	1	NR	NR		Crosley 1996
Berland River (U/S)	1992		suspended sediment	NR	NR	NR	NR	NR	0.8	NR	NR		Crosley 1996
Windfall Bridge	1992		suspended sediment	NR	NR	NR	NR	NR	0.6	NR	NR		Crosley 1996
Maskuta Creek (U/S)	1993		suspended sediment	NR	NR	NR	NR	NR	<0.1	NR	NR		Crosley 1996
Hinton Combined Effluent	1993		suspended sediment	NR	NR	NR	NR	NR	24	NR	NR		Crosley 1996
Weldwood Haul Bridge	1993		suspended sediment	NR	NR	NR	NR	NR	3	NR	NR		Crosley 1996
Obed Bridge	1993	3	suspended sediment	NR	NR	NR	NR	NR	3.1	NR	NR		Crosley 1996
Emerson Lakes Bridge	1993		suspended sediment	NR	NR	NR	NR	NR	3.7	NR	NR		Crosley 1996
Berland River (U/S)	1993		suspended sediment	NR	NR	NR	NR	NR	2	NR	NR		Crosley 1996

Table 20. Levels of T_4CDD, T_4CDF, and TEQ in freshwater sediments in Canada.

Location	Year	N	Sample Depth (cm)	TOC (% dw)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	T_4CDD ($ng \cdot kg^{-1}$) Mean (Range)	T_4CDF ($ng \cdot kg^{-1}$) Mean (Range)	TEQ ($ng \cdot kg^{-1}$) Mean (Range)	TEF Source	Reference
Windfall Bridge	1993		suspended sediment	NR	NR	NR	NR	NR	1.5	NR	NR		Crosley 1996
Blue Ridge	1993		suspended sediment	NR	NR	NR	NR	NR	0.94	NR	NR		Crosley 1996
Alpac Site (U/S)	1993		suspended sediment	NR	NR	NR	NR	NR	0.45	NR	NR		Crosley 1996
Ft. McMurray (U/S)	1993		suspended sediment	NR	NR	NR	NR	NR	<0.18	NR	NR		Crosley 1996
At 27 Baseline	1993		suspended sediment	NR	NR	NR	NR	NR	<0.1	NR	NR		Crosley 1996
Maskuta Creek (U/S)	1992		depositional sediment	NR	NR	NR	NR	NR	<0.1	NR	NR		Crosley 1996
Weldwood Haul Bridge	1992		depositional sediment	NR	NR	NR	NR	NR	0.2	NR	NR		Crosley 1996
Obed Bridge	1992	2	depositional sediment	NR	NR	NR	NR	NR	0.4	NR	NR		Crosley 1996
Emerson Lakes Bridge	1992	2	depositional sediment	NR	NR	NR	NR	NR	0.4	NR	NR		Crosley 1996
Windfall Bridge	1992		depositional sediment	NR	NR	NR	NR	NR	0.4	NR	NR		Crosley 1996
Maskuta Creek (U/S)	1993		depositional sediment	NR	NR	NR	NR	NR	<0.13	NR	NR		Crosley 1996
Weldwood Haul Bridge	1993		depositional sediment	NR	NR	NR	NR	NR	0.23	NR	NR		Crosley 1996
Obed Bridge	1993		depositional sediment	NR	NR	NR	NR	NR	0.14	NR	NR		Crosley 1996
Emerson Lakes Bridge	1993		depositional sediment	NR	NR	NR	NR	NR	0.22	NR	NR		Crosley 1996
Berland River (U/S)	1993		depositional sediment	NR	NR	NR	NR	NR	0.29	NR	NR		Crosley 1996
Windfall Bridge	1993	2	depositional sediment	NR	NR	NR	NR	NR	0.17	NR	NR		Crosley 1996
Blue Ridge	1993		depositional sediment	NR	NR	NR	NR	NR	0.14	NR	NR		Crosley 1996

Table 20. Levels of T_4CDD, T_4CDF, and TEQ in freshwater sediments in Canada.

Location	Year	N	Sample Depth (cm)	TOC (% dw)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	T_4CDD ($ng \cdot kg^{-1}$) Mean (Range)	T_4CDF ($ng \cdot kg^{-1}$) Mean (Range)	TEQ ($ng \cdot kg^{-1}$) Mean (Range)	TEF Source	Reference
Alpac Site (U/S)	1993		depositional sediment	NR	NR	NR	NR	NR	0.12	NR	NR		Crosley 1996
Ft. McMurray (U/S)	1993		depositional sediment	NR	NR	NR	NR	NR	<0.25	NR	NR		Crosley 1996
Above Maskuta Creek	1993		suspended sediment	0.94	17.61	66.44	15.95	NR	0.41	0.51	NR		Crosley 1996
Weldwood Haul Bridge	1993		suspended sediment	4.6	40.59	57.64	1.76	NR	3.1	28	NR		Crosley 1996
Obed Bridge	1993		suspended sediment	4.6	41.88	50.01	8.11	NR	3.8	32	NR		Crosley 1996
Obed Bridge (Dup.)	1993		suspended sediment	4.6	41.88	50.01	8.11	NR	4.2	32	NR		Crosley 1996
Obed Bridge (Trip.)	1993		suspended sediment	4.6	41.88	50.01	8.11	NR	3.9	34	NR		Crosley 1996
Emerson Lakes Bridge	1993		suspended sediment	6.2	68.21	31.39	0.39	NR	6.4	33	NR		Crosley 1996
Above Berland River	1993		suspended sediment	NR	NR	NR	NR	NR	2.5	29	NR		Crosley 1996
Windfall Bridge	1993		suspended sediment	NR	NR	NR	NR	NR	2.4	23	NR		Crosley 1996
At Blue Ridge	1993		suspended sediment	8.7	51.67	46.22	2.11	NR	4.8	20	NR		Crosley 1996
At Athabasca	1993		suspended sediment	NR	NR	NR	NR	NR	140	130	NR		Crosley 1996
Alpac Site	1993		suspended sediment	5.6	NR	NR	NR	NR	6.1	7	NR		Crosley 1996
Above Ft. McMurray	1993		suspended sediment	6.2	NR	NR	NR	NR	2.7	7.7	NR		Crosley 1996
27 Baseline	1993		suspended sediment	4.9	77.13	21.99	0.88	NR	3	1.9	NR		Crosley 1996
Saskatchewan													
North Saskatchewan River at Prince Albert (D/S)	NR		1 - 4	2.17	7.1	17.8	74.4	0.7	< 2	< 2	16.4	I-TEFs	Trudel 1991

Table 20. Levels of T_4CDD, T_4CDF, and TEQ in freshwater sediments in Canada.

Location	Year	N	Sample Depth (cm)	TOC (% dw)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	T_4CDD ($ng \cdot kg^{-1}$) Mean (Range)	T_4CDF ($ng \cdot kg^{-1}$) Mean (Range)	TEQ ($ng \cdot kg^{-1}$) Mean (Range)	TEF Source	Reference
Manitoba													
Saskatchewan River at The Pas (U/S)	NR		1 - 4	NR	44	41.2	14.8	0	< 15	< 10	32	I-TEFs	Trudel 1991
Saskatchewan River at The Pas (D/S)	NR		1 - 4	NR	10	23.7	65.6	0.7	< 15	< 10	16.3	I-TEFs	Trudel 1991
Ontario													
St. Lawrence River at Cornwall (U/S)	NR		1 - 4	1.87	4.2	9	80.4	6.4	< 20	< 20	35.6	I-TEFs	Trudel 1991
St. Lawrence River at Cornwall (D/S)	NR		1 - 4	2.75	4.2	4.8	8.1	2.9	< 13	< 13	108.5	I-TEFs	Trudel 1991
St. Lawrence River at Cornwall (D/S)	NR		1 - 4	4.31	6.2	23.9	69.9	0	< 12	< 12	94.3	I-TEFs	Trudel 1991
Wabigoon Lake (U/S)	NR		1 - 4	6.93	2	43	36	0	< 20	< 10	18.8	I-TEFs	Trudel 1991
Wabigoon River (D/S)	NR		1 - 4	3.54	25	65	10	0	< 30	280	52.7	I-TEFs	Trudel 1991
Wabigoon River (D/S)	NR		1 - 4	4.8	41	54	5	0	66	1200	207.9	I-TEFs	Trudel 1991
Wabigoon River (D/S)	NR		1 - 4	7.52	10	7	83	0	< 10	72	34	I-TEFs	Trudel 1991
Wabigoon River (D/S)	NR		1 - 4	17.19	< 0.01	3.3	96.7	-	< 30	120	61.6	I-TEFs	Trudel 1991
Spanish River at Espanola	NR		1 - 4	1.91	9.3	28	61.7	1	< 2	< 2	18.2	I-TEFs	Trudel 1991
Spanish River at Espanola	NR		1 - 4	0.34	0	0.8	40.8	58.6	< 9	58	23.1	I-TEFs	Trudel 1991
Spanish River at Espanola	NR		1 - 4	0.57	0	0.2	40.6	59	< 2	31	20.2	I-TEFs	Trudel 1991
Lake Superior at Red Rock	1989		1 - 4	25.7	3	57	40	0	< 12	< 12	22.8	I-TEFs	Trudel 1991
Lake Superior at Red Rock	1986		1 - 4	3.26	27	63.6	9.4	0	< 4	12	270.4	I-TEFs	Trudel 1991
Lake Superior at Red Rock	1986		1 - 4	10	6	70	24	0	< 6	< 6	205.4	I-TEFs	Trudel 1991
Lake Superior at Red Rock	1986		1 - 4	13.4	5	60	35	0	< 5	20	266	I-TEFs	Trudel 1991
Lake Superior at Red Rock	1989		1 - 4	3.14	50	48.5	1.2	0.3	< 10	< 10	16.4	I-TEFs	Trudel 1991
Lake Superior at Red Rock	1989		1 - 4	7.72	15.2	48	36.8	0	< 18	< 18	36.4	I-TEFs	Trudel 1991
Old Welland Canal at Thorold (D/S)	NR		1 - 4	7.17	0	1.6	95.4	3	< 24	< 24	45.8	I-TEFs	Trudel 1991
Kaministiquia River (U/S)	NR		1 - 4	1.41	13.1	55.2	31.7	0	< 7	< 7	19.9	I-TEFs	Trudel 1991
Kaministiquia River (D/S)	NR		1 - 4	1.5	5.8	22	63.5	8.7	< 7	< 7	16.5	I-TEFs	Trudel 1991
Kaministiquia River (D/S)	NR		1 - 4	3.28	10	85.4	4.6	0	< 4	< 4	19.1	I-TEFs	Trudel 1991
Mattagami River (U/S)	NR		1 - 4	5.24	29	56.6	14.4	0	< 11	< 11	18.2	I-TEFs	Trudel 1991
Mattagami River (D/S)	NR		1 - 4	2.1	14.5	6.8	72.7	6	< 3	< 3	16.5	I-TEFs	Trudel 1991
Mattagami River (D/S)	NR		1 - 4	0.84	5.5	12.2	63.6	18.7	< 11	< 11	19.1	I-TEFs	Trudel 1991

Table 20. Levels of T_4CDD, T_4CDF, and TEQ in freshwater sediments in Canada.

Location	Year	N	Sample Depth (cm)	TOC (% dw)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	T_4CDD ($ng{\cdot}kg^{-1}$) Mean (Range)	T_4CDF ($ng{\cdot}kg^{-1}$) Mean (Range)	TEQ ($ng{\cdot}kg^{-1}$) Mean (Range)	TEF Source	Reference
Niagara River	NR		suspended sediment	NR	NR	NR	NR	NR	NR	ND - 412	NR		Hallett & Brooksbank 1986
Quebec													
Ottawa River at Témiscaming (D/S)	NR		1 - 4	3.75	1	11	88	0	< 1	< 3	17.3	I-TEFs	Trudel 1991
Ottawa River at Portage-du-Fort (D/S)	NR		1 - 4	4.12	20	64	16	0	< 8	8	20.8	I-TEFs	Trudel 1991
Ottawa River at Thurso (D/S)	NR		1 - 4	3.77	11	5	84	0	< 9	5	16.7	I-TEFs	Trudel 1991
Saguenay River at Jonquiére (D/S)	NR		1 - 4	1.22	10	47	43	0	< 1	< 1	16.3	I-TEFs	Trudel 1991
Quévillon River (D/S)	NR		1 - 4	3.81	41	43	16	0	43	57	63.9	I-TEFs	Trudel 1991
St. Maurice River at La Tuque (D/S)	NR		1 - 4	3.67	1	42	57	0	5	46	26.1	I-TEFs	Trudel 1991
St. Maurice River (U/S)	NR		1 - 4	1.5	0.04	44.5	55	0	< 1	25	19.6	I-TEFs	Trudel 1991
St. Maurice River at Cap de la Madeleine (D/S)	NR		1 - 4	0.04	0	0.2	97.9	1.9	< 9	< 9	28.3	I-TEFs	Trudel 1991
St. Maurice River at Cap de la Madeleine (D/S)	NR		1 - 4	0.03	0	0.1	100	0	< 18	< 18	45.6	I-TEFs	Trudel 1991
St. Lawerence River at Cap de la Madeleine (D/S)	NR		1 - 4	0.08	-	10.7[b]	87.9	2.4	< 17	< 17	31.6	I-TEFs	Trudel 1991
St. François River at Windsor (D/S)	NR		1 - 4	3.01	4	44	50	2	< 6	14	18.9	I-TEFs	Trudel 1991
St. Lawrence Estuary - Baie des Mille Vaches	1991		1 - 2	NR	NR	NR	NR	NR	0.5	7.2	NR		Brochu et al. 1995
St. Lawrence Estuary - Baie des Mille Vaches	1991		5 - 7	NR	NR	NR	NR	NR	0.9	8.3	NR		Brochu et al. 1995
St. Lawrence Estuary - Baie des Anglais	1991		1 - 2	NR	NR	NR	NR	NR	0.7	87	NR		Brochu et al. 1995
St. Lawrence Estuary - Baie des Anglais	1991		6 - 7	NR	NR	NR	NR	NR	2.5	115	NR		Brochu et al. 1995
Saguenay Fjord (<50 from major industries) (D/S)	1991		3 - 5	NR	NR	NR	NR	NR	ND	5	NR		Brochu et al. 1995
Saguenay Fjord (<50 from major industries) (D/S)	1991		5 - 7	NR	NR	NR	NR	NR	ND	1.6	NR		Brochu et al. 1995

Table 20. Levels of T_4CDD, T_4CDF, and TEQ in freshwater sediments in Canada.

Location	Year	N	Sample Depth (cm)	TOC (% dw)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	T_4CDD ($ng \cdot kg^{-1}$) Mean (Range)	T_4CDF ($ng \cdot kg^{-1}$) Mean (Range)	TEQ ($ng \cdot kg^{-1}$) Mean (Range)	TEF Source	Reference
New Brunswick													
Miramichi River at Newcastle (U/S)	NR		1 - 4	8.32	29.1	60.1	10.5	0.3	< 5	91	28.7	I-TEFs	Trudel 1991
Miramichi River at Newcastle (D/S)	NR		1 - 4	1.97	6.3	15.2	73.1	5.4	< 3	34	20.4	I-TEFs	Trudel 1991
Miramichi River at Newcastle (D/S)	NR		1 - 4	3.05	6	14	64	16	< 10	21	18.3	I-TEFs	Trudel 1991
Saint John River at Nackawic (U/S)	NR		1 - 4	2.12	10	67	23	0	< 2	< 2	19.7	I-TEFs	Trudel 1991
Saint John River at Nackawic (U/S)	NR		1 - 4	2.08	20	60	20	0	< 5	< 6	16.8	I-TEFs	Trudel 1991
Saint John River at Nackawic (D/S)	NR		1 - 4	4.95	9	75	16	0	< 2	18	43.5	I-TEFs	Trudel 1991
Saint John River at Nackawic (D/S)	NR		1 - 4	5.17	22	58	17	3	< 20	10	40.4	I-TEFs	Trudel 1991
Saint John River at Saint John (U/S)	NR		1 - 4	0.97	8	64	28	0	< 1	< 1	16.4	I-TEFs	Trudel 1991
Saint John River at Saint John (D/S)	NR		1 - 4	0.5	6	57	27	0	< 1	< 1	16.6	I-TEFs	Trudel 1991
Nova Scotia													
Saint John River at Edmunston (U/S)	NR		1 - 4	1.3	8	32.4	58	2	< 1	< 1	16.3	I-TEFs	Trudel 1991
Saint John River at Edmunston (U/S)	NR		1 - 4	3.18	8	71	21	0	< 1	5	18.2	I-TEFs	Trudel 1991
Restigouche River at Atholville (U/S)	NR		1 - 4	1.21	9	18	73	0	< 3	< 2	16.3	I-TEFs	Trudel 1991
Restigouche River at Atholville (D/S)	NR		1 - 4	2.5	17	56.7	19.5	6.8	< 6	< 4	16.4	I-TEFs	Trudel 1991

NR - not reported.
ND - not detected
N - number of samples used to calculate the mean
Location: U/S = upstream of pulp mill; D/S = downstream of pulp mill.

[redacted]

Table 20. Levels of T_4CDD, T_4CDF, and TEQ in freshwater sediments in Canada.

Location	Year	N	Sample Depth (cm)	TOC (% dw)	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	T_4CDD ($ng \cdot kg^{-1}$) Mean (Range)	T_4CDF ($ng \cdot kg^{-1}$) Mean (Range)	TEQ ($ng \cdot kg^{-1}$) Mean (Range)	TEF Source	Reference

Sediment size classes: clay = < 0.004 mm; silt = 0.004-0.062 mm; sand = 0.062 - 2 mm; gravel = 2-64 mm.

[a]background samples are believed to be indicative of ambient levels of dioxins and furans in the environment.
Secondary samples were collected from areas directly impacted by the primary source, and could be used to indicate movement of contaminants.

[b]combined clay and silt.

[c]loss on ignition (%).

[d]chemical sources - chlorophenol contamination (i.e., contaminated wood chips, power lines, rail lines, sawmill, spill sites) herbicide contamination, oil refineries, PCB contamination pulpmill landfill, sewage

[e]combustion sources - biomedical waste incineration, forest fire, industrial waste incineration, municipal waster incineration, PCB fire, pulpmill power boilers, scrap iron yard, pulpmill recovery boilers, sewage sludge incineration, smelter (primary, secondary), woodwaste burners

Table 21. Levels of T_4CDD, T_4CDF, and TEQ in marine sediments in Canada.

Location	Year	Sample Depth (cm)	TOC (% dry wt	Clay (%)[a]	Silt (%)[a]	Sand (%)[a]	Gravel (%)[a]	T_4CDD ($ng{\cdot}kg^{-1}$) (dw)	T_4CDF ($ng{\cdot}kg^{-1}$) (dw)	TEQ ($ng{\cdot}kg^{-1}$) (dw)	TEF Source	Reference
British Columbia												
Elk Falls - Discovery Passage	NR	1 - 4	9.5	NR	NR	NR	NR	< 3	22	99.4	I-TEFs	Trudel 1991
Elk Falls - Discovery Passage	NR	1 - 4	0.32	0.8	1.7	97.5	0	< 1	< 1	16.3	I-TEFs	Trudel 1991
Elk Falls - Discovery Passage	NR	1 - 4	0.17	1.2	3.1	90.2	5.4	<1	3	16.3	I-TEFs	Trudel 1991
Crofton - Georgia Strait	NR	1 - 4	0.47	3	10	82	5	<3	29	51.2	I-TEFs	Trudel 1991
Crofton - Georgia Strait	NR	1 - 4	5.81	9	41	50	0	15	726	1398	I-TEFs	Trudel 1991
Crofton - Georgia Strait	NR	1 - 4	8.2	5	56	39	0	11	478	539.5	I-TEFs	Trudel 1991
Nanaimo - Geogia Strait	NR	1 - 4	4.65	2	11	69	18	< 3	25	352.3	I-TEFs	Trudel 1991
Nanaimo - Geogia Strait	NR	1 - 4	NR	NR	NR	NR	NR	4	288	696.1	I-TEFs	Trudel 1991
Nanaimo - Geogia Strait	NR	1 - 4	NR	NR	NR	NR	NR	< 3	165	213.7	I-TEFs	Trudel 1991
Powell River - Georgia Strait	NR	1 - 4	NR	NR	NR	NR	NR	5	983	982.9	I-TEFs	Trudel 1991
Port Mellon - Howe Sound	NR	1 - 4	0.87	0	4	88	8	17	875	733.1	I-TEFs	Trudel 1991
Port Mellon - Howe Sound	NR	1 - 4	0.35	0	3	92	5	13	897	310.8	I-TEFs	Trudel 1991
Woodfibre - Howe Sound	NR	1 - 4	NR	NR	NR	NR	NR	27	2005	2142.5	I-TEFs	Trudel 1991
Woodfibre - Howe Sound	NR	1 - 4	4.46	10	67	23	0	9	3179	860.3	I-TEFs	Trudel 1991
Woodfibre - Howe Sound	NR	1 - 4	1.26	29	68	3	0	< 3	148	145	I-TEFs	Trudel 1991
Gold River - Muchalat Inlet	NR	1 - 4	7.01	1.3	6	62.9	29.8	< 3	360	169.1	I-TEFs	Trudel 1991
Gold River - Muchalat Inlet	NR	1 - 4	1.69	1.2	3	63.3	32.5	2	430	112	I-TEFs	Trudel 1991
Port Alberni - Alberni Inlet	NR	1 - 4	NR	NR	NR	NR	NR	8	326	1699	I-TEFs	Trudel 1991
Kitimat Arm - Douglas Channel	NR	1 - 4	0.06	4	74	22	0	< 7	< 7	34.3	I-TEFs	Trudel 1991
Kitimat Arm - Douglas Channel	NR	1 - 4	1.39	3	50	46.3	0.7	< 28	< 28	254.2	I-TEFs	Trudel 1991
Kitimat Arm - Douglas Channel	NR	1 - 4	4.75	0	0.4	99	0.6	< 6	< 6	27.9	I-TEFs	Trudel 1991
Port Alice - Neroutsos Inlet	NR	1 - 4	NR	NR	NR	NR	NR	< 4	64	96	I-TEFs	Trudel 1991
Port Alice - Neroutsos Inlet	NR	1 - 4	NR	NR	NR	NR	NR	< 4	13	50	I-TEFs	Trudel 1991
Prince Rupert - Hecate Strait	NR	1 - 4	1.96	41.8	55.7	2.5	0	< 4	340	128.7	I-TEFs	Trudel 1991
Prince Rupert - Hecate Strait	NR	1 - 4	1.61	36.8	61.2	2	0	25	860	449.9	I-TEFs	Trudel 1991
Nova Scotia												
New Glasgow - Northumberland Strait	NR	1 - 4	0.15	0	3	97	0	< 9	6	16.3	I-TEFs	Trudel 1991
New Glasgow - Northumberland Strait	NR	1 - 4	0.16	0	3	97	0	< 1	1	16.3	I-TEFs	Trudel 1991
Port Hawksbury - Strait of Canso	NR	1 - 4	4.43	NR	NR	NR	NR	< 2	< 2	67.6	I-TEFs	Trudel 1991
Port Hawksbury - Strait of Canso	NR	1 - 4	8.56	2	24	74	0	< 4	210	36.8	I-TEFs	Trudel 1991

NR = not reported

[a]Sediment size classes: clay = <0.004 mm; silt = 0.004-0.062 mm; sand = 0.062 - 2 mm; gravel = 2-64 mm.

Table 22. Scientific and common names of organisms included in this document.

Common Name	Species Name	Common Name	Species Name
Freshwater Fish		**Marine Fish**	
Alewife	*Alosa pseudoharengus*	Canary rockfish	*Sebastes maliger*
Brook trout	*Salvelinus fontinalis*	Chinook salmon	*Oncorhynchus tshawytscha*
Brown bullhead	*Ictalurus nebulosus*	Cod	*Gadus morhua*
Carp	*Cyprinus carpio*	Coho salmon	*Oncorhychus kisutch*
Channel catfish	*Ictalurus punctatus*	Dogfish	*Squalus acanthias*
Coast range sculpin	*Cottus aleuticus*	English sole	*Parophrys vetulus*
Cresent gunnel	*Pholis laeta*	Eulachon	*Thaleichthys pacificus*
Cutthroat trout	*Oncorhynchus clarki clarki*	Greenland halibut	*Reinharditus hippoglossoides*
Dolly varden	*Salvelinus malma*	Greenstripe rockfish	
Fathead minnow	*Pimephales promelas*	Pacific herring	
Goldfish	*Carassius auratus*	Pacific staghorn sculpin	*Leptcottus armatus*
Guppy	*Poecilia reticulata*	Peamouth chub	*Mylocheilus caurinus*
Kokanee	*Oncorhynchus nerka*	Pollock	*Pollachius virens*
Lake herring	*Coregonus artedii*	Quillback rockfish	*Sebastes maliger*
Lake trout	*Salvelinus namaycush*	Ratfish	*Hydrolagus colliei*
Lake whitefish	*Coregonus clupeaformis*	Red Irish lord	*Hemilepidotus hemilepidotus*
Largescale sucker	*Catostomus macrocheilus*	Red snapper	*Sebastes ruberrimus*
Longnose sucker	*Catostomus catostomus*	Redside shiner	*Richardsonius balteatus*
Medaka	*Oryzias latipes*	Rockfish	*Sebastes sp.*
Mountain whitefish	*Prosopium williamsoni*	Sculpin	*Cottus cognatus*
Northern pike	*Esox lucius*	Shiner perch	*Cymatogaster aggregata*
Northern squawfish	*Ptychocheilus oreogonensis*	Silverside	*Menidia berllina*
Plainfin midshipman	*Porichthys notatus*	Starry flounder	*Platichthys stellatus*
Prickly sculpin	*Cottus asper*	Threespine stickleback	*Gasterosteus aculeatus*
Rainbow trout	*Oncorhynchus mykiss*, formally *Salmo gairdneri*	Yellow eye rockfish	
Sculpin	*Cottus cognatus*	Cabezon	*Scorpaenichthys marmoratus*
Shiner perch	*Cymatogaster aggregata*	Lingcod	*Ophiodon elongatus*
Shiner perch	*Cymatogaster aggregata*	Kelp greenling	*Hexagrammos decagrammus*
Smallmouth bass	*Micropterus dolomieui*		
Smelt	*Osmerus mordax*		
Walleye	*Stizostedion vitreum*		
White sturgeon	*Acipenser transmontanus*		
White sucker	*Catostomus commersoni*		
Amphibians		**Reptiles**	
American toad	*Bufo americanus*	Snapping turtle	*Chelydra serpentina*
Bull frog	*Rana catesbeiana*		
Green frog	*Rana clamitans*		
Leopard frogs	*Rana pipiens*		

Table 22. Scientific and common names of organisms included in this document.

Common Name	Species Name	Common Name	Species Name
Freshwater Invertebrates		**Marine Invertebrates**	
Amphipod	*Hexagenia limbata*	Amphipod	*Ampelisca abdita*
Crayfish	*Pacificastus* spp.	Box crab	*Cancer* spp.
Midge	*Chironomus tentans*	Butter clam	*Saxidomas giganteus*
Mosquito	*Aedes aegypti*	Crab	*Chionoecetes opilio*
Mussels	*Elliptio complenata*	Dungeness crab	*Cancer magister*
Oligochaete	*Paranais* spp.	Littleneck clam	*Protothaca staminea*
Snails	*Helosoma* spp.	Lobster	*Homarus americanus*
Snails	*Physa* spp.	Mussel	*Mytilus* spp.
Water flea	*Daphnia magna*	Mysid	*Mysidopsis bahia*
		Oyster	*Crassostrea* spp.
Plants		Pacific oyster	*Crassostrea gigas*
Algae	*Oedogonium cardiacum*	Pink shrimp	*Penaeus duorarum*
Coontail	*Certophyllum emersum*	Red rock crab	*Cancer productus*
Duckweed	*Lemna minor*	Sea urchins	*Arabacia punctulata*
Slender waterweed	*Elodea nuttali*	Shrimp	*Pandalus borealis*
Macrophyte	*Ceratophyllum demersum*	Snow Crab	*Chionoecetes opilio*
		Softshell clam	*Mya arenaria*
		Whelk	*Buccinum undatum*
Marine Mammals		**Terrestrial Mammals**	
Beluga	*Delphinapterus leucas*	Caribou	*Rangifer tarandus*
Dall's Porpoise	*Phocoenoides dalli*	Mink	*Mustela vison*
False Killer Whale	*Pseudorca crassidens*	Muskrat	*Ondatra zibethicus*
Grey Whale	*Eschrichtius robustus*	Otter	*Lutra lutra*
Harbour porpoise	*Phocoena phocoena*		
Harbour seal	*Phoca vitulina*		
Killer Whale	*Orcinus orca*		
Narwhal	*Monodon monoceros*		
Pilot whale			
Polar bear	*Thalarctos maritimus*		
Ringed seal	*Phoca hispida*		
Risso's dolphin	*Grampus griseus*		
Walrus	*Odebenus rosmarus*		
White-beaked dolphin			

Table 22. Scientific and common names of organisms included in this document.

Common Name	Species Name	Common Name	Species Name
<u>Birds</u>			
Bald eagle chicks	*Haliaetus leucocephalus*	Greater scaup	*Aythya marila*
Bald eagle	*Haliaetus leucocephalus*	Harlequin duck	*Histrionicus histrionicus*
Barrow's goldeneye	*Bucephala islandica*	Herring gull	*Larus argentatus*
Bobwhite quail	*Colinus virginianus*	Hooded merganser	*Lophodytes cucullatus*
Bufflehead	*Bucephala albeola*	Lesser scaup	*Aythya affinis*
Canvasbacks	*Aythya valisineria*	Mallard duck	*Anas platyrhynchos*
Caspian Tern	*Hydroprogne caspia,* formally *Sterna caspia*	Night Heron	*Nycticorax nyticorax*
Common goldeneye	*Bucephala clangula*	Oldsquaw duck	*Clangula hyemalis*
Common merganser	*Mergus merganser*	Pied-billed grebe	*Podilymbus podiceps*
Common terns	*Sterna hirundo*	Red-necked grebe	*Podiceps grisegena*
Cormorants	*Phalacrocorax carbo*	Ringed turtle dove	*Streptopelia risoria*
Double-crested cormorants	*Phalacrocorax auritus*	Ring-necked pheasants	*Phasianus colchicus*
Eider Ducks	*Somateria mollissima*	Surf scoter	*Melanitta perspicillata*
Foster's Tern	*Sterna forsteri*	Western grebe	*Aechmorphus occidentalis*
Goldeneye	*Bucephala clangula*	White-winged scoter	*Melanitta fusca*
Great blue heron	*Ardea herodias*	Wood ducks	*Aix sponsa*

Table 23. Levels of T_4CDD, T_4CDF, and TEQ in freshwater invertebrates in Canada.

Location	Species	Year	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ ($ng \cdot kg^{-1}$) (ww)	TEF Source	Reference
British Columbia									
Kootenay River (U/S of mill)	Benthic macroinvertebrates	1990	whole	NR	< 0.7	1.3	1.6	NR	Dwernychuk et al. 1991a
Kootenay River (D/S of mill)	Benthic macroinvertebrates	1990	whole	NR	3.5	140	18	NR	Dwernychuk et al. 1991a
Side channel (D/S of mill)	Benthic macroinvertebrates	1990	whole	NR	17	1000	127.4	NR	Dwernychuk et al. 1991a
Fraser River	Crayfish	1992	muscle	21	<1.3	<0.69	0[a]	I-TEFs	Dwernychuk et al. 1993
Fraser River	Crayfish	1992	muscle	21	<1.2	<0.91	0[a]	I-TEFs	Dwernychuk et al. 1993
Fraser River	Crayfish	1992	epatopancrea	21	2.6	12	15.4[a]	I-TEFs	Dwernychuk et al. 1993
Ontario									
Frog Creek (U/S of disposal site)	Mussels	1986	whole	NR	< 4.0	< 3.6	NR	NR	Hayton et al. 1990
Frog Creek (D/S of disposal site)	Mussels	1986	whole	NR	2.3	2.7	NR	NR	Hayton et al. 1990
Stanjikoming Bay (D/S of disposal	Mussels	1986	whole	NR	< 1.2	< 2.4	NR	NR	Hayton et al. 1990

Location: U/S = upstream; D/S = downstream.
N = number of samples.
NR = not reported.
[a]TEQ is normalized to lipid weight

Table 24. Levels of T_4CDD, T_4CDF, and TEQ in marine invertebrates in Canada.

Location	Year	Species	Life Stage	Tissue	N	T_4CDD $(ng\cdot kg^{-1})$ (ww)	T_4CDF $(ng\cdot kg^{-1})$ (ww)	TEQ[ab] $(ng\cdot kg^{-1})$ (ww)	Lipid $(ng\cdot kg^{-1})$ (ww)	TEF Source	Reference
British Columbia											
Gold River mouth	NR	Dungeness & Redrock	NR	muscle	NR	5.4	420	44.5	1.11	WHO 1998	CPPA 1989
Gold River mouth	NR	Dungeness & Redrock	NR	hepatopancreas	NR	80	4400	403.75	4.27	WHO 1998	CPPA 1989
Cous Creek 6 km D/S Port Alberni,	NR	Dungeness crab	NR	muscle	NR	ND	2	0.14	0.77	WHO 1998	CPPA 1989
Cowichan Bay	NR	Dungeness crab	NR	muscle	NR	1.3	11	1.95	1.64	WHO 1998	CPPA 1989
Cowichan Bay	NR	Dungeness crab	NR	hepatopancreas	NR	12	221	59.97	9.63	WHO 1998	CPPA 1989
Port Alberni 1 km D/S outfall	NR	Dungeness crab	NR	hepatopancreas	NR	ND	6.6	0.95	2.02	WHO 1998	CPPA 1989
Powell River 1 km S of outfall	NR	Dungeness crab	NR	hepatopancreas	NR	ND	190	11.22	1.43	WHO 1998	CPPA 1989
Powell River outfall off of pulp mill docks	NR	Dungeness crab	NR	muscle	NR	ND	240	12.09	1.31	WHO 1998	CPPA 1989
Crofton B.C. 2.5 km S D/S outfall	NR	Little neck clams	NR	soft tissue	NR	ND	5.8	0.42	1.43	WHO 1998	CPPA 1989
Crofton, B.C.	NR	Little neck clams	NR	soft tissue	NR	ND	55	3.76	0.08	WHO 1998	CPPA 1989
Coastal outfall @ Crofton, B.C. 500 m W of mill outfall	NR	Oyster	NR	soft tissue	NR	16	350	101.91	0.66	WHO 1998	CPPA 1989
Crofton, B.C. 4.4 km NW of outfall	NR	Oyster	NR	soft tissue	NR	3.2	190	49.1	3.25	WHO 1998	CPPA 1989
Powell River outfall	NR	Oyster	NR	soft tissue	NR	7.8	1500	83.46	3.65	WHO 1998	CPPA 1989
Powell River outfall	NR	Pink shrimp	NR	muscle	NR	0.94	110	6.7	2.21	WHO 1998	CPPA 1989
Alberni, B.C.	NR	Prawn	NR	muscle	NR	ND	2	0.2	2.07	WHO 1998	CPPA 1989
Crofton	NR	Prawn	NR	muscle	NR	ND	16	0.8	NA	WHO 1998	CPPA 1989
Crofton, B.C. 4 km NW outfall	NR	Prawn	NR	muscle	NR	ND	20	1.11	NA	WHO 1998	CPPA 1989
Powell River outfall	NR	Prawn	NR	muscle	NR	ND	36	1.8	1.67	WHO 1998	CPPA 1989
Crofton, B.C.	NR	Shrimp	NR	muscle	NR	ND	28	1.5	7.67	WHO 1998	CPPA 1989
Crofton, B.C. 2 km SE outfall	NR	Shrimp	NR	muscle	NR	ND	38	1.99	10.64	WHO 1998	CPPA 1989
Prince Rupert 750 m N U/S	NR	Shrimp	NR	muscle	NR	26	710	72.36	1.99	WHO 1998	CPPA 1989
Prince Rupert 750 m S D/S	NR	Shrimp	NR	muscle	NR	20	580	49.83	1.31	WHO 1998	CPPA 1989
New Brunswick											
Miramichi River Estuary	1983	Lobster	ADT	digestive glands	8	< 2	190 - 270	29.85	NR	WHO 1998	Clement et al. 1987
Limestone Point, Chaleur Bay	1983	Lobster	ADT	digestive glands	4	< 2	160 - 170	43.1	NR	WHO 1998	Clement et al. 1987
Nova Scotia											
Sydney Harbour (South Arm)	1984	Lobster	ADT	digestive glands	5	< 2 - < 5	30 - 590	36.11	NR	WHO 1998	Clement et al. 1987
Sydney Harbour (Mouth)	1984	Lobster	ADT	digestive glands	4	< 4- <5	30 - 60	10.83	NR	WHO 1998	Clement et al. 1987
Port Morien (control)	1983	Lobster	ADT	digestive glands	5	< 3	37 - 85	9.81	NR	WHO 1998	Clement et al. 1987
Eastern Canada											
Baie des Anglais (BDA)	1991	Crab	NR	whole	1	1.7	40.5	2.54	NR	I-TEFs	Brochu et al. 1995
Baie des Anglais (BDA)	1991	Crab	NR	whole	1	1.5	28.4	2.31	NR	I-TEFs	Brochu et al. 1995
Baie des Mille Vaches (BMV)	1991	Crab	NR	whole	NR	1.2	5.7	2.19	NR	I-TEFs	Brochu et al. 1995
Baie des Anglais (BDA)	1991	Shrimp	NR	whole	10-25	ND	4.5	0.85	NR	I-TEFs	Brochu et al. 1995

Table 24. Levels of T_4CDD, T_4CDF, and TEQ in marine invertebrates in Canada.

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ[ab] ($ng \cdot kg^{-1}$) (ww)	Lipid ($ng \cdot kg^{-1}$) (ww)	TEF Source	Reference
Baie des Mille Vaches (BMV)	1991	Shrimp	NR	whole	10-25	ND	8.1	0.5	NR	I-TEFs	Brochu et al. 1995
Saguenay Fjord (few km D/S of p&p mill not using kraft bleaching	1991	Shrimp	NR	whole	1	ND	7	0.7	NR	I-TEFs	Brochu et al. 1995
Saguenay Fjord 20 (not receiving direct urban or industrial inputs)	1991	Shrimp	NR	whole	1	ND	6.2	0.47	NR	I-TEFs	Brochu et al. 1995
Saguenay Fjord 30 (not receiving direct urban or industrial inputs)	1991	Shrimp	NR	whole	1	ND	3.5	0.46	NR	I-TEFs	Brochu et al. 1995
Saguenay Fjord (few km D/S of p&p mill not using kraft bleaching	1991	Snow crab	NR	whole	1	4.4	36.5	2.99	NR	I-TEFs	Brochu et al. 1995
Saguenay Fjord 20 (not receiving direct urban or industrial inputs)	1991	Snow crab	NR	whole	1	3.9	27	2.38	NR	I-TEFs	Brochu et al. 1995
Saguenay Fjord 30 (not receiving direct urban or industrial inputs)	1991	Snow crab	NR	whole	1	1.9	15.4	1.69	NR	I-TEFs	Brochu et al. 1995
Baie des Anglais (BDA)	1991	Whelk	NR	whole	1	ND	26	1.84	NR	I-TEFs	Brochu et al. 1995
Baie des Anglais (BDA)	1991	Whelk	NR	whole	1	0.7	21.2	1.79	NR	I-TEFs	Brochu et al. 1995
Baie des Mille Vaches (BMV)	1991	Whelk	NR	whole	10-25	ND	1.4	0.23	NR	I-TEFs	Brochu et al. 1995

N = number of samples.
NR = not reported.
ND = not detected. Where detection limits (DL) are given, values reported as < DL have been changed to (DL/2) in the calculation of TEF.
ADT = adult

[a]TEQ calculations based on WHO 1998 TEFs for fish reported in van den Berg et al. 1998

[b]Half of the detection limit for those congeners not detected (ND) was used when calculating the TEQ

Table 25. Levels of PCDD/Fs and TEQ in freshwater fish in Canada

Location	Year	Species	Life Stage	Sex	Tissue	N	Total PCDD/F (ng·kg⁻¹) (ww)	TEQ_{fish}[abc] (ng·kg⁻¹) (ww)	TEQ_{mam}[ab] (ng·kg⁻¹) (ww)	TEQ_{avian}[ab] (ng·kg⁻¹) (ww)	Lipid (ng·kg⁻¹) (ww)	Reference
British Columbia												
Nicomekl, B.C.	1986	Brown bullhead	NR	NR	Regurgitated Prey	NR	10.00	2.07	2.32	3.02	1.6	Elliott et al. 1989
Eurocan Pulp & Paper Co.	1989	Coast range sculpin	NR	NR	muscle	NR	<208	CNR	CNR	CNR	4.2	Tuominen & Sekela 1992
Sidney Island, B.C.	1986	Cresent gunnel	NR	NR	Regurgitated Prey	NR	11.00	1.16	1.43	4.01	0.99	Elliott et al. 1989
Station CT1 - Fraser River between Hope and Mission	1992	Cutthroat trout	NR	NR	Muscle	1	5.25	0.50	0.62	3.32	NR	Dwernychuk et al. 1993
Station CT1 - Fraser River between Hope and Mission	1992	Cutthroat trout	NR	NR	Liver	1	2.99	0.27	0.34	1.88	NR	Dwernychuk et al. 1993
Station F1 - Kootenay River 39 km upstream Crestbrook	1990	Cutthroat Trout	NR	NR	Muscle	1	6.45	1.01	0.99	1.92	NR	Dwernychuk et al. 1991a
Station F1 - Kootenay River 39 km upstream Crestbrook	1990	Cutthroat Trout	NR	NR	Liver	1	9.85	1.03	1.04	2.93	NR	Dwernychuk et al. 1991a
Eurocan Pulp and Paper Co.	1989	Dolly varden	NR	NR	muscle	NR	<278	CNR	CNR	CNR	7.6	Tuominen & Sekela 1992
Eurocan Pulp and Paper Co.	1989	Dolly varden	NR	NR	muscle	NR	<102	CNR	CNR	CNR	7.6	Tuominen & Sekela 1992
Station F1 - Kootenay River 39 km upstream Crestbrook	1990	Dolly varden	NR	NR	Muscle	1	6.90	1.14	1.09	1.65	NR	Dwernychuk et al. 1991a
Station F1 - Kootenay River 39 km upstream Crestbrook	1990	Dolly varden	NR	NR	Liver	1	30.65	4.82	4.80	9.75	NR	Dwernychuk et al. 1991a
Station F2 - Kootenay River 1.3 km D/S Crestbrook discharge	1990	Dolly varden	NR	NR	Muscle	3 C	24.65	2.57	2.94	12.88	NR	Dwernychuk et al. 1991a
Station F2 - Kootenay River 1.3 km D/S Crestbrook discharge	1990	Dolly varden	NR	NR	Liver	3 C	31.20	4.73	3.93	21.90	NR	Dwernychuk et al. 1991a
Station F4 - Kootenay River 70 km D/S Crestbrook discharge	1990	Dolly varden	NR	NR	Muscle	3 C	27.65	2.71	3.05	12.98	NR	Dwernychuk et al. 1991a
Station F4 - Kootenay River 70 km D/S Crestbrook discharge	1990	Dolly varden	NR	NR	Liver	3 C	65.30	6.33	7.12	30.62	NR	Dwernychuk et al. 1991a
Station F5 - Kootenay River 80 km D/S Crestbrook discharge	1990	Dolly varden	NR	NR	Muscle	1	24.35	3.06	3.16	8.42	NR	Dwernychuk et al. 1991a
Station F5 - Kootenay River 80 km D/S Crestbrook discharge	1990	Dolly varden	NR	NR	Liver	1	26.85	2.59	1.70	19.68	NR	Dwernychuk et al. 1991a
Station R1 - Fraser River @ Hansard, B.C.	1990	Dolly varden	NR	NR	Muscle	3 C	12.25	1.53	1.68	1.78	NR	Dwernychuk et al. 1991b
Station R1 - Fraser River @ Hansard, B.C.	1990	Dolly varden	NR	NR	Liver	3 C	34.00	4.06	4.34	4.84	NR	Dwernychuk et al. 1991b
University of British Columbia	1986	Goldfish	NR	NR	Regurgitated Prey	NR	10.00	2.16	2.42	5.01	15.2	Elliott et al. 1989
Station F5 - Kootenay River 80 km D/S Crestbrook discharge	1990	Kokanee	NR	NR	Muscle	8 C	22.35	2.37	2.76	11.84	NR	Dwernychuk et al. 1991a

Table 25. Levels of PCDD/Fs and TEQ in freshwater fish in Canada

Location	Year	Species	Life Stage	Sex	Tissue	N	Total PCDD/F (ng·kg^{-1}) (ww)	TEQ$_{fish}$[abc] (ng·kg^{-1}) (ww)	TEQ$_{mam}$[ab] (ng·kg^{-1}) (ww)	TEQ$_{avian}$[ab] (ng·kg^{-1}) (ww)	Lipid (ng·kg^{-1}) (ww)	Reference
Station F5 - Kootenay River 80 km D/S Crestbrook discharge	1990	Kokanee	NR	NR	Liver	8 C	32.10	4.27	3.81	16.10	NR	Dwernychuk et al. 1991a
Station F6 - Kootenay River 160 km D/S Crestbrook	1990	Kokanee	NR	NR	Muscle	1	13.35	1.62	1.88	7.70	NR	Dwernychuk et al. 1991a
Station F6 - Kootenay River 160 km D/S Crestbrook	1990	Kokanee	NR	NR	Liver	1	29.40	1.54	2.22	15.76	NR	Dwernychuk et al. 1991a
Columbia River U/S of Celgar pulp mill	1990	Lake whitefish	32-36 cm	M/F	muscle	3	122.10		19.7 / 18.5[d]			EVS 1991
Columbia River at Lower Arrow Lake	1990	Largescale sucker	33 cm	M/F	muscle	6 C	1.40		4.2 / 0.5[d]		3.5	EVS 1991
Columbia River at Lower Arrow Lake	1990	Largescale sucker	33 cm	M/F	liver	6 C	1.80		3.0 / 0.0[d]		3.5	EVS 1991
Columbia River D/S of Celgar pulp mill	1990	Largescale sucker	44-52 cm	M/F	muscle	6 C	42.30		5.9 / 4.5[d]		3	EVS 1991
Columbia River D/S of Celgar pulp mill	1990	Largescale sucker	44-52 cm	M/F	liver	6 C	83.80		19.7 / 16.4[d]		3.5	EVS 1991
Columbia River D/S of Kootenay River	1990	Largescale sucker	51 cm	M/F	muscle	5 C	6.00		4.8 / 0.5[d]		2.5	EVS 1991
Columbia River D/S of Kootenay River	1990	Largescale sucker	51 cm	M/F	liver	5 C	106.50		19.4 / 16.5d		2.5	EVS 1991
Columbia River D/S of Trail	1990	Largescale sucker	47 cm	M/F	muscle	9 C	24.00		6.6 / 2.3[d]		5.5	EVS 1991
Columbia River D/S of Trail	1990	Largescale sucker	47 cm	M/F	liver	9 C	76.40		14.3 / 11.6[d]		4.5	EVS 1991
Columbia River U/S of Trail	1990	Largescale sucker	50 cm	NR	muscle	6 C	24.60		5.2 / 2.7[d]		2.5	EVS 1991
Columbia River U/S of Trail	1990	Largescale sucker	50 cm	NR	liver	6 C	76.20		15.6 / 12.3[d]		6.5	EVS 1991
Fibrelco Pulp Inc. (D/S)	1989	Largescale sucker	NR	NR	muscle	NR	<139	CNR	CNR	CNR	5.1	Tuominen & Sekela 1992
Lower Fraser River Mills (U/S)	1989	Largescale sucker	NR	NR	muscle	NR	<55.6	CNR	CNR	CNR	4	Tuominen & Sekela 1992
Paperboard Industries Corp.	1989	Largescale sucker	NR	NR	muscle	NR	<62	CNR	CNR	CNR	3.2	Tuominen & Sekela 1992
Scott Paper Ltd. (D/S)	1989	Largescale sucker	NR	NR	muscle	NR	<32	CNR	CNR	CNR	3.8	Tuominen & Sekela 1992
Site 96CBF1 - Kootenay R. upstream of Crestbrook Forest Industry Mill.	1996	Largescale sucker	NR	NR	Muscle	4 C	5.20	0.51	0.59	2.60	1.4	Dwernychuk et al. 1996
Site 96CBF2 - Kootenay River, Skookumchuck bridge (D/S of	1996	Largescale sucker	NR	NR	Muscle	4 C	10.90	0.98	1.34	8.30	1.4	Dwernychuk et al. 1996
Site 96CBF2 - Kootenay River, Skookumchuck bridge (D/S of	1996	Largescale sucker	NR	NR	Liver	4 C	44.50	4.55	6.47	41.90	7.5	Dwernychuk et al. 1996

