Superfund Records Center
SITE: Centredale
BREAK: 3.4
OTHER: 206668

APPENDIX G

APPENDIX G

BIOTA TISSUE RESIDUE EFFECTS

SDMS DocID 000206668

TABLE G-1
SUMMARY OF TISSUE RESIDUE EFFECTS DATA

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

				Fish[a]								Invertebrate[a]							
				All Effects		Mortality		Growth		Reproduction		All Effects		Mortality		Growth		Reproduction	
Parameter	Screening Value[b]	Surrogate Value[c]	Basis	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
1,1'-Biphenyl	na																		
Anthracene	3.4			3.4	6.3							3.4	6.3	3.4	6.3				
Pyrene	1.1			1.1	10							1.1	10	1.1	10		465		
Benzo(g,h,i)perylene	0.022	0.022	a																
Indeno(1,2,3-cd)pyrene	0.022	0.022	a																
Benzo(b)fluoranthene	0.022	0.022	a																
Fluoranthene	0.022			24	0.22							24	0.22	24	25				0.22
Benzo(k)fluoranthene	0.022	0.022	a																
Acenaphthylene	0.022	0.022	a																
Chrysene	2.6			2.6								2.6		2.6					
Benzo(a)pyrene	0.03			1.9	2.1	24			12.3	1.93	2.1	40	0.3	40					0.3
Dibenzo(a,h)anthracene	0.022	0.022	a																
Benzo(a)anthracene	17.5			18		17.5						0.6		0.6					
Acenaphthene	3.5			3.5		3.5						3.5							
Phenanthrene	0.078			88	0.78	88						0.78	0.78	0.78	71		0.78		0.78
Fluorene	189			189								189		189					
Naphthalene	1.7				17		17						17						
Dibenzofuran	na																		
2-Methylnaphthalene	1.8			1.8	15.96	1.79	15.96					1.8	16						
Total PAH	0.022	0.022	a																
delta-BHC	0.0028	0.0028	b																
4,4'-DDT	0.13			0.26	0.464	0.26	0.464	5	7.6	2.9	3.8	0.13	0.15	0.13	0.15		0.82		
Methoxychlor	0.01			2.5	0.1	6.07		2.5				0.1	0.1		0.1				
4,4'-DDD	0.008			0.008	0.6	0.008	0.9	5			0.6	0.008	0.6						
4,4'-DDE	0.042			0.042	0.29	0.042	0.29	5			19.6	0.042	0.29						
Heptachlor epoxide	0.001			0.016	0.02	0.016	0.02					0.01	0.01	0.054	0.18	0.01	0.01		
Endosulfan sulfate	0.001	0.001	d																
alpha-Chlordane	0.001	0.001	e																
gamma-Chlordane	0.001	0.001	e																
Technical Chlordane	0.001			0.01	0.01	0.01	0.01			1.38	3.18	0.71	0.02	0.71	1.7		0.02		
Dieldrin	0.01			1.0	1.21	1	1.21	2.13	10.7			0.01	0.08	0.01	0.08	13.9			
Heptachlor	0.01			0.01	0.022	0.01	0.022					0.01	0.021	0.01	0.033	0.016	0.021		26
Aroclor-1254	1.4			0.98	1.53	0.98	1.53	54	71	11.6	13.7	10	8.1	10	16		8.1		
Aroclor-1268	0.045				0.45		0.45						0.45						
Total Aroclors	0.036	0.036	g																
2,2'-Dichlorobiphenyl (4)	0.20			0.20		0.197						0.20							
2,3-Dichlorobiphenyl (5)	0.16			0.16		0.164						0.16							
2,4',5-Trichlorobiphenyl (31)	0.096			0.096		0.096						0.096							
Decachlorobiphenyl (209)	na	na	k																
2-Monochlorobiphenyl (1)	na	na	k																

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Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