Table 25. Levels of PCDD/Fs and TEQ in freshwater fish in Canada

Location	Year	Species	Life Stage	Sex	Tissue	N	Total PCDD/F (ng·kg⁻¹) (ww)	TEQ_{fish} [abc] (ng·kg⁻¹) (ww)	TEQ_{mam} [ab] (ng·kg⁻¹) (ww)	TEQ_{avian} [ab] (ng·kg⁻¹) (ww)	Lipid (ng·kg⁻¹) (ww)	Reference
Site 96CBF3 - Kootenay River-Bummers Flats (U/S of Fort Steele,B.C.)	1996	Largescale sucker	NR	NR	Muscle	2 C	8.15	0.64	0.86	5.30	0.97	Dwernychuk et al. 1996
Site 96CBF3 - Kootenay River-Bummers Flats (U/S of Fort Steele,B.C.)	1996	Largescale sucker	NR	NR	Liver	2 C	22.60	1.95	2.87	20.00	7.2	Dwernychuk et al. 1996
Site 96CBF4 - Wardner (Koocanusa Lake)	1996	Largescale sucker	NR	NR	Muscle	1	6.00	0.56	0.62	2.63	1.3	Dwernychuk et al. 1996
Site 96CBF4 - Wardner (Koocanusa Lake)	1996	Largescale sucker	NR	NR	Liver	1	24.60	1.41	1.61	6.98	4.9	Dwernychuk et al. 1996
Site 96CBS1 - Kootenay R. upstream of Crestbrook Forest Industry Mill.	1996	Largescale sucker	NR	NR	Liver	4 C	10.50	1.06	1.39	7.90	5.6	Dwernychuk et al. 1996
Station F2 - Kootenay River 1.3 km D/S Crestbrook discharge	1990	Largescale sucker	NR	NR	Muscle	3 C	64.05	9.17	11.54	56.34	NR	Dwernychuk et al. 1991a
Station F2 - Kootenay River 1.3 km D/S Crestbrook discharge	1990	Largescale sucker	NR	NR	Liver	3 C	220.40	32.47	40.01	186.79	NR	Dwernychuk et al. 1991a
Station F3 - Kootenay River 35 km D/S Crestbrook discharge	1990	Largescale sucker	NR	NR	Muscle	6 C	20.15	2.04	2.32	9.61	NR	Dwernychuk et al. 1991a
Station F3 - Kootenay River 35 km D/S Crestbrook discharge	1990	Largescale sucker	NR	NR	Liver	6 C	60.95	8.27	10.14	47.14	NR	Dwernychuk et al. 1991a
Station F4 - Kootenay River 70 km D/S Crestbrook discharge	1990	Largescale sucker	NR	NR	Muscle	5 C	10.70	1.44	1.26	5.97	NR	Dwernychuk et al. 1991a
Station F4 - Kootenay River 70 km D/S Crestbrook discharge	1990	Largescale sucker	NR	NR	Liver	5 C	78.80	10.35	12.27	53.74	NR	Dwernychuk et al. 1991a
Station F5 - Kootenay River 80 km D/S Crestbrook discharge	1990	Largescale sucker	NR	NR	Muscle	2 C	9.85	1.49	1.50	3.53	NR	Dwernychuk et al. 1991a
Station F5 - Kootenay River 80 km D/S Crestbrook discharge	1990	Largescale sucker	NR	NR	Liver	2 C	41.65	4.53	5.36	25.27	NR	Dwernychuk et al. 1991a
Station F6 - Kootenay River 160 km D/S Crestbrook	1990	Largescale sucker	NR	NR	Muscle	1	7.20	1.20	1.13	1.62	NR	Dwernychuk et al. 1991a
Station F6 - Kootenay River 160 km D/S Crestbrook	1990	Largescale sucker	NR	NR	Liver	1	24.85	2.41	3.26	19.47	NR	Dwernychuk et al. 1991a
Station R1 - Fraser River @ Hansard, B.C.	1990	Largescale sucker	NR	NR	Muscle	3 C	24.00	3.74	4.08	4.32	NR	Dwernychuk et al. 1991b
Station R1 - Fraser River @ Hansard, B.C.	1990	Largescale sucker	NR	NR	Liver	3 C	29.25	4.11	4.47	4.65	NR	Dwernychuk et al. 1991b

Table 25. Levels of PCDD/Fs and TEQ in freshwater fish in Canada

Location	Year	Species	Life Stage	Sex	Tissue	N	Total PCDD/F ($ng \cdot kg^{-1}$) (ww)	TEQ_{fish} [abc] ($ng \cdot kg^{-1}$) (ww)	TEQ_{mam} [ab] ($ng \cdot kg^{-1}$) (ww)	TEQ_{avian} [ab] ($ng \cdot kg^{-1}$) (ww)	Lipid ($ng \cdot kg^{-1}$) (ww)	Reference
Station R12 - Thompson River @ McLure, B.C.	1990	Largescale sucker	NR	NR	Muscle	6 C	11.55	2.11	2.18	3.07	NR	Dwernychuk et al. 1991b
Station R12 - Thompson River @ McLure, B.C.	1990	Largescale sucker	NR	NR	Liver	6 C	24.60	3.53	3.46	7.46	NR	Dwernychuk et al. 1991b
Station R3- Fraser River below Prince George, B.C.	1990	Largescale sucker	NR	NR	Muscle	6 C	20.95	3.61	3.82	4.83	NR	Dwernychuk et al. 1991b
Station R3- Fraser River below Prince George, B.C.	1990	Largescale sucker	NR	NR	Liver	6 C	85.15	40.70	39.93	56.67	NR	Dwernychuk et al. 1991b
Station R4 - Fraser River @ Stoner, B.C.	1990	Largescale sucker	NR	NR	Muscle	6 C	23.10	3.24	3.44	4.60	NR	Dwernychuk et al. 1991b
Station R4 - Fraser River @ Stoner, B.C.	1990	Largescale sucker	NR	NR	Liver	6 C	49.25	5.45	4.63	24.95	NR	Dwernychuk et al. 1991b
Fibrelco Pulp Inc. (D/S)	1989	Longnose sucker	NR	NR	muscle	NR	<172	CNR	CNR	CNR	6.4	Tuominen & Sekela 1992
Fibrelco Pulp Inc. U/S Peace	1989	Longnose sucker	NR	NR	muscle	NR	<132	CNR	CNR	CNR	4.4	Tuominen & Sekela 1992
Fibrelco Pulp Inc. U/S Pine	1989	Longnose sucker	NR	NR	muscle	NR	<106	CNR	CNR	CNR	2.5	Tuominen & Sekela 1992
Station F1 - Kootenay River 39 km upstream Crestbrook	1990	Longnose sucker	NR	NR	Muscle	2 C	6.75	1.13	1.05	1.22	NR	Dwernychuk et al. 1991a
Station F1 - Kootenay River 39 km upstream Crestbrook	1990	Longnose sucker	NR	NR	Liver	2 C	18.30	2.05	1.76	1.88	NR	Dwernychuk et al. 1991a
Columbia River D/S of Celgar pulp mill	1990	Mountain whitefish	31-35 cm	F	muscle	6 C	137.50		19.4 / 16.5[d]		3	EVS 1991
Columbia River D/S of Celgar pulp mill	1990	Mountain whitefish	31-35 cm	F	liver	6 C	39.80		10.1 / 7.4[d]		4	EVS 1991
Columbia River D/S of Kootenay River	1990	Mountain whitefish	37 cm	M/F	muscle	6 C	84.40		14.0 / 10.6[d]		3.5	EVS 1991
Columbia River D/S of Kootenay River	1990	Mountain whitefish	37 cm	M/F	liver	6 C	77.80		19.9 / 13.8[d]		4	EVS 1991
Columbia River U/S of Trail	1990	Mountain whitefish	36 cm	M/F	muscle	6 C	186.10		26.1 / 24.1[d]		3	EVS 1991
Columbia River U/S of Trail	1990	Mountain whitefish	36 cm	M/F	liver	6 C	75.90		13.4 / 10.2[d]		4	EVS 1991
Columbia RiverD/S of Trail	1990	Mountain whitefish	34 cm	M/F	muscle	9 C	225.50		31.9 / 27.5[d]		3	EVS 1991
Columbia RiverD/S of Trail	1990	Mountain whitefish	34 cm	M/F	liver	9 C	54.40		11.6 / 5.3[d]		4.5	EVS 1991
Fibrelco Pulp Inc. U/S Peace	1989	Mountain whitefish	NR	NR	muscle	NR	<358	CNR	CNR	CNR	8.4	Tuominen & Sekela 1992
Fibrelco Pulp Inc. U/S Pine	1989	Mountain whitefish	NR	NR	muscle	NR	<142	CNR	CNR	CNR	7.3	Tuominen & Sekela 1992
Site 96CBS1 - Kootenay R. upstream of Crestbrook Forest Industry Mill.	1996	Mountain whitefish	NR	NR	Muscle	6 C	22.90	1.40	2.37	20.40	2	Dwernychuk et al. 1996

Table 25. Levels of PCDD/Fs and TEQ in freshwater fish in Canada

Location	Year	Species	Life Stage	Sex	Tissue	N	Total PCDD/F (ng·kg^{-1}) (ww)	TEQ_{fish}[abc] (ng·kg^{-1}) (ww)	TEQ_{mam}[ab] (ng·kg^{-1}) (ww)	TEQ_{avian}[ab] (ng·kg^{-1}) (ww)	Lipid (ng·kg^{-1}) (ww)	Reference
Site 96CBS1 - Kootenay R. upstream of Crestbrook Forest Industry Mill.	1996	Mountain whitefish	NR	NR	Liver	6 C	30.35	2.29	3.11	20.29	2.9	Dwernychuk et al. 1996
Site 96CBS2 - Kootenay River, Skookumchuck bridge (D/S of	1996	Mountain whitefish	NR	NR	Muscle	6 C	30.50	2.25	3.57	27.90	2	Dwernychuk et al. 1996
Site 96CBS2 - Kootenay River, Skookumchuck bridge (D/S of	1996	Mountain whitefish	NR	NR	Liver	6 C	45.60	3.42	5.13	37.60	4.6	Dwernychuk et al. 1996
Site 96CBS3 - Kootenay River-Bummers Flats (U/S of Fort Steele,B.C.)	1996	Mountain whitefish	NR	NR	Muscle	6 C	31.50	2.30	3.67	28.90	2.2	Dwernychuk et al. 1996
Site 96CBS3 - Kootenay River-Bummers Flats (U/S of Fort Steele,B.C.)	1996	Mountain whitefish	NR	NR	Liver	6 C	35.95	3.06	4.26	27.73	3.6	Dwernychuk et al. 1996
Site 96CBS4 - Wardner (Koocanusa Lake)	1996	Mountain whitefish	NR	NR	Muscle	6 C	17.20	1.37	2.04	14.65	0.94	Dwernychuk et al. 1996
Site 96CBS4 - Wardner (Koocanusa Lake)	1996	Mountain whitefish	NR	NR	Liver	6 C	40.80	3.56	4.70	28.19	2.3	Dwernychuk et al. 1996
Station F1 - Kootenay River 39 km upstream Crestbrook	1990	Mountain whitefish	NR	NR	Muscle	6 C	38.60	3.22	4.74	33.56	NR	Dwernychuk et al. 1991a
Station F1 - Kootenay River 39 km upstream Crestbrook	1990	Mountain whitefish	NR	NR	Liver	6 C	35.15	4.17	4.74	19.27	NR	Dwernychuk et al. 1991a
Station F2 - Kootenay River 1.3 km D/S Crestbrook discharge	1990	Mountain whitefish	NR	NR	Muscle	9 C	46.70	3.79	5.58	39.79	NR	Dwernychuk et al. 1991a
Station F2 - Kootenay River 1.3 km D/S Crestbrook discharge	1990	Mountain whitefish	NR	NR	Liver	9 C	98.65	7.52	10.29	67.92	NR	Dwernychuk et al. 1991a
Station F3 - Kootenay River 35 km D/S Crestbrook discharge	1990	Mountain whitefish	NR	NR	Muscle	8	56.65	4.82	7.19	51.34	NR	Dwernychuk et al. 1991a
Station F3 - Kootenay River 35 km D/S Crestbrook discharge	1990	Mountain whitefish	NR	NR	Liver	8	61.90	6.15	8.32	50.75	NR	Dwernychuk et al. 1991a
Station F4 - Kootenay River 70 km D/S Crestbrook discharge	1990	Mountain whitefish	NR	NR	Muscle	5 C	47.60	3.15	4.85	37.29	NR	Dwernychuk et al. 1991a
Station F4 - Kootenay River 70 km D/S Crestbrook discharge	1990	Mountain whitefish	NR	NR	Liver	5 C	54.25	4.69	3.35	31.78	NR	Dwernychuk et al. 1991a
Station F5 - Kootenay River 80 km D/S Crestbrook discharge	1990	Mountain whitefish	NR	NR	Muscle	5 C	56.05	5.90	3.48	50.93	NR	Dwernychuk et al. 1991a
Station F5 - Kootenay River 80 km D/S Crestbrook discharge	1990	Mountain whitefish	NR	NR	Liver	5 C	123.00	15.92	10.47	114.94	NR	Dwernychuk et al. 1991a

Table 25. Levels of PCDD/Fs and TEQ in freshwater fish in Canada

Location	Year	Species	Life Stage	Sex	Tissue	N	Total PCDD/F ($ng \cdot kg^{-1}$) (ww)	TEQ_{fish} [abc] ($ng \cdot kg^{-1}$) (ww)	TEQ_{mam} [ab] ($ng \cdot kg^{-1}$) (ww)	TEQ_{avian} [ab] ($ng \cdot kg^{-1}$) (ww)	Lipid ($ng \cdot kg^{-1}$) (ww)	Reference
Station F6 - Kootenay River 160 km D/S Crestbrook	1990	Mountain whitefish	NR	NR	Muscle	1	16.85	1.85	2.17	9.86	NR	Dwernychuk et al. 1991a
Station F6 - Kootenay River 160 km D/S Crestbrook	1990	Mountain whitefish	NR	NR	Liver	1	20.60	2.01	2.28	9.26	NR	Dwernychuk et al. 1991a
Station R10 - Fraser River @ Lillooet, B.C.	1995	Mountain whitefish	NR	NR	Muscle	6 C	4.40	0.49	0.49	1.33	3.2	Dwernychuk et al. 1995
Station R10 - Fraser River @ Lillooet, B.C.	1995	Mountain whitefish	NR	NR	Liver	6 C	7.35	0.74	0.75	2.05	2.9	Dwernychuk et al. 1995
Station R10 - Fraser River near Lillooet, B.C.	1992	Mountain whitefish	NR	NR	Muscle	6 C	5.40	0.98	1.00	1.76	NR	Dwernychuk et al. 1993
Station R10 - Fraser River near Lillooet, B.C.	1992	Mountain whitefish	NR	NR	Liver	6 C	12.95	2.57	2.60	4.57	NR	Dwernychuk et al. 1993
Station R11 - Thompson River @ Chase/Monte Creek	1990	Mountain whitefish	NR	NR	Muscle	6 C	33.50	9.42	8.49	27.51	NR	Dwernychuk et al. 1991b
Station R11 - Thompson River @ Chase/Monte Creek	1990	Mountain whitefish	NR	NR	Liver	38 C	51.75	15.25	14.05	39.67	NR	Dwernychuk et al. 1991b
Station R12 - Thompson River @ McClure, B.C.	1995	Mountain whitefish	NR	NR	Muscle	6 C	12.30	1.08	1.46	9.23	6	Dwernychuk et al. 1995
Station R12 - Thompson River @ McLure, B.C.	1990	Mountain whitefish	NR	NR	Muscle	6 C	208.30	47.95	39.55	201.07	NR	Dwernychuk et al. 1991b
Station R12 - Thompson River @ McLure, B.C.	1990	Mountain whitefish	NR	NR	Liver	17 C	164.00	47.32	41.43	155.48	NR	Dwernychuk et al. 1991b
Station R13 - Thompson River @ Kamloops/Tranquille, B.C.	1990	Mountain whitefish	NR	NR	Muscle	6 C	185.45	50.34	43.45	177.07	NR	Dwernychuk et al. 1991b
Station R13 - Thompson River @ Kamloops/Tranquille, B.C.	1990	Mountain whitefish	NR	NR	Liver	7 C	351.60	115.99	104.14	332.17	NR	Dwernychuk et al. 1991b
Station R14 - Thompson River @ Savona/Walhachin B.C.	1990	Mountain whitefish	NR	NR	Muscle	6 C	115.80	26.08	21.64	108.06	NR	Dwernychuk et al. 1991b
Station R14 - Thompson River @ Savona/Walhachin B.C.	1990	Mountain whitefish	NR	NR	Liver	9 C	279.65	109.88	102.12	254.38	NR	Dwernychuk et al. 1991b
Station R14 - Thompson River @ Walhachin, B.C.	1995	Mountain whitefish	NR	NR	Muscle	6 C	14.75	1.35	1.87	11.80	5.1	Dwernychuk et al. 1995
Station R14 - Thompson River @ Walhachin, B.C.	1995	Mountain whitefish	NR	NR	Liver	6 C	18.10	1.88	2.29	11.16	3.8	Dwernychuk et al. 1995
Station R14 - Thompson River near Walhachin, B.C.	1992	Mountain whitefish	NR	NR	Muscle	6 C	14.90	2.46	2.85	10.26	NR	Dwernychuk et al. 1993

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Location	Year	Species	Life Stage	Sex	Tissue	N	Total PCDD/F (ng·kg^{-1}) (ww)	TEQ_{fish} [abc] (ng·kg^{-1}) (ww)	TEQ_{mam} [ab] (ng·kg^{-1}) (ww)	TEQ_{avian} [ab] (ng·kg^{-1}) (ww)	Lipid (ng·kg^{-1}) (ww)	Reference
Station R14 - Thompson River near Walhachin, B.C.	1992	Mountain whitefish	NR	NR	Liver	6 C	18.00	3.31	3.69	11.71	NR	Dwernychuk et al. 1993
Station R16 - Fraser River @ Hope, B.C.	1995	Mountain whitefish	NR	NR	Muscle	6 C	4.80	0.51	0.53	1.73	3	Dwernychuk et al. 1995
Station R16 - Fraser River @ Hope, B.C.	1995	Mountain whitefish	NR	NR	Liver	6 C	6.80	0.72	0.72	1.75	2.9	Dwernychuk et al. 1995
Station R16 - Fraser River near Hope, B.C.	1992	Mountain whitefish	NR	NR	Muscle	6 C	10.40	2.27	2.28	4.14	NR	Dwernychuk et al. 1993
Station R16 - Fraser River near Hope, B.C.	1992	Mountain whitefish	NR	NR	Liver	6 C	49.35	5.15	5.15	11.59	NR	Dwernychuk et al. 1993
Station R17 - Fraser River @ Mission, B.C.	1995	Mountain whitefish	NR	NR	Muscle	6 C	4.55	0.45	0.46	1.48	3	Dwernychuk et al. 1995
Station R2 - Nechako River	1995	Mountain whitefish	NR	NR	Muscle	6 C	3.50	0.45	0.41	0.53	3.8	Dwernychuk et al. 1995
Station R2 - Nechako River	1995	Mountain whitefish	NR	NR	Liver	6 C	7.05	0.85	0.79	1.03	2.5	Dwernychuk et al. 1995
Station R4 - Fraser River @ Stoner, B.C.	1990	Mountain whitefish	NR	NR	Muscle	3 C	167.60	53.60	47.79	144.19	NR	Dwernychuk et al. 1991b
Station R4 - Fraser River @ Stoner, B.C.	1990	Mountain whitefish	NR	NR	Liver	3 C	223.80	79.10	72.86	155.88	NR	Dwernychuk et al. 1991b
Station R4 - Fraser River @ Stoner, B.C.	1995	Mountain whitefish	NR	NR	Muscle	6 C	5.05	0.51	0.53	1.63	2.7	Dwernychuk et al. 1995
Station R4 - Fraser River @ Stoner, B.C.	1995	Mountain whitefish	NR	NR	Liver	1	10.20	1.16	1.11	2.08	2.8	Dwernychuk et al. 1995
Station R4 - Fraser River near Stoner, B.C.	1992	Mountain whitefish	NR	NR	Muscle	6 C	10.75	5.13	5.16	6.96	NR	Dwernychuck et al. 1993
Station R4 - Fraser River near Stoner, B.C.	1992	Mountain whitefish	NR	NR	Liver	6 C	41.95	18.69	19.32	23.68	NR	Dwernychuck et al. 1993
Station R5 - Fraser River near Quesnel, B.C.	1992	Mountain whitefish	NR	NR	Muscle	6 C	8.25	1.70	1.73	3.13	NR	Dwernychuk et al. 1993
Station R5 - Fraser River near Quesnel, B.C.	1992	Mountain whitefish	NR	NR	Liver	6 C	11.85	4.55	4.66	7.36	NR	Dwernychuk et al. 1993
Station R6 - Fraser River @ Quesnel River	1990	Mountain whitefish	NR	NR	Muscle	6 C	295.95	102.35	92.74	255.90	NR	Dwernychuk et al. 1991b
Station R6 - Fraser River @ Quesnel River	1990	Mountain whitefish	NR	NR	Liver	6 C	312.65	113.30	101.48	207.13	NR	Dwernychuk et al. 1991b
Station R6A - Fraser River @ Quesnel River, B.C.	1995	Mountain whitefish	NR	NR	Muscle	6 C	2.85	0.27	0.25	0.30	3.1	Dwernychuk et al. 1995

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Location	Year	Species	Life Stage	Sex	Tissue	N	Total PCDD/F ($ng \cdot kg^{-1}$) (ww)	TEQ_{fish}[abc] ($ng \cdot kg^{-1}$) (ww)	TEQ_{mam}[ab] ($ng \cdot kg^{-1}$) (ww)	TEQ_{avian}[ab] ($ng \cdot kg^{-1}$) (ww)	Lipid ($ng \cdot kg^{-1}$) (ww)	Reference
Station R6A - Fraser River @ Quesnel River, B.C.	1995	Mountain whitefish	NR	NR	Liver	6 C	8.25	0.90	0.83	1.06	2.3	Dwernychuk et al. 1995
Station R6A - Quesnel River,	1992	Mountain whitefish	NR	NR	Muscle	6 C	2.30	0.19	0.20	0.49	NR	Dwernychuk et al. 1993
Station R6A - Quesnel River,	1992	Mountain whitefish	NR	NR	Liver	6 C	3.07	0.33	0.31	0.41	NR	Dwernychuk et al. 1993
Station R7 - Fraser River below Quesnel, B.C.	1995	Mountain whitefish	NR	NR	Muscle	6 C	21.00	12.24	12.52	16.84	4.6	Dwernychuk et al. 1995
Station R7 - Fraser River below Quesnel, B.C.	1995	Mountain whitefish	NR	NR	Liver	1	40.90	21.60	22.12	26.83	3.8	Dwernychuk et al. 1995
Station R7 - Fraser River between Quesnel and	1992	Mountain whitefish	NR	NR	Muscle	6 C	11.65	3.76	3.87	6.77	NR	Dwernychuk et al. 1993
Station R7 - Fraser River between Quesnel and	1992	Mountain whitefish	NR	NR	Liver	6 C	45.20	20.86	22.09	33.45	NR	Dwernychuk et al. 1993
Station R8 - Fraser River @Soda Creek, B.C.	1995	Mountain whitefish	NR	NR	Muscle	6 C	3.85	0.56	0.53	0.88	2.2	Dwernychuk et al. 1995
Station R8 - Fraser River @Soda Creek, B.C.	1995	Mountain whitefish	NR	NR	Liver	6 C	10.20	1.16	1.10	1.98	2.8	Dwernychuk et al. 1995
Station R8 - Fraser River near Marguerite, B.C.	1992	Mountain whitefish	NR	NR	Muscle	6 C	25.60	11.39	11.76	16.95	NR	Dwernychuk et al. 1993
Station R8 - Fraser River near Marguerite, B.C.	1992	Mountain whitefish	NR	NR	Liver	6 C	79.15	38.37	39.50	46.75	NR	Dwernychuk et al. 1993
Fibrelco Pulp Inc. (D/S)	1989	Northern pike	NR	NR	muscle	NR	<122	CNR	CNR	CNR	2.1	Tuominen & Sekela 1992
Fibrelco Pulp Inc. U/S Peace	1989	Northern pike	NR	NR	muscle	NR	<212	CNR	CNR	CNR	2.1	Tuominen & Sekela 1992
Columbia River at Lower Arrow Lake	1990	Northern squawfish	38 cm	F	muscle	6 C	2.30		4.4 / 0.0[d]		3	EVS 1991
Columbia River at Lower Arrow Lake	1990	Northern squawfish	38 cm	F	liver	6 C	7.05		3.7 / 0.6[d]		4	EVS 1991
Lower Fraser River Mills (U/S)	1989	Northern squawfish	NR	NR	muscle	NR	<72	CNR	CNR	CNR	4	Tuominen & Sekela 1992
Paperboard Industries Corp.	1989	Northern squawfish	NR	NR	muscle	NR	<66	CNR	CNR	CNR	4.2	Tuominen & Sekela 1992
Scott Paper Ltd. (D/S)	1989	Northern squawfish	NR	NR	muscle	NR	<150	CNR	CNR	CNR	4.1	Tuominen & Sekela 1992
Nicomekl, B.C.	1986	Plainfin	NR	NR	Regurgitated Prey	NR	31.00	4.22	5.75	5.17	0.22	Elliott et al. 1989
University of British Columbia	1986	Plainfin	NR	NR	Regurgitated Prey	NR	16.00	3.42	4.02	11.02	2.76	Elliott et al. 1989
Eurocan Pulp & Paper Co.	1989	Prickly sculpin	NR	NR	muscle	NR	<304	CNR	CNR	CNR	3	Tuominen & Sekela 1992
Eurocan Pulp & Paper Co.	1989	Rainbow trout	NR	NR	muscle	NR	<132	CNR	CNR	CNR	6.8	Tuominen & Sekela 1992
Eurocan Pulp & Paper Co.	1989	Rainbow trout	NR	NR	muscle	NR	<88	CNR	CNR	CNR	5.3	Tuominen & Sekela 1992
Station F2 - Kootenay River 1.3 km D/S Crestbrook discharge	1990	Rainbow trout	NR	NR	Muscle	3 C	30.00	5.05	5.95	24.00	NR	Dwernychuk et al. 1991a

Table 25. Levels of PCDD/Fs and TEQ in freshwater fish in Canada

Location	Year	Species	Life Stage	Sex	Tissue	N	Total PCDD/F ($ng \cdot kg^{-1}$) (ww)	TEQ_{fish} [abc] ($ng \cdot kg^{-1}$) (ww)	TEQ_{mam} [ab] ($ng \cdot kg^{-1}$) (ww)	TEQ_{avian} [ab] ($ng \cdot kg^{-1}$) (ww)	Lipid ($ng \cdot kg^{-1}$) (ww)	Reference
Station F2 - Kootenay River 1.3 km D/S Crestbrook discharge	1990	Rainbow trout	NR	NR	Liver	3 C	101.15	15.68	19.15	86.91	NR	Dwernychuk et al. 1991a
Station F6 - Kootenay River 160 km D/S Crestbrook	1990	Rainbow trout	NR	NR	Muscle	1	5.05	0.88	0.83	1.00	NR	Dwernychuk et al. 1991a
Station F6 - Kootenay River 160 km D/S Crestbrook	1990	Rainbow trout	NR	NR	Liver	1	18.40	3.50	3.28	3.73	NR	Dwernychuk et al. 1991a
Nicomekl, B.C.	1986	Shiner perch	NR	NR	Regurgitated Prey	NR	16.00	2.27	2.74	7.02	0.9	Elliott et al. 1989
Point Roberts, B.C.	1986	Shiner perch	NR	NR	Regurgitated Prey	NR	14.00	2.32	2.82	8.02	0.36	Elliott et al. 1989
Fibrelco Pulp Inc. U/S Pine	1989	Walleye	NR	NR	muscle	NR	<100	CNR	CNR	CNR	3.1	Tuominen & Sekela 1992
Petro - Canada Products (D/S)	1989	Walleye	NR	NR	muscle	NR	<96	CNR	CNR	CNR	3.4	Tuominen & Sekela 1992
Fraser River 10 km U/S Prince George (by pulp mill outfall)	1991	White sturgeon	NR	F	white muscle	1	19.90	2.80	3.89	15.24	NR	MacDonald et al. 1997
Fraser River 10 km U/S Prince George (by pulp mill outfall).	1991	White sturgeon	NR	F	red muscle	1	288.90	41.77	57.07	224.66	NR	MacDonald et al. 1997
Fraser River 10 km U/S Prince George (by pulp mill outfall)	1991	White sturgeon	NR	F	liver	1	115.40	16.93	23.04	88.15	NR	MacDonald et al. 1997
Fraser River 10 km U/S Prince George (by pulp mill outfall)	1991	White sturgeon	NR	F	roe	1	64.70	9.02	12.42	50.01	NR	MacDonald et al. 1997
Fraser River 10 km U/S Prince George (by pulp mill outfall)	1991	White sturgeon	60+	M	white muscle	1	50.10	6.60	9.11	41.36	NR	MacDonald et al. 1997
Fraser River 10 km U/S Prince George (by pulp mill outfall)	1991	White sturgeon	60+	M	red muscle	1	674.70	80.83	115.06	579.05	NR	MacDonald et al. 1997
Fraser River 10 km U/S Prince George (by pulp mill outfall)	1991	White sturgeon	60+	M	liver	1	216.30	28.97	39.66	197.42	NR	MacDonald et al. 1997
Fraser River 10 km U/S Prince George (by pulp mill outfall)	1991	White sturgeon	23+	I	white muscle	1	4.50	0.31	0.53	4.58	NR	MacDonald et al. 1997
Fraser River 10 km U/S Prince George (by pulp mill outfall)	1991	White sturgeon	23+	I	red muscle	1	91.70	5.38	9.44	79.43	NR	MacDonald et al. 1997
Fraser River 10 km U/S Prince George (by pulp mill outfall)	1991	White sturgeon	23+	I	liver	1	156.70	10.04	17.14	140.14	NR	MacDonald et al. 1997
Fraser River 10 km U/S Prince George (by pulp mill outfall)	1992	White sturgeon	52+	M	white muscle	1	13.20	0.75	1.37	12.53	NR	MacDonald et al. 1997
Fraser River 10 km U/S Prince George (by pulp mill outfall)	1992	White sturgeon	52+	M	red muscle	1	228.40	12.98	24.61	193.36	NR	MacDonald et al. 1997
Fraser River 10 km U/S Prince George (by pulp mill outfall)	1992	White sturgeon	52+	M	liver	1	231.20	13.74	23.87	193.50	NR	MacDonald et al. 1997
Paperboard Industries Corp.	1989	White sturgeon	NR	NR	muscle	NR	<80	CNR	CNR	CNR	1.8	Tuominen & Sekela 1992

Table 25. Levels of PCDD/Fs and TEQ in freshwater fish in Canada

Location	Year	Species	Life Stage	Sex	Tissue	N	Total PCDD/F ($ng \cdot kg^{-1}$) (ww)	TEQ_{fish} [abc] ($ng \cdot kg^{-1}$) (ww)	TEQ_{mam} [ab] ($ng \cdot kg^{-1}$) (ww)	TEQ_{avian} [ab] ($ng \cdot kg^{-1}$) (ww)	Lipid ($ng \cdot kg^{-1}$) (ww)	Reference
Ontario												
Lake Ontario (Grimsby)	1992	Alewife	NR	NR	whole	NR	9.10	9.10	9.23	10.81	NR	Niimi 1996
Western Lake Ontario	1985	Alewife	7-20 cm	NR	whole	239	0.01	> 4	6.30	7.21	NR	Braune & Norstrom 1989
Lake Huron	1984	Lake trout	ADT	NR	composite	5 C	48.60	8.29	9.44	36.67	NR	DeVault et al. 1989
Lake Michigan	1984	Lake trout	ADT	NR	composite	5 C	105.20	20.76	22.88	78.42	NR	DeVault et al. 1989
Lake Ontario	1984	Lake trout	ADT	NR	composite	5 C	58.00	12.44	13.37	40.27	NR	DeVault et al. 1989
Lake Ontario (D/S of chlorophenol wastedump	1990	Lake trout	NR	NR	whole	1	220.50	75.31	76.55	160.78	NR	Whittle et al. 1992
Lake Ontario (Grimsby)	1992	Lake trout	NR	NR	whole	NR	148.00	81.65	83.36	120.16	NR	Niimi 1996
Lake Superior	1984	Lake trout	ADT	NR	composite	5 C	22.70	2.20	2.95	17.60	NR	DeVault et al. 1989
Lake Superior (near kraft mill	1990	Lake trout	NR	NR	whole	1	49.60	9.41	10.24	32.45	NR	Whittle et al. 1992
Lake Ontario (Grimsby)	1992	Sculpin	NR	NR	whole	NR	160.00	48.52	51.63	101.33	NR	Niimi 1996
Lake Ontario (Grimsby)	1992	Smelt	NR	NR	whole	NR	16.75	30.54	31.51	46.83	NR	Niimi 1996
Lake Erie	1984	Walleye	ADT	NR	composite	5 C	22.00	2.10	2.68	14.27	NR	DeVault et al. 1989
Lake St. Clair	1984	Walleye	ADT	NR	composite	5 C	38.80	4.33	5.57	30.7692	NR	DeVault et al. 1989

N = number of samples; C = composite sample of N fish.
NR = not reported. NDR = incorrect isotope ratio
CNR - Congeners not reported.
Location: U/S = upstream; D/S = downstream.
Life Stage: JUV = juvenile; ADT = adult. Length (cm) is fork length; YOY = young of the year.
Sex: M = male; F = female; N = sexually undifferentiated.
Concentrations are reported as wet weight, mean values.

[a]TEQs were calculated based on the WHO 1998 TEFs for fish reported in van den Berg et al. (1998) unless otherwise indicated

[b]TEQ calculations are for Dioxins and Furans only.

[c]calculations for Total TCDD/TCDF and TEQ's used 1/2 of the reported detection limit if the amount of congener present in the sample was not quantified.

[d]TEQs were reported based on Provincial government (BC) and Federal government methods. TEQ calculated using I-TEFs. Provincial TEQ used DL/2 and Federal method uses 0 if below DL.

Table 26. Levels of T_4CDD, T_4CDF, and TEQ in marine fish in Canada.

Location	Year	Species	Life Stage	Tissue	N	Total PCDD/F (ng·kg^{-1} ww)	TEQ$_{fish}$[ab] (ng·kg^{-1}) (ww)	TEQ$_{mam}$[ab] (ng·kg^{-1}) (ww)	TEQ$_{avian}$[ab] (ng·kg^{-1}) (ww)	% Lipid (ww)	Reference
British Columbia											
Mouth of Gold River vicinity of pulp mill outfall		Canary rockfish	NR	fillet	NR	57.7	8.2	3.65	13.15	2.12	CPPA 1989
Neck Point Georgia St.		Chinook salmon	NR	fillet	NR	51.2	5.12	2.39	47.04	6.46	CPPA 1989
Powell River 2.5 km N of pulp mill		Chinook salmon	NR	fillet	NR	70.4	6.92	3.52	68.24	3.18	CPPA 1989
Powell River 6 km D/S of pulp mill		Chinook salmon	NR	fillet	NR	127.6	10.41	7	65.97	4.31	CPPA 1989
Quinsam River, Elk Falls		Chinook salmon	NR	fillet	NR	42.4	0.88	0.38	7.41	2.4	CPPA 1989
Alberni, Thurburn Bay D/S		Coho salmon	NR	fillet	NR	40.5	0.75	0.64	1.88	2.06	CPPA 1989
Mouth of Gold River		Coho salmon	NR	fillet	NR	3.2	0.32	0.16	3.2	2.15	CPPA 1989
Quinsam River, Elk Falls		Coho salmon	NR	fillet	NR	9.7	0.81	0.36	6.91	1.79	CPPA 1989
Elk Falls outfall		Dogfish	NR	fillet	NR	48	8.81	5.82	24.82	10	CPPA 1989
Crofton 2 km SE U/S Pulp mill outfall		English sole	NR	fillet	NR	15	1.5	0.75	15	1.64	CPPA 1989
Crofton 4km NW pulp mill outfall		English sole	NR	fillet	NR	28.2	2.82	1.16	22.06	2.15	CPPA 1989
Crofton NW of Willy Island		English sole	NR	fillet	NR	27.8	2.78	1.08	20.08	1.82	CPPA 1989
Prince Rupert, 750 m S D/S		English Sole	NR	fillet	NR	27.1	2.71	1.15	22.05	1.13	CPPA 1989
Prince Rupert, Morse Basin		English sole	NR	fillet	NR	15.6	2.1	1.35	15.6	1.16	CPPA 1989
Fraser estuary - Westham Island	1991	Eulachon	NR	whole	1	<3.1[c]	CNR	CNR	CNR	11.7	Harfenist et al. 1995
Fraser estuary - Westham Island	1991	Eulachon	NR	whole	1	<13.6[c]	CNR	CNR	CNR	6.4	Harfenist et al. 1995
University of British Columbia	1986	Eulachon	NR	regurgitated prey	NR	14.00	2.36	2.82	9.01	8.73	Elliott et al. 1989
Powell River outfall		Greenstripe rockfish	NR	fillet	NR	22.14	2.61	1.38	18.48	1.51	CPPA 1989
Harmac outfall		Pacific herring	NR	fillet	NR	22	2.2	0.86	16.06	6.13	CPPA 1989
Harmac outfall		Pacific herring	NR	roe	NR	10.2	0.85	0.51	7.14	3.2	CPPA 1989
Fraser estuary - Iona Island	1991	Pacific staghorn sculpi	NR	whole	1	<6.5[c]	CNR	CNR	CNR	1	Harfenist et al. 1995
Fraser estuary - Iona Island	1991	Pacific staghorn sculpi	NR	whole	1	<4.8[c]	CNR	CNR	CNR	0.7	Harfenist et al. 1995
Fraser estuary - Iona Island	1991	Pacific staghorn sculpi	NR	whole	1	<8.4[c]	CNR	CNR	CNR	2	Harfenist et al. 1995
Fraser estuary - Westham Island	1991	Pacific staghorn sculpi	NR	whole	1	<14.9[c]	CNR	CNR	CNR	1.5	Harfenist et al. 1995
Fraser estuary - Westham Island	1991	Pacific staghorn sculpi	NR	whole	1	<7.6[c]	CNR	CNR	CNR	1.3	Harfenist et al. 1995
Fraser estuary - Westham Island	1991	Peamouth chub	NR	whole	1	5.5[c]	CNR	CNR	CNR	2.9	Harfenist et al. 1995
Fraser estuary - Westham Island	1991	Peamouth chub	NR	whole	1	17.2[c]	CNR	CNR	CNR	3	Harfenist et al. 1995
Lower Fraser River Mills (U/S)	1989	Peamouth chub	NR	muscle	NR	0.83	CNR	CNR	CNR	6	Tuominen & Sekela 1992
Paperboard Industries Corp. (D/S)	1989	Peamouth chub	NR	muscle	NR	ND	CNR	CNR	CNR	3.4	Tuominen & Sekela 1992

Table 26. Levels of T_4CDD, T_4CDF, and TEQ in marine fish in Canada.

Location	Year	Species	Life Stage	Tissue	N	Total PCDD/F (ng·kg^{-1} ww)	TEQ_{fish} [ab] (ng·kg^{-1}) (ww)	TEQ_{mam} [ab] (ng·kg^{-1}) (ww)	TEQ_{avian} [ab] (ng·kg^{-1}) (ww)	% Lipid (ww)	Reference
Scott Paper Ltd. (D/S)	1989	Peamouth chub	NR	muscle	NR	ND	CNR	CNR	CNR	3.6	Tuominen & Sekela 1992
Gowlland Harbour Elk Falls		Pink Salmon	NR	fillet	NR	42.6	4.92	2.9	32.35	1.22	CPPA 1989
Elk Falls outfall		Quillback rockfish	NR	fillet	NR	51.7	3.12	0.71	10.11	0.85	CPPA 1989
Fraser estuary - Westham Island	1991	Redside shiner	NR	whole	1	4.6[c]	CNR	CNR	CNR	2.5	Harfenist et al. 1995
Fraser estuary - Westham Island	1991	Redside shiner	NR	whole	1	3.1[c]	CNR	CNR	CNR	2.4	Harfenist et al. 1995
Crofton 2 km SE U/S Pulp mill outfall		Rockfish	NR	fillet	NR	27.8	4.31	2.64	18.79	1.84	CPPA 1989
Crofton 500 m W Pulp mill outfall		Rockfish	NR	fillet	NR	40.3	1.09	0.73	6.21	1.11	CPPA 1989
Fraser estuary - Iona Island	1991	Shiner perch	NR	whole	1	<34.2[c]	CNR	CNR	CNR	1.6	Harfenist et al. 1995
Fraser estuary - Iona Island	1991	Shiner perch	NR	whole	1	<23.2[c]	CNR	CNR	CNR	2.5	Harfenist et al. 1995
Fraser estuary - Westham Island	1991	Shrimp	NR	whole	1	<2.9[c]	CNR	CNR	CNR	0.7	Harfenist et al. 1995
Point Roberts, B.C.	1986	Staghorn sculpin	NR	regurgitated prey	NR	8.00	2.06	2.22	3.01	0.2	Elliott et al. 1989
Somass River estuary, Vancouver	1991	Staghorn sculpins	NR	whole	6	2.2[c]	0.49[f]	0.58[f]	2.2[f]	NR	Vermeer et al. 1993
Fraser estuary - Westham Island	1991	Starry flounder	NR	whole	1	<5.7[c]	CNR	CNR	CNR	0.48	Harfenist et al. 1995
Fraser estuary - Westham Island	1991	Starry flounder	NR	whole	1	<2.7[c]	CNR	CNR	CNR	0.64	Harfenist et al. 1995
Fraser estuary - Westham Island	1991	Starry flounder	NR	whole	1	<3.6[c]	CNR	CNR	CNR	1.06	Harfenist et al. 1995
Fraser estuary - Westham Island	1991	Starry flounder	NR	whole	1	<3.6[c]	CNR	CNR	CNR	0.48	Harfenist et al. 1995
Fraser estuary - Westham Island	1991	Starry flounder	NR	whole	1	<6.3[c]	CNR	CNR	CNR	2.7	Harfenist et al. 1995
Fraser estuary - Westham Island	1991	Starry flounder	NR	whole	1	<4.6[c]	CNR	CNR	CNR	0.3	Harfenist et al. 1995
Fraser estuary - Westham Island	1991	Starry flounder	NR	whole	1	<13.1[c]	CNR	CNR	CNR	1.6	Harfenist et al. 1995
University of British Columbia	1986	Starry flounder	NR	regurgitated prey	NR	33.00	4.12	5.42	25.02	1.18	Elliott et al. 1989
Somass River estuary, Vancouver	1991	Three spine stickleback	NR	whole	6	3.4[c]	0.14[f]	0.88[f]	3.4[f]	NR	Vermeer et al. 1993
Fraser estuary - Westham Island	1991	Threespine stickleback	NR	whole	1	<12.6[c]	CNR	CNR	CNR	2	Harfenist et al. 1995
Fraser estuary - Westham Island	1991	Threespine stickleback	NR	whole	1	<2.1[c]	CNR	CNR	CNR	0.35	Harfenist et al. 1995
Southeast of Vicor Is. Gold River		Yellow eye rockfish	NR	fillet	NR	12	1.2	0.6	12	0.73	CPPA 1989
Eastern Canada											
Saguenay Fjord 30 (not receiving direct urban or industrial inputs)	1991	Greenland halibut	NR	whole	1						Brochu et al. 1995

Table 26. Levels of T_4CDD, T_4CDF, and TEQ in marine fish in Canada.

Location	Year	Species	Life Stage	Tissue	N	Total PCDD/F (ng·kg^{-1} ww)	TEQ_{fish} [ab] (ng·kg^{-1}) (ww)	TEQ_{mam} [ab] (ng·kg^{-1}) (ww)	TEQ_{avian} [ab] (ng·kg^{-1}) (ww)	% Lipid (ww)	Reference
Saguenay Fjord 30 (not receiving direct urban or industrial inputs)	1991	Greenland halibut	NR	whole	1						Brochu et al. 1995
Northwest Atlantic											
Off Labrador coast	1990	Cod	7-9 yr	liver	10	7.1[e]	CNR	CNR	CNR	58[d]	Hellou & Payne 1993

Life Stage: JUV = juvenile; ADT = adult.
Concentrations are reported as wet weight, mean values.
N: N = number of samples.
NR = not reported. ND = not detected. CNR = Congeners not reported
Note: only observations where TEQ > 5 have been reported or used in the calculation of mean TEQ, TCDD, and TCDF concentrations.
[a]TEQs were calculated based on WHO 1998 TEFs reported in van den Berg et al. (1998) unless otherwise indicated
[b]TEQ calculations are for Dioxins and Furans only.
[c]Total PCDD/PCDF is the total of 2378-TCDD and 2378-TCDF only.
[d]Arithmetic mean of the % lipid in all samples
[e]Arithmetic mean of the reported congener concentrations found in 10 fish was reported (calculation does not include 1/2 of detection limit for those congeners not reported)
[f]TEQ calculated did not include 1/2 of detection limit. Detection limits were not specifically reported.

Table 27. Levels of T_4CDD, T_4CDF, and TEQ in reptiles in Canada.