				Fish[a]								Invertebrate[a]							
				All Effects		Mortality		Growth		Reproduction		All Effects		Mortality		Growth		Reproduction	
Parameter	Screening Value[b]	Surrogate Value[c]	Basis	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
4-Chlorobiphenyl (3)	na	na	k																
2,3'-Dichlorobiphenyl (6)	na	na	k																
3,4-Dichlorobiphenyl (12)	na	na	k																
2,3',4,4',5-Pentachlorobiphenyl (118)	0.00013			0.0001								0.0001		0.0001		0.0001		0.0001	
2,3',4,4'-Tetrachlorobiphenyl (66)	0.092			0.092		0.092						0.092							
3,3',4,4'-Tetrachlorobiphenyl (77)	0.000065			2	0.0006	2						7E-05	0.0006	83.7		7E-05	0.0006	11	
2,3,3',4,4'-Pentachlorobiphenyl (105)	na	na	j																
3,3',4,4',5,5'-Hexachlorobiphenyl (169)	3.7			3.7								3.7		3.7					
2,3,4,4'-Tetrachlorobiphenyl (60)	na	na	k																
2,2',3,3',4,4',6,6'-Octachlorobiphenyl (197)	100			100	144	100	144					100	144						
2,6-Dichlorobiphenyl (10)	na	na	k																
2,4-Dichlorobiphenyl (7)	na	na	k																
2,3,4,5-Tetrachlorobiphenyl (61)	0.91			0.91		0.91						0.91							
2,5-Dichlorobiphenyl (9)	0.051			0.051		0.051						0.051							
2,4'-Dichlorobiphenyl (8)	na	na	k																
2,2',4,4',5,5'-Hexachlorobiphenyl (153)	2.65			2.7	3.6	2.65	3.6	18				14	3.6	14		14		14	
2,2',3,4,4',5,5'-Heptachlorobiphenyl (180)	na	na	j																
2,2',3,3',4,4',5-Heptachlorobiphenyl (170)	na	na	j																
2,2',3,4,4',5-Hexachlorobiphenyl (137)	na	na	k																
2,2',3,3',4,4',5,5'-Octachlorobiphenyl (194)	0.065			0.065		0.065						0.065							
2,2',3,4'-Tetrachlorobiphenyl (42)	0.091			0.091		0.091						0.091							
2,2',5-Trichlorobiphenyl (18)	0.083			0.083		0.083						0.083							
2,2',4-Trichlorobiphenyl (17)	na	na	k																
2,2',3,5',6-Pentachlorobiphenyl (95)	na	na	k																
2,3,3',4',6-Pentachlorobiphenyl (110)	na	na	k																
2,2',3,3',4,6'-Hexachlorobiphenyl (132)	na	na	k																
2,2',3,3',4,4'-Hexachlorobiphenyl (128)	0.086			0.086		0.086						0.086							
2,3,3',4,4',5-Hexachlorobiphenyl (156)	0.079			0.079	0.082	0.079						0.079	0.082						
2,2',3,3',6,6'-Hexachlorobiphenyl (136)	na	na	k																
2,2',3,3',4,5,6'-Heptachlorobiphenyl (174)	na	na	k																
2,2',6-Trichlorobiphenyl (19)	na	na	k																
2,4',6-Trichlorobiphenyl (32)	na	na	k																
2,2',3'-Trichlorobiphenyl (16)	na	na	k																
2,3',5-Trichlorobiphenyl (26)	na	na	k																
2,3,3'-Trichlorobiphenyl (20)	na	na	k																
2,3,4'-Trichlorobiphenyl (22)	na	na	k																
2,2',3,3'-Tetrachlorobiphenyl (40)	0.089			0.089		0.089						0.089							
2,3,3',4,4',5,5'-Heptachlorobiphenyl (189)	na	na	j																
2,2',3,3',4,5',6-Heptachlorobiphenyl (175)	na	na	k																
2,2',3,3',4,5',6,6'-Octachlorobiphenyl (201)	na	na	k																

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				Fish[a]								Invertebrate[a]							
				All Effects		Mortality		Growth		Reproduction		All Effects		Mortality		Growth		Reproduction	
Parameter	Screening Value[b]	Surrogate Value[c]	Basis	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (206)	0.036			**0.036**		0.036						**0.036**							
2,3,3',4,4',5,6-Heptachlorobiphenyl (190)	na	na	k																
2,2',3,5'-Tetrachlorobiphenyl (44)	na	na	k																
2,2',4,5'-Tetrachlorobiphenyl (49)	na	na	k																
2,3,3',4'-Tetrachlorobiphenyl (56)	na	na	k																
2,2',3,6'-Tetrachlorobiphenyl (46)	na	na	k																
2,2',3,3',4,4',5,6'-Octachlorobiphenyl (196)	na	na	k																
2,2',3,4',5,5'-Hexachlorobiphenyl (146)	na	na	k																
2,3,4',6-Tetrachlorobiphenyl (64)	na	na	k																
2,2',3,3',6-Pentachlorobiphenyl (84)	na	na	k																
2,2',3,5,5'-Pentachlorobiphenyl (92)	na	na	k																
2,2',3,3',4-Pentachlorobiphenyl (82)	na	na	k																
2,2',3,3',4,6,6'-Heptachlorobiphenyl (176)	na	na	k																
2,2',3,3',4,5'-Hexachlorobiphenyl (130)	na	na	k																
2,2',3,3',5,5',6-Heptachlorobiphenyl (178)	na	na	k																
2,2',3,4',5,5',6-Heptachlorobiphenyl (187)	na	na	k																
2,2',3,4,4',5',6-Heptachlorobiphenyl (183)	na	na	k																
2,2',3,3',4,5',6'-Heptachlorobiphenyl (177)	na	na	k																
2,2',3,3',4,4',6-Heptachlorobiphenyl (171)	na	na	k																
2,3',4,4',5,5'-Hexachlorobiphenyl (167)	na	na	j																
2,2',3,3',4,5,6,6'-Octachlorobiphenyl (200)	na	na	k																
2,2',3,3',4,5,5'-Heptachlorobiphenyl (172)	na	na	k																
2,2',3,4,4',5,5',6-Octachlorobiphenyl (203)	na	na	k																
2,2',3,3',4,4',5,6-Octachlorobiphenyl (195)	na	na	k																
2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (207)	na	na	k																
2,2',3,3',5,6-Hexachlorobiphenyl (134)	na	na	k																
2,2',3,4,5,5'-Hexachlorobiphenyl (141)	0.07			**0.07**		0.07						**0.07**							
2,2',3,4,5,5',6-Heptachlorobiphenyl (185)	na	na	k																
2,2',3,3',5,6'-Hexachlorobiphenyl (135)	na	na	k																
2,2',3,4,6-Pentachlorobiphenyl (88)	na	na	k																
2,2',3,3',4,5-Hexachlorobiphenyl (129)	na	na	k																
2,2',3,4,5-Pentachlorobiphenyl (86)	na	na	k																
2,3,6-Trichlorobiphenyl (24)	na	na	k																
2,3',4-Trichlorobiphenyl (25)	na	na	k																
3,3',4,4',5-Pentachlorobiphenyl (126)	0.00004			**2**	**0.0004**	2						**3.3**	**0.0004**	3.3					
2,2',3,3',5-Pentachlorobiphenyl (83)	na	na	k																
2,2',3,4,4',5,6'-Heptachlorobiphenyl (182)	na	na	k																
2,2',3,3',4,6-Hexachlorobiphenyl (131)	na	na	k																
2,2',4,6-Tetrachlorobiphenyl (50)	0.37				**3.7**		3.7						**3.7**						
2,2',3,4,4'-Pentachlorobiphenyl (85)	na	na	k																