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ ($ng \cdot kg^{-1}$) (ww)	TEF Source	% Lipid	Reference
Ontario											
St. Lawrence River - Steele's Bay	1984	Snapping turtle	16 y, M	fat	1	474	12	585.20	Safe 1990	93	Ryan et al. 1986
St. Lawrence River - Steele's Bay	1984	Snapping turtle	16 y, M	liver	1	107	1	128.10	Safe 1990	11	Ryan et al. 1986
St. Lawrence River - Goose Bay	1984	Snapping turtle	8 y, F	fat	1	232	6	298.60	Safe 1990	71	Ryan et al. 1986
St. Lawrence River - Goose Bay	1984	Snapping turtle	8 y, F	liver	1	32	1	41.70	Safe 1990	9.2	Ryan et al. 1986
St. Lawrence River - East Massena	1985	Snapping turtle	14 y, F	fat	1	370	330	2094.30	Safe 1990	85	Ryan et al. 1986
St. Lawrence River - East Massena	1985	Snapping turtle	14 y, F	liver	1	74	74	355.40	Safe 1990	16	Ryan et al. 1986
Algonquin Park - Inland	1989	Snapping turtle	egg	eggs	10	ND	ND	0[b]	WHO 1998	5.35	Bishop et al. 1996
Lake Ontario - Lynde Creek	1989	Snapping turtle	egg	egg	1	982.1	ND	366.51[b]	WHO 1998	5.6	Bishop et al. 1996
Lake Ontario - Lynde Creek	1991	Snapping turtle	egg	eggs	10	482.4	ND	224.49[b]	WHO 1998	5.68	Bishop et al. 1996
Lake Ontario - Cranberry Marsh	1989	Snapping turtle	egg	eggs	6	75.8	ND	37.90[b]	WHO 1998	4.75	Bishop et al. 1996
Lake Ontario - Cootes Paradise	1984[a]	Snapping turtle	egg	eggs	3	1030	ND	107.73[b]	WHO 1998	6.5	Bishop et al. 1996
Lake Ontario - Cootes Paradise	1989	Snapping turtle	egg	eggs	9	167.6	ND	422.38[b]	WHO 1998	6.98	Bishop et al. 1996
Lake Ontario - Cootes Paradise	1990	Snapping turtle	egg	eggs	14	419.7	ND	125.46[b]	WHO 1998	6.1	Bishop et al. 1996
Lake Erie - Big Creek Marsh	1989	Snapping turtle	egg	eggs	10	ND	ND	21.60[b]	WHO 1998	5.34	Bishop et al. 1996
Lake Erie - Rondeau Park	1989	Snapping turtle	egg	eggs	9	ND	ND	23.65[b]	WHO 1998	5.72	Bishop et al. 1996

N = number of samples.
Life Stage: M = male; F = female; y = year.
ND = Not Detected; NR = Not Reported

[a]1984 data from Struger et al. (1994)
[b]TEQ calculated using TEFs for fish as reported in van den Berg et al. (1998) Detection limits were not reported thus DL/2 could not be used in the TEQ calculation. Concentrations are in lipid weight.

Table 28. Levels of T_4CDD, T_4CDF, and TEQ in birds in Canada.

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ ($ng \cdot kg^{-1}$) (ww)	TEF Source	% Lipid	Reference
British Columbia											
Lower Fraser Valley - Brunswick Pt.	1990	Bald eagle chicks	egg	egg	1	42	23	NR		5.1	Elliott et al. 1996b
B.C.- southeast coast -	1990	Bald eagle	4 yr	liver	1	263	15	1430	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast - Campbell River	1990	Bald eagle	3 yr	liver	1	30	1	197	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast - Campbell River	1993	Bald eagle	adult	liver	1	212	8	2440	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast -	1990	Bald eagle	3 yr	liver	1	21	60	155	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast -	1990	Bald eagle	adult	liver	1	6	42	30	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast - Denman Island	1990	Bald eagle	adult	liver	1	49	78	205	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast - Dent Island	1993	Bald eagle	1 yr	liver	1	4	35	110	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast - Nanaimo	1990	Bald eagle	adult	liver	1	25	15	129	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast - Nanoose	1990	Bald eagle	adult	liver	1	23	28	135	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast - Port Hardy	1989	Bald eagle	adult	liver	1	33	101	276	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast - Powell River	1990	Bald eagle	adult	liver	1	392	3	2817	WHO 1998[a]	NR	Elliott et al. 1996c
B.C.- southeast coast - Powell River	1989-1994	Bald eagle	adult	liver	19	70	33	606	WHO 1998[a]	NR	Elliott et al. 1996c
B.C.- southeast coast - Powell River	1990	Bald eagle	adult	liver	1	41	63	193	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast -	1990	Bald eagle	adult	liver	1	29	24	417	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast -	1992	Bald eagle	adult	liver	1	30	15	394	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast - Campbell River	1990	Bald eagle	2 yr	liver	1	18	33	83	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast - Port Hardy	1990	Bald eagle	3 yr	liver	1	5	20	53	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast - Port Hardy	1990	Bald eagle	1 yr	liver	1	77	41	1220	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast - Port Hardy	1993	Bald eagle	adult	liver	1	54	3	832	Safe 1990	NR	Elliott et al. 1996c
B.C.- southeast coast - Port Hardy	1993	Bald eagle	adult	liver	1	17	45	302	Safe 1990	NR	Elliott et al. 1996c
Berryman Pt.	1992	Bald eagle chicks	egg	egg	1	10	7	NR		5.9	Elliott et al. 1996b

Table 28. Levels of T_4CDD, T_4CDF, and TEQ in birds in Canada.

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng{\cdot}kg^{-1}$) (ww)	T_4CDF ($ng{\cdot}kg^{-1}$) (ww)	TEQ ($ng{\cdot}kg^{-1}$) (ww)	TEF Source	% Lipid	Reference
Crofton River - Crofton	1991	Bald eagle chicks	egg	egg	1	51	60	NR		6	Elliott et al. 1996b
Crofton River - Pringle	1990	Bald eagle chicks	egg	egg	1	104	16	NR		4.4	Elliott et al. 1996b
Crofton River - Southey	1990	Bald eagle chicks	egg	egg	1	110	26	NR		5.9	Elliott et al. 1996b
East Vancouver I. - Crofton	1992	Bald eagle chicks		yolk sacs	1	1800	923	NR		NR	Elliott et al. 1996a
East Vancouver I. - Jack	1992	Bald eagle chicks		yolk sacs	1	1450	2930	NR		NR	Elliott et al. 1996a
East Vancouver I. - Winchelsea Is.	1992	Bald eagle chicks		yolk sacs	1	2460	2190	NR		NR	Elliott et al. 1996a
Fraser Delta - Brunswick	1992	Bald eagle chicks		yolk sacs	1	868	661	NR		NR	Elliott et al. 1996a
Fraser Delta - River Road	1992	Bald eagle chicks		yolk sacs	1	646	238	NR		NR	Elliott et al. 1996a
Johnstone Strait - Harbledon Island	1991	Bald eagle chicks	egg	egg	1	15	68	NR		2.8	Elliott et al. 1996b
Johnstone Strait - Owl Island	1991	Bald eagle chicks	egg	egg	1	11	39	NR		3.9	Elliott et al. 1996b
Johnstone Strait - Pearce 3	1991	Bald eagle chicks	egg	egg	1	32	80	NR		6	Elliott et al. 1996b
Johnstone Strait - Pearce 5	1991	Bald eagle chicks	egg	egg	1	11	37	NR		4.4	Elliott et al. 1996b
Johnstone Strait - Plumber 5	1991	Bald eagle chicks	egg	egg	1	22	58	NR		4.8	Elliott et al. 1996b
Johnstone Strait - Plumber 8	1991	Bald eagle chicks	egg	egg	1	12	39	NR		4.3	Elliott et al. 1996b
Johnstone Strait - Swanson Island	1991	Bald eagle chicks	egg	egg	1	10	29	NR		4.1	Elliott et al. 1996b
Lower Fraser Valley - Agassiz Bridge	1991	Bald eagle chicks	egg	egg	1	41	13	NR		6.2	Elliott et al. 1996b
Lower Fraser Valley - Annacis Is.	1990	Bald eagle chicks	egg	egg	1	58	112	NR		5.9	Elliott et al. 1996b
Lower Fraser Valley - Chahalis Flats	1990	Bald eagle chicks	egg	egg	1	58	89	NR		6.1	Elliott et al. 1996b
Lower Fraser Valley - Cheam Island	1991	Bald eagle chicks	egg	egg	1	23	73	NR		4.9	Elliott et al. 1996b
Lower Fraser Valley - Island	1991	Bald eagle chicks	egg	egg	1	51	16	NR		5.3	Elliott et al. 1996b
Nanaimo - Canoxy	1990	Bald eagle chicks	egg	egg	1	59	29	NR		3	Elliott et al. 1996b
Nanaimo - Canso	1990	Bald eagle chicks	egg	egg	1	82	29	NR		4.2	Elliott et al. 1996b
Nanaimo - Jack Point	1992	Bald eagle chicks	egg	egg	1	24	56	NR		4.7	Elliott et al. 1996b
Nanaimo - Jack Pt.	1990	Bald eagle chicks	egg	egg	1	79	49	NR		4.5	Elliott et al. 1996b
Nanaimo - Leask	1990	Bald eagle chicks	egg	egg	1	63	36	NR		4.7	Elliott et al. 1996b
Nanaimo - Maude Island	1991	Bald eagle chicks	egg	egg	1	70	119	NR		4.5	Elliott et al. 1996b
Nanaimo - Northwest Bay	1992	Bald eagle chicks	egg	egg	1	14	18	NR		4.9	Elliott et al. 1996b
Nanaimo - Southey Island	1991	Bald eagle chicks	egg	egg	1	28	65	NR		4.2	Elliott et al. 1996b
Pocahontas Pt.	1992	Bald eagle chicks	egg	egg	1	17	7	NR		2.4	Elliott et al. 1996b
Powell River	1992	Bald eagle chicks	egg	egg	1	32	18	NR		3.7	Elliott et al. 1996b
Powell River - Ball Pt.	1992	Bald eagle chicks		yolk sacs	1	1130	1670	NR		NR	Elliott et al. 1996a
Powell River - Ball Pt.	1992	Bald eagle chicks		yolk sacs	1	1120	1880	NR		NR	Elliott et al. 1996a

Table 28. Levels of T_4CDD, T_4CDF, and TEQ in birds in Canada.

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ ($ng \cdot kg^{-1}$) (ww)	TEF Source	% Lipid	Reference
Powell River - Convent	1990	Bald eagle chicks	egg	egg	1	88	97	NR		5.7	Elliott et al. 1996b
Powell River - Evenden point	1992	Bald eagle chicks		yolk sacs	1	2670	18800	NR		NR	Elliott et al. 1996a
Powell River - Evenden point	1992	Bald eagle chicks		yolk sacs	1	3560	24100	NR		NR	Elliott et al. 1996a
Powell River - Grise Point	1992	Bald eagle chicks	egg	egg	1	10	38	NR		6.1	Elliott et al. 1996b
Powell River - Kelly Pt.	1990	Bald eagle chicks	egg	egg	1	98	59	NR		6.1	Elliott et al. 1996b
Powell River - Limekiln Bay	1992	Bald eagle chicks		yolk sacs	1	1470	6900	NR		NR	Elliott et al. 1996a
Powell River - Limekiln Bay	1992	Bald eagle chicks		yolk sacs	1	2250	7970	NR		NR	Elliott et al. 1996a
Powell River - Lund	1991	Bald eagle chicks	egg	egg	1	41	110	NR		5	Elliott et al. 1996b
Powell River - Scuttle Bay	1992	Bald eagle chicks		yolk sacs	1	2700	16700	NR		NR	Elliott et al. 1996a
Powell River - Scuttle Bay	1992	Bald eagle chicks		yolk sacs	1	2450	11590	NR		NR	Elliott et al. 1996a
Powell River - Stillwater (1)	1992	Bald eagle chicks	egg	egg	1	78	166	NR		5.8	Elliott et al. 1996b
Powell River - Stillwater (2)	1992	Bald eagle chicks	egg	egg	1	81	168	NR		6.7	Elliott et al. 1996b
West Vancouver Island - Bawden Bay	1992	Bald eagle chicks		yolk sacs	1	218	672	NR		NR	Elliott et al. 1996a
West Vancouver Island - Mercantile Creek	1992	Bald eagle chicks		yolk sacs	1	323	360	NR		NR	Elliott et al. 1996a
West Vancouver Island - Thornton Cr.	1992	Bald eagle chicks		yolk sacs	1	629	1070	NR		NR	Elliott et al. 1996a
West Vancouver Island - White Pine 1	1992	Bald eagle chicks		yolk sacs	1	306	305	NR		NR	Elliott et al. 1996a
West Vancouver Island - White Pine 4	1992	Bald eagle chicks		yolk sacs	1	353	465	NR		NR	Elliott et al. 1996a
Howe Sound	1993	Barrow's goldeneye	NR	breast muscle	1	<6	<3	NC		NR	Elliott & Martin 1998
Port Alberni	1989	Barrow's goldeneye	NR	liver	1	6	115	NR		NR	Vermeer et al. 1993
Powell River	1991	Barrow's goldeneye	NR	breast muscle	1	3	131	NC		NR	Elliott & Martin 1998
Rupert	1991	Barrow's goldeneye	NR	breast muscle	1	<2	45	11.3[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Alert Bay	1992	Bufflehead	NR	breast muscle	1	<1.1	1.4	3.03[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Annacis Island	1990	Bufflehead	NR	breast muscle	1	18	9.5	NR		NR	Elliott & Martin 1998
Campbell River	1991	Bufflehead	NR	breast muscle	1	<3.2	23	14.2[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Crofton	1990	Bufflehead	NR	breast muscle	1	9.4	28	NR		NR	Elliott & Martin 1998
Crofton	1990	Bufflehead	NR	liver	1	<2.3	13	NR		NR	Elliott & Martin 1998
Gold River	1991	Bufflehead	NR	breast muscle	1	<1.5	30	5.81[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Rupert	1991	Bufflehead	NR	breast muscle	1	<15	70	38[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998

Table 28. Levels of T_4CDD, T_4CDF, and TEQ in birds in Canada.

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ ($ng \cdot kg^{-1}$) (ww)	TEF Source	% Lipid	Reference
Rupert	1991	Bufflehead	NR	liver	1	24	100	60.2[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Peace-Athabasca Delta	1992	Canvasback	NR	liver	6	NR	NR	2.6	NR	25-30	
Annacis Island	1990	Common goldeneye	NR	liver	1	<12	17	NR		NR	Elliott & Martin 1998
Annacis Island	1990	Common goldeneye	NR	breast muscle	1	<2.1	9.4	NR	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Campbell River	1991	Common goldeneye	NR	breast muscle	1	<5.8	38	12.1[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Howe Sound	1990	Common goldeneye	NR	liver	1	7.1	66	NR		NR	Elliott & Martin 1998
Howe Sound	1990	Common goldeneye	NR	breast muscle	1	<1.4	30	NR		NR	Whitehead et al. 1992
Rupert	1991	Common goldeneye	NR	breast muscle	1	7.9	75	32.5[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Annacis Island	1990	Common merganser	NR	breast muscle	1	13	18	NR		NR	Elliott & Martin 1998
Annacis Island	1990	Common merganser	NR	liver	1	14	23	NR		NR	Elliott & Martin 1998
Gold River	1992	Common merganser	NR	breast muscle	1	6.8	120	27[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Howe Sound	1990	Common merganser	NR	breast muscle	1	21	116.5	NR		NR	Elliott & Martin 1998
Howe Sound	1990	Common merganser	NR	liver	1	37	163	NR		NR	Elliott & Martin 1998
Howe Sound	1993	Common merganser	NR	breast muscle	1	<9	26	NC		NR	Elliott & Martin 1998
Nanaimo	1992	Common merganser	NR	breast muscle	1	<1.8	38	11.8[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Port Alberni	1989	Common merganser	NR	liver	1	24	123	NR		NR	Vermeer et al. 1993
Port Alberni	1992	Common merganser	NR	breast muscle	1	<4.3	26	29.5[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Chain Islands	NR	Double-crested cormorants	egg	eggs	7	20	(0)[b]	80	WHO 1998	NR	Sanderson et al. 1994b
Christy Islands	NR	Double-crested cormorants	egg	eggs	7	39	3	97.1	WHO 1998	NR	Sanderson et al. 1994b
Crofton	NR	Double-crested cormorants	egg	eggs	7	26	2	82.6	WHO 1998	NR	Sanderson et al. 1994b
Howe Sound	1988	Double-crested cormorants	egg	eggs	7	68	4	NR		4.5	Whitehead et al. 1992
Howe Sound	1989	Double-crested cormorants	egg	eggs	10	30	2[c]	NR		5	Whitehead et al. 1992
Burrard Inlet	1990	Goldeneye species		liver	1	14	1.7	NR		NR	Elliott & Martin 1998
Crofton	1988	Great blue heron	egg	eggs	6	211	8	NR		NR	Bellward et al. 1990
Crofton	1986	Great blue heron	egg	eggs	10	66	2	79	Elliott et al. 1989[d]	NR	Elliott et al. 1989
Crofton	1987	Great blue heron	egg	eggs	10	210	3	230	Elliott et al. 1989[d]	NR	Elliott et al. 1989

Table 28. Levels of T_4CDD, T_4CDF, and TEQ in birds in Canada.

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ ($ng \cdot kg^{-1}$) (ww)	TEF Source	% Lipid	Reference
Crofton	1991	Great blue heron	egg	eggs	7	16	4	66.7	WHO 1998	NR	Sanderson et al. 1994a
Nicomeki	1986	Great blue heron	egg	eggs	5	10	ND	14	Elliott et al. 1989[d]	NR	Elliott et al. 1989
Nicomekl River	1988	Great blue heron	egg	eggs	11	10	<1	NR		NR	Bellward et al. 1990
Sidney	1986	Great blue heron	egg	eggs	4	9	1	11	Elliott et al. 1989[d]	NR	Elliott et al. 1989
UBC	1987	Great blue heron	egg	eggs	7	25	3	34	Elliott et al. 1989[d]	NR	Elliott et al. 1989
UBC	1987	Great blue heron	egg	eggs	10	55	17	64	Elliott et al. 1989[d]	NR	Elliott et al. 1989
Vancouver	1988	Great blue heron	egg	eggs	12	135	11	NR		NR	Bellward et al. 1990
Vancouver	1990	Great blue heron	egg	eggs	7	42	15	80.6	WHO 1998	NR	Sanderson et al. 1994a
Vancouver	1992	Great blue heron	egg	eggs	7	10	4	25.1	WHO 1998	NR	Sanderson et al. 1994a
Crofton	1990	Greater scaup	NR	breast muscle	1	<7.2	37	NR		NR	Elliott & Martin 1998
Crofton	1990	Greater scaup	NR	liver	1	<1.5	34	NR		NR	Elliott & Martin 1998
Port Alberni	1989	Greater scaup	NR	liver	1	3	32	NR		NR	Vermeer et al. 1993
Howe Sound	1990	Harlequin duck	NR	liver	1	<2	36	NR		NR	Elliott & Martin 1998
Rupert	1991	Hooded merganser	NR	breast muscle	1	9	44	23.1[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Burrard Inlet	1990	Lesser scaup	NR	liver	1	14	11	NR			Elliott & Martin 1998
Rupert	1991	Lesser scaup	NR	breast muscle	1	<3.9	60	13.9[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Howe Sound	1990	Oldsquaw duck	NR	liver	1	9.2	9.6	NR		NR	Elliott & Martin 1998
Powell River	1992	Pied-billed grebe	NR	breat muscle	1	3.6	6.8	15.3[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Powell River	1992	Pied-billed grebe	NR	liver	1	10	36	49.1[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Howe Sound	1993	Red-necked grebe	NR	breast muscle	1	0.9	2.5	NC		NR	Elliott & Martin 1998
Alert Bay	1992	Surf scoter	NR	breast muscle	1	<2	2.6	4.32[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Burrard In.	1991	Surf scoter	NR	breast muscle	1	<1.7	25	7[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Crofton	1990	Surf scoter	NR	breast muscle	1	<5.1	40	NR		NR	Elliott & Martin 1998
Crofton	1990	Surf scoter	NR	liver	1	6.9	57	NR		NR	Elliott & Martin 1998
Gold River	1991	Surf scoter	NR	breast muscle	1	<1.7	53	8.3[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Howe Sound	1990	Surf scoter	NR	breast muscle	1	2.2	31	NR		NR	Elliott & Martin 1998
Howe Sound	1990	Surf scoter	NR	liver	1	8.7	34	NR		NR	Elliott & Martin 1998
Howe Sound	1993	Surf scoter	NR	breast muscle	1	0.2	3.3	NC		NR	Elliott & Martin 1998
Nanaimo	1992	Surf scoter	NR	breast muscle	1	0.5	7.4	6.1[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Port Alberni	1989	Surf scoter	NR	liver	1	24	123	NR		NR	Vermeer et al. 1993

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Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ ($ng \cdot kg^{-1}$) (ww)	TEF Source	% Lipid	Reference
Powell River	1992	Surf scoter	NR	breast muscle	1	<1.6	12	5.55[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Westham Island	1989	Surf scoter	NR	breast muscle	1	<1.6	13	NR		NR	Elliott & Martin 1998
Westham Island	1989	Surf scoter	NR	liver	1	<2.3	17	NR		NR	Elliott & Martin 1998
Alert Bay	1992	Western grebe	NR	breast muscle	1	<1.6	<0.9	5.88[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Howe Sound	1990	Western grebe	NR	liver	1	46	109	NR		NR	Elliott & Martin 1998
Howe Sound	1993	Western grebe	NR	breast muscle	1	1.7	44	NC		NR	Elliott & Martin 1998
Nanaimo	1992	Western grebe	NR	breast muscle	1	2.9	41	13.7[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Port Alberni	1989	Western grebe	NR	liver	1	117	217	NR		NR	Vermeer et al. 1993
Port Alberni	1992	Western grebe	NR	breast muscle	1	25	69	99.8[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Powell River	1992	Western grebe	NR	breast muscle	1	44	230	42.8[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Powell River	1991	Western grebe	NR	breast muscle	1	4	198	NC		NR	Elliott & Martin 1998
Alert Bay	1992	White-winged scoter	NR	breast muscle	1	<2	3.2	4.91[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Gold River	1991	White-winged scoter	NR	breast muscle	1	<1.9	110	15.4[a]	Safe 1990; Ahlborg et al. 1994	NR	Elliott & Martin 1998
Ontario											
Lake Huron	1991	Caspian Tern	egg	eggs	3	19	10	42.1		NR	Ewins et al. 1994
Lake Ontario	1991	Caspian Tern	egg	eggs	3	29	5	42.1		NR	Ewins et al. 1994
Green Bay, Little Gull	1989	Double-crested cormorants	egg	eggs	12			382.3	H4IIE[c]	NR	Jones et al. 1994
Lake Huron, North Channel	1989	Double-crested cormorants	4 days		5	NR	NR	83.78	H4IIE[c]	NR	Jones et al. 1994
Lake Huron, North Channel	1989	Double-crested cormorants	10 days		5	NR	NR	24.86	H4IIE[c]	NR	Jones et al. 1994
Lake Huron, North Channel	1989	Double-crested cormorants	21 days		5	NR	NR	85.22	H4IIE[c]	NR	Jones et al. 1994
Lake Huron, North Channel	1989	Double-crested cormorants	32 days		5	NR	NR	37.32	H4IIE[c]	NR	Jones et al. 1994
Lake Huron, North Channel	1989	Double-crested cormorants	egg	eggs	12			325.2	H4IIE[c]	NR	Jones et al. 1994
Lake Huron, St. Martins	1989	Double-crested cormorants	egg	eggs	12			329.8	H4IIE[c]	NR	Jones et al. 1994

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Location	Year	Species	Life Stage	Tissue	N	T_4CDD (ng·kg^{-1}) (ww)	T_4CDF (ng·kg^{-1}) (ww)	TEQ (ng·kg^{-1}) (ww)	TEF Source	% Lipid	Reference
Lake Huron, Tahquamenon Island	1989	Double-crested cormorants	egg	eggs	12			155.4	H4IIE[c]	NR	Jones et al. 1994
Lake Huron, Thunder Bay	1989	Double-crested cormorants	4 days		5	NR	NR	149.62	H4IIE[c]	NR	Jones et al. 1994
Lake Huron, Thunder Bay	1989	Double-crested cormorants	10 days		5	NR	NR	20.85	H4IIE[c]	NR	Jones et al. 1994
Lake Huron, Thunder Bay	1989	Double-crested cormorants	21 days		5	NR	NR	55.84	H4IIE[c]	NR	Jones et al. 1994
Lake Huron, Thunder Bay	1989	Double-crested cormorants	32 days		5	NR	NR	45.01	H4IIE[c]	NR	Jones et al. 1994
Lake Huron, Thunder Bay	1989	Double-crested cormorants	egg	eggs	12			211.5	H4IIE[c]	NR	Jones et al. 1994
Lake Michigan	1983	Double-crested cormorants	NR	nestlings	3	4	2	NR		NR	Stalling et al. 1985
Lake Michigan, Beaver Islands	1989	Double-crested cormorants	4 days		5	NR	NR	124.26	H4IIE[c]	NR	Jones et al. 1994
Lake Michigan, Beaver Islands	1989	Double-crested cormorants	10 days		5	NR	NR	69.53	H4IIE[c]	NR	Jones et al. 1994
Lake Michigan, Beaver Islands	1989	Double-crested cormorants	21 days		5	NR	NR	83.14	H4IIE[c]	NR	Jones et al. 1994
Lake Michigan, Beaver Islands	1989	Double-crested cormorants	32 days		5	NR	NR	106.86	H4IIE[c]	NR	Jones et al. 1994
Lake Michigan, Beaver Islands	1989	Double-crested cormorants	egg	eggs	12			329.4	H4IIE[c]	NR	Jones et al. 1994
Lake Michigan, Northern Green Bay	1989	Double-crested cormorants	4 days		5	NR	NR	111.97	H4IIE[c]	NR	Jones et al. 1994
Lake Michigan, Northern Green Bay	1989	Double-crested cormorants	10 days		5	NR	NR	23.66	H4IIE[c]	NR	Jones et al. 1994
Lake Michigan, Northern Green Bay	1989	Double-crested cormorants	21 days		5	NR	NR	84.06	H4IIE[c]	NR	Jones et al. 1994
Lake Michigan, Northern Green Bay	1989	Double-crested cormorants	32 days		5	NR	NR	168.34	H4IIE[c]	NR	Jones et al. 1994
Lake Ontario	NR	Double-crested cormorants	egg	eggs	5	36	(0)[b]	100.6	WHO 1998	NR	Sanderson et al. 1994b
Lake Superior, Apostle Islands	1989	Double-crested cormorants	4 days		5	NR	NR	26.86	H4IIE[c]	NR	Jones et al. 1994
Lake Superior, Apostle Islands	1989	Double-crested cormorants	32 days		5	NR	NR	17.8	H4IIE[c]	NR	Jones et al. 1994

Table 28. Levels of T_4CDD, T_4CDF, and TEQ in birds in Canada.

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ ($ng \cdot kg^{-1}$) (ww)	TEF Source	% Lipid	Reference
Lake Superior, Apostles Island	1989	Double-crested cormorants	egg	eggs	12			141.7	H4IIE[c]	NR	Jones et al. 1994
Lake Superior, Tahquamenon Island	1989	Double-crested cormorants	4 days		5	NR	NR	95.03	H4IIE[c]	NR	Jones et al. 1994
Lake Superior, Tahquamenon Island	1989	Double-crested cormorants	10 days		5	NR	NR	91.08	H4IIE[c]	NR	Jones et al. 1994
Lake Superior, Tahquamenon Island	1989	Double-crested cormorants	21 days		5	NR	NR	17.9	H4IIE[c]	NR	Jones et al. 1994
Lake Superior, Tahquamenon Island	1989	Double-crested cormorants	32 days		5	NR	NR	27.38	H4IIE[c]	NR	Jones et al. 1994
northern Lake Huron, St. Martins Shoal	1989	Double-crested cormorants	4 days		5	NR	NR	27.55	H4IIE[c]	NR	Jones et al. 1994
northern Lake Huron, St. Martins Shoal	1989	Double-crested cormorants	10 days		5	NR	NR	86.24	H4IIE[c]	NR	Jones et al. 1994
northern Lake Huron, St. Martins Shoal	1989	Double-crested cormorants	21 days		5	NR	NR	72.7	H4IIE[c]	NR	Jones et al. 1994
northern Lake Huron, St. Martins Shoal	1989	Double-crested cormorants	32 days		5	NR	NR	55.38	H4IIE[c]	NR	Jones et al. 1994
Lake Erie	1984	Herring gull	egg	eggs	3	9-32	NR	NR		NR	Bishop et al. 1992
Lake Erie - Fighting colony	84 -91	Herring gull	egg	eggs	NR	16.75	0.89	NR		NR	Hebert et al. 1994
Lake Erie - Middle colony	84 -91	Herring gull	egg	eggs	NR	15.81	1.62	NR		NR	Hebert et al. 1994
Lake Erie - Niagara colony	84 -91	Herring gull	egg	eggs	NR	23.77	0.84	NR		NR	Hebert et al. 1994
Lake Erie - Port Colborne colony	84 -91	Herring gull	egg	eggs	NR	17.13	0.73	NR		NR	Hebert et al. 1994
Lake Huron	1983	Herring gull	egg	eggs	3	15-141	NR	NR		NR	Bishop et al. 1992
Lake Huron - Channel/Shelter colony	84 -91	Herring gull	egg	eggs	NR	86.5	3.61	NR		NR	Hebert et al. 1994
Lake Huron - Chantry colony	84 -91	Herring gull	egg	eggs	NR	18.32	9.12	NR		NR	Hebert et al. 1994
Lake Huron - Double colony	84 -91	Herring gull	egg	eggs	NR	24.99	1.3	NR		NR	Hebert et al. 1994
Lake Huron - Double Island	84 - 88	Herring gull	egg	egg	NR	< 40	NR	NR		NR	Bishop & Weseloh 1990
Lake Huron, Saginaw Bay	1989	Herring Gull	4 days	eggs	5	NR	NR	226.49	H4IIE[c]	NR	Jones et al. 1994
Lake Huron, Saginaw Bay	1989	Herring Gull	10 days	eggs	5	NR	NR	96.85	H4IIE[c]	NR	Jones et al. 1994
Lake Huron, Saginaw Bay	1989	Herring Gull	21 days	eggs	5	NR	NR	398.92	H4IIE[c]	NR	Jones et al. 1994
Lake Huron, Saginaw Bay	1989	Herring Gull		eggs	12	NR	NR	557.2	H4IIE[c]	NR	Jones et al. 1994
Lake Michigan	1984	Herring gull	egg	eggs	2	10-18	NR	NR		NR	Bishop et al. 1992
Lake Michigan - Big Sister colony	84 -91	Herring gull	egg	eggs	NR	14.16	2.58	NR		NR	Hebert et al. 1994
Lake Michigan - Gull colony	84 -91	Herring gull	egg	eggs	NR	14.09	2.24	NR		NR	Hebert et al. 1994

Table 28. Levels of T_4CDD, T_4CDF, and TEQ in birds in Canada.

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ ($ng \cdot kg^{-1}$) (ww)	TEF Source	% Lipid	Reference
Lake Ontario	1983	Herring gull	egg	eggs	3	19-90	NR	NR		NR	Bishop et al. 1992
Lake Ontario - Muggs colony	84 -91	Herring gull	egg	eggs	NR	43.55	0.77	NR		NR	Hebert et al. 1994
Lake Ontario - Mugg's Island	84 - 88	Herring gull	egg	egg	NR	25 - 60	NR	NR		NR	Bishop & Weseloh 1990
Lake Ontario - Scotch Bonnet Island	71 - 82	Herring gull	egg	egg	NR	165-2350 (est.)	NR	NR		NR	Bishop & Weseloh 1990
Lake Ontario - Snake colony	84 -91	Herring gull	egg	eggs	NR	68.87	0.84	NR		NR	Hebert et al. 1994
Lake Ontario - Snake Island	1985	Herring gull	ADT	whole	10	127	2.6	151.09	WHO 1998	NR	Braune & Norstrom 1989
Lake Ontario - Snake Island	1985	Herring gull	ADT	liver	10	72	2.4	108.3	WHO 1998	NR	Braune & Norstrom 1989
Lake Ontario - Snake Island	1985	Herring gull	egg	eggs	9	83	ND	99.6	WHO 1998	NR	Braune & Norstrom 1989
Lake Superior	1983	Herring gull	egg	egg	1	13	NR	NR		NR	Weseloh et al. 1994
Lake Superior - Agawa	84 -91	Herring gull	egg	eggs	NR	20.09	1.58	NR		NR	Hebert et al. 1994
Lake Superior - Granite	84 -91	Herring gull	egg	eggs	NR	16.03	1.49	NR		NR	Hebert et al. 1994
Lake Superior - Granite	84 - 88	Herring gull	egg	egg	NR	< 25	NR	NR		NR	Bishop & Weseloh 1990
Green Bay and Lake	1978	Night Heron	NR	whole	NR	59	8	NR		NR	Stalling et al. 1985
Green Bay and Lake	1978	Night Heron	NR	whole	NR	12	ND	NR		NR	Stalling et al. 1985
Green Bay and Lake	1982	Night Heron	NR	whole	NR	21	4	NR		NR	Stalling et al. 1985
Quebec											
La Tuque	1989	Common Merganser	egg		1	7	111	44	Safe 1992	NR	Champoux 1996
La Tuque	1991	Common Merganser	egg		1	24	270	101	Safe 1992	NR	Champoux 1996
La Tuque U/S from mill	NR	Common Merganser	fledgling		4		0.24	0.2	Safe 1992	NR	Champoux 1996
La Tuque D/S from mill	NR	Common Merganser	fledgling		4	2.5	20.75[f]	5.4	Safe 1992	NR	Champoux 1996
La Tuque	1991	Hooded Merganser	egg	eggs	2	26.5	204	59.9	Safe 1992	NR	Champoux 1996
Saskatchewan											
Last Mountain Lake	NR	Double-crested cormorants	eggs	eggs	12	6	ND	18.5	WHO 1998	NR	Sanderson et al. 1994b

NR = not reported; NC - not calculated; ND - not detected; Life Stage: ADT = adult.

[a]TEQ includes mono-ortho PCBs, non-ortho PCBs, PCDDs, and PCDFs

[b]levels in parenthesis are averages of values of which more than half were at or below the limit of detection, defined by a signal to noise ratio of 3:1 (aprox. 0.5 - 2 ng/kg)

[c]minimum detectable level

[d]Elliott et al. 1989 uses TEF from a variety of sources to derive their TEQ. See Table 7.

[e]TEQ measured by H4IIE bioassay as described by Tillet et al. 1991

[f]significant difference at $p \leq 0.05$

Table 29. Levels of PCDD/Fs and TEQ in terrestrial animals in Canada

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ ($ng \cdot kg^{-1}$) (ww)	% Lipid	TEF Source	Reference
Northwest Territories											
Bathurst	1991-92	Caribou	age 4.1	fat	7	ND[a]	ND[a]	NR	43		Hebert et al. 1996
Southampton Is.	1991-92	Caribou	age 3.6	fat	5	ND[a]	0.16[a]	NR	92.3		Hebert et al. 1996
Cape Dorset	1991-92	Caribou	age 3.7	fat	3	0.73[a]	0.99[a]	NR	19.2		Hebert et al. 1996
Lake Harbour	1991-92	Caribou	age 4.3	fat	4	0.14[a]	0.21[a]	NR	80.4		Hebert et al. 1996
Quebec											
La Tuque, St. Maurice River, U/S	1991	Mink	NR	liver	3	<2.0	<1.0	2.3		Safe 1992	Champoux 1996
La Tuque, St. Maurice River, D/S, Near	1991	Mink	NR	liver	6	0.41	0.19	2.7		Safe 1992	Champoux 1996
La Tuque, St. Maurice River, D/S, Far	1991	Mink	NR	liver	2	0.9	0.38	32.7		Safe 1992	Champoux 1996
Yukon											
Finlayson	1993	Caribou	age 2	fat	3	ND[a]	ND[a]	NR	88.7		Hebert et al. 1996
Finlayson	1993	Caribou	age 3	fat	2	ND[a]	ND[a]	NR	85.5		Hebert et al. 1996
Finlayson	1993	Caribou	age 3	liver	2	ND[a]	ND[a]	NR	4.1		Hebert et al. 1996
Finlayson	1993	Caribou	age 3	muscle	2	ND[a]	ND[a]	NR	1.8		Hebert et al. 1996
Finlayson	1993	Caribou	age 4	fat	6	ND[a]	ND[a]	NR	87.2		Hebert et al. 1996
Finlayson	1993	Caribou	age 5	fat	3	ND[a]	ND[a]	NR	71.3		Hebert et al. 1996
Finlayson	1993	Caribou	age 6	fat	1	ND[a]	ND[a]	NR	88.1		Hebert et al. 1996
Tay	1993	Caribou	age 5.3	fat	13	ND[a]	0.14[a]	NR	84.2		Hebert et al. 1996
Bonnet Plume	1993	Caribou	age 6.6	fat	14	ND[a]	ND[a]	NR	83.8		Hebert et al. 1996
Alberta											
M1 - 3km D/S Weyerhauser pulp mill	1991-92	Mink	NR	liver	3	0.2	ND	NR	NR		Wayland 1995a
M2 - Athabasca Delta	1991-92	Mink	NR	liver	5	ND	ND	NR	NR		Wayland 1995a
M3 - 40 km D/S Hinton, AB.	1991-92	Mink	NR	liver	2	0.6	ND	NR	NR		Wayland 1995a
Peace-Athabasca Delta	1992	Muskrat	NR	fat	12	ND	ND	NR	30.1		Wayland 1995b

ND - not detected

NR - not reported

[a]concentrations in lipid weight

Table 30. Data from unpublished or unconfirmed sources

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ[a] ($ng \cdot kg^{-1}$) (ww)	% Lipid	Reference
Marine Invertebrates										
Lower Fraser River	1988	Dungeness crab	egg	whole	1	0.95	46.1	9.6		DFO - unpublished data
Lower Fraser River	1988	Dungeness crab	NR	hepatopancreas	5	3.1	71	16.1		DFO - unpublished data
Campbell River	1988	Dungeness crab	NR	hepatopancreas	1	12	540	314.8		DFO - unpublished data
Gold River	1988	Dungeness crab	NR	muscle	9	3.4	393.3	49.9		DFO - unpublished data
Gold River	1988	Dungeness crab	NR	hepatopancreas	6	60.5	7466.7	980.3		DFO - unpublished data
Gold River	1988	Dungeness crab	NR	muscle	1	5.4	260	49.5		DFO - unpublished data
Gold River	1988	Dungeness crab	NR	hepatopancreas	1	58	3000	525.8		DFO - unpublished data
McCurdy Creek	1990	Dungeness crab	NR	hepatopancreas	1	42	9200	1158		DFO - unpublished data
Mooyah Bay	1990	Dungeness crab	NR	hepatopancreas	1	27	2400	323.4		DFO - unpublished data
Kleeptee Creek	1990	Dungeness crab	NR	hepatopancreas	1	41	3900	565.2		DFO - unpublished data
Silverado Creek	1990	Dungeness crab	NR	hepatopancreas	1	12	1100	142.6		DFO - unpublished data
Houston River	1990	Dungeness crab	NR	hepatopancreas	1	27	1600	284.6		DFO - unpublished data
Powell River	1988	Dungeness crab	NR	muscle	3	1.2	116.7	15		DFO - unpublished data
Powell River	1988	Dungeness crab	NR	hepatopancreas	1	4.7	270	50.5		DFO - unpublished data
Powell River	1988	Dungeness crab	NR	muscle	1	ND	220	22.9		DFO - unpublished data
Powell River	1988	Dungeness crab	NR	hepatopancreas	1	ND	170	19		DFO - unpublished data
Savary Island	1990	Dungeness crab	NR	hepatopancreas	1	0.5	90	12		DFO - unpublished data
Harwood Island	1990	Dungeness crab	NR	hepatopancreas	1	5.2	320	50.7		DFO - unpublished data
Algerine Passage	1990	Dungeness crab	NR	hepatopancreas	1	0.35	38	6.7		DFO - unpublished data
Saltery Bay	1990	Dungeness crab	NR	hepatopancreas	1	2	98	18.7		DFO - unpublished data
Elk Falls	1988	Dungeness crab	NR	muscle	1	0.4	31	5.6		DFO - unpublished data
Elk Falls	1988	Dungeness crab	NR	hepatopancreas	2	11	685	188		DFO - unpublished data
Elk Falls	1988	Dungeness crab	NR	hepatopancreas	1	ND	330	95		DFO - unpublished data
Maude Island	1990	Dungeness crab	NR	hepatopancreas	1	3.3	230	78.4		DFO - unpublished data
Orange Point	1990	Dungeness crab	NR	hepatopancreas	1	10	550	133.8		DFO - unpublished data
Campbell River	1990	Dungeness crab	NR	hepatopancreas	1	12	910	133		DFO - unpublished data
Nanaimo	1988	Dungeness crab	NR	hepatopancreas	3	11.5	416.7	136.4		DFO - unpublished data
Harmac	1988	Dungeness crab	NR	hepatopancreas	1	16	353	135.4		DFO - unpublished data
Pylades Channel	1990	Dungeness crab	NR	hepatopancreas	1	7.4	230	53.1		DFO - unpublished data
Ruxton Island	1990	Dungeness crab	NR	hepatopancreas	1	3.8	91	28.6		DFO - unpublished data
Fairway Channel	1990	Dungeness crab	NR	hepatopancreas	1	4.9	140	27.4		DFO - unpublished data
Northumberland Channel	1990	Dungeness crab	NR	hepatopancreas	1	0.7	72	22.2		DFO - unpublished data
Hammond Bay	1990	Dungeness crab	NR	hepatopancreas	1	0.6	34	7.5		DFO - unpublished data
Crofton	1988	Dungeness crab	NR	muscle	4	1.7	58.2	16.1		DFO - unpublished data

Table 30. Data from unpublished or unconfirmed sources

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ[a] ($ng \cdot kg^{-1}$) (ww)	% Lipid	Reference
Crofton	1988	Dungeness crab	NR	hepatopancreas	9	13.9	418.9	179.5		DFO - unpublished data
Crofton	1988	Dungeness crab	NR	hepatopancreas	2	88	2510.5	528.8		DFO - unpublished data
Crofton	1988	Dungeness crab	NR	muscle	1	ND	49	9.1		DFO - unpublished data
North Reef	1990	Dungeness crab	NR	hepatopancreas	1	8.3	190	110.6		DFO - unpublished data
Maple Bay	1990	Dungeness crab	NR	hepatopancreas	1	16	410	153.7		DFO - unpublished data
Satellite Channel	1990	Dungeness crab	NR	hepatopancreas	1	0.7	43	13.6		DFO - unpublished data
Houston Channel	1990	Dungeness crab	NR	hepatopancreas	2	4	70	21.9		DFO - unpublished data
Ladysmith Harbour	1990	Dungeness crab	NR	hepatopancreas	2	6.6	165	53.7		DFO - unpublished data
Saanich Inlet	1990	Dungeness crab	NR	hepatopancreas	2	1.9	47.8	13.6		DFO - unpublished data
Cowichan Bay	1988	Dungeness crab	NR	hepatopancreas	1	2.5	66	34.7		DFO - unpublished data
Cowichan Bay	1988	Dungeness crab	NR	hepatopancreas	1	12	161	64.9		DFO - unpublished data
Kitimat Arm	1988	Dungeness crab	NR	hepatopancreas	7	26	10	132.3		DFO - unpublished data
Kitimat	1988	Dungeness crab	NR	hepatopancreas	1	17	13	169.1		DFO - unpublished data
Port Mellon	1988	Dungeness crab	NR	muscle	3	7.7	245	43.6		DFO - unpublished data
Port Mellon	1988	Dungeness crab	NR	hepatopancreas	2	112.5	3902.5	742.4		DFO - unpublished data
Prince Rupert	1988	Dungeness crab	NR	muscle	7	16	375.3	64.6		DFO - unpublished data
Prince Rupert	1988	Dungeness crab	NR	hepatopancreas	4	462.8	13834	2413.5		DFO - unpublished data
Prince Rupert	1988	Dungeness crab	NR	body fluids	2	3.5	115.5	19		DFO - unpublished data
Woodfibre - Howe Sound	1988	Dungeness crab	NR	muscle	7	7.9	205	51.9		DFO - unpublished data
Cous Creek - Port Alberni	1988	Dungeness crab	NR	hepatopancreas	1	ND	6.6	6.9		DFO - unpublished data
Alberni Harbour	1990	Dungeness crab	NR	hepatopancreas	1	3.5	65	47		DFO - unpublished data
Polly Point	1990	Dungeness crab	NR	hepatopancreas	1	6.7	300	94.4		DFO - unpublished data
Stamp Narrows	1990	Dungeness crab	NR	hepatopancreas	1	3	55	36.1		DFO - unpublished data
Howe Sound	1988/89	Dungeness crab	NR	muscle	8	8.9	313.4	43.4		DFO - unpublished data
Howe Sound	1988/89	Dungeness crab	NR	hepatopancreas	8	126.9	4562.5	820.2		DFO - unpublished data
Victoria	1988	Crab	NR	hepatopancreas	1	10	99	446.3		DFO - unpublished data
Crofton	1988	Crab	NR	hepatopancreas	2	88	2510.5	534.3		DFO - unpublished data
Buntzen Bay	1988	Crab	NR	hepatopancreas	1	3	129	174.4		DFO - unpublished data
Boundary Bay	1988	Crab	NR	hepatopancreas	1	1.5	44	37.9		DFO - unpublished data
Iona Jetty	1988	Crab	NR	hepatopancreas	1	22	290	113.6		DFO - unpublished data
Chemainus	1988	Crab	NR	hepatopancreas	1	10	161	139.4		DFO - unpublished data
Nanaimo	1988	Crab	NR	hepatopancreas	1	4	93	51		DFO - unpublished data
Seabord Terminus	1988	Crab	NR	hepatopancreas	1	5	123	74.4		DFO - unpublished data
Harmac	1988	Crab	NR	hepatopancreas	1	16	353	136.8		DFO - unpublished data
Port Mellon	1988	Crab	NR	hepatopancreas	1	662	24968	3634.4		DFO - unpublished data

Table 30. Data from unpublished or unconfirmed sources

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ[a] ($ng \cdot kg^{-1}$) (ww)	% Lipid	Reference
Woodfibre - Howe Sound	1988	Crab	NR	muscle	1	12	333	61		DFO - unpublished data
Woodfibre - Howe Sound	1988	Crab	NR	hepatopancreas	1	356	16547	2874.5		DFO - unpublished data
Prince Rupert	1988	Crab	NR	muscle	1	14	310	47.5		DFO - unpublished data
Prince Rupert	1988	Crab	NR	hepatopancreas	1	487	11890	2177		DFO - unpublished data
Nanaimo	1988	Red rock crab	NR	hepatopancreas	1	0.4	42	8.7		DFO - unpublished data
Stuart Channel	1990	Red rock crab	NR	hepatopancreas	1	1.4	50.5	20.4		DFO - unpublished data
May Island	1990	Red rock crab	NR	hepatopancreas	1	1.3	50	28.5		DFO - unpublished data
Menzies Bay	1990	Red rock crab	NR	hepatopancreas	1	0.8	26	12.4		DFO - unpublished data
Saltwater Lagoon	1990	Red rock crab	NR	hepatopancreas	1	0.45	97	45		DFO - unpublished data
Queen Charlotte Channel	1988/89	Red rock crab	NR	hepatopancreas	1	7.1	320	47.3		DFO - unpublished data
Powell River	1988	Box crab	NR	muscle	1	0.7	58	7.4		DFO - unpublished data
Powell River	1988	Box crab	NR	hepatopancreas	1	8.9	1100	155.3		DFO - unpublished data
Gold River	1988	Prawn	NR	muscle	3	2	176.7	21.3		DFO - unpublished data
Gold River	1988	Prawn	NR	muscle tissue	1	ND	350	35.4		DFO - unpublished data
McCurdy Creek	1990	Prawn	NR	muscle	1	2	150	18.7		DFO - unpublished data
Houston River	1990	Prawn	NR	muscle	1	1.4	46	8.9		DFO - unpublished data
Port Mellon - Howe Sound	1988	Prawn	NR	soft tissue	2	8.4	205.5	36.1		DFO - unpublished data
Port Mellon - Howe Sound	1988	Prawn	NR	muscle tissue	1	14	337	50.7		DFO - unpublished data
Woodfibre - Howe Sound	1988	Prawn	NR	muscle tissue	4	4.7	72.8	18.1		DFO - unpublished data
Woodfibre - Howe Sound	1988	Prawn	NR	muscle tissue	1	9	108	44.6		DFO - unpublished data
Howe Sound area	1988/89	Prawn	NR	muscle tissue	6	3.3	82	13.1		DFO - unpublished data
Howe Sound	1988	Prawn	NR	muscle tissue	1	2.9	67	11.4		DFO - unpublished data
Anvil Island - Howe Sound	1989	Prawn	NR	muscle tissue	2	3	70	12.5		DFO - unpublished data
Howe Sound area	1988/89	Small prawn	NR	muscle tissue	5	6	399.4	46.3		DFO - unpublished data
Port Mellon - Howe Sound	1988	Large prawn	NR	soft tissue	7	8.3	200.4	34.5		DFO - unpublished data
Woodfibre - Howe Sound	1988	Shrimp	NR	soft tissue	2	5	135.2	22.4		DFO - unpublished data
Howe Sound	1988/89	Shrimp	NR	muscle	6	ND - 6.2	158.8	17.4		DFO - unpublished data
Port Mellon - Howe Sound	1988	Shrimp	NR	soft tissue	5	17.6	611.8	87.2		DFO - unpublished data
Prince Rupert - Hecate Strait	1988	Shrimp	NR	muscle	2	23	605	94		DFO - unpublished data
Powell River - Georgia Strait	1988	Pink shrimp	NR	muscle tissue	1	0.94	100	13.7		DFO - unpublished data
Powell River - Georgia Strait	1988	Pacific oyster	NR	soft tissue	4	0.5	190	20.4		DFO - unpublished data
Nanaimo - Georgia Strait	1988	Pacific oyster	NR	soft tissue	2	0.4	42	5.4		DFO - unpublished data
Crofton - Georgia Strati	1988	Pacific oyster	NR	soft tissue	2	0.2	51.5	9.2		DFO - unpublished data
Crofton	1988	Oyster	NR	soft tissue	1	0.6	33	6.4		DFO - unpublished data
Crofton	1988	Oyster	NR	soft tissue	2	7.6	190	75.2		DFO - unpublished data

Table 30. Data from unpublished or unconfirmed sources

Location	Year	Species	Life Stage	Tissue	N	T_4CDD (ng·kg^{-1}) (ww)	T_4CDF (ng·kg^{-1}) (ww)	TEQ[a] (ng·kg^{-1}) (ww)	% Lipid	Reference
Powell River	1988	Oyster	NR	soft tissue	1	4	1000	110.3		DFO - unpublished data
Kleeptee Creek	1990	Oyster	NR	soft tissue	1	0.6	120	13.5		DFO - unpublished data
Silverado Creek	1990	Oyster	NR	soft tissue	1	0.6	130	14.6		DFO - unpublished data
Crofton	1988	Oyster	NR	NR	2	13	315	81.6		DFO - unpublished data
Nanaimo	1988	Oyster	NR	NR	2	ND	35.5	22.7		DFO - unpublished data
Harmac	1988	Oyster	NR	NR	1	6	98	34.1		DFO - unpublished data
Gabriola Bar	1988	Oyster	NR	NR	1	3	91	22.8		DFO - unpublished data
Crofton	1988	Littleneck clam	NR	soft tissue	1	ND	42	14.3		DFO - unpublished data
Crofton	1988	Butter clam	NR	NR	1	ND	36	13.7		DFO - unpublished data
Port Mellon	1988	Softshell clam	NR	NR	1	3	76	12		DFO - unpublished data
Harmac	1988	Clam	NR	NR	1	3	14	21.4		DFO - unpublished data
Howe Sound	1988/89	Mussel	NR	whole	2	ND	77	12.9		DFO - unpublished data
Gold River	1988	Mussel	NR	whole	1	2.5	341	42.9		DFO - unpublished data
Crofton	1988	Mussel	NR	NR	1	5	75	31.6		DFO - unpublished data
Marine Fish										
Powell River	1988	Chinook salmon	NR	fillet	ND - 2.2	65	8.8		2	DFO - unpublished data
Georgia Strait	1988	Chinook salmon	NR	fillet	ND	47	5.1		1	DFO - unpublished data
Morse Basin - Prince Rupert	1988	Chinook salmon	NR	whole	1	75	10		1	DFO - unpublished data
Morse Basin - Prince Rupert	1988	Chinook salmon	ADT	muscle	14.5	13	23.8		1	DFO - unpublished data
Port Mellon - Howe Sound	1988	Chinook salmon	JUV	muscle	4	51	12.3		1	DFO - unpublished data
Gold River	1988	Rockfish	NR	liver	150	6800	1056.3		1	DFO - unpublished data
McCurdy Creek - Gold River	1990	Rockfish	NR	liver	16	380	75.3		1	DFO - unpublished data
Mooyah Bay - Gold River	1990	Rockfish	NR	liver	12	200	42.6		1	DFO - unpublished data
Houston River - Gold River	1990	Rockfish	NR	liver	32	650	139.8		1	DFO - unpublished data
Kleeptee Creek - Gold River	1990	Rockfish	NR	liver	46	550	135.4		1	DFO - unpublished data
Port Mellon - Howe Sound	1988	Rockfish	NR	fillet	ND	27	24.7		1	DFO - unpublished data
Gold River	1988	Canary rockfish	NR	fillet	2.7	10	8.2		1	DFO - unpublished data
Port Mellon - Howe Sound	1988	Quillback rockfish	NR	muscle tissue	3	28	8.2		1	DFO - unpublished data
Maude Island - Elk Falls	1990	Quillback rockfish	NR	liver	9.9	420	83.8		1	DFO - unpublished data
Cape Mudge - Elk Falls	1990	Quillback rockfish	NR	liver	4.4	180	37.4		1	DFO - unpublished data
Shelter Point - Elk Falls	1990	Quillback rockfish	NR	liver	8.1	250	74.4		1	DFO - unpublished data
Powell River	1990	Quillback rockfish	NR	liver	16	1600	217.4		1	DFO - unpublished data
Powell River - diffuser	1990	Quillback rockfish	NR	liver	4.6	420	55.5		1	DFO - unpublished data
Blubber Bay - Powell River	1990	Quillback rockfish	NR	liver	5.7	370	51.4		1	DFO - unpublished data

Table 30. Data from unpublished or unconfirmed sources

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ[a] ($ng \cdot kg^{-1}$) (ww)	% Lipid	Reference
Harwood Island - Powell River	1990	Quillback rockfish	NR	liver	7.4	340	60.9		1	DFO - unpublished data
Northumberland Channel - Harmac	1990	Quillback rockfish	NR	liver	22	450	165.5		1	DFO - unpublished data
Mudge Island - Harmac	1990	Quillback rockfish	NR	liver	16	310	59		1	DFO - unpublished data
Snake Island - Harmac	1990	Quillback rockfish	NR	liver	7.9	230	38.1		1	DFO - unpublished data
Stuart Channel - Harmac	1990	Quillback rockfish	NR	liver	7.2	160	42.1		1	DFO - unpublished data
North Reef - Crofton	1990	Quillback rockfish	NR	liver	120	1500	474.4		1	DFO - unpublished data
Cowichan Bay - Crofton	1990	Quillback rockfish	NR	liver	7.3	120	30.2		1	DFO - unpublished data
Saanich Inlet - Crofton	1990	Quillback rockfish	NR	liver	3.9	60	13.8		1	DFO - unpublished data
Stamp Narrows - Port Alberni	1990	Quillback rockfish	NR	liver	4.4	22	25		1	DFO - unpublished data
Dunsmuir Point - Port Alberni	1990	Quillback rockfish	NR	liver	4.2	20	38.2		1	DFO - unpublished data
Powell River	1990	Red snapper	NR	liver	11	1300	165		1	DFO - unpublished data
Powell River - diffuser	1990	Red snapper	NR	liver	4	290	39.4		1	DFO - unpublished data
Blubber Bay - Powell River	1990	Red snapper	NR	liver	7.8	300	51.9		1	DFO - unpublished data
Prince Rupert - Hecate Strait	1988	Pollock	NR	muscle tissue	9.5	11.5	12.6		2	DFO - unpublished data
Gold River	1988	Ratfish	NR	liver	330	50000	5516.4		1	DFO - unpublished data
Elk Falls	1988	Dogfish	NR	fillet	1	20	7		1	DFO - unpublished data
Elk Falls	1988	Cabezon	NR	liver	7.9	550	167.2		2	DFO - unpublished data
Silverado Creek - Gold River	1990	Lingcod	NR	liver	39	550	206.3		1	DFO - unpublished data
Maude Island - Elk Falls	1990	Lingcod	NR	liver	0.6	140	21.8		1	DFO - unpublished data
Snake Island - Harmac	1990	Lingcod	NR	liver	0.8	130	22		1	DFO - unpublished data
Northumberland Channel - Harmac	1990	Lingcod	NR	liver	1.2	190	57.3		1	DFO - unpublished data
Mudge Island - Harmac	1990	Lingcod	NR	liver	0.8	130	15.8		1	DFO - unpublished data
Stuart Channel - Harmac	1990	Lingcod	NR	liver	2.9	120	47.9		1	DFO - unpublished data
North Reef - Crofton	1990	Lingcod	NR	liver	3.6	96	29.3		1	DFO - unpublished data
Mudge Island - Harmac	1990	Kelp greenling	NR	liver	19	390	63.8		1	DFO - unpublished data
Satellite Channel - Crofton	1990	Kelp greenling	NR	liver	3.6	96	29.3		1	DFO - unpublished data
Polly Point - Port Alberni	1990	Kelp greenling	NR	liver	4.9	80	16.3		1	DFO - unpublished data
Chemainus	1988	Perch	NR	NR	3	14	10.5		1	DFO - unpublished data
Harmac	1988	Perch	NR	NR	4	288	42		1	DFO - unpublished data
Lower Fraser River	1988	Threespine stickleback	NR	NR	2	19	9.4		1	DFO - unpublished data
Harmac	1988	Threespine stickleback	NR	NR	2	20	8.4		1	DFO - unpublished data
Alberni Harbour	1990	Threespine stickleback	NR	whole	1.6	31	9.1		1	DFO - unpublished data
Powell River	1988	English sole	NR	liver	3.4	140.5	35.7		2	DFO - unpublished data
Nanaimo	1988	English sole	NR	fillet	1.3	30	6.8		1	DFO - unpublished data
Nanaimo	1988	English sole	NR	liver	3.3	69.7	21.1		3	DFO - unpublished data

Table 30. Data from unpublished or unconfirmed sources

Location	Year	Species	Life Stage	Tissue	N	T_4CDD ($ng \cdot kg^{-1}$) (ww)	T_4CDF ($ng \cdot kg^{-1}$) (ww)	TEQ[a] ($ng \cdot kg^{-1}$) (ww)	% Lipid	Reference
Crofton	1988	English sole	NR	fillet	2.5	18	7.8		1	DFO - unpublished data
Crofton	1988	English sole	NR	liver	3.6	70.7	22.6		3	DFO - unpublished data
Crofton	1988	Sculpin	NR	NR	6	123	31		2	DFO - unpublished data
Port Alberni	1988	Sculpin	NR	NR	9	16	20.6		1	DFO - unpublished data
Chemainus	1988	Sculpin	NR	NR	ND	23	5.4		1	DFO - unpublished data
Powell River	1988	English sole	NR	liver	3.4	140.5	35.7		2	DFO - unpublished data
Nanaimo	1988	English sole	NR	fillet	1.3	30	6.8		1	DFO - unpublished data
Nanaimo	1988	English sole	NR	liver	3.3	69.7	21.1		3	DFO - unpublished data
Crofton	1988	English sole	NR	fillet	2.5	18	7.8		1	DFO - unpublished data
Crofton	1988	English sole	NR	liver	3.6	70.7	22.6		3	DFO - unpublished data
Crofton	1988	Sculpin	NR	NR	6	123	31		2	DFO - unpublished data
Port Alberni	1988	Sculpin	NR	NR	9	16	20.6		1	DFO - unpublished data
Chemainus	1988	Sculpin	NR	NR	ND	23	5.4		1	DFO - unpublished data
Maude Island - Elk Falls	1990	Red Irish lord	NR	liver	7.2	170	33.2		1	DFO - unpublished data
Cape Mudge - Elk Falls	1990	Red Irish lord	NR	liver	2.3	70	11.2		1	DFO - unpublished data
Freshwater Fish										
North Thompson River at McLure	1990	Rainbow trout	24.5 cm	muscle	5			3.40		B.C. MELP 1991
North Thompson River at McLure	1990	Rainbow trout	24.5 cm	liver	5			2.60		B.C. MELP 1991
North Thompson River at McLure	1990	Rainbow trout	38 cm	muscle	2			2.40		B.C. MELP 1991
North Thompson River at McLure	1990	Rainbow trout	38 cm	liver	2			0.60		B.C. MELP 1991
North Thompson River at McLure	1990	Rainbow trout	10-20 cm	muscle	NR			2.10		B.C. MELP 1991
North Thompson River at McLure	1990	Rainbow trout	10-20 cm	liver	NR			26.00		B.C. MELP 1991
South Thompson River at Chase	1990	Rainbow trout	23.6 cm	muscle	5			1.90		B.C. MELP 1991
South Thompson River at Chase	1990	Rainbow trout	23.6 cm	liver	5			0.50		B.C. MELP 1991
South Thompson River at Chase	1990	Rainbow trout	39.3 cm	muscle	4			5.50		B.C. MELP 1991
South Thompson River at Chase	1990	Rainbow trout	39.3 cm	liver	4			4.80		B.C. MELP 1991
South Thompson River at Chase	1990	Rainbow trout	20-35 cm	muscle	NR			2.90		B.C. MELP 1991
South Thompson River at Chase	1990	Rainbow trout	20-35 cm	liver	NR			1.40		B.C. MELP 1991
Kamloops Lake	1990	Rainbow trout	40.7 cm	muscle	2			4.60		B.C. MELP 1991
Kamloops Lake	1990	Rainbow trout	40.7 cm	liver	4			10.50		B.C. MELP 1991
Kamloops Lake	1990	Rainbow trout	20-35 cm	muscle	NR			2.40		B.C. MELP 1991
Lower Thompson River at Walachin	1990	Rainbow trout	14.2 cm	muscle	6			2.40		B.C. MELP 1991
Lower Thompson River at Walachin	1990	Rainbow trout	14.2 cm	liver	6			2.60		B.C. MELP 1991
Lower Thompson River at Walachin	1990	Rainbow trout	30.8 cm	muscle	5			4.80		B.C. MELP 1991

Table 30. Data from unpublished or unconfirmed sources

Location	Year	Species	Life Stage	Tissue	N	T_4CDD (ng·kg^{-1}) (ww)	T_4CDF (ng·kg^{-1}) (ww)	TEQ[a] (ng·kg^{-1}) (ww)	% Lipid	Reference
Lower Thompson River at Walachin	1990	Rainbow trout	30.8 cm	liver	5			11.80		B.C. MELP 1991
Lower Thompson River at Walachin	1990	Rainbow trout	39.6 cm	muscle	5			8.50		B.C. MELP 1991
Lower Thompson River at Walachin	1990	Rainbow trout	39.6 cm	liver	5			12.00		B.C. MELP 1991
Lower Thompson River at Walachin	1990	Rainbow trout	> 35 cm	muscle	3			8.60		B.C. MELP 1991
Lower Thompson River at Walachin	1990	Rainbow trout	> 35 cm	liver	3			42.80		B.C. MELP 1991
Lower Thompson River D/S of Ashcroft	1990	Rainbow trout	16.6 cm	muscle	7			2.90		B.C. MELP 1991
Lower Thompson River D/S of Ashcroft	1990	Rainbow trout	16.6 cm	liver	7			1.70		B.C. MELP 1991
Lower Thompson River D/S of Ashcroft	1990	Rainbow trout	28.4 cm	muscle	5			8.10		B.C. MELP 1991
Lower Thompson River D/S of Ashcroft	1990	Rainbow trout	28.4 cm	liver	5			9.60		B.C. MELP 1991
Lower Thompson River D/S of Ashcroft	1990	Rainbow trout	39.1 cm	muscle	5			6.70		B.C. MELP 1991
Lower Thompson River D/S of Ashcroft	1990	Rainbow trout	39.1 cm	liver	5			5.50		B.C. MELP 1991
Barriere River	1990	Rainbow trout	> 35 cm	muscle	2	0.9 - 2.2	1.1 - 4.2	3.40		B.C. MELP 1991
Barriere River	1990	Rainbow trout	> 35 cm	liver	2	1.3 - 2.2	1.2 - 1.9	3.80		B.C. MELP 1991
Barriere River	1990	Rainbow trout	> 35 cm	roe	1	1.4	1.7	2.40		B.C. MELP 1991
Corbett Lake	1990	Rainbow trout	30.1 cm	muscle	5			3.00		B.C. MELP 1991
Corbett Lake	1990	Rainbow trout	30.1 cm	liver	5			0.50		B.C. MELP 1991
Corbett Lake	1990	Rainbow trout	38 cm	muscle	2			2.30		B.C. MELP 1991
Corbett Lake	1990	Rainbow trout	38 cm	liver	2			0.60		B.C. MELP 1991
North Thompson River at McLure	1990	Dolly varden	50 cm	muscle	1			2.50		B.C. MELP 1991
North Thompson River at McLure	1990	Dolly varden	50 cm	liver	1			5.50		B.C. MELP 1991

[a]TEF source not reported

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

Species Name	Life Stage	Test Type	Duration Exp/Total	Water Concentration (TEQ ng·L⁻¹)	Nominal Tissue Dose (TEQ µg·kg⁻¹ ww)	Tissue Residue (TEQ µg·kg⁻¹ ww)	Endpoint	Reference
			Exposure Conditions					
Amphibia								
American bullfrog	tadpole	IP	SD/50 d	NA	0	NR	20% mortality - control	Beatty et al. 1976
Rana catesbeiana				NA	25	NR	13% mortality	
				NA	50	NR	27% mortality	
				NA	100	NR	7% mortality	
				NA	200	NR	20% mortality	
				NA	1000	NR	20% mortality	
	adult	IP	SD/35 d	NA	0	NR	0% mortality - control	Beatty et al. 1976
				NA	50	NR	0% mortality	
				NA	100	NR	0% mortality	
				NA	250	NR	0% mortality	
				NA	500	NR	0% mortality	
American toad	eggs	S,N	24 h/67 d	0	NR	NR	19% mortality - control	Jung and Walker 1997
Bufo americanus				3	NR	0.010	10% mortality - NS	
				30	NR	0.123	17% mortality - NS	
				300	NR	1.078	11% mortality - NS	
				3000	NR	7.125	15% mortality - NS	
				30,000	NR	19.331	17% mortality - NS	
	tadpoles	S,N	24 h/7 d	0	NR	NR	<2% mortality - control	Jung and Walker 1997
				300[a]	NR	2.663	<1% mortality - NS	
				300[b]	NR	5.661	0% mortality - NS	
leopard frog	eggs	S,N	24 h/28 d	0	NR	NR	31% mortality at <1.5 d post-hatch - control	Jung and Walker 1997
Rana pipiens				3,000	NR	17.486	42% mortality at <1.5 d post-hatch - SIG	
green frog	eggs	S,N	24 h/41 d	0	NR	NR	11% mortality - control	Jung and Walker 1997
Rana clamitans				300	NR	0.891	2% mortality - NS	
				3,000	NR	3.682	2% mortality - NS	
				10,000	NR	11.482	21% mortality - NS	
				30,000	NR	28.227	6% mortality - NS	
				100,000	NR	73.717	5% mortality - NS	
Salmonidae								
coho salmon	3.5 g	S,N	24, 48, 96 h / 59 d	0	0	NR	2% mortality - control[c]	Miller et al. 1973
Oncorhynchus kisutch				0.056[LOEL]	0.054	NR	12% mortality	
				0.56	0.54	NR	15% mortality	
				5.6	5.4	NR	55% mortality	
				56	54	NR	100% mortality	

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

	Exposure Conditions							
Species Name	Life Stage	Test Type	Duration Exp/Total	Water Concentration (TEQ ng·L^{-1})	Nominal Tissue Dose (TEQ μg·kg^{-1} ww)	Tissue Residue (TEQ μg·kg^{-1} ww)	Endpoint	Reference
	3.5 g	S,N	24 h/60 d	0	0	NR	0% mortality - control	Miller et al. 1979
				0.056	0.054	NR	5% mortality - NS	
				0.56	0.54	NR	5% mortality - NS	
				5.6^{NOEL}	5.4^{NOEL}	NR	15% mortality - NS	
				56^{LOEL}	54^{LOEL}	NR	100% mortality -SIG	
	3.5 g	S,N	48 h/60 d	0	0	NR	5% mortality - control	Miller et al. 1979
				0.056	0.054	NR	5% mortality - NS	
				0.56^{NOEL}	0.54^{NOEL}	NR	10% mortality - NS	
				5.6^{LOEL}	5.4^{LOEL}	NR	15% mortality - SIG	
				56	54	NR	100% mortality -SIG	
	3.5 g	S,N	96 h/60 d	0	0	NR	0% mortality - control	Miller et al. 1979
				0.001	0.00054	NR	0% mortality - NS	
				0.005	0.0054	NR	0% mortality - NS	
				0.056	0.054	NR	0% mortality - NS	
				0.56^{NOEL}	0.54^{NOEL}	NR	15% mortality - NS	
				5.6^{LOEL}	5.4^{LOEL}	NR	50% mortality - SIG	
				56	54	NR	100% mortality - SIG	
	3.5 g	S,N	24 h/60 d	0	0	NR	control - growth set at 100%	Miller et al. 1979
				0.056	0.054	NR	growth rate increased by 8% - NS	
				0.56^{NOEL}	0.54^{NOEL}	NR	no effect on growth	
				5.6^{LOEL}	5.4^{LOEL}	NR	growth rate reduced by 60% - SIG	
	3.5 g	S,N	48 h/60 d	0	0	NR	control - growth set at 100%	Miller et al. 1979
				0.056	0.054	NR	growth rate reduced by 30% - NS	
				0.56^{NOEL}	0.54^{NOEL}	NR	growth rate increased by 4% - NS	
				5.6^{LOEL}	5.4^{LOEL}	NR	growth rate reduced by 82% - SIG	
	3.5 g	S,N	96 h/60 d	0	0	NR	control - growth set at 100%	Miller et al. 1979
				0.056	0.054	NR	growth rate reduced by 5% - NS	
				0.56^{NOEL}	0.54^{NOEL}	NR	growth rate reduced by 14% - NS	
				5.6^{LOEL}	5.4^{LOEL}	NR	growth rate reduced by 84% - SIG	
	6.6 g	S,N	96 h/114 d	0	0	ND	13% mortality - control	Miller et al. 1979
				0.001	0.00054	ND	20% mortality - NS	
				0.011	0.0054	ND	7% mortality - NS	
				0.105	0.054	ND	20% mortality - NS	

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

Species Name	Life Stage	Test Type	Duration Exp/Total	Water Concentration (TEQ ng·L^{-1})	Nominal Tissue Dose (TEQ µg·kg^{-1} ww)	Tissue Residue (TEQ µg·kg^{-1} ww)	Endpoint	Reference
				Exposure Conditions				
				1.053[NOEL]	0.54[NOEL]	0.125[WB, NOEL]	7% mortality - NS	
				10.53[LOEL]	5.4[LOEL]	2.17[WB, LOEL]	53% mortality -SIG	
	6.6 g	S,N	24 h/114 d	0	0	NR	control - growth set at 100%	Miller et al. 1979
				0.001	0.00054	NR	growth rate increased by 21% - NS	
				0.011	0.0054	NR	growth rate increased by 13% - NS	
				0.105	0.054	NR	growth rate increased by 3% - NS	
				1.053[NOEL]	0.54[NOEL]	0.021[WB, NOEL]	growth rate increased by 17% - NS	
				10.53[LOEL]	5.4[LOEL]	0.478[WB, LOEL]	growth rate reduced by 65% - SIG	
	6.6 g	S,N	96 h/114 d	0	0	ND	control - growth set at 100%	Miller et al. 1979
				0.001	0.00054	ND	growth rate reduced by 5% - NS	
				0.011	0.0054	ND	growth rate increased by 15% - NS	
				0.105	0.054	ND	growth rate reduced by 6% - NS	
				1.053[NOEL]	0.54[NOEL]	0.125[WB, NOEL]	growth rate reduced by 12% - NS	
				10.53[LOEL]	5.4[LOEL]	2.17[WB, LOEL]	growth rate reduced by 93% - SIG	
chinook salmon *Oncorhynchus tshawytscha*	fingerling	F,N	d 1-60/210 d	0%[TBKME-FW]	NR	0.0014[d]	hepatic EROD activity - control	Servizi et al. 1993
			d 1-60/210 d	1.5%[TBKME-FW]	NR	0.00255[d]	hepatic EROD activity elevated - SIG	
			d 1-60/210 d	4%[TBKME-FW]	NR	0.00255[d]	hepatic EROD activity elevated - SIG	
			d 61-144/210 d	0%[TBKME-FW]	NR	0.00015[d]	hepatic EROD activity - control	
			d 61-144/210 d	0.3%[TBKME-FW]	NR	0.0023[d]	hepatic EROD activity elevated - SIG	
			d 61-144/210 d	0.8%[TBKME-FW]	NR	0.0021[d]	hepatic EROD activity elevated - SIG	
			d 145-210/210 d	0%[TBKME-SW]	NR	0.00045[d]	hepatic EROD activity - control	
			d 145-210/210 d	0%[TBKME-SW]	NR	NR	no effect on hepatic EROD activity	
			d 145-210/210 d	0%[TBKME-SW]	NR	0.00015[d]	no effect on hepatic EROD activity	
rainbow trout *Oncorhynchus mykiss*	eggs	SR,N	96 h/168 d	0	NR	NR	0.9% mortality in alevins after 56 d - control	Helder 1981
				0.1[NOEL]	NR	NR	0.9% mortality in alevins after 56 d - NS	
				1[LOEL]	NR	NR	2.3% mortality in alevins after 56 d - SIG	
				10	NR	NR	15.8% mortality in alevins after 56 d - SIG	
	eggs	SR,N	96 h/168 d	0	NR	NR	no evidence of terata after 84 d - control	Helder 1981
				0.1[NOEL]	NR	NR	no evidence of terata after 84 d	
				1[LOEL]	NR	NR	terata evident in 20% of fry after 84 d	
				10	NR	NR	terata evident in 90% of fry after 84 d	
	eggs	SR,N	96 h/168 d	0	NR	NR	growth - control	Helder 1981
				0.1[LOEL]	NR	NR	growth reduced after 72 d - SIG	
				1	NR	NR	growth reduced after 118 d - SIG	

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

Species Name	Life Stage	Test Type	Duration Exp/Total	Water Concentration (TEQ ng·L^{-1})	Nominal Tissue Dose (TEQ µg·kg^{-1} ww)	Tissue Residue (TEQ µg·kg^{-1} ww)	Endpoint	Reference
				Exposure Conditions				
				10	NR	NR	growth reduced at all times - SIG	
	eggs	S,N	48 h/24+ d	0	NR	0	~37% mortality to swim-up - control	Walker et al. 1992
				83.3[LOEL]	NR	0.279[LOEL]	~63% mortality to swim-up - SIG	
				167	NR	0.428	~65% mortality to swim-up - SIG	
				250	NR	0.466	~78% mortality to swim-up - SIG	
				333	NR	0.72	~90% mortality to swim-up - SIG	
				500	NR	1.620	~93% mortality to swim-up - SIG	
							LD_{50} = 0.439 µg·kg^{-1} ww	
	eggs	INJ	SD/24+ d	NA	0	NR	~50% mortality to swim-up - control	Walker et al. 1992
				NA	0.194[NOEL]	NR	~57% mortality to swim-up - NS	
				NA	0.291[LOEL]	NR	~47% mortality to swim-up - NS	
				NA	0.437	NR	~78% mortality to swim-up - SIG	
				NA	0.656	NR	~97% mortality to swim-up - SIG	
				NA	0.983	NR	~98% mortality to swim-up - SIG	
							LD_{50} = 0.421 µg·kg^{-1} ww	
	eggs	INJ	SD/24+ d	NA	0*	NR	~11% sac fry mortality - control	Walker and Peterson 1991
				NA	0.14*	NR	~20% sac fry mortality - NS	
				NA	.18*	NR	~16% sac fry mortality - NS	
				NA	0.24*	NR	~22% sac fry mortality - NS	
				NA	0.32*[NOEL]	NR	~40% sac fry mortality - NS	
				NA	0.40*[LOEL]	NR	~67% sac fry mortality - SIG	
				NA	0.57*	NR	~73% sac fry mortality - SIG	
				NA	0.75*	NR	~99% sac fry mortality - SIG	
							LD_{50}* = 0.404 µg TEQ·kg^{-1} ww	
							LD_{50}(2,3,7,8-T_4CDD) = 0.230 - 0.488[e] µg·kg^{-1} ww	
							LD_{50}(1,2,3,7,8-P_5CDD) = 0.566 µg TEQ·kg^{-1} ww	
							LD_{50}(1,2,3,7,8-P_5CDF) = 0.367 µg TEQ·kg^{-1} ww	
							LD_{50}(2,3,4,7,8-P_5CDF) = 0.350 µg TEQ·kg^{-1} ww	
							LD_{50}(1,2,3,4,7,8-H_6CDD) = 0.714 µg TEQ·kg^{-1} ww	
							LD_{50}(1,2,3,4,7,8-H_6CDF) = 0.099 µg TEQ·kg^{-1} ww	
	alevin	SR,N	4 d/25 d	0.61	NR	NR	~1% mortality after 25 d - control	Bol et al. 1989
				1.00	NR	NR	~ 4% mortality after 25 d	
				1.65	NR	NR	~ 40% mortality after 25 d	
				2.72	NR	NR	~ 85% mortality after 25 d	
				4.48	NR	NR	~ 99% mortality after 25 d	
				7.39	NR	NR	~100% mortality after 12 d	

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

Species Name	Life Stage	Test Type	Duration Exp/Total	Water Concentration (TEQ ng·L⁻¹)	Nominal Tissue Dose (TEQ µg·kg⁻¹ ww)	Tissue Residue (TEQ µg·kg⁻¹ ww)	Endpoint	Reference
			Exposure Conditions					
				12.18	NR	NR	~100% mortality after 14 d	
				20.09	NR	NR	~100% mortality after 18 d	
	0.38 g	F,M	28 d/56 d	0.001	NR	0.027[WB, f]	5% mortality after 28 d -control	Mehrle et al. 1988
				0.038	NR	0.98	6% mortality after 28 d -NS	
				0.079[NOEL]	NR	NR	18% mortality after 28 d -NS	
				0.176[LOEL]	NR	4.52[LOEL]	50% mortality after 28 d -SIG	
				0.382	NR	10.95	73% mortality after 28 d -SIG	
				0.789	NR	NR	85% mortality after 28 d -SIG	
	0.38 g	F,M	28 d/56 d	0.001	NR	0.22[WB, g]	7% mortality after 56 d -control	Mehrle et al. 1988
				0.038[LOEL]	NR	0.74[LOEL]	45% mortality after 56 d - SIG	
				0.079	NR	NR	83% mortality after 56 d - SIG	
				0.176	NR	NR	95% mortality after 56 d - SIG	
							56 d LC_{50} = .046 ng/L	
	0.38 g	F,M	28 d/56 d	<0.001*[DL]	NR	0.01*[WB, f]	0% mortality after 28 d - control	Mehrle et al. 1988
				0.02*	NR	0.12*	2% mortality after 28 d -NS	
				0.05*	NR	NR	6% mortality after 28 d -NS	
				0.09*[NOEL]	NR	NR	3% mortality after 28 d -NS	
				0.20*[LOEL]	NR	0.48*[LOEL]	18% mortality after 28 d -SIG	
				0.44*	NR	NR	28% mortality after 28 d -SIG	
	0.38 g	F,M	28 d/56 d	<0.001*[DL]	NR	<0.003*[DL, WB, g]	0% mortality after 56 d -control	Mehrle et al. 1988
				0.02*	NR	0.005*	2% mortality after 56 d -NS	
				0.05*	NR	NR	6% mortality after 56 d -NS	
				0.09*[NOEL]	NR	NR	3% mortality after 56 d -NS	
				0.20*[LOEL]	NR	0.027*[LOEL]	22% mortality after 56 d -SIG	
				0.44*	NR	NR	46% mortality after 56 d -SIG	
	0.38 g	F,M	28 d/56 d	0.001	NR	0.027[WB, f]	growth after 28 d - control	Mehrle et al. 1988
				0.038[LOEL]	NR	0.98[LOEL]	growth reduced after 28 d - SIG	
				0.079	NR	NR	growth reduced after 28 d - SIG	
				0.176	NR	4.52	growth reduced after 28 d - SIG	
				0.382	NR	10.95	growth reduced after 28 d - SIG	
				0.789	NR	NR	growth reduced after 28 d - SIG	
	0.38 g	F,M	28 d/56 d	0.001	NR	0.22[WB, g]	growth after 56 d - control	Mehrle et al. 1988
				0.038[LOEL]	NR	0.74[LOEL]	growth reduced after 56 d - SIG	

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

	Exposure Conditions							
Species Name	Life Stage	Test Type	Duration Exp/Total	Water Concentration (TEQ ng·L^{-1})	Nominal Tissue Dose (TEQ μg·kg^{-1} ww)	Tissue Residue (TEQ μg·kg^{-1} ww)	Endpoint	Reference
	0.38 g	F,M	28 d/56 d	<0.001*[DL]	NR	0.01*[WB, f]	growth after 28 d - control	Mehrle et al. 1988
				0.02*	NR	0.12*	growth after 28 d - NS	
				0.05*[NOEL]	NR	NR	growth reduced after 28 d - NS	
				0.09*[LOEL]	NR	NR	growth reduced after 28 d - SIG	
				0.20*	NR	0.48*	growth reduced after 28 d - SIG	
				0.44*	NR	NR	growth reduced after 28 d - SIG	
	0.38 g	F,M	28 d/56 d	<0.001*[DL]	NR	<0.003*[DL,WB, g]	growth after 56 d - control	Mehrle et al. 1988
				0.02*[NOEL]	NR	0.005*[NOEL]	growth reduced after 56 d - NS	
				0.05*[LOEL]	NR	NR	growth reduced after 56 d - SIG	
				0.09*	NR	NR	growth reduced after 56 d - SIG	
				0.20*	NR	0.027*	growth reduced after 56 d - SIG	
				0.44*	NR	NR	growth reduced after 56 d - SIG	
	juvenile	IP	SD/80 d	NA	0	NR	0% mortality - control	Spitsbergen et al. 1988a
				NA	1[NOEL]	NR	0% mortality	
				NA	5[LOEL]	NR	20% mortality	
				NA	25	NR	90% mortality	
				NA	125	NR	95% mortality	
							80 d LD_{50} = 10 μg·kg^{-1} ww	
	juvenile	IP	SD/80 d	NA	0	NR	470% initial body weight (IBW) after 80 d - control	Spitsbergen et al. 1988a
				NA	1[NOEL]	NR	430% IBW after 80 d - NS	
				NA	5[LOEL]	NR	155% IBW after 35 d (control = 200%) - SIG	
				NA	25	NR	125% IBW after 14 d (control = 145%) - SIG	
				NA	125	NR	120% IBW after 14 d (control = 145%) - SIG	
	juvenile	IP	SD/25 d	NA	0	NR	28.75 X 10^3 leukocytes/μL - control	Spitsbergen et al. 1988a
				NA	1[LOEL]	NR	10.82 X 10^3 leukocytes/μL - SIG	
				NA	10	NR	7.81 X 10^3 leukocytes/μL - SIG	
	juvenile	IP	SD/25 d	NA	0	NR	16.83 X 10^3 thrombocytes/μL - control	Spitsbergen et al. 1988a
				NA	1[LOEL]	NR	11.04 X 10^3 thrombrocytes/μL - SIG	
				NA	10	NR	3.06 X 10^3 thrombrocytes/μL - SIG	
	juvenile	IP	SD/80 d	NA	0	NR	~0% mortality after 80 d - control	Kleeman et al. 1988
				NA	1[NOEL]	NR	~3% mortality after 80 d	
				NA	5[LOEL]	NR	~25% mortality after 57 d	
				NA	25	NR	~91% mortality after 42 d	
				NA	125	NR	~97% mortality after 29 d	

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

Species Name	Life Stage	Test Type	Duration Exp/Total	Water Concentration (TEQ ng·L^{-1})	Nominal Tissue Dose (TEQ µg·kg^{-1} ww)	Tissue Residue (TEQ µg·kg^{-1} ww)	Endpoint	Reference
				Exposure Conditions				
							80 d LD_{50} = 10 µg·kg^{-1} ww	
	juvenile	diet	105 d	NA	0^{DW}	NR	0% mortality after 105 d - control	Hawkes & Norris 1977
				NA	0.000032	NR	0% mortality after 105 d	
				NA	0.036^{NOEL}	NR	0% mortality after 105 d	
				NA	21^{LOEL}	NR	88% mortality in 71 d	
	juvenile	diet	105 d	NA	0^{DW}	NR	growth after 30 d - control	Hawkes & Norris 1977
				NA	0.000032	NR	no effect on growth after 30 d - NS	
				NA	0.036^{NOEL}	NR	no effect on growth after 30 d - NS	
				NA	21^{LOEL}	NR	growth reduced after 30 d - SIG	
	35 - 57g	IP	SD/84 d	NA	0	NR	no adverse effects - control	van der Weiden et al. 1989b
				NA	0.01	NR	increased inflammatory cells in liver after 42 d	
				NA	0.05	NR	accumulation of erythrocytes in spleen after 21 d	
				NA	0.1	NR	scattering of hepatocytes in liver after 42 d	
				NA	0.5	NR	EROD activity 7 times control after 21 d	
				NA	1.0	NR	focal coagulation necrosis in liver after 21 d	
				NA	5.0	NR	growth reduction after 42 d - SIG, 20% mortality after 84 d	
	35 - 57g	IP	SD/84 d	NA	0	NR	no adverse effects - control	van der Weiden et al. 1992
				NA	0.006^{NOEL}	NR	no adverse effects	
				NA	0.03^{LOEL}	NR	relative spleen weight reduced after 21 d - SIG	
				NA	0.06	NR	relative liver weight reduced after 42 d - SIG	
				NA	0.3	NR	EROD activity 7 times control after 21 d - SIG	
				NA	0.6	NR	EROD activity 16 times control after 42 d - SIG	
				NA	3.06	NR	growth reduction after 42 d - SIG, 20% mortality after 84 d	
							21 d ED_{50} for EROD activity = 0.79 µg·kg^{-1}	
	200 g	OI	SD/2,4,8,16 d	NA	$0.060\text{-}3.7^{liver}$		TEL(2,3,7,8-T_4CDD)$_{\text{EROD-OI dose}}$ = 0.072 µg·kg^{-1} ww	Parrott et al. 1995
							TEL(2,3,7,8-T_4CDD)$_{\text{EROD-[LIVER]}}$ = 0.016 µg·kg^{-1} ww	
				NA	0.032-9.6		TEL(1,2,3,7,8-P_5CDD)$_{\text{EROD-OI dose}}$ = 0.039 µg·kg^{-1} ww	
							TEL(1,2,3,7,8-P_5CDD)$_{\text{EROD-[LIVER]}}$ = NR	
				NA	<0.01-0.08		TEL(1,2,3,6,7,8-H_6CDD)$_{\text{EROD-OI dose}}$ = <0.01 µg·kg^{-1} ww	
							TEL(1,2,3,6,7,8-H_6CDD)$_{\text{EROD-[LIVER]}}$ = NR	
				NA	0.05-5		TEL(1,2,3,4,7,8-H_6CDD)$_{\text{EROD-OI dose}}$ = 0.13 µg·kg^{-1} ww	
							TEL(1,2,3,4,7,8-H_6CDD)$_{\text{EROD-[LIVER]}}$ = 0.020 µg·kg^{-1} ww	
				NA	<0.01-.08		TEL(1,2,3,4,6,7,8-H_7CDD)$_{\text{EROD-OI dose}}$ = <0.01 µg·kg^{-1} ww	
							TEL(1,2,3,4,6,7,8-H_7CDD)$_{\text{EROD-[LIVER]}}$ = <0.001 µg·kg^{-1} ww	
				NA	0.04-1.25		TEL(2,3,7,8-T_4CDF)$_{\text{EROD-OI dose}}$ = 0.01 µg·kg^{-1} ww	

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

Species Name	Exposure Conditions: Life Stage	Test Type	Duration Exp/Total	Water Concentration (TEQ ng·L^{-1})	Nominal Tissue Dose (TEQ µg·kg^{-1} ww)	Tissue Residue (TEQ µg·kg^{-1} ww)	Endpoint	Reference
							TEL(2,3,7,8-T_4CDF)$_{EROD\text{-}[LIVER]}$ = 0.002 µg·kg^{-1} ww	
				NA	0.04-1.25		TEL(1,2,3,7,8-P_5CDF)$_{EROD\text{-}OI\ dose}$ = 0.04 µg·kg^{-1} ww	
							TEL(1,2,3,7,8-P_5CDF)$_{EROD\text{-}[LIVER]}$ = 0.002 µg·kg^{-1} ww	
				NA	0.20-6		TEL(2,3,4,7,8-P_5CDF)$_{EROD\text{-}OI\ dose}$ = 0.40 µg·kg^{-1} ww	
							TEL(2,3,4,7,8-P_5CDF)$_{EROD\text{-}[LIVER]}$ = 0.0024 µg·kg^{-1} ww	
				NA	0.03-0.86		TEL(1,2,3,4,7,8-H_6CDF)$_{EROD\text{-}OI\ dose}$ = 0.06 µg·kg^{-1} ww	
							TEL(1,2,3,4,7,8-H_6CDF)$_{EROD\text{-}[LIVER]}$ = 0.005 µg·kg^{-1} ww	
lake trout	eggs	SR,N	48 h/113 d	0	NR	0[h]	18% mortality to swim-up - control	Spitsbergen et al. 1991
Salvelinus namaycush				0.1 - 1.0[NOEL]	NR	<0.015[DL, NOEL]	15.8% mortality to swim-up - NS	
				10[LOEL]	NR	0.04[LOEL]	22.5% mortality to swim-up - SIG	
				100	NR	0.400	100% mortality to swim-up - SIG	
	eggs	SR,N	48 h/175 d	0	NR	0[i]	~21% mortality to swim-up (120 d) - control	Walker et al. 1991
				10[NOEL]	NR	0.034[NOEL]	~28% mortality to swim-up (120 d) - NS	
				20[LOEL]	NR	0.055[LOEL]	~43% mortality to swim-up (120 d) - SIG	
				40	NR	0.121	~50% mortality after hatch (97 d) - SIG	
				62	NR	0.226	~55% mortality after hatch (97 d) - SIG	
				100	NR	0.302	~50% mortality after hatch (80 d) - SIG	
							LD_{50} = 0.065 µg·kg^{-1} ww	
	eggs[j]	SR,N	48 h/217 d	0-150[k]	NR	0-0.126[e]	$NOEL_{SFM}$ = 0.045, LOEL[e]$_{SFM}$ = 0.061 µg·kg^{-1} ww	Guiney et al. 1996
							$LD_{50\text{-}SFM}$ = 0.069 µg·kg^{-1} ww	
				0-150[m]	NR	0-0.128[e]	$NOEL_{SFM}$ = 0.045, LOEL[e]$_{SFM}$ = 0.061 µg·kg^{-1} ww	
							$LD_{50\text{-}SFM}$ = 0.072 µg·kg^{-1} ww	
	eggs[n]	SR,N	48 h/217 d	0-150[k]	NR	0-0.121[e]	$NOEL_{SFM}$ = 0.030, LOEL[e]$_{SFM}$ = 0.036 µg·kg^{-1} ww	
							$LD_{50\text{-}SFM}$ = 0.044 µg·kg^{-1} ww	
				0-150[m]	NR	0-0.121[e]	$NOEL_{SFM}$ = 0.036, LOEL[e]$_{SFM}$ = 0.047 µg·kg^{-1} ww	
							$LD_{50\text{-}SFM}$ = 0.057 µg·kg^{-1} ww	
	eggs[p]	SR,N	48 h/217 d	0-150[k]	NR	0-0.101[e]	$NOEL_{SFM}$ = 0.041, LOEL[e]$_{SFM}$ = 0.054 µg·kg^{-1} ww	
							$LD_{50\text{-}SFM}$ = 0.053 µg·kg^{-1} ww	
				0-150[m]	NR	0-0.099[e]	$NOEL_{SFM}$ = 0.035, LOEL[e]$_{SFM}$ = 0.036 µg·kg^{-1} ww	
							$LD_{50\text{-}SFM}$ = 0.042 µg·kg^{-1} ww	
	eggs[q]	SR,N	48 h/217 d	0-100[k]	NR	0.034-0.115[e]	$NOEL_{SFM}$ = 0.034, LOEL[e]$_{SFM}$ = 0.053 µg·kg^{-1} ww	
							$LD_{50\text{-}SFM}$ = 0.065 µg·kg^{-1} ww	
	eggs	INJ	SD/24+ d	NA	0	NR	~12% sac fry mortality - control	Walker et al. 1992
				NA	0.024	NR	~20% sac fry mortality - NS	
				NA	0.033	NR	~43% sac fry mortality - NS	
				NA	0.044[NOEL]	NR	~48% sac fry mortality - NS	