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				Fish[a]								Invertebrate[a]							
				All Effects		Mortality		Growth		Reproduction		All Effects		Mortality		Growth		Reproduction	
Parameter	Screening Value[b]	Surrogate Value[c]	Basis	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
2,2',3,4',5-Pentachlorobiphenyl (90)	na	na	k																
2,2',3,4',5,6-Hexachlorobiphenyl (147)	na	na	k																
2,2',3,4,5',6-Hexachlorobiphenyl (144)	na	na	k																
2,2',3,3',4,5,5',6-Octachlorobiphenyl (198)	na	na	k																
2,3,3',4',5'-Pentachlorobiphenyl (108)	na	na	k																
2,2',3,6-Tetrachlorobiphenyl (45)	na	na	k																
2,2',3,5-Tetrachlorobiphenyl (43)	na	na	k																
2,2',4,5-Tetrachlorobiphenyl (48)	na	na	k																
3,4,4',5-Tetrachlorobiphenyl (81)	na	na	k																
2,3,3',4,5-Pentachlorobiphenyl (106)	na	na	k																
2,2',3,5,6-Pentachlorobiphenyl (93)	na	na	k																
2,2',3,4,6'-Pentachlorobiphenyl (89)	na	na	k																
2,3,3',6-Tetrachlorobiphenyl (59)	na	na	k																
2,3,4',5-Tetrachlorobiphenyl (63)	na	na	k																
2,3,4,4',5-Pentachlorobiphenyl (114)	na	na	j																
2,3,3',4,4',6-Hexachlorobiphenyl (158)	na	na	k																
2,2',3,4,4',6,6'-Heptachlorobiphenyl (184)	na	na	k																
2,3,3',4,4',5',6-Heptachlorobiphenyl (191)	na	na	k																
2,3,3',4,4',5,5',6-Octachlorobiphenyl (205)	na	na	k																
2,3,7,8-TCDD	0.00015			0.0002	0.0002	0.0002	0.0002	0.0003	0.0007	0.0006	0.0012	0.0003	0.003	0.0003	0.003	0.47		0.0083	
1,2,3,7,8,9-HxCDD	na	na	i																
Total PeCDF	na																		
OCDD	na	na	i																
Total HxCDD	na	na	i																
1,2,3,4,6,7,8-HpCDD	na	na	i																
Total PeCDD	na	na	i																
Total HpCDD	na	na	i																
1,2,4,5,7,8-hexachloro(9H)xanthene	na	na	i																
OCDF	na	na	i																
1,2,3,4,7,8-HxCDD	na	na	i																
1,2,3,7,8-PeCDD	na	na	i																
Total TCDD	na	na	i																
2,3,7,8-TCDF	0.0025	na	i	0.0025		0.0076		0.0025				0.0025							
1,2,3,4,7,8,9-HpCDF	na	na	i																
Total HxCDF	na	na	i																
Total TCDF	na	na	i																
2,3,4,7,8-PeCDF	na	na	i																
1,2,3,7,8-PeCDF	na	na	i																
1,2,3,6,7,8-HxCDF	na	na	i																
1,2,3,6,7,8-HxCDD	na	na	i																

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				Fish[a]								Invertebrate[a]							
				All Effects		Mortality		Growth		Reproduction		All Effects		Mortality		Growth		Reproduction	
Parameter	Screening Value[b]	Surrogate Value[c]	Basis	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
2,3,4,6,7,8-HxCDF	na	na	i																
1,2,3,4,6,7,8-HpCDF	na	na	i																
1,2,3,4,7,8-HxCDF	na	na	i																
1,2,3,7,8,9-HxCDF	na	na	i																
Mercury (methyl)	0.0043			1.9	2	1.9	2	2.3	2.4	3.4	9.4	0.045	0.043	7.57	12		0.043	0.045	0.79
Aluminum	1			1	8	1	8	12.5				1	8						
Iron	na																		
Lead	2.6			2.6	4.0			2.6	4.0			2.3	5.8	4	5.8	2.3		2.6	1880
Manganese	18			18		18						18							
Mercury	0.004			0.8	0.04		0.04	0.8	1.31			1.5	1.64	7.57	18	6	8	1.5	1.6
Molybdenum	na																		
Nickel	0.059			0.59	0.59	0.59	0.59	575				0.59	0.59						
Silver	5.4			5.4	1650							5.4	1650	1650	2510	800	1650	5.4	
Thallium	2.7			2.7		2.7						2.7							
Antimony	5.0			5.0	9.0	5.0	9.0					5	9						
Arsenic	0.53			0.53	0.62	2	2.24	0.9	0.62	0.53	1.72	1.0	4.2	4	4.2	1.03			87
Barium	0.041				0.41								0.41				0.41		
Beryllium	5.1			5.1		5.1						5.1							
Cadmium	0.08			0.06	0.12	0.11	0.14	0.06	0.12	1.2	2	1.1	0.0934		0.0934	1.1	1.3	4.5	6
Chromium	3.2	3.2	h																
Cobalt	na																		
Copper	0.16			12	1.6		1.6		18	12	24.1	3.4	4.4		5		13	3.4	4.4
Vanadium	0.02			0.02	0.41	2.4	3.12	0.02	0.41	5.74		0.8	0.41	0.8					
Zinc	3.9			3.9	4.5	3.9	4.5	37	40	58		13	20	13	20	22	24		1340
Selenium	0.14			0.14	0.18	0.8	0.92	0.14	0.18	4.54		2.9	0.2		0.22		0.2	2.9	6.3
Total Aroclors	0.036	0.036	g																
Total Dioxin Equivalent birds (Dioxins/furans) (½	na	na	i																
Total Dioxin Equivalent mammals (Dioxins/Fura	na	na	i																
Total Dioxin Equivalent mammals (PCBs) (½)	na	na	i																
Total Dioxin Equivalent birds (PCBs) (½)	na	na	i																
Total Dioxin Equivalent fish (Dioxins/Furans) (½	na	na	i	0.0002	0.0002	0.0002	0.0002	0.0003	0.0007	0.0006	0.0012								
Total Dioxin Equivalent fish (PCBs) (½)	na	na	i	0.0002	0.0002	0.0002	0.0002	0.0003	0.0007	0.0006	0.0012								