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

Species Name	Life Stage	Test Type	Exposure Conditions: Duration Exp/Total	Water Concentration (TEQ ng·L^{-1})	Nominal Tissue Dose (TEQ µg·kg^{-1} ww)	Tissue Residue (TEQ µg·kg^{-1} ww)	Endpoint	Reference
				NA	0.058^{LOEL}	NR	~83% sac fry mortality - SIG	
				NA	0.077	NR	~73% sac fry mortality - SIG	
				NA	0.103	NR	~100% sac fry mortality - SIG	
							LD_{50} = 0.047 µg·kg^{-1} ww	
brook trout	eggs	SR,N	48 h/80 d	0	NR	ND	~0% sac fry mortality - control	Walker and Peterson 1994b
Salvelinus fontinalis				4	NR	0.101	~0% sac fry mortality - NS	
				6^{NOEL}	NR	0.135^{NOEL}	~11% sac fry mortality - NS	
				8^{LOEL}	NR	0.185^{LOEL}	~24% sac fry mortality - SIG	
				10	NR	0.233	~90% sac fry mortality - SIG	
				15	NR	0.337	~98% sac fry mortality - SIG	
				20	NR	0.434	~100% sac fry mortality - SIG	
				30	NR	0.470	~100% sac fry mortality - SIG	
							LD_{50} = 0.200 µg·kg^{-1} ww	
cisco/lake herring	eggs	RC,M	0[r] m/100 d	$<0.0065^{DL}$	NR	$<0.0008^{DL}$	94% survival - control[r]	Elonen et al. 1998
Coregonus artedii			0[s] m/100 d	0.05	NR	0.023	92% survival - control[s]	
			7 m/100 d	31	NR	0.175^{NOEL}	88% survival - NS	
			20 m/100 d	31	NR	0.270^{LOEL}	80% survival - SIG	
			60 m/100 d	31	NR	0.717	63% survival - SIG	
			180 m/100 d	31	NR	1.210	24% survival - SIG	
			540 m/100 d	31	NR	2.090	2% survival - SIG	
							LD_{50} = 0.902 µg·kg^{-1} ww	
	eggs	RC,M	0[r] m/100 d	$<0.0065^{DL}$	NR	$<0.0008^{DL}$	growth - control[r]	Elonen et al. 1998
			0[s] m/100 d	0.05	NR	0.023	growth - control[s]	
			7 m/100 d	31	NR	0.175	no effect on growth - NS	
			20 m/100 d	31	NR	0.270^{NOEL}	no effect on growth - NS	
			60 m/100 d	31	NR	0.717^{LOEL}	growth reduced - SIG	
			180 m/100 d	31	NR	1.210	growth reduced - SIG	
			540 m/100 d	31	NR	2.090	(no statistics possible - replicates dead)	
Poeciliidae								
guppy	8 - 12 mm	SR,N	24 h/69 d	0	0	NR	7% fish with fin necrosis after 42 d - control	Miller et al. 1979
Poecilia reticulata				0.01^{NOEL}	0.08^{NOEL}	NR	12% fish with fin necrosis after 42 d - NS	
				0.1^{LOEL}	0.8^{LOEL}	NR	37% fish with fin necrosis after 42 d - SIG	
				1	8.0	NR	49% fish with fin necrosis after 42 d - SIG	
				10	80.0	NR	87% fish with fin necrosis after 42 d - SIG	
	9 - 40 mm	SR,N	120 h/37 d	0	NR	NR	0% mortality - control	Norris & Miller 1974
				100^{LOEL}	NR	NR	100% mortality, LT_{50} = 21.7 d	

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

Species Name	Life Stage	Test Type	Duration Exp/Total	Water Concentration (TEQ ng·L^{-1})	Nominal Tissue Dose (TEQ µg·kg^{-1} ww)	Tissue Residue (TEQ µg·kg^{-1} ww)	Endpoint	Reference
				Exposure Conditions				
				1000	NR	NR	100% mortality, LT_{50} = 11.6 d	
				10000	NR	NR	100% mortality, LT_{50} = 18.2 d	
mosquitofish *Gambusia affinis*	NR	S,M	15 d	2.8	NR	6.3[WB, t]	100% mortality	Yockim et al. 1978
Percidae								
yellow perch *Perca flavescens*	40 g	IP	SD/80 d	NA	0	NR	~0% mortality - control	Spitsbergen et al. 1988b
				NA	1	NR	~5% mortality after 80 d	
				NA	5	NR	~76% mortality after 80 d	
				NA	25	NR	~100% mortality after 46 d	
				NA	125	NR	~96% mortality after 25 d	
							80 d LD_{50} = 3 µg·kg^{-1} ww	
zebrafish *Danio rerio*	eggs	RC,M	0[r] m/32 d	0.01	NR	0.007	84% survival - control[r]	Elonen et al. 1998
			0[s] m/32 d	0.08	NR	0.070	81% survival - control[s]	
			6 m/32 d	23	NR	0.422	82% survival - NS	
			16 m/32 d	23	NR	0.424[NOEL]	76% survival - NS	
			40 m/32 d	23	NR	2.000[LOEL]	66% survival - SIG	
			100 m/32 d	23	NR	2.650	36% survival - SIG	
			250 m/32 d	23	NR	4.390	6% survival - SIG	
							LD_{50} = 2.610 µg·kg^{-1} ww	
	eggs	RC,M	0[r] m/32 d	0.01	NR	0.007	growth - control[r]	Elonen et al. 1998
			0[s] m/32 d	0.08	NR	0.070	growth - control[s]	
			6 m/32 d	23	NR	0.422	no effect on growth - NS	
			16 m/32 d	23	NR	0.424	no effect on growth - NS	
			40 m/32 d	23	NR	2.000	no effect on growth - NS	
			100 m/32 d	23	NR	2.650[NOEL]	no effect on growth - NS	
			250 m/32 d	23	NR	4.390[LOEL]	growth reduced - SIG	
Cyprinidae								
fathead minnow *Pimephales promelas*	eggs	RC,M	0[r] m/32 d	0.01	NR	0.005	100% survival - control[r]	Elonen et al. 1998
			0[s] m/32 d	0.07	NR	0.032	100% survival - control[s]	
			6 m/32 d	9	NR	0.126	100% survival - NS	
			15 m/32 d	9	NR	0.235[NOEL]	95% survival - NS	
			38 m/32 d	9	NR	0.435[LOEL]	73% survival - SIG	
			94 m/32 d	9	NR	0.823	10% survival - SIG	
			234 m/32 d	9	NR	1.540	5% survival - SIG	
							LD_{50} = 0.539 µg·kg^{-1} ww	

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

	Exposure Conditions							
Species Name	Life Stage	Test Type	Duration Exp/Total	Water Concentration (TEQ ng·L^{-1})	Nominal Tissue Dose (TEQ µg·kg^{-1} ww)	Tissue Residue (TEQ µg·kg^{-1} ww)	Endpoint	Reference
	eggs	RC,M	0[r] m/32 d	0.01	NR	0.005	growth - control[r]	Elonen et al. 1998
			0[s] m/32 d	0.07	NR	0.032	growth - control[s]	
			6 m/32 d	9	NR	0.126	no effect on growth - NS	
			15 m/32 d	9	NR	0.235	no effect on growth - NS	
			38 m/32 d	9	NR	0.435	no effect on growth - NS	
			94 m/32 d	9	NR	0.823	no effect on growth - NS	
			234 m/32 d	9	NR	1.540	no effect on growth - NS	
	eggs	S,N	blastula to 48 h	0[r]	NR	0	0% mortality - control[r]	Olivieri and Cooper 1997
			post-hatch/7 d	0[s]	NR	0	0% mortality - control[s]	
				0.37	NR	0.040	0% mortality	
				1.20	NR	0.130[NOEL]	0% mortality	
				0.59[LOEL]	NR	2.46[LOEL]	16% mortality	
				2.83	NR	12.070	46% mortality	
				10.16	NR	37.010	50% mortality	
							7 d LD_{50} = 25.710 µg·kg^{-1} ww	
	eggs	S,N	blastula to 48 h	0[r]	NR	0	0% total lesions - control[r]	Olivieri and Cooper 1997
			post-hatch/7 d	0[s]	NR	0	0% total lesions - control[s]	
				0.37[LOEL]	NR	0.04[LOEL]	36% total lesions	
				1.20	NR	0.130	56% total lesions	
				0.59	NR	2.460	41% total lesions	
				2.83	NR	12.070	86% total lesions	
				10.16	NR	37.010	100% total lesions	
							7 d ED_{50} = 0.140 µg·kg^{-1} ww	
	larvae	S,N	24 h/64 d	0[r]	NR	0	0% mortality - control[r]	Olivieri and Cooper 1997
				0[s]	NR	0	0% mortality - control[s]	
				3.8	NR	3.590	0% mortality - NS	
				90	NR	20.000	0% mortality - NS	
				40	NR	26.51[NOEL]	1% mortality - NS	
				76.5	NR	44.698[LOEL]	28% mortality - SIG	
				68.6[LOEL]	NR	163.000	98% mortality - SIG	
							LD_{50} = 70.915 µg·kg^{-1} ww	
	larvae	S,N	24 h/64 d	0[r]	NR	0	growth - control[r]	Olivieri and Cooper 1997
				0[s]	NR	0	growth - control[s]	
				3.8	NR	3.590	no fish affected by reduced growth - NS	
				90	NR	20.000	80% of fish affected by reduced growth - SIG	
				40	NR	26.51[NOEL]	56% of fish affected by reduced growth - NS	

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

Species Name	Exposure Conditions							
	Life Stage	Test Type	Duration Exp/Total	Water Concentration (TEQ $ng \cdot L^{-1}$)	Nominal Tissue Dose (TEQ $\mu g \cdot kg^{-1}$ ww)	Tissue Residue (TEQ $\mu g \cdot kg^{-1}$ ww)	Endpoint	Reference
				76.5^{LOEL}	NR	44.698^{LOEL}	100% of fish affected by reduced growth - SIG	
				68.6	NR	163.000	(no statistics possible - replicates dead)	
							ED_{50} = 25.727 $\mu g \cdot kg^{-1}$ ww	
	larvae	S,N	24 h/64 d	0^{r}	NR	0	0% of fish affected by wasting syndrome - control[r]	Olivieri and Cooper 1997
				0^{s}	NR	0	0% of fish affected by wasting syndrome - control[s]	
				3.8	NR	3.590	0% of fish affected by wasting syndrome	
				90	NR	20.000^{LOEL}	81% of fish affected by wasting syndrome	
				40^{LOEL}	NR	26.510	69% of fish affected by wasting syndrome	
				76.5	NR	44.698	100% of fish affected by wasting syndrome	
				68.6	NR	163.000	100% of fish affected by wasting syndrome	
	1 - 2 g	SR,M	24 h/60 d	0	NR	NR	~8% mortality - control	Adams et al. 1986
				0.12	NR	NR	~2% mortality	
				0.72^{NOEL}	NR	NR	~6% mortality	
				7.14^{LOEL}	NR	NR	~40% mortality	
				81.8	NR	NR	~94% mortality	
	1 - 2 g	SR,M	48 h/60 d	0	NR	NR	~8% mortality - control	Adams et al. 1986
				0.12	NR	NR	~2% mortality	
				0.72^{NOEL}	NR	NR	~6% mortality	
				7.14^{LOEL}	NR	NR	~58% mortality	
				81.8	NR	NR	~100% mortality in 42 d	
	1 - 2 g	SR,M	72 h/60 d	0	NR	NR	~8% mortality - control	Adams et al. 1986
				0.12	NR	NR	~2% mortality	
				0.72^{NOEL}	NR	NR	~6% mortality	
				7.14^{LOEL}	NR	NR	~40% mortality	
				81.8	NR	NR	~100% mortality in 19 d	
	1 - 2 g	SR,M	96 h/60 d	0	NR	NR	~8% mortality - control	Adams et al. 1986
				0.12	NR	NR	~2% mortality	
				0.72^{NOEL}	NR	NR	~6% mortality	
				7.14^{LOEL}	NR	NR	~50% mortality	
				81.8	NR	NR	~100% mortality in 30 d	
	0.5 - 1.0 g	SR,M	28 d/28 d	1.7	NR	NR	28 d LC_{50}	Adams et al. 1986
carp	20 g	IP	SD/80 d	NA	0	NR	~0% mortality after 80 days - control	Kleeman et al. 1988
Cyprinus carpio				NA	1	NR	~0% mortality after 80 days	

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

	Exposure Conditions							
Species Name	Life Stage	Test Type	Duration Exp/Total	Water Concentration (TEQ ng·L^{-1})	Nominal Tissue Dose (TEQ µg·kg^{-1} ww)	Tissue Residue (TEQ µg·kg^{-1} ww)	Endpoint	Reference
				NA	5	NR	~86% mortality after 80 days	
				NA	25	NR	~100% mortality after 62 days	
				NA	125	NR	~100% mortality after 56 days	
							80 d LD_{50} = 3 µg·kg^{-1} ww	
	38 - 70 g	IP	SD/14 d	NA	0.01-0.85	0.0457-4.395^{liver}	TEL(2,3,7,8-T_4CDD)$_{\text{EROD-IP dose}}$ = 0.03 µg·kg^{-1} ww	van der Weiden et al. 1994
							TEL(2,3,7,8-T_4CDD)$_{\text{P4501A-IP dose}}$ = 0.03 µg·kg^{-1} ww	
							TEL(2,3,7,8-T_4CDD)$_{\text{EROD-[LIVER]}}$ = 0.3395 µg·kg^{-1} ww	
							TEL(2,3,7,8-T_4CDD)$_{\text{P4501A-[LIVER]}}$ = 0.3395 µg·kg^{-1} ww	
	54 - 89 g	IP	SD/14 d	NA	0.006-0.85	0.1276-3.891^{liver}	TEL(2,3,7,8-T_4CDD)$_{\text{EROD-IP dose}}$ = 0.03 µg·kg^{-1} ww	van der Weiden et al. 1994
							TEL(2,3,7,8-T_4CDD)$_{\text{P4501A-IP dose}}$ = 0.03 µg·kg^{-1} ww	
							TEL(2,3,7,8-T_4CDD)$_{\text{EROD-[LIVER]}}$ = 0.1276 µg·kg^{-1} ww	
							TEL(2,3,7,8-T_4CDD)$_{\text{P4501A-[LIVER]}}$ = 0.1276 µg·kg^{-1} ww	
				NA	0.002-0.25	0.0638-20.394	TEL(1,2,3,7,8-P_5CDD)$_{\text{EROD-IP dose}}$ = 0.002 µg·kg^{-1} ww	
							TEL(1,2,3,7,8-P_5CDD)$_{\text{P4501A-IP dose}}$ = 0.01 µg·kg^{-1} ww	
							TEL(1,2,3,7,8-P_5CDD)$_{\text{EROD-[LIVER]}}$ = 0.0638 µg·kg-1 ww	
							TEL(1,2,3,7,8-P_5CDD)$_{\text{P4501A-[LIVER]}}$ = 0.6355 µg·kg-1 ww	
				NA	<0.01-0.08	0.0017-0.6965	TEL(1,2,3,6,7,8-H_6CDD)$_{\text{EROD-IP dose}}$ = <0.01 µg·kg^{-1} ww	
							TEL(1,2,3,6,7,8-H_6CDD)$_{\text{P4501A-IP dose}}$ = 0.02 µg·kg^{-1} ww	
							TEL(1,2,3,6,7,8-H_6CDD)$_{\text{EROD-[LIVER]}}$ = 0.0196 µg·kg-1 ww	
							TEL(1,2,3,6,7,8-H_6CDD)$_{\text{P4501A-[LIVER]}}$ = 0.1221 µg·kg-1 ww	
				NA	<0.01-0.53	0.0061-0.2807	TEL(2,3,7,8-T_4CDF)$_{\text{EROD-IP dose}}$ = no induction	
							TEL(2,3,7,8-T_4CDF)$_{\text{P4501A-IP dose}}$ = 0.53 µg·kg^{-1} ww	
							TEL(2,3,7,8-T_4CDF)$_{\text{EROD-[LIVER]}}$ = no induction	
							TEL(2,3,7,8-T_4CDF)$_{\text{P4501A-[LIVER]}}$ = 0.2807 µg·kg^{-1} ww	
				NA	0.01-0.90	0.0291-4.008	TEL(2,3,4,7,8-P_5CDF)$_{\text{EROD-IP dose}}$ = 0.04 µg·kg^{-1} ww	
							TEL(2,3,4,7,8-P_5CDF)$_{\text{P4501A-IP dose}}$ = 0.04 µg·kg^{-1} ww	
							TEL(2,3,4,7,8-P_5CDF)$_{\text{EROD-[LIVER]}}$ = 0.1476 µg·kg^{-1} ww	
							TEL(2,3,4,7,8-P_5CDF)$_{\text{P4501A-[LIVER]}}$ = 0.1476 µg·kg^{-1} ww	
	77 - 123g	IP	SD/84 d	NA	0	NR	no adverse effects - control	van der Weiden et al. 1989b
				NA	0.01	NR	relative liver weight increased	
				NA	0.05	NR	EROD activity elevated after 7 d - SIG	
				NA	0.1	NR	EROD activity elevated after 21 d - SIG	
				NA	0.5	NR	EROD activity 40 times control after 21 d	
				NA	1.0	NR	cutaneous hemorrhages in caudal fin after 21 d	
				NA	5.0	NR	growth reduction after 42 d - SIG, 60% mortality after 42 d	
Esocidae								
northern pike	eggs	SR,N	96 h/23 d	0	NR	NR	body length after 11 d - control	Helder 1980

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

Species Name	Life Stage	Test Type	Duration Exp/Total	Exposure Conditions: Water Concentration (TEQ ng·L^{-1})	Nominal Tissue Dose (TEQ µg·kg^{-1} ww)	Tissue Residue (TEQ µg·kg^{-1} ww)	Endpoint	Reference
Esox lucius				0.1[LOEL]	NR	NR	reduced body length of fry by 6% after 11 d - SIG	
				1	NR	NR	reduced body length of fry by 13% after 11 d - SIG	
				10	NR	NR	reduced body length of fry by 19% after 11 d - SIG	
	eggs	SR,N	96 h/23 d	0	NR	NR	39.5% mortality to swim-up (15 d) - control	Helder 1980
				0.1	NR	NR	48.8% mortality to swim-up (15 d)	
				1.0	NR	NR	65.9% mortality to swim-up (15 d)	
				10.0	NR	NR	61.8% mortality to swim-up (15 d)	
	eggs	RC,M	0[r] m/32 d	<0.0065[DL]	NR	0.001	98% survival - control[r]	Elonen et al. 1998
			0[s] m/32 d	0.03	NR	0.132	100% survival - control[s]	
			6 m/32 d	208	NR	0.433	98% survival - NS	
			15 m/32 d	208	NR	0.647	88% survival - NS	
			38 m/32 d	208	NR	1.190[NOEL]	93% survival - NS	
			94 m/32 d	208	NR	1.800[LOEL]	75% survival - SIG	
			234 m/32 d	208	NR	4.770	3% survival - SIG LD$_{50}$ = 2.460 µg·kg^{-1} ww	
	eggs	RC,M	0[r] m/32 d	<0.0065[DL]	NR	0.001	growth - control[r]	Elonen et al. 1998
			0[s] m/32 d	0.03	NR	0.132	growth - control[s]	
			6 m/32 d	208	NR	0.433	no effect on growth - NS	
			15 m/32 d	208	NR	0.647	no effect on growth - NS	
			38 m/32 d	208	NR	1.190	no effect on growth - NS	
			94 m/32 d	208	NR	1.800[NOEL]	no effect on growth - NS	
			234 m/32 d	208	NR	4.770[LOEL]	growth reduced - SIG	
Ictaluridae								
channel catfish	eggs	RC,M	0[r] m/32 d	NR	NR	<0.0008[DL]	100% survival - control[r]	Elonen et al. 1998
Ictalurus punctatus			0[s] m/32 d	NR	NR	0.017	100% survival - control[s]	
			6 m/32 d	31	NR	0.041	94% survival - NS	
			18 m/32 d	31	NR	0.097	100% survival - NS	
			52 m/32 d	31	NR	0.140	100% survival - NS	
			156 m/32 d	31	NR	0.385[NOEL]	94% survival - NS	
			486 m/32 d	31	NR	0.855[LOEL]	18% survival - SIG LD$_{50}$ = 0.644 µg·kg^{-1} ww	
	eggs	RC,M	0[r] m/32 d	NR	NR	<0.0008[DL]	growth - control[r]	Elonen et al. 1998
			0[s] m/32 d	NR	NR	0.017	growth - control[s]	
			6 m/32 d	31	NR	0.041	no effect on growth - NS	
			18 m/32 d	31	NR	0.097	no effect on growth - NS	

Table 31. **Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.**

Species Name	Life Stage	Test Type	Duration Exp/Total	Exposure Conditions: Water Concentration (TEQ ng·L^{-1})	Nominal Tissue Dose (TEQ µg·kg^{-1} ww)	Tissue Residue (TEQ µg·kg^{-1} ww)	Endpoint	Reference
			52 m/32 d	31	NR	0.140	no effect on growth - NS	
			156 m/32 d	31	NR	0.385	no effect on growth - NS	
			486 m/32 d	31	NR	0.855	no effect on growth - NS	
	juvenile	S,M	20 d	4.2	NR	3.3[u]	100% mortality	Yockim et al. 1978
bullhead *Ictalurus melas*	6 g	IP	SD/80 d	NA	0	NR	~0% mortality after 80 days - control	Kleeman et al. 1988
				NA	1[NOEL]	NR	~0% mortality after 80 days	
				NA	5[LOEL]	NR	~53% mortality after 69 days	
				NA	25	NR	~100% mortality after 34 days	
				NA	125	NR	~100% mortality after 34 days 80 d LD_{50} = 5 µg·kg^{-1} ww	
Catostomidae								
white sucker *Catostomus commersoni*	eggs	RC,M	0[r] m/32 d	NR	NR	0.003	95% survival - control[r]	Elonen et al. 1998
			0[s] m/32 d	NR	NR	0.001	90% survival - control[s]	
			30 m/32 d	285	NR	0.848	93% survival - NS	
			60 m/32 d	285	NR	1.220[NOEL]	83% survival - NS	
			120 m/32 d	285	NR	1.960[LOEL]	38% survival - SIG	
			240 m/32 d	285	NR	2.400	3% survival - SIG	
			480 m/32 d	285	NR	3.090	0% survival - SIG LD_{50} = 1.890 µg·kg^{-1} ww	
	eggs	RC,M	0[r] m/32 d	NR	NR	0.003	growth - control[r]	Elonen et al. 1998
			0[s] m/32 d	NR	NR	0.001	growth - control[s]	
			30 m/32 d	285	NR	0.848[NOEL]	no effect on growth - NS	
			60 m/32 d	285	NR	1.220[LOEL]	growth reduced - SIG	
			120 m/32 d	285	NR	1.960	growth reduced - SIG	
			240 m/32 d	285	NR	2.400	growth reduced - SIG	
			480 m/32 d	285	NR	3.090	(no statistics possible - replicates dead)	
Centrarchidae								
bluegill *Lepomis macrochirus*	30 g	IP	SD/80 d	NA	0	NR	~0% mortality after 80 days - control	Kleeman et al. 1988
				NA	1	NR	~6% mortality after 80 days	
				NA	5	NR	~1% mortality after 80 days	
				NA	25	NR	~79% mortality after 78 days	
				NA	125	NR	~100% mortality after 26 days 80 d LD_{50} = 16 µg·kg^{-1} ww	
largemouth bass *Micropterus salmoides*	7 g	IP	SD/80 d	NA	0	NR	~0% mortality after 80 days - control	Kleeman et al. 1988
				NA	5	NR	~6% mortality after 80 days	

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

Species Name		Life Stage	Test Type	Duration Exp/Total	Water Concentration (TEQ ng·L⁻¹)	Nominal Tissue Dose (TEQ µg·kg⁻¹ ww)	Tissue Residue (TEQ µg·kg⁻¹ ww)	Endpoint	Reference
					Exposure Conditions				
					NA	25	NR	~96% mortality after 80 days	
					NA	125	NR	~100% mortality after 28 days	
								80 d LD_{50} = 11 µg·kg⁻¹ ww	
Oryziatidae									
medaka		eggs	S,M	14 d	0	NR	NR	10% incidence of minor lesions - control	Wisk & Cooper 1990a; b
	Oryzias latipes				0.4[LOEL]	NR	NR	50% incidence of minor lesions	
					1.7	NR	NR	60% incidence of minor lesions	
					5.9	NR	NR	50% incidence of minor lesions	
					13.2	NR	NR	80% incidence of minor lesions	
					31.7	NR	NR	100% incidence of minor lesions	
					50.8	NR	NR	100% incidence of minor lesions	
								EC_{50} = 3.5 ng TCDD·L⁻¹	
		eggs	S,M	14 d	0	NR	NR	0% incidence of severe lesions[v] - control	Wisk & Cooper 1990a; b
					0.4[LOEL]	NR	NR	10% incidence of severe lesions	
					1.7	NR	NR	10% incidence of severe lesions	
					5.9	NR	NR	10% incidence of severe lesions	
					13.2	NR	NR	40% incidence of severe lesions	
					31.7	NR	NR	100% incidence of severe lesions	
					50.8	NR	NR	100% incidence of severe lesions	
								EC_{50} = 14 ng TCDD·L⁻¹	
		eggs	S,M	14 d	0	NR	NR	0% mortality to 3 d post-hatch - control	Wisk & Cooper 1990a; b
					0.4[LOEL]	NR	NR	10% mortality to 3 d post-hatch	
					1.7	NR	NR	1.7% mortality to 3 d post-hatch	
					5.9	NR	NR	40% mortality to 3 d post-hatch	
					13.2	NR	NR	60% mortality to 3 d post-hatch	
					31.7	NR	NR	100% mortality to 3 d post-hatch	
					50.8	NR	NR	100% mortality to 3 d post-hatch	
								LC_{50} = 9 ng TCDD·L⁻¹	
		eggs	S,M	11 d	0	NR	NR	10% incidence of any lesions[w] - control	Wisk & Cooper 1990a; b
					0.5[NOEL]	NR	<0.1[DCE, NOEL]	10% incidence of any lesions	
					2.4[LOEL]	NR	0.3[LOEL]	50% incidence of any lesions	
					7.0	NR	0.7	80% incidence of any lesions	
					12.0	NR	1.2	80% incidence of any lesions	
					33.5	NR	3.3	90% incidence of any lesions	
					57.9	NR	4.8	100% incidence of any lesions	
								EC_{50} = 2.2 ng·L⁻¹, ED_{50} = 0.24 µg·kg⁻¹ ww	

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

Species Name	Life Stage	Test Type	Duration Exp/Total	Water Concentration (TEQ ng·L⁻¹)	Nominal Tissue Dose (TEQ µg·kg⁻¹ ww)	Tissue Residue (TEQ µg·kg⁻¹ ww)	Endpoint	Reference
	Exposure Conditions							
	eggs	RC,M	0[f] m/32 d	<0.0065[DL]	NR	0.009	83% survival - control[f]	Elonen et al. 1998
			0[g] m/32 d	0.10	NR	0.057	89% survival - control[g]	
			6 m/32 d	29	NR	0.251	96% survival - NS	
			15 m/32 d	29	NR	0.455[NOEL]	83% survival - NS	
			43 m/32 d	29	NR	0.949[LOEL]	58% survival - SIG	
			114 m/32 d	29	NR	2.110	5% survival - SIG	
			234 m/32 d	29	NR	3.670	0% survival - SIG	
							LD_{50} = 1.110 µg·kg⁻¹ ww	
	eggs	RC,M	0[f] m/32 d	<0.0065[DL]	NR	0.009	growth - control[f]	Elonen et al. 1998
			0[g] m/32 d	0.10	NR	0.057	growth - control[g]	
			6 m/32 d	29	NR	0.251	no effect on growth - NS	
			15 m/32 d	29	NR	0.455	no effect on growth - NS	
			43 m/32 d	29	NR	0.949[NOEL]	no effect on growth - NS	
			114 m/32 d	29	NR	2.110[LOEL]	growth reduced - SIG	
			234 m/32 d	29	NR	3.670	(no statistics possible - replicates dead)	
Crustacea								
water flea	<1 d	SR,M	48 h/7 d	1030	NA	NR	insignificant mortality	Adams et al. 1986
Daphnia magna	7 d	SR,M	48 h/7 d	1030	NA	NR	insignificant mortality	
	21 d	SR,M	48 h/7 d	1030	NA	NR	insignificant mortality	
	NR	S,M	32 d	3.1	NA	10.4[x]	no effect on growth and reproduction	Yockim et al. 1978
	NR	S,M	33 d	0	NA	NR	no adverse effects reported - control	Isensee and Jones 1975
				1330	NA	10,400[DW]	no adverse effects reported	
Insecta								
mosquito	larvae	S,N	17 d/39 d	0	NA	NR	no effect on pupation - control	Miller et al. 1973
Aedes aegypti				200	NA	NR	no effect on pupation	
Oligochaeta								
Oligochaetes	40 mm	S,N	55 d	0	NA	NR	no effect on reproduction - control	Miller et al. 1973
Paranais sp.				200	NA	NR	36% reduction in reproductive success - SIG	
Gastropoda								
snail								
Helosoma sp.	NR	S,M	32 d	3.1	NA	5.3[x]	no effect on growth and reproduction	Yockim et al. 1978
snail								
Physa sp.	adult	S,N	36 d/48 d	0	NA	NR	no effect on reproduction - control	Miller et al. 1973
				200	NA	NR	~35% reduction in total hatch	

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

Species Name	Life Stage	Test Type	Duration Exp/Total	Water Concentration (TEQ ng·L^{-1})	Nominal Tissue Dose (TEQ µg·kg^{-1} ww)	Tissue Residue (TEQ µg·kg^{-1} ww)	Endpoint	Reference
			Exposure Conditions					
	NR	S,M	33 d	0	NA	NR	no adverse effects reported - control	Isensee and Jones 1975
				1330	NA	1820	no adverse effects reported	
Plants								
algae								
Oedogonium cardiacum	NR	S,M	32 d	3.1	NA	2.8[x]	no effect on growth and reproduction	Yockim et al. 1978
		S,M	33 d	0	NA	NR	no adverse effects reported - control	Isensee and Jones 1975
				1330	NA	6690[DW]	no adverse effects reported	
duckweed								
Lemna minor	NR	S,M	33 d	0	NA	NR	no adverse effects reported - control	Isensee and Jones 1975
				1330	NA	NR	no adverse effects reported	
macrophyte								
Elodea nuttali	NR	S,M	40 d	<12[DL]	NA	0.500[y]	no adverse effects reported	Tsushimoto et al. 1982
macrophyte								
Ceratophyllum demersum	NR	S,M	40 d	<12[DL]	NA	0.500[y]	no adverse effects reported	Tsushimoto et al. 1982

Test Type: F = flow-through; INJ = egg injection; IP = intraperitoneal injection; OI = oral intubation; RC = recirculating; S = static; SR = static renewal
M = measured water concentration; N = nominal water concentration
Duration Exp/Total: exposure period to test compound/duration of observation; SD = single dose; d = days; h = hours; m = minutes
NA = not applicable; ND = not detected; NR = not reported
Endpoint: NS = not-significant; SIG = significant; EC_{50}, LC_{50}, LD_{50}, LT_{50} = effective concentration, lethal concentration, lethal dose, lethal tolerance, affecting 50% of the population respectively
TEL = minimum dose causing statistically significant increases in EROD or P4501A activity above controls
~ endpoint estimated from original figures (graphs), tables
* = 2,3,7,8-T_4CDF
[a] tadpoles fed during exposure and observation period
[b] tadpoles not fed during exposure period but fed during observation period
[c] mean endpoint for 24, 48 and 96 hr exposures
[d] TEQ includes 2,3,7,8-T_4CDD, 2,3,7,8-T_4CDF, and 2,3,4,7,8-P_5CDF
[e] based on four different strains of rainbow trout
[f] tissue residue measured at end of exposure phase
[g] tissue residue measured at end of depuration phase
[h] mean concentration of [^{3}H]-TCDD in eggs 1-6 wk post-exposure
[i] mean concentration of [^{3}H]-TCDD in eggs on days 3, 31, and 52 post-exposure
[j] eggs taken from fish collected from Western Lake Ontario - Fifty Point
[k] water temperature maintained at 8°C
[m] water temperature regime: 8-3-8°C
[n] eggs taken from fish collected from Eastern Lake Ontario - Stony Island
[p] eggs taken from hatchery fish - Crystal Springs, Altura, MN
[q] eggs taken from fish collected from Southwestern Lake Superior - Gull Island

Table 31. Acute and chronic toxicity data of PCDD/Fs to freshwater organisms.

Species Name	Exposure Conditions							
	Life Stage	Test Type	Duration Exp/Total	Water Concentration (TEQ ng·L^{-1})	Nominal Tissue Dose (TEQ µg·kg^{-1} ww)	Tissue Residue (TEQ µg·kg^{-1} ww)	Endpoint	Reference

[r] clean water control

[s] solvent control

[t] mean of fish sampled on days 1, 3, and 7

[u] mean of fish sampled on days 1, 3, 7 and 15

[v] severe lesions included severe vascualr hemorrhage and pericardial edema, or lesions that resulted in death prior to hatching or at hatching

[w] any lesions includes both minor and severe

[x] mean of organisms sampled on days 1, 3, 7, 15 and 32

[y] not a pure sample of this species, mixed with other predominant macrophyte species, see Tsushimoto et al. 1982

[DCE] tissue residue based on dechorionated embryo

[DL] detection limit

[DW] dry weight

[LIVER] = measured liver concentration of 2,3,7,8-T_4CDD

[LOEL] = lowest observable effect level

[NOEL] = no observable effect level

SFM = sac fry mortality

[TBKME-FW] v/v treated bleached kraft mill effluent mixed with freshwater

[TBKME-SW] v/v treated bleached kraft mill effluent mixed with seawater

[WB] tissue residue based on whole-body sample

Table 32. Summary of the available biological effects and related physicochemical data for sediment-associated PCDD/Fs

TEQ (µg/kg) Conc.	S.D.	Hit	Analysis Type	Test Type	Endpoint Measured	Species
0.00083		NE	SQG		Interim Assessment Criteria (low risk)	Mammalian wildlife
0.001			*ISQG*			
0.0011		*	SBA		WDNR Interim Criteria for In-Water Disposal of Dredged Sediments	
0.0014		NE	COA	28-d FT	Not significantly toxic (7.5% mortality)	*Hyalella azteca* (amphipod)
0.0022		NC	COA	14-d FT	Toxic (36.2% mortality)	*Hyalella azteca* (amphipod)
0.0022		NE	COA	14-d FT	Not significantly toxic (4.2% sexual maturity)	*Hyalella azteca* (amphipod)
0.0024	0.0016	NC	COA		Significantly toxic (15.5±2.12% deformities)	Chironomidae
0.0032		NE	COA		High abundance (2771 N/sq.m.)	Chironomidae
0.0032		NE	COA		High abundance (378 N/sq.m.)	Gastropoda
0.0035	0.0013	NE	COA		High abundance (16865±2383 N/sq.m.)	Benthic invertebrates
0.0036	0.0042	NE	COA		Not significantly toxic (5.5±2.56% deformities)	Chironomidae
0.0043	0.0041	SG	COA		Low abundance (20.8±27 N/sq.m.)	Gastropoda
0.0043	0.0041	SG	COA		Low abundance (154±102 N/sq.m.)	Chironomidae
0.0044	0.00045	NE	COA	10-d ST	Not significantly toxic (9.51±1.75 mg weight)	*Chironomus tentans* (midge)
0.0045	0.0054	NE	COA	28-d FT	Not significantly toxic (99.7±0.716% sexual maturity)	*Hyalella azteca* (amphipod)
0.0045	0.0054	NE	COA	10-d ST	Not significantly toxic (5.36±3% mortality)	*Chironomus tentans* (midge)
0.0045	0.0046	SG	COA		Low abundance (6050±2566 N/sq.m.)	Benthic invertebrates
0.0046	0.0023	NE	COA	10-d FT	Not significantly toxic (8.17±9.85% mortality)	*Hyalella azteca* (amphipod)
0.005	0.006	*	COA	14-d FT	Significantly toxic (0.35±0.7% sexual maturity)	*Hyalella azteca* (amphipod)
0.005	0.006	NE	COA	14-d FT	Not toxic (20.9±11.5% mortality)	*Hyalella azteca* (amphipod)
0.0052	0.0059	*	COA	28-d FT	Significantly toxic (20±5.1% mortality)	*Hyalella azteca* (amphipod)
0.0069	0.003	NE	COA	10-d ST	Not significantly toxic (4.77±1.66% mortality)	*Chironomus tentans* (midge)
0.007		NE	SQG		Interim Assessment Criteria (low risk)	Avian wildlife
0.0073	0.0032	NE	COA	21-d ST	Not significantly toxic (2.66±4.34% mortality)	*Hexagenia limbata* (mayfly)
0.0074	0.00028	NE	COA	10-d FT	Not significantly toxic (21±1.4% mortality)	*Chironomus tentans* (midge)
0.0074	0.0034	NE	COA	21-d ST	Not significantly toxic (1.65±1.67)	*Pimephales promelas* (fathead minnow)
0.0077	0.0044	SG	COA	21-d ST	Significantly toxic (46.6±43.3)	*Hexagenia limbata* (mayfly)
0.0077	0.0035	NE	COA	21-d ST	Not significantly toxic (11.0±6.3 mg weight)	*Hexagenia limbata* (mayfly)
0.0083		*	SQG		Interim Assessment Criteria (high risk of mortality-sensitive spp.)	Mammalian wildlife
0.009	0.0053	SG	COA	10-d ST	Significantly toxic (58.9±51.8% mortality)	*Chironomus tentans* (midge)
0.0091	0.0032	*	COA	10-d ST	Significantly toxic (4.57±1.72 mg weight)	*Chironomus tentans* (midge)
0.010			*TEL*			
0.01		*	SQO		International Joint Commission Sediment Quality Objective	Aquatic Life
0.012	0.014	NE	COA	21-d ST	Not significantly toxic (0% mortality)	*Hexagenia limbata* (mayfly)
0.012	0.014	NE	COA	10-d ST	Not significantly toxic (6.65±6.29% mortality)	*Chironomus tentans* (midge)
0.012	0.014	NE	COA	10-d ST	Not significantly toxic (17.17±1.73 mg weight)	*Chironomus tentans* (midge)
0.012	0.014	NE	COA	21-d ST	Not significantly toxic (1.65±2.33% mortality)	*Pimephales promelas* (fathead minnow)
0.02		NE	SQG		Interim Assessment Criteria (low risk)	Aquatic life
0.02		NE	COA	30-d	Not significantly toxic (645% increase in number)	*Lumbriculus variegatus* (oligochaete)
0.0189			*adjusted PEL*			
0.033		*	SQG		Interim Assessment Criteria (high risk of mortality-sensitive spp.)	Aquatic life
0.041		NE	COA		Not significantly toxic (2% deformities)	Chironomidae
0.046		NE	COA		High abundance (2204 N/sq.m.)	Chironomidae
0.046		NE	COA		High abundance (7152 N/sq.m.)	Benthic invertebrates
0.063	0.056	NE	COA	10-d ST	Not significantly toxic (19.2±12.4% mortality)	*Hexagenia limbata* (mayfly)
0.065	0.054	NE	COA	10-d ST	Not significantly toxic (5.77±6.07% mortality)	*Pimephales promelas* (fathead minnow)
0.065	0.054	NE	COA	30-d	Not significantly toxic (18.8±5.05% mortality)	*Pimephales promelas* (fathead minnow)
0.065	0.054	NE	COA	10-d ST	Not significantly toxic (6.15±7.40% mortality)	*Chironomus riparius* (midge)
0.069	0.055	*	COA	30-d	Significantly toxic (402±40.6% increase in number)	*Lumbriculus variegatus* (oligochaete)
0.069	0.057	NE	COA	10-d ST	Not significantly toxic (3.08±3.84% mortality)	*Lumbriculus variegatus* (oligochaete)
0.07	0.1	NE	COA	21-d ST	Not significantly toxic (25.95±17.37 mg weight)	*Hexagenia limbata* (mayfly)
0.07		*	SQG		Interim Assessment Criteria (high risk of mortality-sensitive spp.)	Avian wildlife
0.086	0.16	NE	COA	10-d ST	Not signicicantly toxic (2±1.58% mortality)	*Hyalella azteca* (amphipod)
0.098		SG	COA	10-d ST	Significantly toxic (50% mortality)	*Hexagenia limbata* (mayfly)
0.15	0.04	NE	COA		High abundance (301±88.4 N/sq.m.)	Chironomidae
0.17	0.14	NE	COA	28-d FT	Not significantly toxic (5.03±3.41% mortality)	*Hyalella azteca* (amphipod)

(µg TEQ·kg⁻¹ dry weight) in freshwater systems.

Life Stage	TOC (%)	AVS (µmol/g)	Unionized Ammonia (mg/L)	Sand (%)	Silt (%)	Clay (%)	Area	Reference
	1						United States	USEPA 1993
							Great Lakes	Sullivan et al. 1985[a]
LAR	1.7	2.6	0.07	10	9.5	74.3	Buffalo River, NY	Ingersoll et al. 1992
LAR	2	5.8	0.05	34.6	7	54	Buffalo River, NY	Ingersoll et al. 1992
LAR	2	5.8	0.05	34.6	7	54	Buffalo River, NY	Ingersoll et al. 1992
	2.0±0.4	5.4±0.4	0.10±0.03	14±9.8	7.6±3.5	76.7±13.7	Buffalo River, NY	Ingersoll et al. 1992
	1.9	13.5		33.6	7.9	55.8	Buffalo River, NY	Ingersoll et al. 1992
	1.8	4.2		7.5	3.7	92	Buffalo River, NY	Ingersoll et al. 1992
	1.9±0.3	6.3±4.0		7.5±2.3	6.7±2.5	83.3±7.9	Buffalo River, NY	Ingersoll et al. 1992
	2.6±2.6	27±54.4		32.4±29.6	5.8±2.9	57.7±29.1	Buffalo River, NY	Ingersoll et al. 1992
	2.5±2.5	24.7±51.4		31±28	6.4±2.9	58.1±26.6	Buffalo River, NY	Ingersoll et al. 1992
	2.5±2.5	23.7±51.7		28.1±29	6.0±3.0	62.1±28.8	Buffalo River, NY	Ingersoll et al. 1992
10-12 d	3.1±2.3			39.2±40.8	48.5±34.1	12.5±6.8	St. Marys River, ON	Bedard and Petro 1997
LAR	3.3±3.1	36±69.9	0.08±0.02	22.9±15.3	7.8±2.0	65.1±16.8	Buffalo River, NY	Ingersoll et al. 1992
LAR	3.3±3.1	36±69.9	0.21±0.20	22.9±15.3	7.8±2.0	65.1±16.8	Buffalo River, NY	Ingersoll et al. 1992
	2.7±2.8	29.7±58.2		37.8±28.3	5.9±3.2	52.1±27.5	Buffalo River, NY	Ingersoll et al. 1992
1-3 mm				36.5±7.0	47.5±4.8	15.9±3.1	St. Louis River and Duluth/ Superior Harbour area	Crane et al. 1997
LAR	3.6±3.5	43.6±78.3	0.08±0.02	20±15.9	8.1±2.2	67.9±18	Buffalo River, NY	Ingersoll et al. 1992
LAR	3.6±3.5	43.6±72.3	0.08±0.02	20±15.9	8.1±2.2	67.9±18	Buffalo River, NY	Ingersoll et al. 1992
LAR	3.7±3.5	44.4±77.7	0.08±0.03	26.2±15.5	7.4±2.0	62.8±18.4	Buffalo River, NY	Ingersoll et al. 1992
10-12 d	4.1±2.8			22.6±23.9	59±17.9	18.5±8.9	St. Marys River, ON	Bedard and Petro 1997
	1						United States	USEPA 1993
3 M	3.5±2.7			22.6±26.7	58.3±19.9	19.2±9.7	St. Marys River, ON	Bedard and Petro 1997
14 d				41.3±11.9	45.2±9.0	13.6±2.9	St. Louis River and Duluth/ Superior Harbour area	Crane et al. 1997
JUV	5.9±6.2			23.9±22.0	57.6±17.0	18.6±7.6	St. Marys River, ON	Bedard and Petro 1997
3 M	10.0±8.9			26.2±16.1	56.3±14.6	17.5±3.3	St. Marys River, ON	Bedard and Petro 1997
3 M	3.9±2.6			21.1±22.1	60.1±16.6	18.9±8.2	St. Marys River, ON	Bedard and Petro 1997
EMB/JUV	1						United States	USEPA 1993
10-12 d	11.4±12.2			27.9±22.4	53.3±19.2	18.9±3.3	St. Marys River, ON	Bedard and Petro 1997
10-12 d	4.2±2.9			13.9±9.6	64.8±5.4	21.4±7.8	St. Marys River, ON	Bedard and Petro 1997
							Canada	Boddington et al. 1990
4 M	3.2±1.1		0.05±0.02	8.5±0.7	62.6±3.5	28.7±0.4	Canagagigue Creek, ON	Jaagumagi and Bedard 1997
10-12 d	3.2±1.1		0.05±0.02	8.5±0.7	62.6±3.5	28.7±0.4	Canagagigue Creek, ON	Jaagumagi and Bedard 1997
10-12 d	3.2±1.1		0.05±0.02	8.5±0.7	62.6±3.5	28.7±0.4	Canagagigue Creek, ON	Jaagumagi and Bedard 1997
JUV	3.2±1.1		0.10±0.00	8.5±0.7	62.6±3.5	28.7±0.4	Canagagigue Creek, ON	Jaagumagi and Bedard 1997
	1						United States	USEPA 1993
ADT	4.3			2.8	39.1	58.1	Lower Fox River & Green Bay, WI	Call et al. 1991
EMB/JUV	1						United States	USEPA 1993
	1.1		0.02	57.4	13.2	29.2	Saginaw River, MI	Ingersoll et al. 1992
	1.1		0.02	57.4	13.2	29.2	Saginaw River, MI	Ingersoll et al. 1992
	1.1		0.02	57.4	13.2	29.2	Saginaw River, MI	Ingersoll et al. 1992
LAR	4.4±2.4			35.4±29	33±15	31.6±18.8	Lower Fox River & Green Bay, WI	Call et al. 1991
FRY	4.5±2.4			33.4±28.7	35.3±16.7	31.3±18	Lower Fox River & Green Bay, WI	Call et al. 1991
FRY	4.5±2.4			33.4±28.7	35.3±16.7	31.3±18	Lower Fox River & Green Bay, WI	Call et al. 1991
LAR	4.5±2.4			33.4±28.7	35.3±16.7	31.3±18	Lower Fox River & Green Bay, WI	Call et al. 1991
ADT	4.5±2.5			36±28.4	35±17.4	29±16.8	Lower Fox River & Green Bay, WI	Call et al. 1991
ADT	4.5±2.4			33.4±28.7	35.3±16.7	31.3±18	Lower Fox River & Green Bay, WI	Call et al. 1991
4 M	3.2±0.8		0.11±0.11	9.0±1.1	61.4±3.2	29.2±3.0	Canagagigue Creek, ON	Jaagumagi and Bedard 1997
EMB/JUV	1						United States	USEPA 1993
	2.3±2.3			62.2±16.6	28±13	5.9±3.7	Willamette River, OR	PTI Environmental 1992; Pastorok et al. 1994
LAR	6.7			9.2	63.6	27.2	Lower Fox River & Green Bay, WI	Call et al. 1991
	3.5±0.5	5.2±0.8		32.7±20.9	9.9±0.4	55.2±22.9	Saginaw River, MI	Ingersoll et al. 1992
LAR	2.1±1.3	4.2±2.6	0.05±0.03	57.3±26.5	9.7±4.4	31.4±23.7	Saginaw River, MI	Ingersoll et al. 1992

Table 32. Summary of the available biological effects and related physicochemical data for sediment-associated PCDD/Fs

TEQ (µg/kg) Conc.	S.D.	Hit	Analysis Type	Test Type	Endpoint Measured	Species
0.17	0.14	NE	COA	28-d FT	Not significantly toxic (82.2±11.3% sexual maturity)	*Hyalella azteca* (amphipod)
0.17	0.14	NE	COA	14-d FT	Not significantly toxic (7.61±5.17% mortality)	*Hyalella azteca* (amphipod)
0.18		*	COA	21-d ST	Significantly toxic (50% mortality)	*Hexagenia limbata* (mayfly)
0.18		*	COA	10-d ST	Significantly toxic (51.1% mortality)	*Chironomus tentans* (midge)
0.18		*	COA	10-d ST	Significantly toxic (9.65 mg weight)	*Chironomus tentans* (midge)
0.18		*	COA	21-d ST	Significantly toxic (20% mortality)	*Pimephales promelas* (fathead minnow)
0.19	0.028	NE	COA		High abundance (6616±538 N/sq.m.)	Benthic invertebrates
0.189			*PEL*			
0.19	0.15	NE	COA	14-d FT	Not significantly toxic (11.5±8.37% mortality)	*Chironomus riparius* (midge)
0.2	0.17	NE	COA	14-d FT	Not significantly toxic (13.1±5.95% sexual maturity)	*Hyalella azteca* (amphipod)
0.2		SG	COA	14-d FT	Significantly toxic (2.8% sexual maturity)	*Hyalella azteca* (amphipod)
0.2	0.07	*	COA		Low abundance (806±434 N/sq.m.)	Benthic invertebrates
0.2	0.17	NE	COA	10-d ST	Not significantly toxic (43.3±22.5% mortality)	*Chironomus tentans* (midge)
0.22	0.15	*	COA		Significantly toxic (19.2±4.45% deformities)	Chironomidae
0.23	0.15	*	COA		Low abundance (176±163 N/sq.m.)	Chironomidae
0.23		SG	COA	10-d ST	Significantly toxic (100% mortality)	*Chironomus tentans* (midge)
0.24	0.27	SG	COA		Low abundance (1494±533 N/sq.m.)	Benthic invertebrates
0.27	0.22	*	COA		Moderate abundance (3304±588 N/sq.m.)	Benthic invertebrates
0.27	0.34	NE	COA		Not significantly toxic (3±4.24% deformities)	Chironomidae
0.51		*	COA	14-d FT	Significantly toxic (90% mortality)	*Hyalella azteca* (amphipod)
0.51		*	COA	28-d FT	Significantly toxic (90% mortality)	*Hyalella azteca* (amphipod)
0.51		*	COA	28-d FT	Significantly toxic (37.5% sexual maturity)	*Hyalella azteca* (amphipod)
0.55	0.87	SG	COA		Significantly toxic (16.6±4.83% deformities)	Chironomidae
0.55		*	COA	14-d FT	Significantly toxic (85.5% mortality)	*Chironomus riparius* (midge)
0.62	0.85	*	COA		Low abundance (65±41.7 N/sq.m.)	Chironomidae
0.75	1	*	COA	10-d ST	Significantly toxic (85±13% mortality)	*Hyalella azteca* (amphipod)
2.1		*	COA		Moderate abundance (3686 N/sq.m.)	Benthic invertebrates
<100		-	EqPA		New York State Sediment Criteria Value	
128		NE	COA		High abundance (493917 N/sq.m.)	Benthic invertebrates
214	194.4966	SG	COA		Low abundance (3357±2112 N/sq.m.)	Benthic invertebrates

[a] As cited in Fitchko 1989

(µg TEQ·kg^{-1} dry weight) in freshwater systems.