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				Fish[a]								Invertebrate[a]							
				All Effects		Mortality		Growth		Reproduction		All Effects		Mortality		Growth		Reproduction	
Parameter	Screening Value[b]	Surrogate Value[c]	Basis	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL

Notes:
Concentration units in ug/g wet weight tissue unless otherwise specified.
a. No Observed Adverse Effect Levels (NOAELs) and Lowest Observed Adverse Effect Levels (LOAELs) selected from information compiled in Tables G-2 through G-12.
Information compiled from the following sources:
1. ACOE, 2002. Tissue Effects Database; Army Corps of Engineers, U.S. Waterways Experiment Station, Vicksburg, MS.
2. Jarvinen and Ankley, 1999.
3. USEPA, 2000. Bioaccumulation Summary; United States Environmental Protection Agency; EPA-823-R-00-002.
b. Screening values were estimated as the lowest NOAEL value or one tenth of the lowest LOAEL value for all receptor categories combined.
These values were added to the COPC selection tables but were not used to retain or eliminate analytes.
c. The following surrogate values were used to develop screening values for analytes lacking specific effects data:
a. Fluoranthene (lowest effect concentration for PAHs)
b. BHC
c. 4,4'-DDT
d. Endosulfan
e. Technical chlordane
f. Endrin
g. Aroclor 1260 (lowest effect concentration for Aroclors)
h. Chromium VI
i. TCDD
j. PCB 126 (lowest effect concentration for coplanar PCBs)
k. PCB 206 (lowest effect concentration for non coplanar PCBs)

Prepared by: SGD
Checked by: NAR

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	Wildlife[a]								Bird Egg[a]							
	All Effects		Mortality		Growth		Reproduction		All Effects		Mortality		Growth		Reproduction	
Parameter	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
1,1'-Biphenyl																
Anthracene	3.4	6.3														
Pyrene	1.1	10														
Benzo(g,h,i)perylene																
Indeno(1,2,3-cd)pyrene																
Benzo(b)fluoranthene																
Fluoranthene	24	0.22														
Benzo(k)fluoranthene																
Acenaphthylene																
Chrysene	2.6															
Benzo(a)pyrene	40	0.3														
Dibenzo(a,h)anthracene																
Benzo(a)anthracene	18															
Acenaphthene	3.5															
Phenanthrene	0.78	0.78														
Fluorene	189															
Naphthalene		17														
Dibenzofuran																
2-Methylnaphthalene	1.8	16														
Total PAH																
delta-BHC																
4,4'-DDT	0.13	0.15														
Methoxychlor	0.1	0.1														
4,4'-DDD	0.008	0.6								0.009						0.009
4,4'-DDE	0.042	0.29								0.1						0.1
Heptachlor epoxide	0.01	0.01														
Endosulfan sulfate																
alpha-Chlordane																
gamma-Chlordane																
Technical Chlordane	0.01	0.01														
Dieldrin	0.01	0.08								0.059						0.059
Heptachlor	0.01	0.021														
Aroclor-1254	1.4	1.53														
Aroclor-1268		0.45														
Total Aroclors																
2,2'-Dichlorobiphenyl (4)	0.20															
2,3-Dichlorobiphenyl (5)	0.16															
2,4',5-Trichlorobiphenyl (31)	0.096															
Decachlorobiphenyl (209)																
2-Monochlorobiphenyl (1)																

TABLE G-1
SUMMARY OF TISSUE RESIDUE EFFECTS DATA

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

	Wildlife[a]								Bird Egg[a]							
	All Effects		Mortality		Growth		Reproduction		All Effects		Mortality		Growth		Reproduction	
Parameter	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
4-Chlorobiphenyl (3)																
2,3'-Dichlorobiphenyl (6)																
3,4-Dichlorobiphenyl (12)																
2,3',4,4',5-Pentachlorobiphenyl (118)	0.0001									0.45						0.45
2,3',4,4'-Tetrachlorobiphenyl (66)	0.092															
3,3',4,4'-Tetrachlorobiphenyl (77)	7E-05	0.0006								0.0015						0.0015
2,3,3',4,4'-Pentachlorobiphenyl (105)										0.072						0.072
3,3',4,4',5,5'-Hexachlorobiphenyl (169)	3.7															
2,3,4,4'-Tetrachlorobiphenyl (60)																
2,2',3,3',4,4',6,6'-Octachlorobiphenyl (197)	100	144														
2,6-Dichlorobiphenyl (10)																
2,4-Dichlorobiphenyl (7)																
2,3,4,5-Tetrachlorobiphenyl (61)	0.91															
2,5-Dichlorobiphenyl (9)	0.051															
2,4'-Dichlorobiphenyl (8)																
2,2',4,4',5,5'-Hexachlorobiphenyl (153)	2.7	3.6														
2,2',3,4,4',5,5'-Heptachlorobiphenyl (180)																
2,2',3,3',4,4',5-Heptachlorobiphenyl (170)																
2,2',3,4,4',5-Hexachlorobiphenyl (137)																
2,2',3,3',4,4',5,5'-Octachlorobiphenyl (194)	0.065															
2,2',3,4'-Tetrachlorobiphenyl (42)	0.091															
2,2',5-Trichlorobiphenyl (18)	0.083															
2,2',4-Trichlorobiphenyl (17)																
2,2',3,5',6-Pentachlorobiphenyl (95)																
2,3,3',4',6-Pentachlorobiphenyl (110)																
2,2',3,3',4,6'-Hexachlorobiphenyl (132)																
2,2',3,3',4,4'-Hexachlorobiphenyl (128)	0.086															
2,3,3',4,4',5-Hexachlorobiphenyl (156)	0.079	0.082						0.082		0.082						0.082
2,2',3,3',6,6'-Hexachlorobiphenyl (136)																
2,2',3,3',4,5,6'-Heptachlorobiphenyl (174)																
2,2',6-Trichlorobiphenyl (19)																
2,4',6-Trichlorobiphenyl (32)																
2,2',3'-Trichlorobiphenyl (16)																
2,3',5-Trichlorobiphenyl (26)																
2,3,3'-Trichlorobiphenyl (20)																
2,3,4'-Trichlorobiphenyl (22)																
2,2',3,3'-Tetrachlorobiphenyl (40)	0.089															
2,3,3',4,4',5,5'-Heptachlorobiphenyl (189)																
2,2',3,3',4,5',6-Heptachlorobiphenyl (175)																
2,2',3,3',4,5',6,6'-Octachlorobiphenyl (201)																

TABLE G-1
SUMMARY OF TISSUE RESIDUE EFFECTS DATA

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

	Wildlife[a]								Bird Egg[a]							
	All Effects		Mortality		Growth		Reproduction		All Effects		Mortality		Growth		Reproduction	
Parameter	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (206)	0.036															
2,3,3',4,4',5,6-Heptachlorobiphenyl (190)																
2,2',3,5'-Tetrachlorobiphenyl (44)																
2,2',4,5'-Tetrachlorobiphenyl (49)																
2,3,3',4'-Tetrachlorobiphenyl (56)																
2,2',3,6'-Tetrachlorobiphenyl (46)																
2,2',3,3',4,4',5,6'-Octachlorobiphenyl (196)																
2,2',3,4',5,5'-Hexachlorobiphenyl (146)																
2,3,4',6-Tetrachlorobiphenyl (64)																
2,2',3,3',6-Pentachlorobiphenyl (84)																
2,2',3,5,5'-Pentachlorobiphenyl (92)																
2,2',3,3',4-Pentachlorobiphenyl (82)																
2,2',3,3',4,6,6'-Heptachlorobiphenyl (176)																
2,2',3,3',4,5'-Hexachlorobiphenyl (130)																
2,2',3,3',5,5',6-Heptachlorobiphenyl (178)																
2,2',3,4',5,5',6-Heptachlorobiphenyl (187)																
2,2',3,4,4',5',6-Heptachlorobiphenyl (183)																
2,2',3,3',4,5',6'-Heptachlorobiphenyl (177)																
2,2',3,3',4,4',6-Heptachlorobiphenyl (171)																
2,3',4,4',5,5'-Hexachlorobiphenyl (167)																
2,2',3,3',4,5,6,6'-Octachlorobiphenyl (200)																
2,2',3,3',4,5,5'-Heptachlorobiphenyl (172)																
2,2',3,4,4',5,5',6-Octachlorobiphenyl (203)																
2,2',3,3',4,4',5,6-Octachlorobiphenyl (195)																
2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (207)																
2,2',3,3',5,6-Hexachlorobiphenyl (134)																
2,2',3,4,5,5'-Hexachlorobiphenyl (141)	0.07															
2,2',3,4,5,5',6-Heptachlorobiphenyl (185)																
2,2',3,3',5,6'-Hexachlorobiphenyl (135)																
2,2',3,4,6-Pentachlorobiphenyl (88)																
2,2',3,3',4,5-Hexachlorobiphenyl (129)																
2,2',3,4,5-Pentachlorobiphenyl (86)																
2,3,6-Trichlorobiphenyl (24)																
2,3',4-Trichlorobiphenyl (25)																
3,3',4,4',5-Pentachlorobiphenyl (126)	1.0	0.0004					0.0004									
2,2',3,3',5-Pentachlorobiphenyl (83)																
2,2',3,4,4',5,6'-Heptachlorobiphenyl (182)																
2,2',3,3',4,6-Hexachlorobiphenyl (131)																
2,2',4,6-Tetrachlorobiphenyl (50)		3.7														
2,2',3,4,4'-Pentachlorobiphenyl (85)																