Life Stage	TOC (%)	AVS (µmol/g)	Unionized Ammonia (mg/L)	Sand (%)	Silt (%)	Clay (%)	Area	Reference
LAR	2.1±1.3	4.2±2.6	0.05±0.03	57.3±26.5	9.7±4.4	31.4±23.7	Saginaw River, MI	Ingersoll et al. 1992
LAR	2.1±1.3	4.2±2.6	0.05±0.03	57.3±26.5	9.7±4.4	31.4±23.7	Saginaw River, MI	Ingersoll et al. 1992
4 M	3.1		0.24	10.1	59.1	30.2	Canagagigue Creek, ON	Jaagumagi and Bedard 1997
10-12 d	3.1		0.82	10.1	59.1	30.2	Canagagigue Creek, ON	Jaagumagi and Bedard 1997
10-12 d	3.1		0.82	10.1	59.1	30.2	Canagagigue Creek, ON	Jaagumagi and Bedard 1997
JUV	3.1		0.64	10.1	59.1	30.2	Canagagigue Creek, ON	Jaagumagi and Bedard 1997
	3.1±0.1	4.8±1.2		12.8±4.6	9.8±0.3	76.7±4.6	Saginaw River, MI	Ingersoll et al. 1992
24 h	2.1±1.3	4.2±2.6	0.05±0.03	57.3±26.5	9.7±4.4	31.4±23.7	Saginaw River, MI	Ingersoll et al. 1992
LAR	2.2±1.5	4.5±3.0	0.06±0.03	60.9±24.9	10.3±5.2	28±18.7	Saginaw River, MI	Ingersoll et al. 1992
LAR	1.4	3.7	0.05	71.2	9.9	16.4	Saginaw River, MI	Ingersoll et al. 1992
	2.6±2.1	5.3±3.9	0.07±0.05	60.4±35.4	9.8±7.2	29±26.3	Saginaw River, MI	Ingersoll et al. 1992
LAR	2.4±1.3	5.0±2.4	0.33±0.29	56.4±18.4	11.7±3.1	30.3±15.4	Saginaw River, MI	Ingersoll et al. 1992
	2.2±1.5	4.4±2.7	0.06±0.03	63.2±25.2	9.7±5.0	25.8±19.2	Saginaw River, MI	Ingersoll et al. 1992
	2.2±1.5	4.4±2.7	0.06±0.03	63.2±25.2	9.7±5.0	25.8±19.2	Saginaw River, MI	Ingersoll et al. 1992
LAR	0.2	1.2	0.85	98.2	1.5	2.3	Saginaw River, MI	Ingersoll et al. 1992
	2.3±1.4	7.6±7.2		61.5±12.2	7.2±2.1	26.1±11.2	Saginaw River, MI	Ingersoll et al. 1992
	1.9±0.9	3.4±0.3	0.05±0.01	66.1±17.5	9.6±3.4	22.6±14.1	Saginaw River, MI	Ingersoll et al. 1992
	1.6±0.8	8.5±9.9	0.04±0.03	68.6±0.9	6.0±0.1	19.6±0.3	Saginaw River, MI	Ingersoll et al. 1992
LAR	2.1	15.5	0.06	69.2	6	19.8	Saginaw River, MI	Ingersoll et al. 1992
LAR	2.1	15.5	0.06	69.2	6	19.8	Saginaw River, MI	Ingersoll et al. 1992
LAR	2.1	15.5	0.06	69.2	6	19.8	Saginaw River, MI	Ingersoll et al. 1992
	3.1±0.4	5.1±1		22.6±15.6	9.6±0.4	64.9±17.4	Saginaw River, MI	Ingersoll et al. 1992
24 h	2.1	15.5	0.06	69.2	6	19.8	Saginaw River, MI	Ingersoll et al. 1992
	2.3±0.8	6.4±5.4		37±29.7	8±1.9	50.7±30	Saginaw River, MI	Ingersoll et al. 1992
	4.3±1.2			29.7±7.8	56.3±6.8	12.7±3.9	Willamette River, OR	PTI Environmental 1992; Pastorok et al. 1994
	2.6	5.6		27.3	9	55.6	Saginaw River, MI	Ingersoll et al. 1992
	1						New York State	Newell 1989
	12.3	31.7		14.2	9.9	72.1	Indiana Harbor, IN	Ingersoll et al. 1992
	9.2±2.3	41.5±21.4		23.9±14.3	5.9±0.6	66.1±15.1	Indiana Harbor, IN	Ingersoll et al. 1992

Table 33. Summary of the available biological effects and related physicochemical data for sediment-associated PCDD/Fs

TEQ (µg/kg) Conc.	S.D.	Hit	Analysis Type	Test Type	Endpoint Measured	Species
0.00056	0.00011	NE	COA	48-h	Not significantly toxic (88.2±4.24% normal development)	*Arbacia punctulata* (sea urchin)
0.001	0.00033	NE	COA	10-d	Not significantly toxic (5.8±3.7% mortality)	*Rhepoxynius abronius* (amphipod)
0.001	0.00033	NE	COA	10-d	Not significantly toxic (3.4±1.82% mortality)	*Nereis virens* (polychaete)
0.001	0.00033	NE	COA	28-d	Not significantly toxic (11.2±3.7% mortality)	*Nereis virens* (polychaete)
0.001	0.00033	NE	COA	28-d	Not significantly toxic (3.52±1.66% mortality)	*Macoma nasuta* (clam)
0.003		NC	COA	96-h	Significantly toxic (53% normal development)	*Crassostrea gigas* (oyster)
0.0031	0.0022	NE	COA	96-h	Not significantly toxic (6.33±2.34% mortality)	*Mysidopsis bahia* (mysid)
0.0033	2.36	NE	COA	96-h	Not significantly toxic (10±2.77% mortality)	*Menidia berllina* (silverside)
0.0034	0.0022	NE	COA	10-d	Not significantly toxic (10.1±3.53% mortality)	*Ampelisca abdita* (amphipod)
0.0034	0.0022	NE	COA	10-d	Not significantly toxic (8.29±3.25% mortality)	*Mysidopsis bahia* (mysid)
0.0037		SG	COA	96-h	Significantly toxic (22.3% mortality)	*Menidia berllina* (silverside)
0.0045	0.0012	*	COA	48-h	Significantly toxic (14.6±18.9% normal development)	*Arbacia punctulata* (sea urchin)
0.0048	0.0029	NE	COA	30-d	Not significantly toxic (4.35±3.94% mortality)	*Macoma nasuta* (clam)
0.0048	0.0029	NE	COA	60-d	Not significantly toxic (14.2±8.12% mortality)	*Macoma nasuta* (clam)
0.0049		*	COA	96-h	Significantly toxic (16% mortality)	*Mysidopsis bahia* (mysid)
0.005	0.003	NE	COA	96-h	Not significantly toxic (83.6±9.96% normal development)	*Crassostrea gigas* (oyster)
9.98	10.7	NE	SSBA	10-d	Not signigicantly toxic (9.75±4.79% mortality)	*Ampelisca abdita* (amphipod)
9.98	10.7	NE	SSBA	10-d	Not significanlty toxic (0.40±0.04mg Weight)	*Ampelisca abdita* (amphipod)
<100		*	EqPA		New York State Sediment Criteria Value	

(µg TEQ·kg^{-1} dry weight) in marine systems.

Life Stage	TOC (%)	AVS (µmol/g)	Unionized Ammonia (mg/L)	Sand (%)	Silt (%)	Clay (%)	Area	Reference
	0.1±0.1	223±292 µg/g	0.25±0.21				Brunswick Harbor Entrance, GA	Windom 1993
	2.8±0.5	16.3±9.6		51.6+/-31.4	20.2+/-15	28.2+/-17.4	Wilmington Harbor, NC	Ward et al. 1992
	2.8±0.5	16.3±9.6		51.6+/-31.4	20.2+/-15	28.2+/-17.4	Wilmington Harbor, NC	Ward et al. 1992
	2.8±0.5	16.3±9.6		51.6+/-31.4	20.2+/-15	28.2+/-17.4	Wilmington Harbor, NC	Ward et al. 1992
	2.8±0.5	16.3±9.6		51.6+/-31.4	20.2+/-15	28.2+/-17.4	Wilmington Harbor, NC	Ward et al. 1992
LAR	1.3						Grays Harbor/Chehalis River, WA	Word et al. 1990
	1.4±1.1	10566±14023 µg/g	11.45±8.75				Brunswick Harbor Entrance, GA	Windom 1993
	1.4±1.1	10655±13994 µg/g	11.45±8.75				Brunswick Harbor Entrance, GA	Windom 1993
	1.5±1.0	10070±12868 µg/g	12.42±8.39				Brunswick Harbor Entrance, GA	Windom 1993
	1.5±1.0	10070±12868 µg/g	12.42±8.39				Brunswick Harbor Entrance, GA	Windom 1993
	1.7	6562 µg/g	18.2				Brunswick Harbor Entrance, GA	Windom 1993
	2.0±0.6	14009±13434 µg/g	17.29±1.36				Brunswick Harbor Entrance, GA	Windom 1993
ADT	1.5±0.6						Grays Harbor/Chehalis River, WA	Word et al. 1990
ADT	1.5±0.6						Grays Harbor/Chehalis River, WA	Word et al. 1990
	1.8	7095 µg/g	18.25				Brunswick Harbor Entrance, GA	Windom 1993
LAR	1.5±0.7						Grays Harbor/Chehalis River, WA	Word et al. 1990
							Tomales Bay, CA	Barber et al. 1998
							Tomales Bay, CA	Barber et al. 1998
	1						New York State	Newell 1989

Table 34. Acute toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose (µg·kg-1 bw·d-1)	TEQ Dose (ng·kg-1 bw·d-1)	Exposure (days)	Endpoint	Reference
Porton albino guinea pigs	adult	M/F	2,3,7,8-TCDD	0	0	1	control	Greig et al. 1973
Porton albino guinea pigs	adult	M/F	2,3,7,8-TCDD	2, 4, or 10	2000, 4000, 10000	1	15-30% loss of bw within 8-24 d; no obvious abnormalities of the major viscera	Greig et al. 1973
Hartley guinea pigs		M	2,3,7,8-TCDD	0.6	600	1	oral LD50	Schwetz et al. 1973
Golden Syrian hamsters	50-80 g	F	2,3,7,8-TCDD	0[a]	0	1	mortality (0%) and bw gain (71g) by d 50 - control	Olson et al 1980
Golden Syrian hamsters	50-80 g	F	2,3,7,8-TCDD	500	500000	1	mortality (20%) and bw gain (35g) - S by d 50	Olson et al 1980
Golden Syrian hamsters	50-80 g	F	2,3,7,8-TCDD	1000	1 000 000	1	mortality (20%) and bw gain (52g) - S by d 50	Olson et al 1980
Golden Syrian hamsters	50-80 g	F	2,3,7,8-TCDD	2000	2 000 000	1	mortality (20%) and bw gain (30g) - S by d 50	Olson et al 1980
Golden Syrian hamsters	50-80 g	F	2,3,7,8-TCDD	3000	3 000 000	1	mortality (0%) and bw gain (26g) - S by d 50	Olson et al 1980
Golden Syrian hamsters	50-80 g	M	2,3,7,8-TCDD	0[a]	0	1	mortality (0%) and bw gain (75g) by d 50 - control	Olson et al 1980
Golden Syrian hamsters	50-80 g	M	2,3,7,8-TCDD	500	500000	1	mortality (0%) and bw gain (34g) - S by d 50	Olson et al 1980
Golden Syrian hamsters	50-80 g	M	2,3,7,8-TCDD	1000	1 000 000	1	mortality (0%) and bw gain (40g) - S by d 50	Olson et al 1980
Golden Syrian hamsters	50-80 g	M	2,3,7,8-TCDD	2000	2 000 000	1	mortality (0%) and bw gain (41g) - S by d 50	Olson et al 1980
Golden Syrian hamsters	50-80 g	M	2,3,7,8-TCDD	3000	3 000 000	1	mortality (33%) and bw gain (29g) - S by d 50	Olson et al 1980
Golden Syrian hamsters	50-80 g	M/F	2,3,7,8-TCDD	>3000	>3 000 000	1	50 d LD50 for intraperitoneal administration	Olson et al 1980
Golden Syrian hamsters	50-80 g	M	2,3,7,8-TCDD	500[b]	500000	1	mortality (0%) and bw gain (9g) - S by d 50	Olson et al 1980
Golden Syrian hamsters	50-80 g	M	2,3,7,8-TCDD	1000	1 000 000	1	mortality (60%) and bw gain (11g) - S by d 50	Olson et al 1980
Golden Syrian hamsters	50-80 g	M	2,3,7,8-TCDD	2000	2 000 000	1	mortality (100%) and bw gain (-1g) - S by d 50	Olson et al 1980
Golden Syrian hamsters	50-80 g	M	2,3,7,8-TCDD	3000	3 000 000	1	mortality (80%) and bw gain (7g) - S by d 50	Olson et al 1980
Golden Syrian hamsters	50-80 g	M	2,3,7,8-TCDD	1157	1 157 000	1	50 LD50 for oral administration	Olson et al 1980
Golden Syrian hamsters	70-120 g	M	2,3,7,8-TCDD	5051	5 051 000	1	single dose oral LD50	Henck et al. 1981
albino mice	pregnant	F	control		0[c]	1	maternal BW gain = 0.8 g; maternal RLW = 6.8 - pooled control	Nagao et al. 1993
albino mice	pregnant	F	PCDD mixture		21000[d,e]	1	NS effect on BW gain, RLW = 8.0 - S	Nagao et al. 1993
albino mice	pregnant	F	PCDD mixture		63000	1	NS effect on BW gain, RLW = 8.4 - S	Nagao et al. 1993
albino mice	pregnant	F	PCDF mixture I		11000[d,e]	1	NS effect on BW gain, RLW = 6.9 - S	Nagao et al. 1993
albino mice	pregnant	F	PCDF mixture I		34000	1	NS effect on BW gain, RLW = 7.5 - S	Nagao et al. 1993
albino mice	pregnant	F	PCDF mixture II		8000[d,e]	1	NS effect on BW gain, RLW = 7.5 - S	Nagao et al. 1993
albino mice	pregnant	F	PCDF mixture II		15000	1	NS effect on BW gain, RLW = 7.5 - S	Nagao et al. 1993
albino mice	pregnant	F	PCDF mixture II		23000	1	NS effect on BW gain, RLW = 7.8 - S	Nagao et al. 1993
albino mice	pregnant	F	2,3,4,7,8-PCDF	20	10000	1	NS effect on BW gain, RLW = 7.5 - S	Nagao et al. 1993
albino mice	pregnant	F	2,3,4,7,8-PCDF	28	14000	1	NS effect on BW gain, RLW = 7.7 - S	Nagao et al. 1993
albino mice	pregnant	F	2,3,4,7,8-PCDF	55	27500	1	NS effect on BW gain, RLW = 7.9 - S	Nagao et al. 1993
albino mice	pregnant	F	2,3,4,7,8-PCDF	80	40000	1	NS effect on BW gain, RLW = 8.0 - S	Nagao et al. 1993
albino mice	pregnant	F	2,3,7,8-TCDD	5[d,e]	5000	1	NS effect on BW gain, RLW = 7.0 - NS	Nagao et al. 1993
albino mice	pregnant	F	2,3,7,8-TCDD	15	15000	1	NS effect on BW gain, RLW = 7.6 - S	Nagao et al. 1993
albino mice	pregnant	F	2,3,7,8-TCDD	30	30000	1	NS effect on BW gain, RLW = 8.0 - S	Nagao et al. 1993
albino mice	pregnant	F	2,3,7,8-TCDD	45	45000	1	NS effect on BW gain, RLW = 8.0 - S	Nagao et al. 1993

Table 34. Acute toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose (µg·kg-1 bw·d-1)	TEQ Dose (ng·kg-1 bw·d-1)	Exposure (days)	Endpoint	Reference
albino mice	pregnant	F	2,3,7,8-TCDD	90	90000	1	NS effect on BW gain, RLW = 8.3 - S	Nagao et al. 1993
mice (B6C3F1)	10 weeks	M	1:2 mixture 1,2,3,6,7,8-:1,2,3,7,8,9-HCDD	750	75000	1	9 week LD50	US Dept. Health and Human Services 1980
mice (B6C3F1)	10 weeks	F	1:2 mixture 1,2,3,6,7,8-:1,2,3,7,8,9-HCDD	500	50000	1	9 week LD50	US Dept. Health and Human Services 1980
mice	6-8 weeks	F	2,3,7,8-TCDD	0[f]	0	1	endotoxin induced mortality 7d after dioxin dose (0%)	Rosenthal et al. 1989
mice	6-8 weeks	F	2,3,7,8-TCDD	50	50000	1	endotoxin induced mortality 7d after dioxin dose (0%)	Rosenthal et al. 1989
mice	6-8 weeks	F	2,3,7,8-TCDD	100	100000	1	endotoxin induced mortality 7d after dioxin dose (0%)	Rosenthal et al. 1989
mice	6-8 weeks	F	2,3,7,8-TCDD	200	200000	1	endotoxin induced mortality 7d after dioxin dose (87.5%) - S	Rosenthal et al. 1989
mice	6-8 weeks	F	2,3,7,8-TCDD	0[g]	0	1	endotoxin induced mortality 7d after dioxin dose (0%)	Rosenthal et al. 1989
mice	6-8 weeks	F	2,3,7,8-TCDD	50	50000	1	endotoxin induced mortality 7d after dioxin dose (50%) - S	Rosenthal et al. 1989
mice	6-8 weeks	F	2,3,7,8-TCDD	100	100000	1	endotoxin induced mortality 7d after dioxin dose (100%) - S	Rosenthal et al. 1989
mice	6-8 weeks	F	2,3,7,8-TCDD	200	200000	1	endotoxin induced mortality 7d after dioxin dose (100%) - S	Rosenthal et al. 1989
mink	adult		2,3,7,8-TCDD	4.2	4200	1	28 d LC50	Hochstein et al. 1988
mink	adult		2,3,7,8-TCDD	4.3	4300		28 d dietary LC50	Hochstein et al. 1986 cited in Aulerich et al. 1988
mink	adult	M	2,3,7,8-TCDD	0	0	1	mortality = 0%; % BW change = -0.6; relative brain wt = 0.65%; relative kidney wt = 0.57% - control	Hochstein et al. 1988
mink	adult	M	2,3,7,8-TCDD	2.5	2500	1	mortality = 0%; % BW change = -11.4 - S; NS decrease in feed consumption; relative brain wt = 0.68% - NS; relative kidney wt = 0.63% - NS	Hochstein et al. 1988
mink	adult	M	2,3,7,8-TCDD	5	5000	1	mortality = 75% by d17; days to death = 12.3; % BW change = -27.1; S decrease in feed consumption; relative brain wt = 1.02% - S; relative kidney wt = 1.06% - S	Hochstein et al. 1988
mink	adult	M	2,3,7,8-TCDD	7.5	7500	1	mortality = 100% by d14; days to death = 9.5; S decrease in feed consumption; relative brain wt = 0.96% - S; relative kidney wt = 0.96% - S	Hochstein et al. 1988
New Zealand albino rabbit		M/F	2,3,7,8-TCDD	115	115 000	1	oral LD50	Schwetz et al. 1973
Han/Wistar Rats	300-400g	M	2,3,7,8-TCDD	0	0	14	wt gain = 17.5g; RLW = 3.01 - control	Mustonen et al. 1989

Table 34. Acute toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose (µg·kg-1 bw·d-1)	TEQ Dose (ng·kg-1 bw·d-1)	Exposure (days)	Endpoint	Reference
Han/Wistar Rats	300-400g	M	2,3,7,8-TCDD	0.007[b]	7	14	wt gain = 33.8g - NS; RLW = 3.03 - NS	Mustonen et al. 1989
Han/Wistar Rats	300-400g	M	2,3,7,8-TCDD	0.07	70	14	wt gain = 32.5g - S; RLW = 3.3 - S	Mustonen et al. 1989
Han/Wistar Rats	300-400g	M	2,3,7,8-TCDD	0.7	700	14	wt gain = 17.5g - S; RLW = 3.47 - S	Mustonen et al. 1989
Osborne-Mendel rats	9 weeks	M	1:2 mixture 1,2,3,6,7,8-:1,2,3,7,8,9-HCDD	1800	180000	1	9 week LD50	US Dept. Health and Human Services 1980
Osborne-Mendel rats	9 weeks	F	1:2 mixture 1,2,3,6,7,8-:1,2,3,7,8,9-HCDD	800	80000	1	9 week LD50	US Dept. Health and Human Services 1980
Porton albino rats	8-11 weeks	F	2,3,7,8-TCDD	0	0	1	control	Greig et al. 1973
Porton albino rats	8-11 weeks	F	2,3,7,8-TCDD	200	200 000	1	immediate and prolonged reduction in food intake, with S loss of bw 7 d after treatment; S increase in LW·1 d after treatment	Greig et al. 1973
Porton albino rats	8-11 weeks	M	2,3,7,8-TCDD	200	200 000	1	S increase in LW 1 d after treatment	Greig et al. 1973
Sherman rats		M	2,3,7,8-TCDD	22	22 000	1	oral LD50	Schwetz et al. 1973
Sherman rats		F	2,3,7,8-TCDD	45	45 000	1	oral LD50	Schwetz et al. 1973
Sprague-Dawley Rats	140-160g	F	control	0	0	3	6d post-treatment thymus wt = 0.47g; BW = 186g	Shara and Stohs 1987
Sprague-Dawley Rats	140-160g	F	2,3,7,8-TCDD	40	40000	3	6d post-treatment lipid peroxidation 4.4-fold increase; thymus wt = 0.08g - S; BW= 116g	Shara and Stohs 1987
Sprague-Dawley Rats	140-160g	F	2,7-DCDD	40	no TEF	3	6d post-treatment lipid peroxidation-NS; thymus wt - NS; BW NS	Shara and Stohs 1987
Sprague-Dawley Rats	140-160g	F	2,7-DCDD	400	no TEF	3	6d post-treatment lipid peroxidation-NS; thymus wt - NS; BW NS	Shara and Stohs 1987
Sprague-Dawley Rats	140-160g	F	2,7-DCDD	2000	no TEF	3	6d post-treatment lipid peroxidation-NS; thymus wt - NS; BW NS	Shara and Stohs 1987
Sprague-Dawley Rats	140-160g	F	1,2,4-TrCDD	40	no TEF	3	6d post-treatment lipid peroxidation-NS; thymus wt - NS; BW NS	Shara and Stohs 1987
Sprague-Dawley Rats	140-160g	F	1,2,4-TrCDD	400	no TEF	3	6d post-treatment lipid peroxidation-NS; thymus wt - NS; BW NS	Shara and Stohs 1987
Sprague-Dawley Rats	140-160g	F	1,2,3,4-TCDD	40	no TEF	3	6d post-treatment lipid peroxidation-NS; thymus wt - NS; BW NS	Shara and Stohs 1987
Sprague-Dawley Rats	140-160g	F	1,2,3,4-TCDD	400	no TEF	3	6d post-treatment lipid peroxidation-NS; thymus wt - NS; BW NS	Shara and Stohs 1987

Table 34. Acute toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose (µg·kg-1 bw·d-1)	TEQ Dose (ng·kg-1 bw·d-1)	Exposure (days)	Endpoint	Reference
Sprague-Dawley Rats	140-160g	F	OCDD	40	4	3	6d post-treatment lipid peroxidation-NS; thymus wt - NS; BW NS	Shara and Stohs 1987
Sprague-Dawley Rats	140-160g	F	OCDD	400	40	3	6d post-treatment lipid peroxidation-NS; thymus wt - NS; BW NS	Shara and Stohs 1987
Sprague-Dawley Rats	160-180g	F	2,3,7,8-TCDD	0	0	3	6d post-treatment heart rate (beats/min) = 314; blood pressure (mmHg) - systolic = 155.4, diastolic = 106.7, mean arterial = 123.2	Hermansky et al. 1988
Sprague-Dawley Rats	160-180g	F	2,3,7,8-TCDD	40	40000	3	6d post-treatment heart rate (beats/min) = 230.3 - S; blood pressure (mmHg) - systolic = 116.3 - S, diastolic = 71.8 - S, mean arterial = 86.9 - S	Hermansky et al. 1988

[a]intraperitoneal administration

[b]peroral administration

[c]pooled results of 4 control groups; significance was based on pooled control

[d]doses in µg TEQ·kg^{-1} bw; TEQ concentrations were converted from International TEQs to 1998 WHO·TEQs.

[e]administered by subcutaneous injection on day 9 of pregnancy; where doses were greater than 30 µg·kg-1, the amount was given in two divided doses

[f]endotoxin dose of 5 mg·kg^{-1} 7 d following dioxin treatment

[g]endotoxin dose of 25 mg·kg^{-1} 7 d following dioxin treatment

[h]rats treated intragastrically by gavage with 0.05, 0.5, or 5µg·kg^{-1} bw once a week for 2 weeks

Table 35. Chronic toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose (μg·kg⁻¹ bw·d⁻¹)	TEQ dose (ng·kg⁻¹ bw·d⁻¹)	Exposure (days)	Total Dose (μg·kg⁻¹ bw)	Endpoint	Reference
Hartley guinea pigs	4 week		2,3,7,8-TCDD	0.8	800	1		ED50 for body wt gain	Hanberg et al. 1989; 1990
Hartley guinea pigs	4 week		2,3,7,8-TCDD	0.1	100	1		ED50 for hepatic vitamin A gain	Hanberg et al. 1989; 1990
Hartley guinea pigs	4 week		2,3,7,8-TCDD	2.5	2500	1		60% mortality	Hanberg et al. 1989; 1990
guinea pigs	weanling	M	2,3,7,8-TCDD	0	0	90	0	BW = 713g; % initial BW = 186; RLW = 4.54 - control	De Caprio et al. 1986
guinea pigs	weanling	M	2,3,7,8-TCDD	0.0001	0.1	90	0.011	BW = 682g - NS; % initial BW = 176 - NS; RLW = 4.10 - NS	De Caprio et al. 1986
guinea pigs	weanling	M	2,3,7,8-TCDD	0.0006	0.6	90	0.055	BW = 651g - S; % initial BW = 170 - NS; RLW = 5.36 - NS	De Caprio et al. 1986
guinea pigs	weanling	M	2,3,7,8-TCDD	0.0049	4.9	90	0.411	BW = 603g - S; % initial BW = 148 - S; RLW = 5.63 - S	De Caprio et al. 1986
guinea pigs	weanling	M	2,3,7,8-TCDD	0.026	26	90	1.3	BW = 433g - S; % initial BW = 97 - S; 40% mortality + 20% moribund condition	De Caprio et al. 1986
guinea pigs	weanling	F	2,3,7,8-TCDD	0	0	90	0	BW = 602g; % initial BW = 164; RLW = 4.30 - control	De Caprio et al. 1986
guinea pigs	weanling	F	2,3,7,8-TCDD	0.0001	0.1	90	0.011	BW = 583g - NS; % initial BW = 162 - NS; RLW = 4.49 - NS	De Caprio et al. 1986
guinea pigs	weanling	F	2,3,7,8-TCDD	0.0007	0.7	90	0.061	BW = 570g - S; % initial BW = 155 - NS; RLW = 4.27 - NS	De Caprio et al. 1986
guinea pigs	weanling	F	2,3,7,8-TCDD	0.0049	4.9	90	0.437	BW = 531g - S; % initial BW = 142 - S; RLW = 5.54 - S	De Caprio et al. 1986
guinea pigs	weanling	F	2,3,7,8-TCDD	0.031	31	90	1.9	BW = 351g - S; % initial BW = 86 - S; 40% mortality + 20% sacrificed	De Caprio et al. 1986
guinea pigs	weanling	M	2,3,7,8-TCDD	0	0	0	0	no mortality	De Caprio et al. 1986
guinea pigs	weanling	M	2,3,7,8-TCDD	0.025	25	11[a]	0.28	10% mortality @ d 19; BW remained 20% below controls after 79 d recovery	De Caprio et al. 1986
guinea pigs	weanling	M	2,3,7,8-TCDD	0.025	25	21[a]	0.54	10% mortality @ d 71; rate of wt gain and BW severely depressed	De Caprio et al. 1986
guinea pigs	weanling	M	2,3,7,8-TCDD	0.027	27	35[a]	0.95	70% mortality within d 47; rate of wt gain and BW severely depressed	De Caprio et al. 1986

Table 35. Chronic toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose (μg·kg⁻¹ bw·d⁻¹)	TEQ dose (ng·kg⁻¹ bw·d⁻¹)	Exposure (days)	Total Dose (μg·kg⁻¹ bw)	Endpoint	Reference
Golden Syrian hamsters	4 weeks		2,3,7,8-TCDD	>1000	>1000 μg·kg⁻¹	1		ED50 for body wt gain	Hanberg et al. 1989; 1990
Golden Syrian hamsters	4 weeks		2,3,7,8-TCDD	14	14000	1		ED50 for liver enlargement	Hanberg et al. 1989; 1990
Golden Syrian hamsters	4 week		2,3,7,8-TCDD	7.4	7400	1		ED50 for hepatic vitamin A gain	Hanberg et al. 1989; 1990
Golden hamsters	122 d	M	2,3,7,8-TCDD	0	0	1	0	bw= 156 g - control	Gordon et al. 1996
Golden hamsters	122 d	M	2,3,7,8-TCDD	2	2000	1[b]	2	bw = 107 g - S; S reduced core temperature over a range of ambient temperatures; NS effect on metabolic rate; NS effect in motor activity	Gordon et al. 1996
mice	4 weeks	M	2,3,7,8-TCDD	0	0	28	0	control	Thigpen et al. 1975
mice	4 weeks	M	2,3,7,8-TCDD	0.7[c]	700	28	0.02	no effect on wt gain	Thigpen et al. 1975
mice	4 weeks	M	2,3,7,8-TCDD	1.4[c]	1400	28	0.04	decreased wt gain - NS	Thigpen et al. 1975
mice	4 weeks	M	2,3,7,8-TCDD	3.0[c]	3000	28	0.08	decreased wt gain - S	Thigpen et al. 1975
C57bl/6 mice	4 weeks		2,3,7,8-TCDD	890	890 μg·kg⁻¹·d⁻¹	1		ED50 for body wt gain	Hanberg et al. 1989; 1990
C57bl/6 mice	4 weeks		2,3,7,8-TCDD	>1000	>1000 μg·kg⁻¹·d⁻¹	1		ED50 for liver enlargement	Hanberg et al. 1989; 1990
C57bl/6 mice	4 week		2,3,7,8-TCDD	27	27 μg·kg⁻¹·d⁻¹	1		ED50 for hepatic vitamin A gain	Hanberg et al. 1989; 1990
C57bl/6 mice	4 month	M	2,3,7,8-TCDD	0	0	14		bw gain = 0.89g; RLW = 6.07%; relative thymus wt = 0.127% - control	Vos et al. 1974
C57bl/6 mice	4 month	M	2,3,7,8-TCDD	0.03[d]	30	14		bw gain = 0.68g - NS; RLW = 5.99% - NS; relative thymus wt = 0.120% - NS	Vos et al. 1974

Table 35. Chronic toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1} bw \cdot d^{-1}$)	TEQ dose ($ng \cdot kg^{-1} bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
C57b1/6 mice	4 month	M	2,3,7,8-TCDD	0.4	400	14		bw gain = 0.66g - NS; RLW = 6.75% - S; relative thymus wt = 0.110% - S	Vos et al. 1974
C57b1/6 mice	4 month	M	2,3,7,8-TCDD	0.7	700	14		bw loss = 0.5g - S; RLW = 7.01% - S; relative thymus wt = 0.085% - S	Vos et al. 1974
C57b1/6 mice	4 month	M	2,3,7,8-TCDD	3.6	3600	14		bw loss = 2.40g - S; RLW = 7.13% - S; relative thymus wt = 0.030% - S	Vos et al. 1974
C57b1/6 mice	4 month	M	2,3,7,8-TCDD	0	0	42		mortality = 0%; bw gain = 1.45g; RLW = 5.98%; relative thymus wt = 0.173% - control	Vos et al. 1974
C57b1/6 mice	4 month	M	2,3,7,8-TCDD	0.03[e]	30	42		mortality = 0% - NS; bw gain = 3.43g - NS; RLW = 6.39% - NS; relative thymus wt = 0.166% - NS	Vos et al. 1974
C57b1/6 mice	4 month	M	2,3,7,8-TCDD	0.4	400	42		mortality = 0% - NS; bw gain = 2.09g - NS; RLW = 7.03% - S; relative thymus wt = 0.137% - S	Vos et al. 1974
C57b1/6 mice	4 month	M	2,3,7,8-TCDD	0.7	700	42		mortality = 0% - NS; bw gain = 0.58g - NS; RLW = 7.56% - S; relative thymus wt = 0.098% - S	Vos et al. 1974
C57b1/6 mice	4 month	M	2,3,7,8-TCDD	3.6	3600	42		mortality = 17.6% - NS; bw loss = 2.88g S; RLW = 8.53% - S; relative thymus wt = 0.042% - S	Vos et al. 1974
rats	139 g	F	2,3,7,8-TCDD	0	0	91		control	
rats	139 g	F	2,3,7,8-TCDD	0.106	106	91		decreased wt gain - S	Suter-Hofmann and Schlatter 1989
rats	139 g	F	2,3,7,8-TCDD	0.269	269	91		decreased wt gain - S	Suter-Hofmann and Schlatter 1989
rats	139 g	F	2,3,7,8-TCDD	0.542	542	91		decreased wt gain - S	Suter-Hofmann and Schlatter 1989
rats	139 g	F	2,3,4,7,8-PeCDF	1.107	553.5	91		decreased wt gain - S	Suter-Hofmann and Schlatter 1989
rats	139 g	F	1,2,3,7,8-PeCDD	1.124	1124	91		decreased wt gain - S	Suter-Hofmann and Schlatter 1989
rats	139 g	F	1,2,3,7,8-PeCDD	5.051	5051	91		decreased wt gain - S	Suter-Hofmann and Schlatter 1989

Table 35. Chronic toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose (µg·kg⁻¹ bw·d⁻¹)	TEQ dose (ng·kg⁻¹ bw·d⁻¹)	Exposure (days)	Total Dose (µg·kg⁻¹ bw)	Endpoint	Reference
rats	139 g	F	mixture		129[f]	91		decreased wt gain - NS	Suter-Hofmann and Schlatter 1989
rats	139 g	F	mixture		300[f]	91		decreased wt gain - NS	Suter-Hofmann and Schlatter 1989
rats	124 g	M	2,3,7,8-TCDD	0	0	91		control	Suter-Hofmann and Schlatter 1989
rats	124 g	M	2,3,7,8-TCDD	0.091	91	91		decreased wt gain - NS	Suter-Hofmann and Schlatter 1989
rats	124 g	M	2,3,7,8-TCDD	0.23	230	91		decreased wt gain - S	Suter-Hofmann and Schlatter 1989
rats	124 g	M	2,3,7,8-TCDD	0.48	480	91		decreased wt gain - S	Suter-Hofmann and Schlatter 1989
rats	124 g	M	2,3,4,7,8-PeCDF	0.944	472	91		decreased wt gain - S	Suter-Hofmann and Schlatter 1989
rats	124 g	M	1,2,3,7,8-PeCDD	0.919	919	91		decreased wt gain - S	Suter-Hofmann and Schlatter 1989
rats	124 g	M	1,2,3,7,8-PeCDD	4.97	4970	91		decreased wt gain - S	Suter-Hofmann and Schlatter 1989
rats	124 g	M	mixture		109[f]	91		decreased wt gain - NS	Suter-Hofmann and Schlatter 1989
rats	124 g	M	mixture		253[f]	91		decreased wt gain - NS	Suter-Hofmann and Schlatter 1989
Fischer rats	200-250 g	M	OCCD	0		91		control	Birnbaum et al. 1989b
Fischer rats	200-250 g	M	OCCD	36[g]		91		enzyme induction; liver hypertrophy and cytoplasmic vacuolization, and a mild non-regenerative anemia	Birnbaum et al. 1989b
Sprague-Dawley Rats	6-7 weeks	F	2,3,7,8-TCDD	0	0	91 + 91[h]		0% mortality - control	Kociba et al. 1976
Sprague-Dawley Rats	6-7 weeks	F	2,3,7,8-TCDD	0.0007[i]	0.7	91 + 91		8% (1 rat) moribound by d 9 of treatment	Kociba et al. 1976
Sprague-Dawley Rats	6-7 weeks	F	2,3,7,8-TCDD	0.007	7	91 + 91		0% mortality; S increase in RLW	Kociba et al. 1976
Sprague-Dawley Rats	6-7 weeks	F	2,3,7,8-TCDD	0.07	70	91 + 91		0% mortality; S reduced food consumption and BW; S reduced thymus weight; S increase in RLW	Kociba et al. 1976

Table 35. Chronic toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ $bw \cdot d^{-1}$)	TEQ dose ($ng \cdot kg^{-1}$ $bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
Sprague-Dawley Rats	6-7 weeks	F	2,3,7,8-TCDD	0.7	700	91 + 91		50% mortality; S reduced food consumption and BW; S reduced relative thymus, brain and spleen weights; S increase in RLW	Kociba et al. 1976
Sprague-Dawley Rats	6-7 weeks	M	2,3,7,8-TCDD	0	0	91 + 91[h]		0% mortality - control	Kociba et al. 1976
Sprague-Dawley Rats	6-7 weeks	M	2,3,7,8-TCDD	0.0007[i]	0.7	91 + 91		0% mortality	Kociba et al. 1976
Sprague-Dawley Rats	6-7 weeks	M	2,3,7,8-TCDD	0.007	7	91 + 91		0% mortality; S increase in RLW	Kociba et al. 1976
Sprague-Dawley Rats	6-7 weeks	M	2,3,7,8-TCDD	0.07	70	91 + 91		0% mortality; S reduced food consumption and BW; S reduced thymus weight; S increase in RLW	Kociba et al. 1976
Sprague-Dawley Rats	6-7 weeks	M	2,3,7,8-TCDD	0.7	700	91 + 91		17% mortality; S reduced food consumption and BW; S decreased relative thymus, brain, spleen and testes weights; S increase in RLW	Kociba et al. 1976
Sprague-Dawley Rats	6-7 weeks	F	2,3,7,8-TCDD	0	0	728		control	Kociba et al. 1978
Sprague-Dawley Rats	6-7 weeks	F	2,3,7,8-TCDD	0.001	1	728		mortality rates; bw - NS	Kociba et al. 1978
Sprague-Dawley Rats	6-7 weeks	F	2,3,7,8-TCDD	0.01	10	728		mortality rates; bw - NS; increase in relative liver wt - S	Kociba et al. 1978
Sprague-Dawley Rats	6-7 weeks	F	2,3,7,8-TCDD	0.1	100	728		increased cumulative mortality over the latter half of study - S; decreased bw - S; increase in relative liver wt - S; decrease in thymus wt - S	Kociba et al. 1978
Sprague-Dawley Rats	6-7 weeks	M	2,3,7,8-TCDD	0	0	728		control	Kociba et al. 1978
Sprague-Dawley Rats	6-7 weeks	M	2,3,7,8-TCDD	0.001	1	728		mortality rates; bw - NS	Kociba et al. 1978
Sprague-Dawley Rats	6-7 weeks	M	2,3,7,8-TCDD	0.01	10	728		mortality rates; bw - NS	Kociba et al. 1978
Sprague-Dawley Rats	6-7 weeks	M	2,3,7,8-TCDD	0.1	100	728		mortality rates - NS; decreased bw - S	Kociba et al. 1978

Table 35. **Chronic toxicity data for orally administered PCDD/Fs in mammals.**

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ bw$\cdot d^{-1}$)	TEQ dose ($ng \cdot kg^{-1}$ bw$\cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
Sprague-Dawley Rats	lactating	F	2,3,7,8-TCDD	0	0	10		control	Lans et al. 1990
Sprague-Dawley Rats	lactating	F	2,3,7,8-TCDD	0.5	500	10		increase in dam RLW (46% - S) and neonate RLW (58% - S); S decrease in neonate BW (15%)	Lans et al. 1990
Sprague-Dawley Rats	4 weeks		2,3,7,8-TCDD	89	89000	1		ED50 for body wt gain	Hanberg et al. 1989; 1990
Sprague-Dawley Rats	4 weeks		2,3,7,8-TCDD	>100	>100 000	1		ED50 for liver enlargement	Hanberg et al. 1989; 1990
Sprague-Dawley Rats	4 weeks		2,3,7,8-TCDD	26	26000	1		ED50 for thymic atrophy	Hanberg et al. 1989; 1990
Sprague-Dawley Rats	4 week		2,3,7,8-TCDD	3.5	3500	1		ED50 for hepatic vitamin A gain	Hanberg et al. 1989; 1990

[a]after dosing, returned to control diet for 79, 69, or 55 d, respectively

[b]pregnant female hamsters (~135 d in age) were given a single dose on gestation day 11.5. Male offspring underwent experiments when 5 months of age

[c]mice received 0, 5.0, 10.0 or 20.0 $\mu g \cdot kg^{-1}$ bw$\cdot$week^{-1} through a grastric tube (oral gavage) for 4 weeks

[d]mice dosed by gastric intubation with 0.2, 1.0, 5.0, or 25 $\mu g \cdot kg^{-1}$ bw once a week for 2 weeks

[e]mice dosed by gastric intubation with 0.2, 1.0, 5.0, or 25 $\mu g \cdot kg^{-1}$ bw once a week for 6 weeks

[f]in addition to a standard diet, rats were fed pulverized liver lyophilisate from rabbits fed (via gavage) a single dose a known mixture of PCDDs and PCDFs obtained from extracting flyash; doses are in ng TEQ·kg-1 bw; where TEQ concentrations were converted to 1998 WHO TEQs

[g]rats received 50 $\mu g \cdot kg^{-1}$ bw 5 d a week by gavage for 13 weeks

[h]91 days treatment plus 91 days without treatment

[i]given 0, 0.001, 0.01, 0.1, 1.0 $\mu g \cdot kg^{-1}$ bw$\cdot d^{-1}$ via gavage 5 days/week

Table 36. Reproductive toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose (μg·kg⁻¹ bw·d⁻¹)	TEQ (ng·kg⁻¹ bw·d⁻¹)	Exposure (days)	Total Dose (μg·kg⁻¹ bw)	Endpoint	Reference
Golden syrian hamsters	pregnant[a]	F	2,3,7,8-TCDD	0[b]	0	1		kidney congestion = 0%; hydronephrosis = 1.6%; kidney congestion = 0%; hydronephrosis = 1.6% - control	Olson et al. 1990
Golden syrian hamsters	pregnant	F	2,3,7,8-TCDD	1.5	1500	1		kidney congestion = 9.7%; hydronephrosis = 11.2%; S reduction in lymphoid weight	Olson et al. 1990
Golden syrian hamsters	pregnant	F	2,3,7,8-TCDD	3	3000	1		S reduction in lymphoid weight	Olson et al. 1990
Golden syrian hamsters	pregnant	F	2,3,7,8-TCDD	6	6000	1		S reduction in lymphoid weight	Olson et al. 1990
Golden syrian hamsters	pregnant	F	2,3,7,8-TCDD	18	18000	1		58% fetal mortality; incidence of cleft palate in viable fetuses = 7%; S reduction in lymphoid weight	Olson et al. 1990
albino mice	pregnant	F	control		0[c]	1		[d]implantation sites/litter = 13.1; living fetuses/litters = 12.0; resorptions/implantation sites = 8.7%; fetal weight = 1.17 g; cleft palate/fetuses = 0.6%; litters with cleft palate = 7% - control	Nagao et al. 1993
albino mice	pregnant	F	PCDD mixture		21000[e,f]	1		NS effect on implantation, living fetuses, resorptions or fetal weights; cleft palate/fetuses = 19.4 - S; litters with cleft palate = 65.2% - S	Nagao et al. 1993
albino mice	pregnant	F	PCDD mixture		63000	1		NS effect on implantation, living fetuses, resorptions or fetal weights; cleft palate/fetuses = 66.2 - S; litters with cleft palate = 100% - S	Nagao et al. 1993
albino mice	pregnant	F	PCDF mixture I		11000[e,f]	1		NS effect on implantation, living fetuses, resorptions or fetal weights; cleft palate/fetuses = 2.7 - S; litters with cleft palate = 25% - S	Nagao et al. 1993
albino mice	pregnant	F	PCDF mixture I		34000	1		NS effect on implantation, living fetuses, resorptions or fetal weights; cleft palate/fetuses = 11.7 - S; litters with cleft palate = 50% - S	Nagao et al. 1993

Table 36. Reproductive toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ $bw \cdot d^{-1}$)	TEQ ($ng \cdot kg^{-1}$ $bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
albino mice	pregnant	F	PCDF mixture II		8000[e,f]	1		NS effect on implantation, living fetuses, resorptions or fetal weights; cleft palate/fetuses = 1.2 - S; litters with cleft palate = 12.5% - NS	Nagao et al. 1993
albino mice	pregnant	F	PCDF mixture II		15000	1		NS effect on implantation, living fetuses, resorptions or fetal weights; cleft palate/fetuses = 10.4 - S; litters with cleft palate = 52.6% - S	Nagao et al. 1993
albino mice	pregnant	F	PCDF mixture II		23000	1		NS effect on implantation, living fetuses, resorptions or fetal weights; cleft palate/fetuses = 24.6 - S; litters with cleft palate = 66.7% - S	Nagao et al. 1993
albino mice	pregnant	F	2,3,4,7,8-PeCDF	20	10000	1		NS effect on implantation, living fetuses, resorptions or fetal weights; cleft palate/fetuses = 9.5 - S; litters with cleft palate = 55.0% - S	Nagao et al. 1993
albino mice	pregnant	F	2,3,4,7,8-PeCDF	28	14000	1		NS effect on implantation, living fetuses, resorptions or fetal weights; cleft palate/fetuses = 15.8 - S; litters with cleft palate = 61.1% - S	Nagao et al. 1993
albino mice	pregnant	F	2,3,4,7,8-PeCDF	55	27500	1		NS effect on implantation, living fetuses, resorptions or fetal weights; cleft palate/fetuses = 45.6 - S; litters with cleft palate = 93.8% - S	Nagao et al. 1993
albino mice	pregnant	F	2,3,4,7,8-PeCDF	80	40000	1		NS effect on implantation, living fetuses, resorptions or fetal weights; cleft palate/fetuses = 62.1 - S; litters with cleft palate = 100% - S	Nagao et al. 1993
albino mice	pregnant	F	2,3,7,8-TCDD	5[e,f]	5000	1		NS effect on implantation, living fetuses, resorptions or fetal weights; cleft palate/fetuses = 5.4 - S; litters with cleft palate = 38.5% - S	Nagao et al. 1993
albino mice	pregnant	F	2,3,7,8-TCDD	15	15000	1		NS effect on implantation, living fetuses, resorptions or fetal weights; cleft palate/fetuses = 28.1 - S; litters with cleft palate = 71.4% - S	Nagao et al. 1993
albino mice	pregnant	F	2,3,7,8-TCDD	30	30000	1		NS effect on implantation, living fetuses, resorptions or fetal weights; cleft palate/fetuses = 55.8 - S; litters with cleft palate = 100% - S	Nagao et al. 1993

Table 36. Reproductive toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose (μg·kg⁻¹ bw·d⁻¹)	TEQ (ng·kg⁻¹ bw·d⁻¹)	Exposure (days)	Total Dose (μg·kg⁻¹ bw)	Endpoint	Reference
albino mice	pregnant	F	2,3,7,8-TCDD	45	45000	1		NS effect on implantation, living fetuses, resorptions or fetal weights; cleft palate/fetuses = 77.2 - S; litters with cleft palate = 100%	Nagao et al. 1993
albino mice	pregnant	F	2,3,7,8-TCDD	90	90000	1		NS effect on implantation, living fetuses, resorptions or fetal weights; cleft palate/fetuses = 85.5 - S; litters with cleft palate = 100% - S	Nagao et al. 1993
B6C3F1 mice	neonates	M/F	2,3,7,8-TCDD	0	0	4[g]		BW = 13.6g; RLW =6.2; RSW = 0.62; RTW = 0.45;	Luster et al. 1980
B6C3F1 mice	neonates	M/F	2,3,7,8-TCDD	1	1000	4		BW = 12.6g; RLW =6.8; RSW = 0.66; RTW = 0.46	Luster et al. 1980
B6C3F1 mice	neonates	M/F	2,3,7,8-TCDD	5	5000	4		BW = 10.9g - S; RLW =6.5; RSW = 0.64; RTW = 0.33 - S	Luster et al. 1980
B6C3F1 mice	neonates	M/F	2,3,7,8-TCDD	15	15000	4		BW = 7.9g - S; RLW =6.0; RSW = 0.35 - S; RTW = 0.19 - S; overt toxicity; 70% mortality	Luster et al. 1980
Mice (C57BL/6N)	17-20 g; pregnant	F	2,3,7,8-TCDD	0	0	gestation day 10	0	No. of litters = 9; BW gain = 3.8 g; BW:LW = 7.4; no. live fetus/litter 6.9; % fetal mortality = 10.5; no of litters with cleft palate = 0; % fetuses with cleft palate = 0.0; kidney damage = 0.17 - control	Weber et al. 1985
Mice (C57BL/6N)	17-20 g; pregnant	F	2,3,7,8-TCDD	12	12000	gestation day 10	12	NS effects on BW gain; no. of live fetuses/litter; and % fetal mortality; no. of litters = 10; LW:BW = 7.93 - S; no. of litters with cleft palate = 4; % fetuses with cleft palate = 8.7 - S; kidney damage = 2.01 - S;	Weber et al. 1985
Mice (C57BL/6N)	17-20 g; pregnant	F	2,3,7,8-TCDD	17	17000	gestation day 10	17	NS effects on BW gain; no. of live fetuses/litter; and % fetal mortality; no. of litters = 11; LW:BW = 8.36 - S; no. of litters with cleft palate = 9; % fetuses with cleft palate = 43.9 - S; kidney damage = 2.32 - S;	Weber et al. 1985

Table 36. Reproductive toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ $bw \cdot d^{-1}$)	TEQ ($ng \cdot kg^{-1}$ $bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
Mice (C57BL/6N)	17-20 g; pregnant	F	2,3,7,8-TCDD	22	22000	gestation day 10	22	NS effects on BW gain; no. of live fetuses/litter; and % fetal mortality; no. of litters = 10; LW:BW = 8.55 - S; no. of litters with cleft palate = 10; % fetuses with cleft palate = 77.6 - S; kidney damage = 2.16 - S;	Weber et al. 1985
Mice (C57BL/6N)	17-20 g; pregnant	F	2,3,7,8-TCDF	300	30000	gestation day 10	300	NS effects on BW gain; no. of live fetuses/litter; and % fetal mortality; no. of litters = 11; LW:BW = 7.71 - NS; no. of litters with cleft palate = 3; % fetuses with cleft palate = 7.7 - NS; kidney damage = 1.57 - S;	Weber et al. 1985
Mice (C57BL/6N)	17-20 g; pregnant	F	2,3,7,8-TCDF	600	60000	gestation day 10	600	NS effects on BW gain; no. of live fetuses/litter; and % fetal mortality; no. of litters = 10; LW:BW = 8.24 - S; no. of litters with cleft palate = 9; % fetuses with cleft palate = 55.5 - S; kidney damage = 2.13 - S;	Weber et al. 1985
Mice (C57BL/6N)	17-20 g; pregnant	F	2,3,7,8-TCDF	900	90000	gestation day 10	900	NS effects on BW gain; no. of live fetuses/litter; and % fetal mortality; no. of litters = 7; LW:BW = 8.52 - S; no. of litters with cleft palate = 7; % fetuses with cleft palate = 88.8 - S; kidney damage = 2.09 - S;	Weber et al. 1985
Mice (C57BL/6N)	17-20 g; pregnant	F	2,3,7,8-TCDD/F	12/300	42000	gestation day 10	12/300	NS effects on BW gain; no. of live fetuses/litter; and % fetal mortality; no. of litters = 10; LW:BW = 8.40 - S; no. of litters with cleft palate = 10; % fetuses with cleft palate = 79.1 - S; kidney damage = 2.38 - S;	Weber et al. 1985
Mice (C57BL/6N)	17-20 g; pregnant	F	2,3,7,8-TCDD/F	12/600	72000	gestation day 10	12/600	NS effects on BW gain; no. of live fetuses/litter; and % fetal mortality; no. of litters = 11; LW:BW = 8.52 - S; no. of litters with cleft palate = 11; % fetuses with cleft palate = 100 - S; kidney damage = 2.41 - S;	Weber et al. 1985

Table 36. Reproductive toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose (µg·kg⁻¹ bw·d⁻¹)	TEQ (ng·kg⁻¹ bw·d⁻¹)	Exposure (days)	Total Dose (µg·kg⁻¹ bw)	Endpoint	Reference
Mice (C57BL/6N)	10 weeks; pregnant	F	2,3,7,8-TCDD	0[h]	0	gestation day 10		maternal: BW gain = 2.53g; %RLW = 6.91; Fetal: mortality = 11.29; BW = 1.15g; cleft palate: no. of litters = 0; incidence/litter = 0; hydronephrosis: no. of litters = 2; incidence/litter = 6.25 - control	Birnbaum et al. 1989a
Mice (C57BL/6N)	10 weeks; pregnant	F	2,3,7,8-TCDD	6	6000	gestation day 10		maternal: BW gain = 2.33g; %RLW = 7.73 S; Fetal: mortality = 18.66; BW = 1.17g; cleft palate: no. of litters = 0; incidence/litter = 0; hydronephrosis: no. of litters = 11; incidence/litter = 96.97 - S	Birnbaum et al. 1989a
Mice (C57BL/6N)	10 weeks; pregnant	F	2,3,7,8-TCDD	12	12000	gestation day 10		maternal: BW gain = 2.43g; %RLW = 7.44 S; Fetal: mortality = 9.63; BW = 1.21g; cleft palate: no. of litters = 10 - S; incidence/litter = 20.86 - S; hydronephrosis: no. of litters = 14; incidence/litter = 92.00 - S	Birnbaum et al. 1989a
Mice (C57BL/6N)	10 weeks; pregnant	F	2,3,7,8-TCDD	15	15000	gestation day 10		maternal: BW gain = 0.73g - S; %RLW = 7.46 - S; Fetal: mortality = 9.21; BW = 1.20g; cleft palate: no. of litters = 8 - S; incidence/litter = 49.30 - S; hydronephrosis: no. of litters = 8; incidence/litter = 100 - S	Birnbaum et al. 1989a
Mice (C57BL/6N)	10 weeks; pregnant	F	2,3,7,8-TCDD	18	18000	gestation day 10		maternal: BW gain = 1.02g - S; %RLW = 7.51 - S; Fetal: mortality = 5.04; BW = 1.13g; cleft palate: no. of litters = 11 - S; incidence/litter = 70.12 - S; hydronephrosis: no. of litters = 12; incidence/litter = 100 - S	Birnbaum et al. 1989a
Mice (C57BL/6N)	10 weeks; pregnant	F	2,3,7,8-TCDD	0[h]	0	gestation day 12		maternal: BW gain = 0.09g; %RLW = 6.66; Fetal: mortality = 7.27; BW = 1.14g; cleft palate: no. of litters = 0; incidence/litter = 0; hydronephrosis: no. of litters = 2; incidence/litter = 8.33 - control	Birnbaum et al. 1989a

Table 36. Reproductive toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose (μg·kg⁻¹ bw·d⁻¹)	TEQ (ng·kg⁻¹ bw·d⁻¹)	Exposure (days)	Total Dose (μg·kg⁻¹ bw)	Endpoint	Reference
Mice (C57BL/6N)	10 weeks; pregnant	F	2,3,7,8-TCDD	6	6000	gestation day 12		maternal: BW gain = -0.12g; %RLW = 7.53 - S; Fetal: mortality = 11.59; BW = 1.16g; cleft palate: no. of litters = 1; incidence/litter = 1.43; hydronephrosis: no. of litters = 14 - S; incidence/litter = 97.62 - S	Birnbaum et al. 1989a
Mice (C57BL/6N)	10 weeks; pregnant	F	2,3,7,8-TCDD	9	9000	gestation day 12		maternal: BW gain = 0.21g; %RLW = 7.29 S; Fetal: mortality = 5.40; BW = 1.15g; cleft palate: no. of litters = 9 - S; incidence/litter = 19.91 - S; hydronephrosis: no. of litters = 14 - S; incidence/litter = 100 - S	Birnbaum et al. 1989a
Mice (C57BL/6N)	10 weeks; pregnant	F	2,3,7,8-TCDD	12	12000	gestation day 12		maternal: BW gain = 0g; %RLW = 8.19 - S; Fetal: mortality = 8.41; BW = 1.16g; cleft palate: no. of litters = 12 - S; incidence/litter = 51.45 - S; hydronephrosis: no. of litters = 12 - S; incidence/litter = 98.61 - S	Birnbaum et al. 1989a
Mice (C57BL/6N)	10 weeks; pregnant	F	2,3,7,8-TCDD	15	15000	gestation day 12		maternal: BW gain = 0.11g; %RLW = 7.36 S; Fetal: mortality = 7.38; BW = 1.16g; cleft palate: no. of litters = 12 - S; incidence/litter = 77.91 - S; hydronephrosis: no. of litters = 12 - S; incidence/litter = 100 - S	Birnbaum et al. 1989a
Mink	kits	F	2,3,7,8-TCDD	0	0	12		control	Aulerich et al. 1988
Mink	kits	F	2,3,7,8-TCDD	0.1	100	12		S decreased BW by 3 weeks and >50% mortality within 10 weeks; NS effect on tooth eruption or eye opening	Aulerich et al. 1988
Mink	kits	F	2,3,7,8-TCDD	1	1000	12		100% mortality with 2 weeks	Aulerich et al. 1988
Mink	kits	M	2,3,7,8-TCDD	0	0	12		control	Aulerich et al. 1988
Mink	kits	M	2,3,7,8-TCDD	0.1	100	12		S decreased BW by 2 weeks and >50% mortality within 10 weeks; NS effect on tooth eruption or eye opening	Aulerich et al. 1988
Mink	kits	M	2,3,7,8-TCDD	1	1000	12		S decreased BW by week 1; 100% mortality with 2 weeks	Aulerich et al. 1988

Table 36. Reproductive toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ $bw \cdot d^{-1}$)	TEQ ($ng \cdot kg^{-1}$ $bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
Rheus monkey	adult	F	2,3,7,8-TCDD	0	0	9	0	abortions = 25%; maternal toxicity = 0%; maternal death = 0% - control	McNulty 1985
Rheus monkey	adult	F	2,3,7,8-TCDD	0.02	20	9	0.2[i]	abortions = 25%; maternal toxicity = 0%; maternal death = 0%	McNulty 1985
Rheus monkey	adult	F	2,3,7,8-TCDD	0.11/1	110/1000	9/1	1[j]	abortions = 81%; maternal toxicity = 50%; maternal death = 19%	McNulty 1985
Rheus monkey	adult	F	2,3,7,8-TCDD	0.56	560	9	5[j]	abortions = 100%; maternal toxicity = 100%; maternal death = 100%	McNulty 1985
Holtzman rats	32-120 d	M	2,3,7,8-TCDD	0	0	1[k]		control	Mably et al. 1991
Holtzman rats	32-120 d	M	2,3,7,8-TCDD	0.064	64	1		ventral prostate wt 60% reduction by d 32; cauda epidiymis wt reduction 53% by d 63; sperm/cauda epididymis reduction - 75% by d 63; daily sperm reproduction rate reduction - 43% by d 49	Mably et al. 1991
Holtzman rats	32-120 d	M	2,3,7,8-TCDD	0.16	160	1		anogenital distance 21% by d 1; time to testis descent delay by 1.7 d; seminal vesicle wt 56% reduction by d 49; increased latencies to 1st mount, intromission, and ejaculation	Mably et al. 1991
Holtzman rats	32-120 d	M	2,3,7,8-TCDD	0.4	400	1		testis wt reduction - 17% by d 32; copulatory rate decrease - 43%;	Mably et al. 1991
Holtzman rats	32-120 d	M	2,3,7,8-TCDD	1	1000	1		number mounts increase by 130%; number of intromissions increase by 38%	Mably et al. 1991
Holtzman rats	pregnant[L]	F	2,3,7,8-TCDD	0[b]	0	1		gastrointestinal hemorrhaging not observed;	Olson et al. 1990
Holtzman rats	pregnant	F	2,3,7,8-TCDD	1.5	1500	1		gastrointestinal hemorrhaging = 7.7%; S reduction in lymphoid weight	Olson et al. 1990
Holtzman rats	pregnant	F	2,3,7,8-TCDD	3	3000	1		S reduction in lymphoid weight	Olson et al. 1990
Holtzman rats	pregnant	F	2,3,7,8-TCDD	6	6000	1		S decrease in maternal BW gain; S reduction in lymphoid weight	Olson et al. 1990
Holtzman rats	pregnant	F	2,3,7,8-TCDD	18	18000	1		S decrease in maternal BW gain; 72% fetal mortality; incidence of cleft palate in viable fetuses = 38%; S reduction in lymphoid weight	Olson et al. 1990

Table 36. Reproductive toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ $bw \cdot d^{-1}$)	TEQ ($ng \cdot kg^{-1}$ $bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
Sprague-Dawley Rats (F_o) - 1st mating	6-7 weeks	M/F	2,3,7,8-TCDD	0	0	105+[m]		[n]FI 44%; litter size 8; live pups 95%; pup survival to 21 d = 93%;	Murray et al. 1979
Sprague-Dawley Rats (F_o) - 1st mating	6-7 weeks	M/F	2,3,7,8-TCDD	0.001	1	105+		FI 50%; litter size 10; live pups 90%; pup survival to 21 d = 84% - S;	Murray et al. 1979
Sprague-Dawley Rats (F_o) - 1st mating	6-7 weeks	M/F	2,3,7,8-TCDD	0.01	10	105+		FI 60%; litter size 8; live pups 90%; pup survival to 21 d = 68% - S;	Murray et al. 1979
Sprague-Dawley Rats (F_o) - 1st mating	6-7 weeks	M/F	2,3,7,8-TCDD	0.1	100	105+		FI 10% - S; litter size 4 - S; live pups 0%	Murray et al. 1979
Sprague-Dawley Rats (F_o) - 2nd mating	6-7 weeks	M/F	2,3,7,8-TCDD	0	0	156+[p]		FI 66%; litter size 11; live pups 96%; pup survival to 21 d = 74% - control;	Murray et al. 1979
Sprague-Dawley Rats (F_o) - 2nd mating	6-7 weeks	M/F	2,3,7,8-TCDD	0.001	1	156+		FI 74%; litter size 10; live pups 89%; pup survival to 21 d = 92% - S;	Murray et al. 1979
Sprague-Dawley Rats (F_o) - 2nd mating	6-7 weeks	M/F	2,3,7,8-TCDD	0.01	10	156+		FI 75%; litter size 10; live pups 96%; pup survival to 21 d = 71%;	Murray et al. 1979
Sprague-Dawley Rats (F_o) - 2nd mating	6-7 weeks	M/F	2,3,7,8-TCDD	0.1	100	156+		FI 3% - S; litter size 6 - S; live pups 83%; pup survival to 21 d = 80%;	Murray et al. 1979
Sprague-Dawley Rats (F_{1b}) - off spring from 2nd mating of F_o	130 d	M/F	2,3,7,8-TCDD	0	0	from conception to 130 d		FI 85%; litter size 11; live pups 96%; pup survival to 21 d = 87% - control;	Murray et al. 1979
Sprague-Dawley Rats (F_{1b}) - off spring from 2nd mating of F_o	130 d	M/F	2,3,7,8-TCDD	0.001	1	from conception to 130 d		FI 88%; litter size 11; live pups 89% - S; pup survival to 21 d = 85%;	Murray et al. 1979

Table 36. Reproductive toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ $bw \cdot d^{-1}$)	TEQ ($ng \cdot kg^{-1}$ $bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
Sprague-Dawley Rats (F_{1b}) - off spring from 2nd mating of F_o	130 d	M/F	2,3,7,8-TCDD	0.01	10	from conception to 130 d		FI 57% - S; litter size 8 - S; live pups 86% - S; pup survival to 21 d = 59% - S;	Murray et al. 1979
Sprague-Dawley Rats (F_2) - off spring from F_{1b}	130 d	M/F	2,3,7,8-	0	0	from conception to 130 d		FI 88%; litter size 11; live pups 93%; pup survival to 21 d = 79% - control;	Murray et al. 1979
Sprague-Dawley Rats (F_2) - off spring from F_{1b}	130 d	M/F	2,3,7,8-	0.001	1	from conception to 130 d		FI 100%; litter size 11; live pups 93%; pup survival to 21 d = 78%;	Murray et al. 1979
Sprague-Dawley Rats (F_2) - off spring from F_{1b}	130 d	M/F	2,3,7,8-	0.01	10	from conception to 130 d		FI 55% - S; litter size 9 - S; live pups 83% - S; pup survival to 21 d = 77%;	Murray et al. 1979
Secondary Toxicity									
mink	adult	M/F		0% Saginaw River Carp (PCDD - 0.011; PCDF - 0.0003)	PCDD - 0.014; PCDF - 0.0	182		Females whelped (50%); live kits/whelped female (5.0); kit survival to 3 weeks (85%); kit bw @ 3 wks = 98.7g - control	Heaton et al. 1995a, Tillitt et al. 1996
mink	adult	M/F		10% Saginaw River Carp (PCDD - 0.011; PCDF - 0.002)	PCDD - 0.79; PCDF - 0.45	182		Females whelped (50%); live kits/whelped female (3.8); kit survival to 3 weeks (31%); kit bw @ 3 wks = 66.1g - S	Heaton et al. 1995a, Tillitt et al. 1996
mink	adult	M/F		20% Saginaw River Carp (PCDD - 0.008; PCDF - 0.004)	PCDD - 0.95; PCDF - 0.69	182		Females whelped (50%); live kits/whelped female (4.8); kit survival to 3 weeks (29%); kit bw @ 3 wks = 65.8g - S	Heaton et al. 1995a, Tillitt et al. 1996
mink	adult	M/F		40% Saginaw River Carp (PCDD - 0.01; PCDF - 0.005)	PCDD - 1.45; PCDF - 1.1	182		Females whelped (50%); live kits/whelped female (0.7-S); kit survival to 3 weeks (0%)	Heaton et al. 1995a, Tillitt et al. 1996

Table 36. Reproductive toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ $bw \cdot d^{-1}$)	TEQ ($ng \cdot kg^{-1}$ $bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
rats (F_0)	40-44 d	F		control	PCDD/F - 0.018[q]; total TEQ - 0.046	70 + <21 breeding + 21 gestation + 21 lactation		control	Feeley and Jordon 1998; Arnold et al. 1998
rats (F_0)	40-44 d	F		5% Lake Huron chinook salmon	PCDD/F - 0.169; total TEQ - 0.527	70 + <21 breeding + 21 gestation + 21 lactation		NS effects on mating index, fertility index, conception rate, gestation period or index, no. of live pups born or pup survival	Feeley and Jordon 1998; Arnold et al. 1998
rats (F_0)	40-44 d	F		20% Lake Huron chinook salmon	PCDD/F - 0.522; total TEQ - 1.90	70 + <21 breeding + 21 gestation + 21 lactation		NS effects on mating index, fertility index, conception rate, gestation period or index, no. of live pups born or pup survival	Feeley and Jordon 1998; Arnold et al. 1998
rats (F_0)	40-44 d	F		5% Lake Ontario chinook salmon	PCDD/F - 0.224; total TEQ - 0.661	70 + <21 breeding + 21 gestation + 21 lactation		NS effects on mating index, fertility index, conception rate, gestation period or index, no. of live pups born or pup survival	Feeley and Jordon 1998; Arnold et al. 1998
rats (F_0)	40-44 d	F		20% Lake Ontario chinook salmon	PCDD/F - 0.786; total TEQ - 2.43	70 + <21 breeding + 21 gestation + 21 lactation		NS effects on mating index, fertility index, conception rate, gestation period or index, no. of live pups born or pup survival	Feeley and Jordon 1998; Arnold et al. 1998
rats (F_1)	40-44 d	F		control	PCDD/F - 0.019[q]; total TEQ - 0.050	70 d after weaning + <21 breeding + 21 gestation + 21 lactation		mating index = 0.83 - control	Feeley and Jordon 1998; Arnold et al. 1998
rats (F_1)	40-44 d	F		5% Lake Huron chinook salmon	PCDD/F - 0.194; total TEQ - 0.606	70 d after weaning + <21 breeding + 21 gestation + 21 lactation		NS effects on fertility index, conception rate, gestation period or index, no. of live pups born or pup survival; mating index = 0.98 - S; pup bw @ 21 days reduced - S	Feeley and Jordon 1998; Arnold et al. 1998
rats (F_1)	40-44 d	F		20% Lake Huron chinook salmon	PCDD/F - 0.597; total TEQ - 2.18	70 d after weaning + <21 breeding + 21 gestation + 21 lactation		NS effects on mating index, fertility index, conception rate, gestation period or index, no. of live pups born or pup survival; pup bw @ 21 days significantly reduced	Feeley and Jordon 1998; Arnold et al. 1998

Table 36. Reproductive toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose (μg·kg^{-1} bw·d^{-1})	TEQ (ng·kg^{-1} bw·d^{-1})	Exposure (days)	Total Dose (μg·kg^{-1} bw)	Endpoint	Reference
rats (F_1)	40-44 d	F		5% Lake Ontario chinook salmon	PCDD/F - 0.238; total TEQ - 0.702	70 d after weaning + <21 breeding + 21 gestation + 21 lactation		NS effects on mating index, fertility index, conception rate, gestation period or index, no. of live pups born or pup survival; pup bw @ 21 days significantly reduced	Feeley and Jordon 1998; Arnold et al. 1998
rats (F_1)	40-44 d	F		20% Lake Ontario chinook salmon	PCDD/F - 0.918; total TEQ - 2.84	70 d after weaning + <21 breeding + 21 gestation + 21 lactation		NS effects on mating index, fertility index, conception rate, gestation period or index, no. of live pups born or pup survival; pup bw @ 21 days significantly reduced	Feeley and Jordon 1998; Arnold et al. 1998

BW = body weight; RLW = relative liver weight; RSW = relative spleen weight; RTW = relative thymus weight

[a]d 9 of a 16 d gestation period; animals sacrificed on d 15

[b]peroral administration

[c]pooled results of 4 control groups; significance was based on pooled control

[d]measured on day 18 of pregnancy

[e]doses in μg TEQ·kg^{-1} bw; TEQ concentrations were converted from International TEQs to 1998 WHO TEQs

[f]administered by subcutaneous injection on day 9 of pregnancy; where doses were greater than 30 μg·kg-1, the amount was given in two divided doses

[g]mothers were dosed by gavage on d 14 of gestation and on d 1,7, and 14 following birth

[h]dosed by gavage

[i]divided in nine intragastric doses, days 20 to 40 postconception

[j]four animals given nine divided doses, twelve given a single dose, days 20 to 40 postconception

[k]mothers of male offspring were orally dosed on day 15 of gestation

[L]d 10 of a 22 d gestation period; animals sacrificed on d 20

[m]fed diets 90 d prior to mating, through mating (~15 d), gestation, and lactation

[n]FI (fertility index) = number of females delivering a litter/number of females mated

[p]mated a second time 33 d after the first litter was weaned; total expose = 156+gestation and lactation periods

[q]based on international TEFs (could not be converted to 1998 WHO values with the information provided); total TEQ includes PCDD/F and coplanar PCB congeners.

Table 37. Immunotoxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ $bw \cdot d^{-1}$)	TEQ Dose ($ng \cdot kg^{-1}$ $bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
Hartley guinea pigs	4 weeks		2,3,7,8-TCDD	1.8	1800	1		ED50 for thymic atrophy	Hanberg et al. 1989; 1990
Golden Syrian hamsters	4 weeks		2,3,7,8-TCDD	48	48000	1		ED50 for thymic atrophy	Hanberg et al. 1989; 1990
B6C3F1 mice	neonates	M/F	2,3,7,8-TCDD	0	0	4[a]		14 d mortality rates for bacterial challenge (28%) - control	Luster et al. 1980
B6C3F1 mice	neonates	M/F	2,3,7,8-TCDD	1	1000	4		14 d mortality rates for bacterial challenge (40%)	Luster et al. 1980
B6C3F1 mice	neonates	M/F	2,3,7,8-TCDD	5	5000	4		14 d mortality rates for bacterial challenge (73%) - S	Luster et al. 1980
C57bl/6 mice	4 weeks		2,3,7,8-TCDD	280	280 000	1		ED50 for thymic atrophy	Hanberg et al. 1989; 1990
mice	4 weeks	M	2,3,7,8-TCDD	0	0	28	0	14 d mortality rates for bacterial challenge (25%); for viral challenge (15%) following dioxin exposure- control	Thigpen et al. 1975
mice	4 weeks	M	2,3,7,8-TCDD	0.7[b]	700	28	0.02	14 d mortality rates for bacterial challenge (65%) - S; for viral challenge (15%) following dioxin exposure	Thigpen et al. 1975
mice	4 weeks	M	2,3,7,8-TCDD	1.4[b]	1400	28	0.04	14 d mortality rates for bacterial challenge (65%) - S; for viral challenge (0%) following dioxin exposure	Thigpen et al. 1975
mice	4 weeks	M	2,3,7,8-TCDD	3.0[b]	3000	28	0.08	14 d mortality rates for bacterial challenge (95%) - S; for viral challenge (10%) following dioxin exposure	Thigpen et al. 1975
mice	4 weeks	M	2,3,7,8-TCDD	0	0	28	0	14 d mortality rates for bacterial challenge (25%) following dioxin exposure- control	Thigpen et al. 1975
mice	4 weeks	M	2,3,7,8-TCDD	0.07[c]	70	28	0.02	14 d mortality rates for bacterial challenge (25%) - NS following dioxin exposure	Thigpen et al. 1975
mice	4 weeks	M	2,3,7,8-TCDD	0.14[c]	140	28	0.04	14 d mortality rates for bacterial challenge (65%) - S following dioxin exposure	Thigpen et al. 1975
mice	4 weeks	M	2,3,7,8-TCDD	0.7[c]	700	28	0.08	14 d mortality rates for bacterial challenge (75%) - S following dioxin exposure	Thigpen et al. 1975
mice (BALB/cGa)	pregnant	F	2,3,7,8-TCDD	0	0	1[d]		control	Fine et al. 1990

Table 37. Immunotoxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ $bw \cdot d^{-1}$)	TEQ Dose ($ng \cdot kg^{-1}$ $bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
mice (BALB/cGa)	pregnant	F	2,3,7,8-TCDD	15	15000	1		50-60% reduction in thymic wt and cellularity of gestation d 18 and 30-50% on postnatal d 3-11	Fine et al. 1990
mice (B6C3F1)	6-7 weeks	F	2,3,7,8-TCDD	0	0	14		total hemolytic activity (91 $U \cdot ml^{-1}$); C3 (493 A_d) - vehicle control	White et al. 1986
mice (B6C3F1)	6-7 weeks	F	2,3,7,8-TCDD	0.01	10	14		total hemolytic activity (54 $U \cdot ml^{-1}$) - S; C3 (476 A_d) NS	White et al. 1986
mice (B6C3F1)	6-7 weeks	F	2,3,7,8-TCDD	0.05	50	14		total hemolytic activity (63 $U \cdot ml^{-1}$) - S; C3 (464 A_d) NS	White et al. 1986
mice (B6C3F1)	6-7 weeks	F	2,3,7,8-TCDD	0.1	100	14		total hemolytic activity (56 $U \cdot ml^{-1}$) - S; C3 (485 A_d) NS	White et al. 1986
mice (B6C3F1)	6-7 weeks	F	2,3,7,8-TCDD	0.5	500	14		total hemolytic activity (41 $U \cdot ml^{-1}$) - S; C3 (450 A_d) S	White et al. 1986
mice (B6C3F1)	6-7 weeks	F	2,3,7,8-TCDD	1.0	1000	14		total hemolytic activity (32 $U \cdot ml^{-1}$) - S; C3 (398 A_d) S	White et al. 1986
mice (B6C3F1)	6-7 weeks	F	2,3,7,8-TCDD	2.0	2000	14		total hemolytic activity (17 $U \cdot ml^{-1}$) - S; C3 (363 A_d) S	White et al. 1986
mice (B6C3F1)	6-7 weeks	F	1,2,3,5,6,8-HCDD	0	no TEF	14		[e]total hemolytic activity (69 $U \cdot ml^{-1}$); C3 (625 A_d) - vehicle control	White et al. 1986
mice (B6C3F1)	6-7 weeks	F	1,2,3,5,6,8-HCDD	0.1	no TEF	14		total hemolytic activity (74 $U \cdot ml^{-1}$) - NS; C3 (605 A_d) - NS	White et al. 1986
mice (B6C3F1)	6-7 weeks	F	1,2,3,5,6,8-HCDD	1.0	no TEF	14		total hemolytic activity (42 $U \cdot ml^{-1}$) - NS; C3 (575 A_d) - NS	White et al. 1986
mice (B6C3F1)	6-7 weeks	F	1,2,3,5,6,8-HCDD	10.0	no TEF	14		total hemolytic activity (25 $U \cdot ml^{-1}$) - S; C3 (500 A_d) S	White et al. 1986
mice (C57BL/6N)	pregnant	F	2,3,7,8-TCDD	0.0	0	9[f]		relative thymic wt = 0.24%;	Holladay et al. 1991
mice (C57BL/6N)	pregnant	F	2,3,7,8-TCDD	1.5	1500	9		relative thymic wt = 0.14% - S; S effect on T cell (thymocyte) differentiation on d 18 of gestation, but not postnatal d6-d14	Holladay et al. 1991
mice (C57BL/6N)	pregnant	F	2,3,7,8-TCDD	3.0	3000	9		relative thymic wt = 0.1% - S; S effect on T cell differentiation on d 18 of gestation and postnatal d6 but not d14	Holladay et al. 1991

Table 37. Immunotoxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose (µg·kg^{-1} bw·d^{-1})	TEQ Dose (ng·kg^{-1} bw·d^{-1})	Exposure (days)	Total Dose (µg·kg^{-1} bw)	Endpoint	Reference
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	0[g]	0.0	28		endotoxin (10 µg) induced mortality 2d after dioxin dose (0%) - control	Vos et al. 1978
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	0.2	210	28		endotoxin (10 µg) induced mortality 2d after dioxin dose (0%)	Vos et al. 1978
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	0.7	710	28		endotoxin (10 µg) induced mortality 2d after dioxin dose (0%)	Vos et al. 1978
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	2.1	2140	28		endotoxin (10 µg) induced mortality 2d after dioxin dose (25%)	Vos et al. 1978
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	7.1	7140	28		endotoxin (10 µg) induced mortality 2d after dioxin dose (50%)	Vos et al. 1978
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	0[g]	0.0	28		endotoxin (250 µg) induced mortality 2d after dioxin dose (0%) - control	Vos et al. 1978
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	0.2	210	28		endotoxin (250 µg) induced mortality 2d after dioxin dose (20%)	Vos et al. 1978
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	0.7	710	28		endotoxin (250 µg) induced mortality 2d after dioxin dose (100%)	Vos et al. 1978
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	2.1	2140	28		endotoxin (250 µg) induced mortality 2d after dioxin dose (100%)	Vos et al. 1978
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	0[g]	0.0	28		endotoxin (10 µg) induced mortality 2d after dioxin dose (0%) - control	Vos et al. 1978
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	0.2	210	28		endotoxin (10 µg) induced mortality 2d after dioxin dose (0%)	Vos et al. 1978
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	7.1	7100	28		endotoxin (10 µg) induced mortality 2d after dioxin dose (40%)	Vos et al. 1978
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	0[g]	0.0	28		endotoxin (100 µg) induced mortality 2d after dioxin dose (0%) - control	Vos et al. 1978
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	0.2	210	28		endotoxin (100 µg) induced mortality 2d after dioxin dose (17%)	Vos et al. 1978
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	7.1	7100	28		endotoxin (100 µg) induced mortality 2d after dioxin dose (83%)	Vos et al. 1978
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	0[g]	0.0	28		endotoxin (500 µg) induced mortality 2d after dioxin dose (33%) - control	Vos et al. 1978
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	0.2	210	28		endotoxin (500 µg) induced mortality 2d after dioxin dose (50%)	Vos et al. 1978

Table 37. Immunotoxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ $bw \cdot d^{-1}$)	TEQ Dose ($ng \cdot kg^{-1}$ $bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
Swiss mice	3-4 weeks	M	2,3,7,8-TCDD	7.1	7100	28		endotoxin (500 µg) induced mortality 2d after dioxin dose (100%)	Vos et al. 1978
Mice (B6C3F1)	6-8 weeks	F	2,3,7,8-TCDD	0[h]	0.0	1	0	mortality 2d after endotoxin (5 mg/kg) injected 7d after dioxin dose (0%) - control	Rosenthal et al. 1989
Mice (B6C3F1)	6-8 weeks	F	2,3,7,8-TCDD	50.0	50000	1	50	mortality 2d after endotoxin (5 mg/kg) injected 7d after dioxin dose (0%)	Rosenthal et al. 1989
Mice (B6C3F1)	6-8 weeks	F	2,3,7,8-TCDD	100.0	100000	1	100	mortality 2d after endotoxin (5 mg/kg) injected 7d after dioxin dose (0%)	Rosenthal et al. 1989
Mice (B6C3F1)	6-8 weeks	F	2,3,7,8-TCDD	200.0	200000	1	200	mortality 2d after endotoxin (5 mg/kg) injected 7d after dioxin dose (87.5%)	Rosenthal et al. 1989
Mice (B6C3F1)	6-8 weeks	F	2,3,7,8-TCDD	0[h]	0.0	1	0	mortality 2d after endotoxin (25 mg/kg) injected 7d after dioxin dose (0%) - control	Rosenthal et al. 1989
Mice (B6C3F1)	6-8 weeks	F	2,3,7,8-TCDD	50.0	50000	1	50	mortality 2d after endotoxin (25 mg/kg) injected 7d after dioxin dose (50% - S)	Rosenthal et al. 1989
Mice (B6C3F1)	6-8 weeks	F	2,3,7,8-TCDD	100.0	100000	1	100	mortality 2d after endotoxin (5 mg/kg) injected 7d after dioxin dose (100% - S)	Rosenthal et al. 1989
Mice (B6C3F1)	6-8 weeks	F	2,3,7,8-TCDD	200.0	200000	1	200	mortality 2d after endotoxin (5 mg/kg) injected 7d after dioxin dose (100% - S)	Rosenthal et al. 1989
Mice (B6C3F1)	6-8 weeks	F	2,3,7,8-TCDD	0[h]	0.0	1	0	mortality 2d after endotoxin (25 mg/kg) injected 1d after dioxin dose (7.6%) - control	Rosenthal et al. 1989
Mice (B6C3F1)	6-8 weeks	F	2,3,7,8-TCDD	200.0	200000	1	50	mortality 2d after endotoxin (25 mg/kg) injected 1d after dioxin dose (23%)	Rosenthal et al. 1989
rats	139 g	F	2,3,7,8-TCDD	0	0	91		control	
rats	139 g	F	2,3,7,8-TCDD	0.106	106	91		decrease in thymus wt - S	Suter-Hofmann and Schlatter 1989
rats	139 g	F	2,3,7,8-TCDD	0.269	269	91		decrease in thymus wt - S	Suter-Hofmann and Schlatter 1989
rats	139 g	F	2,3,7,8-TCDD	0.542	542	91		decrease in thymus wt - S	Suter-Hofmann and Schlatter 1989
rats	139 g	F	2,3,4,7,8-PeCDF	1.107	553.5	91		decrease in thymus wt - S	Suter-Hofmann and Schlatter 1989

Table 37. **Immunotoxicity data for orally administered PCDD/Fs in mammals.**

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ $bw \cdot d^{-1}$)	TEQ Dose ($ng \cdot kg^{-1}$ $bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
rats	139 g	F	1,2,3,7,8-PeCDD	1.124	1124	91		decrease in thymus wt - S	Suter-Hofmann and Schlatter 1989
rats	139 g	F	1,2,3,7,8-PeCDD	5.051	5051	91		decrease in thymus wt - S	Suter-Hofmann and Schlatter 1989
rats	139 g	F	mixture		129[i]	91		decrease in thymus wt - S	Suter-Hofmann and Schlatter 1989
rats	139 g	F	mixture		300[i]	91		decrease in thymus wt - S	Suter-Hofmann and Schlatter 1989
rats	124 g	M	2,3,7,8-TCDD	0	0	91		control	Suter-Hofmann and Schlatter 1989
rats	124 g	M	2,3,7,8-TCDD	0.091	91	91		decrease in thymus wt - S	Suter-Hofmann and Schlatter 1989
rats	124 g	M	2,3,7,8-TCDD	0.23	230	91		decrease in thymus wt - S	Suter-Hofmann and Schlatter 1989
rats	124 g	M	2,3,7,8-TCDD	0.48	480	91		decrease in thymus wt - S	Suter-Hofmann and Schlatter 1989
rats	124 g	M	2,3,4,7,8-PeCDF	0.944	472	91		decrease in thymus wt - S	Suter-Hofmann and Schlatter 1989
rats	124 g	M	1,2,3,7,8-PeCDD	0.919	919	91		decrease in thymus wt - S	Suter-Hofmann and Schlatter 1989
rats	124 g	M	1,2,3,7,8-PeCDD	4.97	4970	91		decrease in thymus wt - S	Suter-Hofmann and Schlatter 1989
rats	124 g	M	mixture		109[i]	91		decrease in thymus wt - S	Suter-Hofmann and Schlatter 1989

Table 37. Immunotoxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ $bw \cdot d^{-1}$)	TEQ Dose ($ng \cdot kg^{-1}$ $bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
rats	124 g	M	mixture	-	253[i]	91		decrease in thymus wt - S	Suter-Hofmann and Schlatter 1989
rats (F_0)	40-44 d	M/F		control	PCDD/F TEQ - 0.015[j]; total TEQ - 0.038	70 + <21 breeding + 21 gestation + 21 lactation		control	Feeley and Jordon 1998; Tryphonas et al. 1998
rats (F_0)	40-44 d	M/F		5 or 20% Lake Huron or Lake Ontario chinook salmon	PCDD/F TEQ - up to 0.786; total TEQ - up to 2.43	70 + <21 breeding + 21 gestation + 21 lactation		changes in hematological indices and immune functionality could not be related to either fish source or concentration and tended to be reversible	Feeley and Jordon 1998; Tryphonas et al. 1998
rats (F_1)	40-44 d	M/F		control	PCDD/F TEQ - 0.016-0.019[j]; total TEQ - 0.042 0.050	70 d after weaning + <21 breeding + 21 gestation + 21 lactation		control	Feeley and Jordon 1998; Tryphonas et al. 1998
rats (F_1)	40-44 d	M/F		5 or 20% Lake Huron or Lake Ontario chinook salmon	PCDD/F TEQ - up to 0.918; total TEQ - up to 2.84	70 d after weaning + <21 breeding + 21 gestation + 21 lactation		changes in hematological indices and immune functionality could not be related to either fish source or concentration and tended to be reversible	Feeley and Jordon 1998; Tryphonas et al. 1998

[a] mothers were dosed by gavage on d 14 of gestation and on d 1,7, and 14 following birth

[b] mice received 0, 5.0, 10.0 or 20.0 $\mu g \cdot kg^{-1}$ $bw \cdot week^{-1}$ through a grastric tube (oral gavage) for 4 weeks

[c] mice received 0, 0.5, 1.0 or 5.0 $\mu g \cdot kg^{-1}$ $bw \cdot week^{-1}$ through a grastric tube (oral gavage) for 4 weeks

Table 37. **Immunotoxicity data for orally administered PCDD/Fs in mammals.**

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ $bw \cdot d^{-1}$)	TEQ Dose ($ng \cdot kg^{-1}$ $bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference

[d]dosed on d 14 of gestation

[e]values estimated from a graph

[f]dosed from d 6 to d 14 of gestation.

[g]mice received 0, 1.5, 5, 15, or 50 $\mu g \cdot kg^{-1}$ $bw \cdot week^{-1}$ through oral intubation for 4 weeks

[h]oral gavage

[i]in addition to a standard diet, rats were fed pulverized liver lyophilisate from rabbits fed (via gavage) a single dose a known mixture of PCDDs and PCDFs

[j]based on international TEFs (could not be converted to 1998 WHO values with the information provided); total TEQ includes PCDD/F and coplanar PCB congeners.