TABLE G-1
SUMMARY OF TISSUE RESIDUE EFFECTS DATA

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

	Wildlife[a]															
	All Effects		Mortality		Growth		Reproduction		Bird Egg[a] All Effects		Mortality		Growth		Reproduction	
Parameter	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
2,2',3,4',5-Pentachlorobiphenyl (90)																
2,2',3,4',5,6-Hexachlorobiphenyl (147)																
2,2',3,4,5',6-Hexachlorobiphenyl (144)																
2,2',3,3',4,5,5',6-Octachlorobiphenyl (198)																
2,3,3',4',5'-Pentachlorobiphenyl (108)																
2,2',3,6-Tetrachlorobiphenyl (45)																
2,2',3,5-Tetrachlorobiphenyl (43)																
2,2',4,5-Tetrachlorobiphenyl (48)																
3,4,4',5-Tetrachlorobiphenyl (81)										**0.0014**						0.0014
2,3,3',4,5-Pentachlorobiphenyl (106)																
2,2',3,5,6-Pentachlorobiphenyl (93)																
2,2',3,4,6'-Pentachlorobiphenyl (89)																
2,3,3',6-Tetrachlorobiphenyl (59)																
2,3,4',5-Tetrachlorobiphenyl (63)																
2,3,4,4',5-Pentachlorobiphenyl (114)																
2,3,3',4,4',6-Hexachlorobiphenyl (158)																
2,2',3,4,4',5,6'-Heptachlorobiphenyl (184)																
2,3,3',4,4',5',6-Heptachlorobiphenyl (191)																
2,3,3',4,4',5,5',6-Octachlorobiphenyl (205)																
2,3,7,8-TCDD	**0.0002**	**0.0002**							**1E-08**	**4E-06**			8E-06	1E-05	1E-08	4E-06
1,2,3,7,8,9-HxCDD																
Total PeCDF																
OCDD																
Total HxCDD																
1,2,3,4,6,7,8-HpCDD																
Total PeCDD																
Total HpCDD																
1,2,4,5,7,8-hexachloro(9H)xanthene																
OCDF																
1,2,3,4,7,8-HxCDD																
1,2,3,7,8-PeCDD																
Total TCDD																
2,3,7,8-TCDF	**0.0025**								**3E-07**	**5E-06**			1E-06	8E-06	3E-07	5E-06
1,2,3,4,7,8,9-HpCDF																
Total HxCDF																
Total TCDF																
2,3,4,7,8-PeCDF									**2E-06**	**3E-05**			2E-06	3E-05		0.004
1,2,3,7,8-PeCDF									**6E-06**	**6E-05**			6E-06	6E-05		0.011
1,2,3,6,7,8-HxCDF									**1E-05**	**9E-05**			1E-05	9E-05		0.0072
1,2,3,6,7,8-HxCDD																

TABLE G-1
SUMMARY OF TISSUE RESIDUE EFFECTS DATA

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

	Wildlife[a]								Bird Egg[a]							
	All Effects		Mortality		Growth		Reproduction		All Effects		Mortality		Growth		Reproduction	
Parameter	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
2,3,4,6,7,8-HxCDF																
1,2,3,4,6,7,8-HpCDF										0.0007						0.0007
1,2,3,4,7,8-HxCDF										0.0032						0.0032
1,2,3,7,8,9-HxCDF																
Mercury (methyl)	0.045	0.043														
Aluminum	1	8														
Iron																
Lead	2.8	4.02														
Manganese	18															
Mercury	0.8	0.04														
Molybdenum																
Nickel	0.59	0.59														
Silver	5.4	1650														
Thallium	2.7															
Antimony	5	9														
Arsenic	0.53	0.62														
Barium		0.41														
Beryllium	5.1															
Cadmium	0.08	0.0934														
Chromium																
Cobalt																
Copper	3.4	1.6														
Vanadium	0.02	0.41														
Zinc	3.9	4.5														
Selenium	0.14	0.18														
Total Arcolors																
Total Dioxin Equivalent birds (Dioxins/furans) (½									1E-08	4E-06			8E-06	1E-05	1E-08	4E-06
Total Dioxin Equivalent mammals (Dioxins/Fura	0.0002	0.0002														
Total Dioxin Equivalent mammals (PCBs) (½)	0.0002	0.0002														
Total Dioxin Equivalent birds (PCBs) (½)									1E-08	4E-06			8E-06	1E-05	1E-08	4E-06
Total Dioxin Equivalent fish (Dioxins/Furans) (½																
Total Dioxin Equivalent fish (PCBs) (½)																

TABLE G-1
SUMMARY OF TISSUE RESIDUE EFFECTS DATA

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

	Wildlife[a]								Bird Egg[a]							
	All Effects		Mortality		Growth		Reproduction		All Effects		Mortality		Growth		Reproduction	
Parameter	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL

TABLE G-1
SUMMARY OF TISSUE RESIDUE EFFECTS DATA

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

	Fish Egg[a]							
	All Effects		Mortality		Growth		Reproduction	
Parameter	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
1,1'-Biphenyl								
Anthracene								
Pyrene								
Benzo(g,h,i)perylene								
Indeno(1,2,3-cd)pyrene								
Benzo(b)fluoranthene								
Fluoranthene								
Benzo(k)fluoranthene								
Acenaphthylene								
Chrysene								
Benzo(a)pyrene								
Dibenzo(a,h)anthracene								
Benzo(a)anthracene								
Acenaphthene								
Phenanthrene								
Fluorene								
Naphthalene								
Dibenzofuran								
2-Methylnaphthalene								
Total PAH								
delta-BHC								
4,4'-DDT								
Methoxychlor								
4,4'-DDD								
4,4'-DDE								
Heptachlor epoxide								
Endosulfan sulfate								
alpha-Chlordane								
gamma-Chlordane								
Technical Chlordane								
Dieldrin								
Heptachlor		**0.0279**		0.0279				
Aroclor-1254	**0.5**	**0.0071**	0.5	77.9		0.0071		
Aroclor-1268								
Total Aroclors								
2,2'-Dichlorobiphenyl (4)								
2,3-Dichlorobiphenyl (5)								
2,4',5-Trichlorobiphenyl (31)								
Decachlorobiphenyl (209)								
2-Monochlorobiphenyl (1)								

TABLE G-1
SUMMARY OF TISSUE RESIDUE EFFECTS DATA

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

	Fish Egg[a]							
	All Effects		Mortality		Growth		Reproduction	
Parameter	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
4-Chlorobiphenyl (3)								
2,3'-Dichlorobiphenyl (6)								
3,4-Dichlorobiphenyl (12)								
2,3',4,4',5-Pentachlorobiphenyl (118)								
2,3',4,4'-Tetrachlorobiphenyl (66)								
3,3',4,4'-Tetrachlorobiphenyl (77)								
2,3,3',4,4'-Pentachlorobiphenyl (105)								
3,3',4,4',5,5'-Hexachlorobiphenyl (169)								
2,3,4,4'-Tetrachlorobiphenyl (60)								
2,2',3,3',4,4',6,6'-Octachlorobiphenyl (197)								
2,6-Dichlorobiphenyl (10)								
2,4-Dichlorobiphenyl (7)								
2,3,4,5-Tetrachlorobiphenyl (61)								
2,5-Dichlorobiphenyl (9)								
2,4'-Dichlorobiphenyl (8)								
2,2',4,4',5,5'-Hexachlorobiphenyl (153)								
2,2',3,4,4',5,5'-Heptachlorobiphenyl (180)								
2,2',3,3',4,4',5-Heptachlorobiphenyl (170)								
2,2',3,4,4',5-Hexachlorobiphenyl (137)								
2,2',3,3',4,4',5,5'-Octachlorobiphenyl (194)								
2,2',3,4'-Tetrachlorobiphenyl (42)								
2,2',5-Trichlorobiphenyl (18)								
2,2',4-Trichlorobiphenyl (17)								
2,2',3,5',6-Pentachlorobiphenyl (95)								
2,3,3',4',6-Pentachlorobiphenyl (110)								
2,2',3,3',4,6'-Hexachlorobiphenyl (132)								
2,2',3,3',4,4'-Hexachlorobiphenyl (128)								
2,3,3',4,4',5-Hexachlorobiphenyl (156)		**0.082**						0.082
2,2',3,3',6,6'-Hexachlorobiphenyl (136)								
2,2',3,3',4,5,6'-Heptachlorobiphenyl (174)								
2,2',6-Trichlorobiphenyl (19)								
2,4',6-Trichlorobiphenyl (32)								
2,2',3'-Trichlorobiphenyl (16)								
2,3',5-Trichlorobiphenyl (26)								
2,3,3'-Trichlorobiphenyl (20)								
2,3,4'-Trichlorobiphenyl (22)								
2,2',3,3'-Tetrachlorobiphenyl (40)								
2,3,3',4,4',5,5'-Heptachlorobiphenyl (189)								
2,2',3,3',4,5',6-Heptachlorobiphenyl (175)								
2,2',3,3',4,5',6,6'-Octachlorobiphenyl (201)								

TABLE G-1
SUMMARY OF TISSUE RESIDUE EFFECTS DATA

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

	Fish Egg[a]							
	All Effects		Mortality		Growth		Reproduction	
Parameter	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (206)								
2,3,3',4,4',5,6-Heptachlorobiphenyl (190)								
2,2',3,5'-Tetrachlorobiphenyl (44)								
2,2',4,5'-Tetrachlorobiphenyl (49)								
2,3,3',4'-Tetrachlorobiphenyl (56)								
2,2',3,6'-Tetrachlorobiphenyl (46)								
2,2',3,3',4,4',5,6'-Octachlorobiphenyl (196)								
2,2',3,4',5,5'-Hexachlorobiphenyl (146)								
2,3,4',6-Tetrachlorobiphenyl (64)								
2,2',3,3',6-Pentachlorobiphenyl (84)								
2,2',3,5,5'-Pentachlorobiphenyl (92)								
2,2',3,3',4-Pentachlorobiphenyl (82)								
2,2',3,3',4,6,6'-Heptachlorobiphenyl (176)								
2,2',3,3',4,5'-Hexachlorobiphenyl (130)								
2,2',3,3',5,5',6-Heptachlorobiphenyl (178)								
2,2',3,4',5,5',6-Heptachlorobiphenyl (187)								
2,2',3,4,4',5',6-Heptachlorobiphenyl (183)								
2,2',3,3',4,5',6'-Heptachlorobiphenyl (177)								
2,2',3,3',4,4',6-Heptachlorobiphenyl (171)								
2,3',4,4',5,5'-Hexachlorobiphenyl (167)								
2,2',3,3',4,5,6,6'-Octachlorobiphenyl (200)								
2,2',3,3',4,5,5'-Heptachlorobiphenyl (172)								
2,2',3,4,4',5,5',6-Octachlorobiphenyl (203)								
2,2',3,3',4,4',5,6-Octachlorobiphenyl (195)								
2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl (207)								
2,2',3,3',5,6-Hexachlorobiphenyl (134)								
2,2',3,4,5,5'-Hexachlorobiphenyl (141)								
2,2',3,4,5,5',6-Heptachlorobiphenyl (185)								
2,2',3,3',5,6'-Hexachlorobiphenyl (135)								
2,2',3,4,6-Pentachlorobiphenyl (88)								
2,2',3,3',4,5-Hexachlorobiphenyl (129)								
2,2',3,4,5-Pentachlorobiphenyl (86)								
2,3,6-Trichlorobiphenyl (24)								
2,3',4-Trichlorobiphenyl (25)								
3,3',4,4',5-Pentachlorobiphenyl (126)	0.0132	0.0272	0.0132	0.0272				
2,2',3,3',5-Pentachlorobiphenyl (83)								
2,2',3,4,4',5,6'-Heptachlorobiphenyl (182)								
2,2',3,3',4,6-Hexachlorobiphenyl (131)								
2,2',4,6-Tetrachlorobiphenyl (50)								
2,2',3,4,4'-Pentachlorobiphenyl (85)								