Table 38. Carcinogenic toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ $bw \cdot d^{-1}$)	TEQ Dose ($ng \cdot kg^{-1}$ $bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
mice (B6C3F1)		M	2,3,7,8-TCDD	0	0	728	0	vehicle control	US Dept. Health and Human Services 1982
mice (B6C3F1)		M	2,3,7,8-TCDD	0.0014[a]	1.4	728	1.02	dose dependent increase	US Dept. Health and Human Services 1982
mice (B6C3F1)		M	2,3,7,8-TCDD	0.007[a]	7	728	5.10	dose dependent increase	US Dept. Health and Human Services 1982
mice (B6C3F1)		M	2,3,7,8-TCDD	0.071[a]	71	728	51.69	S- incidence of heptocellular carcinomas or adenomas	US Dept. Health and Human Services 1982
mice (B6C3F1)		F	2,3,7,8-TCDD	0	0	728	0	vehicle control	US Dept. Health and Human Services 1982
mice (B6C3F1)		F	2,3,7,8-TCDD	0.006[b]	6	728	4.37	dose dependent increase	US Dept. Health and Human Services 1982
mice (B6C3F1)		F	2,3,7,8-TCDD	0.03[b]	30	728	21.84	dose dependent increase	US Dept. Health and Human Services 1982
mice (B6C3F1)		F	2,3,7,8-TCDD	0.29[b]	290	728	211.12	S- incidence of heptocellular carcinomas or adenomas; S- follicular-cell adenomas	US Dept. Health and Human Services 1982
mice (B6C3F1)		M	1:2 mixture 1,2,3,6,7,8- :1,2,3,7,8,9- HCDD	0	0	728	0	vehicle control	US Dept. Health and Human Services 1980
mice (B6C3F1)		M	1:2 mixture 1,2,3,6,7,8- :1,2,3,7,8,9- HCDD	0.18[c]	18	728	131	dose dependent increase	US Dept. Health and Human Services 1980
mice (B6C3F1)		M	1:2 mixture 1,2,3,6,7,8- :1,2,3,7,8,9- HCDD	0.36[c]	35	728	262	dose dependent increase	US Dept. Health and Human Services 1980
mice (B6C3F1)		M	1:2 mixture 1,2,3,6,7,8- :1,2,3,7,8,9- HCDD	0.71[c]	71	728	517	S- incidence of heptocellular carcinomas or adenomas	US Dept. Health and Human Services 1980

Table 38. Carcinogenic toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ $bw \cdot d^{-1}$)	TEQ Dose ($ng \cdot kg^{-1}$ $bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
mice (B6C3F1)		F	1:2 mixture 1,2,3,6,7,8-:1,2,3,7,8,9-HCDD	0	0	728	0	vehicle control	US Dept. Health and Human Services 1980
mice (B6C3F1)		F	1:2 mixture 1,2,3,6,7,8-:1,2,3,7,8,9-HCDD	0.18[c]	18	728	130	dose dependent increase	US Dept. Health and Human Services 1980
mice (B6C3F1)		F	1:2 mixture 1,2,3,6,7,8-:1,2,3,7,8,9-HCDD	0.36[c]	35	728	260	dose dependent increase	US Dept. Health and Human Services 1980
mice (B6C3F1)		F	1:2 mixture 1,2,3,6,7,8-:1,2,3,7,8,9-HCDD	0.71[c]	71	728	520	S- incidence of heptocellular carcinomas or adenomas	US Dept. Health and Human Services 1980
Charles River CD-1 mice	7-9 weeks	F	DMBA (tumour initiator)	2 μg/ mouse		1		tumor initiating capacity after 32 d (1.8 papillomas/mouse)	DiGiovanni et al. 1977
Charles River CD-1 mice	7-9 weeks	F	2,3,7,8-TCDD	2 μg/ mouse		1		weak tumor initiating capacity after 32 d (0.1papillomas/mouse)	DiGiovanni et al. 1977
Charles River CD-1 mice	7-9 weeks	F	2,3,7,8-TCDD + DMBA	2 μg/ mouse		1		additive tumor initiating capacity after 32 d (2.2 papillomas/mouse)	DiGiovanni et al. 1977
Osborne-Mendel rats		M	2,3,7,8-TCDD	0	0	728	0	vehicle control	US Dept. Health and Human Services 1982
Osborne-Mendel rats		M	2,3,7,8-TCDD	0.0014[a]	1.4	728	1.02	dose dependent increase	US Dept. Health and Human Services 1982
Osborne-Mendel rats		M	2,3,7,8-TCDD	0.007[a]	7	728	5.10	dose dependent increase	US Dept. Health and Human Services 1982
Osborne-Mendel rats		M	2,3,7,8-TCDD	0.071[a]	71	728	51.69	S- follicular-cell adenomas	US Dept. Health and Human Services 1982
Osborne-Mendel rats		F	2,3,7,8-TCDD	0	0	728	0	vehicle control	US Dept. Health and Human Services 1982
Osborne-Mendel rats		F	2,3,7,8-TCDD	0.0014[a]	1.4	728	1.02	dose dependent increase	US Dept. Health and Human Services 1982

Table 38. Carcinogenic toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose (µg·kg^{-1} bw·d^{-1})	TEQ Dose (ng·kg^{-1} bw·d^{-1})	Exposure (days)	Total Dose (µg·kg^{-1} bw)	Endpoint	Reference
Osborne-Mendel rats		F	2,3,7,8-TCDD	0.007[a]	7	728	5.10	dose dependent increase	US Dept. Health and Human Services 1982
Osborne-Mendel rats		F	2,3,7,8-TCDD	0.071[a]	71	728	51.69	S- incidence of neoplastic nodules	US Dept. Health and Human Services 1982
Osborne-Mendel rats		M	1:2 mixture 1,2,3,6,7,8-:1,2,3,7,8,9-HCDD	0	0	728	0	vehicle control	US Dept. Health and Human Services 1980
Osborne-Mendel rats		M	1:2 mixture 1,2,3,6,7,8-:1,2,3,7,8,9-HCDD	0.18[c]	18	728	130	dose dependent increase of incidence of heptocellular carcinomas or neoplastic nodules	US Dept. Health and Human Services 1980
Osborne-Mendel rats		M	1:2 mixture 1,2,3,6,7,8-:1,2,3,7,8,9-HCDD	0.35[c]	35	728	260	dose dependent increase	US Dept. Health and Human Services 1980
Osborne-Mendel rats		M	1:2 mixture 1,2,3,6,7,8-:1,2,3,7,8,9-HCDD	0.71[c]	71	728	520	dose dependent increase	US Dept. Health and Human Services 1980
Osborne-Mendel rats		F	1:2 mixture 1,2,3,6,7,8-:1,2,3,7,8,9-HCDD	0	0	728	0	vehicle control	US Dept. Health and Human Services 1980
Osborne-Mendel rats		F	1:2 mixture 1,2,3,6,7,8-:1,2,3,7,8,9-HCDD	0.18[c]	18	728	130	dose dependent increase	US Dept. Health and Human Services 1980
Osborne-Mendel rats		F	1:2 mixture 1,2,3,6,7,8-:1,2,3,7,8,9-HCDD	0.35[c]	35	728	260	S- incidence of heptocellular carcinomas, adenomas, or neoplastic nodules	US Dept. Health and Human Services 1980
Osborne-Mendel rats		F	1:2 mixture 1,2,3,6,7,8-:1,2,3,7,8,9-HCDD	0.71[c]	71	728	520	S- incidence of heptocellular carcinomas, adenomas, or neoplastic nodules	US Dept. Health and Human Services 1980

Table 38. Carcinogenic toxicity data for orally administered PCDD/Fs in mammals.

Species	Life Stage	Sex	Congener	Dose (µg·kg^{-1} bw·d^{-1})	TEQ Dose (ng·kg^{-1} bw·d^{-1})	Exposure (days)	Total Dose (µg·kg^{-1} bw)	Endpoint	Reference
Sprague-Dawley Rats	6-7 weeks	F	2,3,7,8-TCDD	0	0	728		control	Kociba et al. 1978
Sprague-Dawley Rats	6-7 weeks	F	2,3,7,8-TCDD	0.001	1	728		increase incidence of swollen heptocytes - S	Kociba et al. 1978
Sprague-Dawley Rats	6-7 weeks	F	2,3,7,8-TCDD	0.01	10	728		increased incidence of hepatocellular nodules - S	Kociba et al. 1978
Sprague-Dawley Rats	6-7 weeks	F	2,3,7,8-TCDD	0.1	100	728		increased incidence of heptocellular carcinomas of the liver - S; increased incidence of squamous cell carcinomas - S	Kociba et al. 1978
Sprague-Dawley Rats	6-7 weeks	M	2,3,7,8-TCDD	0	0	728		control	Kociba et al. 1978
Sprague-Dawley Rats	6-7 weeks	M	2,3,7,8-TCDD	0.001	1	728		decrease incidence of swollen heptocytes - S	Kociba et al. 1978
Sprague-Dawley Rats	6-7 weeks	M	2,3,7,8-TCDD	0.01	10	728		increased incidence of hepatocellular nodules - S	Kociba et al. 1978
Sprague-Dawley Rats	6-7 weeks	M	2,3,7,8-TCDD	0.1	100	728		increased incidence of stratified squamous cell carcinomas - S	Kociba et al. 1978

[a]rats and male mice were dosed by oral gavage with 0.005, 0.025, or 0.25 µg·kg^{-1} bw twice a week for 104 weeks

[b]female mice were dosed by oral gavage with 0.02, 0.1, or 0.1 µg·kg^{-1} bw twice a week for 104 weeks

[c]mice were dosed by oral gavage with 0.625 (low dose), 1.25 (mid dose) or 2.5 µg·kg^{-1} bw (high dose) twice a week for 104 weeks and observed for an additional 3-4 weeks

Table 39. Acute toxicity data for orally administered PCDD/Fs in birds.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ bw·d^{-1})	TEQ Dose ($ng \cdot kg^{-1}$ bw·d^{-1})	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
bobwhite quail (*Colinus virginianus*)	7 weeks	M	2,3,7,8-TCDD	15	15 000	1	15	LC50	Hudson et al. 1984
mallard (*Anas platyrhynchos*)	1 week	M/F	2,3,7,8-TCDD	>108	108 000	1	108	LC50	Hudson et al. 1984
pheasants (*Phasianus colchicus*)	40-45 weeks	F	2,3,7,8-TCDD	6.25	6250	1	0	no mortality; NS change in BW	Nosek et al. 1992
pheasants (*Phasianus colchicus*)	40-45 weeks	F	2,3,7,8-TCDD	6.25	6250	1	6.25	no mortality; NS loss in BW (6%)	Nosek et al. 1992
pheasants (*Phasianus colchicus*)	40-45 weeks	F	2,3,7,8-TCDD	25	25000	1	25	~78% mortality after 6 weeks of treatment; S loss in BW (25%)	Nosek et al. 1992
pheasants (*Phasianus colchicus*)	40-45 weeks	F	2,3,7,8-TCDD	100	100000	1	100	100% mortality after 6 weeks of treatment; S loss in BW (38%)	Nosek et al. 1992
ringed turtle-dove (*Streptopelia risoria*)	adult	M	2,3,7,8-TCDD	>810	>810 000	1	810	LC50	Hudson et al. 1984
white leghorn chicken (*Gallus domesticus*)	egg		2,3,7,8-TCDD	0.122	122	1	0.122	LC50 for yolk injected embryos	Henshel et al.1997
white leghorn chicken (*Gallus domesticus*)	egg		2,3,7,8-TCDD	0.297	297	1	0.297	LC50 for air-cell injected embryos	Henshel et al.1997
white leghorn chicken (*Gallus domesticus*)	4-6 weeks		2,3,7,8-TCDD	25-50	25000-50000	1	25-50	death 12-21 days later; weight loss, pericardial edema	Greig et al. 1973

[a] E2, E3, and E4 = embryonic day 2, 3, and 4, respectively

Table 40. Chronic toxicity data for orally administered PCDD/Fs in birds.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1}$ $bw \cdot d^{-1}$)	TEQ Dose (ng·kg-1 $bw \cdot d^{-1}$)	Exposure (days)	Total Dose (µg·kg-1 bw)	Endpoint	Reference
white leg horn chickens	1 day	M	2,3,7,8-TCDF	0	0	21	0	0% mortality; terminal BW = 183.3 g; RLW = 4.16; relative spleen weight = 0.168	McKinney et al. 1976
white leg horn chickens	1 day	M	2,3,7,8-TCDF	1	1000	21	21	16% mortality; NS effect on RLW; reduced food consumption, BW gain and spleen weight; marked thymic involution; depletion of lymphocytes in spleen; marked subcutaneous edema, ascites, hydropericardium.	McKinney et al. 1976
white leg horn chickens	1 day	M	2,3,7,8-TCDF	5	5000	21	105	100% mortality; BW, RLW, or spleen weight not determined; reduced food consumption; marked thymic involution; depletion of lymphocytes in spleen; passive congestion of liver; marked subcutaneous edema, ascites, hydropericardium.	McKinney et al. 1976

Table 41. Reproductive toxicity data for orally administered PCDD/Fs in birds.

Species	Life Stage	Sex	Congener	Dose ($\mu g \cdot kg^{-1} bw \cdot d^{-1}$)	TEQ Dose ($ng \cdot kg^{-1} bw \cdot d^{-1}$)	Exposure (days)	Total Dose ($\mu g \cdot kg^{-1}$ bw)	Endpoint	Reference
pheasants (*Phasianus colchicus*)	40-45 week old	F	2,3,7,8-TCDD	0[a]	0	70	0	no mortality	Nosek et al. 1992
pheasants (*Phasianus colchicus*)	40-45 week old	F	2,3,7,8-TCDD	0.0014	1.4	70	0.1	no mortality; NS effect on fertility, egg production or eggshell thickness index	Nosek et al. 1992
pheasants (*Phasianus colchicus*)	40-45 week old	F	2,3,7,8-TCDD	0.014	14	70	1	no mortality; NS effect on fertility, egg production or eggshell thickness index	Nosek et al. 1992
pheasants (*Phasianus colchicus*)	40-45 week old	F	2,3,7,8-TCDD	0.14	140	70	10	delayed onset of mortality in 57% of birds; S less increase in BW; decline in BW in later stages of egg production; S reduced egg production; NS effect on fertility or eggshell thickness index; S increase in cumulative % mortality of embryos;	Nosek et al. 1992
white leghorn chicken (*Gallus domesticus*)	egg		2,3,7,8-TCDD	0	0	1	0	no abnormalities	Henshel et al. 1993
white leghorn chicken (*Gallus domesticus*)	egg		2,3,7,8-TCDD	0.01	10	1	0.01	[b]E2 - asymmetrical somites and heart abnormalities; overall abnormality rate - 17%	Henshel et al. 1993
white leghorn chicken (*Gallus domesticus*)	egg		2,3,7,8-TCDD	0.1	100	1	0.1	E2 - asymmetrical somites and heart abnormalities; overall abnormality rate - 33%	Henshel et al. 1993
white leghorn chicken (*Gallus domesticus*)	egg		2,3,7,8-TCDD	0.3	300	1	0.3	E2 - asymmetrical somites and heart abnormalities; E4 - abnormal vitelline vasculature; overall abnormality rate - 57%	Henshel et al. 1993
white leghorn chicken (*Gallus domesticus*)	egg		2,3,7,8-TCDD	1	1000	1	1	E2 - asymmetrical somites and heart abnormalities; E3 - discrepancies in developmental indicators; high frequency of abnormal visceral arches; E4 - underdeveloped brain and allantois; missing tailbud; overall abnormality rate - 83%	Henshel et al. 1993
white leghorn chicken (*Gallus domesticus*)	fertile eggs		2,3,7,8-TCDD	0	0	1		% mortality = 21; % cardiovascular malformations (simple/complex) in embryos = 23/6; % subcutaneous edema = 2	Cheung et al. 1981

Table 41. Reproductive toxicity data for orally administered PCDD/Fs in birds.

Species	Life Stage	Sex	Congener	Dose (μg·kg^{-1} bw·d^{-1})	TEQ Dose (ng·kg^{-1} bw·d^{-1})	Exposure (days)	Total Dose (μg·kg^{-1} bw)	Endpoint	Reference
white leghorn chicken (*Gallus domesticus*)	fertile eggs		2,3,7,8-TCDD	0.00003[c]	0.03	1		% mortality = 29; % cardiovascular malformations (simple/complex) in embryos = 29/15; % subcutaneous edema = 3	Cheung et al. 1981
white leghorn chicken (*Gallus domesticus*)	fertile eggs		2,3,7,8-TCDD	0.001	1	1		% mortality = 30; % cardiovascular malformations (simple/complex) in embryos = 38/2; % subcutaneous edema = 2	Cheung et al. 1981
white leghorn chicken (*Gallus domesticus*)	fertile eggs		2,3,7,8-TCDD	0.01	10	1		% mortality = 18; % cardiovascular malformations (simple/complex) in embryos = 32/14; % subcutaneous edema = 4	Cheung et al. 1981
white leghorn chicken (*Gallus domesticus*)	fertile eggs		2,3,7,8-TCDD	0.045	45	1		% mortality = 31; % cardiovascular malformations (simple/complex) in embryos = 25/25; % subcutaneous edema = 11	Cheung et al. 1981
white leghorn chicken (*Gallus domesticus*)	fertile eggs		2,3,7,8-TCDD	0.089	89	1		% mortality = 32; % cardiovascular malformations (simple/complex) in embryos = 48/16; % subcutaneous edema = 7	Cheung et al. 1981
white leghorn chicken (*Gallus domesticus*)	fertile eggs		2,3,7,8-TCDD	0.18	180	1		% mortality = 39; % cardiovascular malformations (simple/complex) in embryos = 30/30; % subcutaneous edema = 20	Cheung et al. 1981
white leghorn chicken (*Gallus domesticus*)	fertile eggs		2,3,7,8-TCDD	0.271	271	1		% mortality = 34; % cardiovascular malformations (simple/complex) in embryos = 46/8; % subcutaneous edema = 13	Cheung et al. 1981
white leghorn chicken (*Gallus domesticus*)	fertile eggs		2,3,7,8-TCDD	0.362	362	1		% mortality = 20; % cardiovascular malformations (simple/complex) in embryos = 30/27; % subcutaneous edema = 7	Cheung et al. 1981
white leghorn chicken (*Gallus domesticus*)	fertile eggs		2,3,7,8-TCDD	0.453	453	1		% mortality = 40; % cardiovascular malformations (simple/complex) in embryos = 40/40; % subcutaneous edema = 30	Cheung et al. 1981
chicken	fertile eggs		2,3,7,8-TCDD	0	0	1	0	dose dependent increase in brain asymmetry (angle and tectal width) on embryo days 9 and 13, and at hatch (d 21)	Henshel et al. 1998
chicken	fertile eggs		2,3,7,8-TCDD	0.01	10	1	0.01		
chicken	fertile eggs		2,3,7,8-TCDD	0.1	100	1	0.1		
chicken	fertile eggs		2,3,7,8-TCDD	0.3	300	1	0.3		
chicken	fertile eggs		2,3,7,8-TCDD	1	1000	1	1		

[a] hens were dosed once/week with vehicle control, 0.01, 0.1, or 1.0 μg·kg^{-1}

[b] E2, E3, and E4 = embryonic day 2, 3, and 4, respectively

[c] eggs injected with 0, 0.009, 0.16, 1.6, 7.8, 15.5, 31.0, 46.5, 62.0, or 77.5 pmol·egg^{-1} where egg weight was 50-60 g

Table 42. Reference concentrations (RCs) for Canadian wildlife species dervived from the lowest mammalian and avian tolerable daily intakes (TDIs).

Species	FI:BW Ratio*	RC
Mammals		
Mustelidae		
Sea otter (*Enhydra lutris*)		
Male	0.18	0.94
Female	0.2	0.85
American mink (Mustela vision)		
Female	**0.24**	**0.71**
River Otter (*Lutra canadensis*)	0.1	1.70
Pinnipedia		
Harbour Seal (*Phoca vitulina*)		
Male	0.16	1.06
Female	0.17	1.00
Northern fur seal (*Callorhinus ursinus*)		
Male	0.13	1.31
Female	0.18	0.94
Northern elephant seal (*Mirounga angustirostris*)		
Male	0.08	2.13
Female	0.1	1.70
Northern seal lion (*Eumetopias jubata*)		
Male	0.1	1.70
Female	0.12	1.42
Walrus (*Odobenus rosmarus*), eastern Arctic race		
Male	0.11	1.55
Female	0.11	1.55
Walrus (*Odobenus rosmarus*), Pacific Ocean race		
Male	0.1	1.70
Female	0.1	1.70
Ursidae		
Polar Bear (*Ursus maritimus*)		
Male	0.12	1.42
Birds		
Anseriformes		
Buffle head (*Bucephala albeola*)		
Male	0.36	12.42
Female	0.42	10.64
Common goldeneye (*Bucephala clangula*)		
Male	0.29	15.41
Female	0.31	14.42
Mallard (*Anas platyrhynchos*)	0.23	19.43
Oldsquaw (*Clangula hyemalis*)		
Male	0.29	15.41
Female	0.31	14.42
Wood duck (*Aix sponsa*)		
Male	0.34	13.15
Female	0.35	12.77
American wigeon (*Anas americana*)		
Male	0.32	13.97
Female	0.32	13.97
Lesser Scaup (*Aythya affinis*)		
Male	0.31	14.42
Female	0.32	13.97
Common merganser (*Mergus merganser*)		
Male	0.24	18.63
Female	0.27	16.56
Red-breasted merganser (*Mergus serrator*)		
Male	0.21	21.29
Falconiformes		
Bald eagle (*Haliaeetus leucocephalus*)	0.11	40.64
Osprey (*Pandion haliaetus*)	0.2	22.35
Coraciiformes		
Belted kingfisher (*Ceryle alcyon*)	0.5	8.94
Gaviiformes		
Common loon (*Gavia immer*)	0.18	24.83
Charadriiformes		
Common tern (*Sterna hirundo*)	0.61	7.33
Herring gull (*Larus argentatus*)		
Male	0.28	15.96
Female	0.29	15.41
Ring-billed gull (*Larus delawarensis*)		
Male	0.17	26.29
Balck-legged kittiwake (*Rissa tridactyla*)		
Male	0.38	11.76
Razorbill (*Alca torda*)	0.32	13.97
Common murre (*Uria aalge*)		
Male	0.39	11.46
Female	0.3	14.90
Thick-billed murre (*Uria lomvia*)	0.3	14.90
Black guillemot (*Cepphus grylle*)	0.4	11.18
Atlantic puffin (*Fratercula arctica*)	0.39	11.46
Tufted puffin (*Fratercula cirrhata*)	0.32	13.97
Ciconiiformes		
Great blue heron (*Ardea herodias*)		
Male	0.21	21.29
Female	0.22	20.32
Green-backed heron (*Butorides striatus*)	0.24	18.63
Procellariiformes		
Wilson's storm-petrel (*Oceanites oceanicus*)	**0.94**	**4.76**
Fork-tailed storm-petrel (*Oceanodroma furcata*)	0.73	6.12
Northern fulmar (*Fulmarus glacialis*)		
Male	0.34	13.15
Female	0.38	11.76

* data from CCME (1998)

Table 43. Basic Freshwater Aquatic Trophic Levels

Trophic Level 1	Primary Producers	Examples
	Phytoplankton	free-floating unicellular algae
	Periphyton	algae attached to substrates (e.g. rocks, mud, surfaces of aquatic macrophytes)
	Emergent macrophytes	marsh plants rooted in the littoral zone with leaves and stems exposed (e.g. cattails and bulrushes)
	Floating aquatic macrophytes	higher plants that are free-floating and not rooted to a substrate (e.g. duckweed, pondweed, water hyacinth)
	Submerged aquatic macrophytes	higher plants rooted to a substrate in the littoral zone that are submerged underwater (e.g. hydrilla)
	Detritus	dead and decaying plant and animal particulate matter. It may float or settle to the bottom.

Table 43. Basic Freshwater Aquatic Trophic Levels

Trophic Level 2	Herbivores and Detritivores	Examples
	Planktivores	generally are zooplankton that filter phytoplankton and floating detritus and bacteria from the water column.
	Order Anostraca	fairy shrimp
	Conchostraca	clam shrimp
	Cladocera	water fleas (e.g. *Daphnia*)
	Copepoda	copepods
	Diptera	aquatic larvae of several species of flies
	Class Bivalvia	mussels and clams
	Periphyton and Macrophyte Consumers	herbivorous invertebrates that feed on the periphyton (and associated detritus) on the surfaces of plants and other aquatic substrates, or that feed on macroalgae and higher plants.
	Order Amphipoda	scuds, side-swimmers, or freshwater shrimp
	Decapoda	crayfish
	Coleoptera	Haliplidae (crawling water beetles)
	Diptera	aquatic larvae of flies and midges
	Lepidoptera	caterpillars of butterflies and moths
	Gastropoda	snails
	Class Amphibia	tadpoles, larval newts
	Bony fishes	several species including lake herring, shad, and carp
	Detritivores	scavenge food from substrates or through filter-feeding.
	Order Copepoda	copepods
	Ostracoda	seed shrimp
	Amphipoda	pontoporeia, scuds, side-swimmeers, or freshwater shrimp
	Diptera	aquatic larvae of midges and several species of flies
	Decapoda	grass shrimp

Table 43. Basic Freshwater Aquatic Trophic Levels

Trophic Level 3	Small Carnivores	Examples
	Invertebrate Carnivores	
	Order Caldocera	*Leptodora* sp., *Polyphemus* sp.
	Mysidae	*Mysis* sp.
	Coleoptera	Dytiscidae (predatory diving beetles)
	Hemiptera	aquatic bugs such as water bugs, water boatmen, and water striders
	Odonata	dragonfly and damselfly nymphs and adults
	Ephemeroptera	nymphs of some mayflies
	Invertebrate Omnivores	many groups of invertebrates include species that feed on both plant and animal matter or that display a wide variety of dietary habits among species. One of the more ubiquitous of these groups are the Trichopterans (or caddis flies). This group includes many omnivorous species, but some species are exclusivley grazers, scrapers, suspension feeders, filter feeders, or carnivores.
	Small Vertebrate Carnivores	species that feed on zooplankton and benthic invertebrates.
	Fish species	forage fish species including shiners (up to 5 to 6 cm), mudminnows, darters, killifish, sticklebacks, longnose dace, mummichog, suckers, alewife, smelt, sculpin, chub, crappie, bullheads, sunfish, white perch, yellow perch (until age 4), carp.

Table 43. Basic Freshwater Aquatic Trophic Levels

Trophic Level 4	Large Carnivores	Examples
	Predacious fish species	the larger carnivores, or predators, can feed on the smaller carnivores, but also tend to feed on the larger herbivorous species. In freshwater aquatic ecosystems, the larger carnivores are exclusively fish.
		examples of key species include trout (particularly greater than 30 cm), salmon, walleye, northern squawfish (> 30 cm), burbot (> 50 cm), redfin and chain pickerel, coho salmon, Arctic char (> 20 cm), channel catfish (> 45 cm), gar, and pike.

Table 44. Basic Marine (Salt Marsh) Aquatic Trophic Levels

Trophic Level 1	Primary Producers	Examples
		the base of salt marsh food webs include the grasses, the algal macrophytes and phytoplankton, and organic detritus predominantly derived from those grasses and algae.
	Emergent grassess	genus *Spartina* (cord grasses) and species of *Juncus* (rushes) and *Salicornia*
	Submerged aquatics	eel grass (*Zostera* sp.)
	Detritus	dead and decaying plant and animal particulate matter. It may float or settle to the bottom.
Trophic Level 2	**Herbivores and Detritivores**	**Examples**
	Herbivores	herbivores that graze directly on the cord grasses, rushes, and eel grass include crabs (e.g. marsh crabs, fiddler crabs), some marsh insects (e.g. grasshoppers), and some waterfowl (e.g. Canada goose, brant goose). The macro-algae is grazed primarily by snails (e.g. periwinkles, marsh snails). The phytoplankton is consumed by zooplankton (e.g. copepods). The marsh insects (including grasshoppers and plant hoppers) which either consume the marsh grass leaves or suck the juices from the plants, serve as prey for spiders, wrens, and sparrows.
	Detritivores	the organic detritus, which provides the bulk of the energy flow in salt marshes, is derived in large part from the bacterial decomposition of the marsh grasses and algae. It is concentrated near the mud surface and provides the food for benthic macroinvertebrates such as crabs (e.g. green crab, blue crab, various shrimp), small crustacea (e.g. isopods, beach fleas, spring-tails amphipods, sand shrimp), filter-feeding bivalves (e.g. ribbed mussel), and marine worms (e.g. *Arenicola*).

Table 44. Basic Marine (Salt Marsh) Aquatic Trophic Levels

Trophic Level 3	Small Carnivores	Examples
	Small vertebrate carnivores	species that feed on zooplankton and benthic invertebrates. Some bottom-feeding fish such as skates, flounders, dabs, and plaice consume the worms and shellfish that feed on the organic detritus. Anchovies and weakfish may consume the various fish species. Weakfish also consume anchovies and crabs. Alewife are anadromous fish found in Atlantic Coast waters and feed almost exclusively on crustacea.
Trophic Level 4	**Large Carnivores**	**Examples**
	Predacious fish species	the larger carnivores, or predators, can feed on the smaller carnivores, but also tend to feed on the larger herbivorous species.
		examples of key species include striped bass.

Table 45. Basic Marine (Open Water) Aquatic Trophic Levels

Trophic Level 1	Primary Producers	Examples
		phytoplankton
Trophic Level 2	**Herbivores**	**Examples**
		zooplankton, krill, copepods, larval lamprey
		mussels and clams are filter feeders on plankton, zooplankton, and detritus.
Trophic Level 3	**Small Carnivores**	**Examples**
	Invertebrates	larval squid, marine crabs, pelagic shrimp
	Bony fish	Atlantic and Pacific herring, walleye pollock, American and Pacific sand lance, shiner perch, juvenile Atlantic mackerel, Pacific sanddab, gulf flounder, sole, American plaice, juvenile salmon, capelin, diamond killifish, menhaden, anchovy
Trophic Level 4	**Large Carnivores**	**Examples**
	Invertebrates	examples of key species include octopus and adult squid.
	Bony fish	examples of key species include Atlantic cod, haddock, pollock, adult Atlantic salmon, chinook salmon, Pacific hake.

Table 46. Feeding Habits and Prey Trophic Levels of Representative Freshwater Amphibian, Reptilian, Avian, and Mammalian Species

Species	Prey Trophic Level	Feeding Habits
Amphibians		
Frogs	2	capture insects that may have an aquatic or terrestrial food chain base.
Salamanders	2	adults and nymphs are carnivorous.
Mudpuppies	2	feed on worms, crayfish, insects, and small fish.
Reptiles		
Water snakes	3	feed primarily on small fish and frogs.
Common snapping turtle	3	feed primarily on aquatic invertebrates, small fish, and amphibians.
Eastern painted turtle	2	feed on insects, snails, and bits of lily pad.

Table 46. Feeding Habits and Prey Trophic Levels of Representative Freshwater Amphibian, Reptilian, Avian, and Mammalian Species

Birds		
Herring gull	4	herring gulls frequent a wide variety of coastal areas including freshwater and marine.They are highly opportunistic feeders and feed on a wide variety of foods depending on availability including fish, squid, crustacea, molluscs, worms, insects, small mammals and birds, duck and gull eggs and chicks, and garbage. Freshwater fish usually considered trophic level 3 (up to 23 cm in length, i.e. small freshwater drum, alewife, smelt) comprise a large proportion of herring gull diets in most populations, although some trophic level 4 fish are also taken. About 75% od their diet is fish.
Bald eagle	4	bald eagles are generally found in coastal areas, lakes, and rivers. They will eat dead or dying fish over most of their range, but also catch live fish swimming near the surface and often eat mammals and birds. In general, bald eagles can be described as opportunistic feeders, eating whatever food source is most plentiful and easy to capture. Bald eagles can capture and carry relatively large prey (i.e. > 60 cm in length) such as chain pickerel, burbot, and lake trout.
Belted kingfisher	3	belted kingfishers are typically found along rivers and streams and along lake and pond edges. They are also common on sea coasts and estuaries. Kingfishers feed predominantly on fish, although they sometimes consume large numbers of crayfish. The largest fish prey taken are generally less than 18 cm, the average length being closer to 5 to 8 cm. Freshwater species known to be captured by kingfishers include brook trout, sculpins, blacknose dace, creek chub, common shiner, darters, brook stickleback, redbelly dace, fathead minnow, and suckers.
Osprey	3	osprey are found near fresh or salt water and are almost completely piscivorous. Although, they have been observed on occasion to take other prey including birds, frogs, and crustacea. Freshwater fish prey include gizzard shad, yellow perch, and salmonids. Most of the fish captured by osprey are between 10 and 35 cm in length.
Ring-billed gull	3	although smaller in body size, ring-billed gulls inhabit areas similar to the herring gull. They are generalized and opportunistic foragers, consuming large quantities of fish as well as significant quantities of terrestrial, aquatic, and areial invertebrates. A study in the Great Lakes found ring-billed gulls to consume mainly smelt, alewives, and sticklebacks. They also consumed earthworms, ephemeroptera (mayflies), homoptera (cicadas), coleoptera (beetles), and diptera (chironomid midges).
Black-crowned night heron	3	black-crowned night herons nest in a wide variety of freshwater, brackish, and saltwater habitats. They are considered opportunistic general predators, feeding primarily on fish, amphibians, and insects (beetles, flies, and dragonfly nymphs) in freshwater habitats, and on molluscs, spiders, small mammals (e.g. voles), and birds and eggs. Fish species up to 17 cm in length have been

Table 46. Feeding Habits and Prey Trophic Levels of Representative Freshwater Amphibian, Reptilian, Avian, and Mammalian Species

		taken and include whiting, herring, carp, pickerel, suckers, hornpouts, black bass, perch, gizzard shad, alewife, and eels.
Common tern	3	common terns usually breed on island or coastal beach habitat. They forage in large flocks over schools of small fish, with fish comprising over 90% of their diet. They feed secondarily on crustaceans and insects. In freshwater, common terns have been found to prey on alewife, smelt, bluntnose minnow, common shiners, emerald shiners, and trout-perch.
Forster's tern	3	Forster's tern breeds in freshwater and saltwater marshes and on marshy borders of ponds and lakes. Little information exists on the feeding preferences of the Forster's tern, but it is known that it feeds on insects as it flies over marshes and also feeds on fish. Chicks are fed minnows almost exclusively. They also eat frogs, scavenge dead fish, and occasionally take the eggs of the Amaerican coot.
Caspian tern	3	caspian terns breed on flat sand or gravel beaches, shell banks, and occasionally marshes in both marine and freshwater. They dive primarily for fish and occasionally take crustaceans. Fish species eaten include alewife, smelt, yellow perch, pumpkinseed, and rock bass. Fish taken are usually 10-12 cm in length.
Black tern	3	black terns breed in shallow freshwater marshes. During the breeding season, they eat mainly insects, including dragonflies, moths, grasshoppers and crickets, beetles, spiders, water scorpions, mayflies, and caddisflies, and smaller amounts of grubs, larvae, small fish, molluscs, and crayfish.
Double-crested cormorant	3	double-crested cormorants frequent coasts, bays, estuaries, marine islands, freshwater lakes and their islands, ponds, rivers, sloughs, and swamps. Their diet consists primarily of schooling fish, but may include some small invertebrates. Double-crested comorants often take small forage fishes such as sticklebacks, sculpins, and burbot, and also take yellow perch, white sucker, and tulibee. Most of the fish taken range from 12-15 cm in length.
Common and American mergansers	3	the American merganser is recognized by some as a subspecies of the common merganser. Common mergansers generally occur in a variety of open freshwater habitats including cold and warm water rivers, ponds, lakes, and inland bays. In riverine habitats, they have been observed to prefer trout and young salmon, and in larger bodies of water will utilize forage fish in large schools. In lakes and rivers, the mergansers were capturing small salmonids and small to medium sculpins (3 to 12 cm in length).
Red-breasted merganser	3	the habit of the red-brested merganser is much more marine than that of the common merganser. In the breeding season, it inhabits inland waters as well as coasts and marine islands. In other seasons it inhabits tidewater and inshore marine areas. In freshwater areas, red-brested mergansers ate salmon eggs, salmonids, sticklebacks, sculpins, schizopods (crusatcean), and caddis larvae.

Table 46. Feeding Habits and Prey Trophic Levels of Representative Freshwater Amphibian, Reptilian, Avian, and Mammalian Species

Great blue heron	3	great blue herons are found in a variety of freshwater and marine habitats, including freshwater lakes and rivers, brackish marshes, lagoons, mangroves, and coastal wetlands. They are often seen on tidal flats and sandbars, and occasionally forage in wet meadows, pastures, and other terrestrial habitats. Fish are the preferred prey, but they also eat amphibians, reptiles, crustacea, insects, birds, and mammals. Most of the fish captured represent trophic level 3 (including horn-pouts, chiners, perch, suckers, black bass, herrings, small pickerel) and are less than 25 cm in length.
Loons	3	loons feed primarily on small fish at trophic level 3.
Western grebe	3	the western grebe diet includes trophic level 2 and 3 aquatic invertebrates and small fish between 3 and 20 cm in length.
Lesser scaup	2	lesser scaup are found on large lakes and bays during the fall and winter, and are common on smaller bodies of water during the spring. Most populations consume primarily aquatic invertebrates year round. Common prey include snails, clams, amphipods, midges, chironomids, and leeches. In spring and summer, egg-laying females and ducklings feed at about trophic level 2.
Common goldeneye	2	during the summer on inland lakes, common goldeneyes tend to consume aquatic invertebrates (75%) and plant material (25%).
Mallard duck	2	mallards prefer natural bottomland wetlands and rivers to reservoirs and farm ponds. They feed primarily on seeds of aquatic plants and cultivated grains, although they also consume aquatic invertebrates, particularly during the breeding season. During the summer, 80-90% of their diet is made up of aquatic invertebrates.
Snow goose	1	snow geese are almost entirely herbivorous year-round.
Canada goose	1	Canada geese are almost exclusivly vegetarian year-round. They graze on terrestrial and wetland plants.
American black duck	1	the spring and summer diet in freshwater habitat is 80% aquatic plants.

Table 46. Feeding Habits and Prey Trophic Levels of Representative Freshwater Amphibian, Reptilian, Avian, and Mammalian Species

Mammals		
River otter	4	river otters are almost exclusively aquatic and are found in food rich coastal areas, the lower portions of streams and rivers, estuaries, nonpolluted waterways, the lakes and tributaries that feed rivers, and areas showing little human impact. They primarily consume fish, but may also consume crustaceans, aquatic insects (e.g. stonefly nymphs, aquaitc beetles), amphibians, insects, birds (e.g. ducks), mammals, and turtles. Otters feed primarily on trophic level 3 fish, including suckers, mudminnows, shiners, darters, and carp. They also capture some perch and level 4 walleye, but very few trout and burbot. The average length of fish captured is about 13 cm.
Harbour seal	4	Some freshwater harbour seals are found in Canada. They were found to be depleting older lake trout populations in Quebec, although all of the fish were less than 55 cm in length.
Mink	3	mink are found associated with aquatic habitats of all kinds, including water ways suchas rivers, streams, lakes, and ditches, as well as swamps, marshes, and backwater areas. Mink are generalist and opportunistic feeders, taking whatever prey is locally abundant. The diet of mink consists primarily of prey linked to aquatic ecosystems, including crayfish, frogs, fish, muskrat, and waterfowl. Terrestrial prey include shrews, mice, and voles. Fish species taken include trout, sculpins, blacknose dace, creek chub, suckers, darters, and redbelly dace measuring less than 18 cm in length.
Raccoon	2	raccoons are found near virtually every aquatic habitat, particulary in hardwood swamps, mangroves, floodplain forests, and fresh and salt water marshes. Raccoons consume less fish then do river otters or mink. They consume a high amount of fruit and nuts., as well as aquatic invertebrates. Their diet rarely contains trophic level 3 fish.

Table 47. Feeding Habits and Prey Trophic Levels of Representative Marine Avian and Mammalian Species

Species	Prey Trophic Level	Feeding Habits
Birds		
Northern fulmar	4	the Northern fulmar feeds on fish, small squid, and crustacea at the surface of the ocean.
Bald eagle	4	bald eagles are generally found in coastal areas, lakes, and rivers. They will eat dead or dying fish over most of their range, but also catch live fish swimming near the surface and often eat mammals and birds. In general, bald eagles can be described as opportunistic feeders, eating whatever food source is most plentiful and easy to capture. When foraging in coastal areas, they tend to include in their diets a high proportion of seabirds (e.g. cormorants, gulls, shearwaters, auklets, petrels) which can raise their effective trophic level. Bald eagles can also capture and carry relatively large fish prey (i.e. > 60 cm in length).
Herring gull	4	herring gulls frequent a wide variety of coastal areas including freshwater and marine.They are highly opportunistic feeders and feed on a wide variety of foods depending on availability including fish, squid, crustacea, molluscs, worms, insects, small mammals and birds, duck and gull eggs and chicks, and garbage. Fish usually considered trophic level 3 (up to 23 cm in length,) comprise a large proportion of herring gull diets in most populations, although some trophic level 4 fish are also taken. In coastal areas, chicks of other seabirds (e.g. Leach's storm petrel, puffins, other gulls) may also be taken.
Black-crowned night heron	3	black-crowned night herons nest in a wide variety of freshwater, brackish, and saltwater habitats. They are considered opportunistic general predators, feeding primarily on fish, and secondarily on crustaceans (shrimo, sandhoppers, crabs, prawns, and crayfish) in saltwater habitats. Fish species up to 17 cm in length have been taken.
Black-legged kittiwake	3	the black-legged kittiwake feeds primarily on small fish and some crustacea.
Caspian tern	3	caspian terns breed on flat sand or gravel beaches, shell banks, and occasionally marshes in both marine and freshwater. They dive primarily for fish and occasionally take crustaceans. In marine areas, caspian terns ate primarily adult shiner perch and less commonly adult northern anchovy.
Common tern	3	common terns usually breed on island or coastal beach habitat. They forage in large flocks over schools of small fish, with fish comprising over 90% of their diet. They feed secondarily on crustaceans and insects. In saltwater, common terns have been found to prey on sandeels, bay anchovies, sandlance, baby

Table 47. Feeding Habits and Prey Trophic Levels of Representative Marine Avian and Mammalian Species

		bluefish, silversides, killifish, butterfish, and a variety of herring.
Common and American mergansers	3	the American merganser is recognized by some as a subspecies of the common merganser. Common mergansers generally occur in a variety of open freshwater habitats including cold and warm water rivers, ponds, lakes, and inland bays. They sometimes are found in saltwater habitats, generally in sheltered estuaries or backwaters. In saltwater and estuaries in winter and spring, the mergansers captured salmonids (2.5 to 6 cm), herring, sticklebacks, sculpins, blennies, rockfish, and other small fish.
Double-crested cormorant	3	double-crested cormorants frequent coasts, bays, estuaries, marine islands, freshwater lakes and their islands, ponds, rivers, sloughs, and swamps. Their diet consists primarily of schooling fish, but may include some small invertebrates. In marine areas, double-crested comorants have taken Atlantic herring, cunners, pinfish, sculpin, and gunnels. Most of the fish taken range from 12-15 cm in length.
Forster's tern	3	Forster's tern breeds in freshwater and saltwater marshes and on marshy borders of ponds and lakes. Little information exists on the feeding preferences of the Forster's tern, but in marine waters it has taken juvenile northern anchovy, juvenile shiner perch, and arrow gobies. Prey is generally less than 10 cm in length.
Great blue heron	3	great blue herons are found in a variety of freshwater and marine habitats, including freshwater lakes and rivers, brackish marshes, lagoons, mangroves, and coastal wetlands. They are often seen on tidal flats and sandbars, and occasionally forage in wet meadows, pastures, and other terrestrial habitats. Fish are the preferred prey, and they have taken staghorn sculpins, threespine sticklebacks, bay pipefish, shiner perch, tube-snout, starry flounders, shiners, sea perch, and saddleback, crescent, and penpoint gunnels. Most of the fish captured represent trophic level 3 and are less than 25 cm in length.
Belted kingfisher	3	belted kingfishers are typically found along rivers and streams and along lake and pond edges. They are also common on sea coasts and estuaries. Kingfishers feed predominantly on fish, although they sometimes consume large numbers of crayfish. The largest fish prey taken are generally less than 18 cm, the average length being closer to 5 to 8 cm.
Leach's storm petrel	3	the Leach's storm petrel feeds on small (trophic level 3) fish in coastal areas and open ocean.
Atlantic puffin	3	the Atlantic puffin feeds on small (probably trophic level 3) fish in coastal waters and open ocean.
Ring-billed gull	3	although smaller in body size, ring-billed gulls inhabit areas similar to the herring gull. They are generalized and opportunistic foragers, consuming large quantities of fish as well as significant

Table 47. Feeding Habits and Prey Trophic Levels of Representative Marine Avian and Mammalian Species

		quantities of terrestrial, aquatic, and areial invertebrates.
Red-breasted merganser	3	the habit of the red-brested merganser is much more marine than that of the common merganser. In the breeding season, it inhabits inland waters as well as coasts and marine islands. In other seasons it inhabits tidewater and inshore marine areas. In saltwater and estuaries, mergansers ate salmonids, herring, eulachon, sticklebacks, smooth sculpin, sculpins, blennies, rock fish, and shrimps.
Osprey	3	osprey are found near fresh or salt water and are almost completely piscivorous. Although, they have been observed on occasion to take other prey including birds, frogs, and crustacea. Most of the fish captured by osprey are between 10 and 35 cm in length.
Least auklet	2	the least auklet feeds primarily on herbivorous zooplankton.
Murres	2	murres feed on fish fry and various planktonic crustacea.

Table 47. Feeding Habits and Prey Trophic Levels of Representative Marine Avian and Mammalian Species

Mammals		
River otter	4	river otters are almost exclusively aquatic and are found in food rich coastal areas, the lower portions of streams and rivers, estuaries, nonpolluted waterways, the lakes and tributaries that feed rivers, and areas showing little human impact. In marine habitats, they primarily consume fish, but may also consume crustaceans (e.g. blue crabs, crayfish), molluscs, shrimp, mammals, and birds. Otters feed primarily on trophic level 3 fish, marine species including sheepshead minnow, diamond killifish, gulf killifish, top minnow, flounder, mullet, and sailfin molly. The average length of fish captured is about 13 cm.
Harbour seal	4	harbour seals are found on both the Atlantic and Pacific coasts. The harbour seal's diet varies seasonally and includes bottom-dwelling fishes (e.g. flounder, sole, eelpout), invertebrates (e.g. octopus and squid), crabs and shrimp, and species that can be caught in periodic spawning aggregations (e.g. herring, lance, and squid). They have also taken haddock, offshore hake, herring, smelt, mackerel, sandlance, capelin, cod, shiner perch, sculpins, pollock, and red hake among other species. The fish taken are estimated to be less than 30 cm in length.
Raccoon	2	raccoons are found near virtually every aquatic habitat, particulary in hardwood swamps, mangroves, floodplain forests, and fresh and salt water marshes. Raccoons consume less fish then do river otters or mink. They consume a high amount of fruit and nuts., as well as aquatic invertebrates. In tidewater mudflats, raccoons took mussels, oysters, shrimp, crabs, gobies, and marine worms. Their diet rarely contains trophic level 3 fish.

Table 48. Aquatic Food Chain Multiplying Factors[a]

Log K_{ow}	Trophic Level 2	Trophic Level 3	Trophic Level 4
2	1	1.005	1
2.5	1	1.01	1.002
3	1	1.028	1.007
3.1	1	1.034	1.007
3.2	1	1.042	1.009
3.3	1	1.053	1.012
3.4	1	1.067	1.014
3.5	1	1.083	1.019
3.6	1	1.103	1.023
3.7	1	1.128	1.033
3.8	1	1.161	1.042
3.9	1	1.202	1.054
4	1	1.253	1.072
4.1	1	1.315	1.096
4.2	1	1.38	1.13
4.3	1	1.491	1.178
4.4	1	1.614	1.242
4.5	1	1.766	1.334
4.6	1	1.95	1.459
4.7	1	2.175	1.633
4.8	1	2.452	1.871
4.9	1	2.78	2.193
5	1	3.181	2.612
5.1	1	3.643	3.162
5.2	1	4.188	3.873
5.3	1	4.803	4.742
5.4	1	5.502	5.821
5.5	1	6.266	7.079
5.6	1	7.096	8.551
5.7	1	7.962	10.209
5.8	1	8.841	12.05

Table 48. Aquatic Food Chain Multiplying Factors[a]

Log K_{ow}	Trophic Level 2	Trophic Level 3	Trophic Level 4
5.9	1	9.716	13.964
6	1	10.556	15.996
6.1	1	11.337	17.783
6.2	1	12.064	19.907
6.3	1	12.691	21.677
6.4	1	13.228	23.281
6.5	1	13.662	24.604
6.6	1	13.98	25.645
6.7	1	14.223	26.363
6.8	1	14.355	26.669
6.9	1	14.388	26.669
7	1	14.305	26.242
7.1	1	14.142	25.468
7.2	1	13.852	24.322
7.3	1	13.474	22.856
7.4	1	12.987	21.038
7.5	1	21.517	19.967
7.6	1	11.708	16.749
7.7	1	10.914	14.388
7.8	1	10.069	12.05
7.9	1	9.162	9.84
8	1	8.222	7.798
8.1	1	7.278	6.012
8.2	1	6.361	4.519
8.3	1	5.489	3.311
8.4	1	4.683	2.371
8.5	1	3.949	1.663
8.6	1	3.296	1.146
8.7	1	2.732	0.778
8.8	1	2.246	0.521
8.9	1	1.837	0.345
9	1	1.493	0.226

[a] From Sample *et al.* 1996.
[b] Trophic level: 2 = zooplankton; 3 = small fish; 4 = piscivorous fish, including top predators.