TABLE G-1
SUMMARY OF TISSUE RESIDUE EFFECTS DATA

Baseline Ecological Risk Assessment - Interim Final
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	Fish Egg[a]							
	All Effects		Mortality		Growth		Reproduction	
Parameter	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
2,2',3,4',5-Pentachlorobiphenyl (90)								
2,2',3,4',5,6-Hexachlorobiphenyl (147)								
2,2',3,4,5',6-Hexachlorobiphenyl (144)								
2,2',3,3',4,5,5',6-Octachlorobiphenyl (198)								
2,3,3',4',5'-Pentachlorobiphenyl (108)								
2,2',3,6-Tetrachlorobiphenyl (45)								
2,2',3,5-Tetrachlorobiphenyl (43)								
2,2',4,5-Tetrachlorobiphenyl (48)								
3,4,4',5-Tetrachlorobiphenyl (81)								
2,3,3',4,5-Pentachlorobiphenyl (106)								
2,2',3,5,6-Pentachlorobiphenyl (93)								
2,2',3,4,6'-Pentachlorobiphenyl (89)								
2,3,3',6-Tetrachlorobiphenyl (59)								
2,3,4',5-Tetrachlorobiphenyl (63)								
2,3,4,4',5-Pentachlorobiphenyl (114)								
2,3,3',4,4',6-Hexachlorobiphenyl (158)								
2,2',3,4,4',6,6'-Heptachlorobiphenyl (184)								
2,3,3',4,4',5',6-Heptachlorobiphenyl (191)								
2,3,3',4,4',5,5',6-Octachlorobiphenyl (205)								
2,3,7,8-TCDD	3E-05	4E-05	4E-05	4E-05	3E-05	6E-05		0.0002
1,2,3,7,8,9-HxCDD								
Total PeCDF								
OCDD								
Total HxCDD								
1,2,3,4,6,7,8-HpCDD								
Total PeCDD								
Total HpCDD								
1,2,4,5,7,8-hexachloro(9H)xanthene								
OCDF								
1,2,3,4,7,8-HxCDD								
1,2,3,7,8-PeCDD								
Total TCDD								
2,3,7,8-TCDF								
1,2,3,4,7,8,9-HpCDF								
Total HxCDF								
Total TCDF								
2,3,4,7,8-PeCDF								
1,2,3,7,8-PeCDF								
1,2,3,6,7,8-HxCDF								
1,2,3,6,7,8-HxCDD								

TABLE G-1
SUMMARY OF TISSUE RESIDUE EFFECTS DATA

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

	Fish Egg[a]							
	All Effects		Mortality		Growth		Reproduction	
Parameter	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
2,3,4,6,7,8-HxCDF								
1,2,3,4,6,7,8-HpCDF								
1,2,3,4,7,8-HxCDF								
1,2,3,7,8,9-HxCDF								
Mercury (methyl)								
Aluminum								
Iron								
Lead								
Manganese								
Mercury								
Molybdenum								
Nickel								
Silver								
Thallium								
Antimony								
Arsenic								
Barium								
Beryllium								
Cadmium								
Chromium								
Cobalt								
Copper								
Vanadium								
Zinc								
Selenium								
Total Aroclors								
Total Dioxin Equivalent birds (Dioxins/furans) (½								
Total Dioxin Equivalent mammals (Dioxins/Fura								
Total Dioxin Equivalent mammals (PCBs) (½)								
Total Dioxin Equivalent birds (PCBs) (½)								
Total Dioxin Equivalent fish (Dioxins/Furans) (½	3E-05	4E-05	4E-05	4E-05	3E-05	6E-05	0.0002	
Total Dioxin Equivalent fish (PCBs) (½)	3E-05	4E-05	4E-05	4E-05	3E-05	6E-05	0.0002	

TABLE G-1
SUMMARY OF TISSUE RESIDUE EFFECTS DATA

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

	Fish Egg[a]							
	All Effects		Mortality		Growth		Reproduction	
Parameter	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL

TABLE G-2
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PAHs

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Acenaphthene								
Lepomis macrochirus	Bluegill	Fresh	invertivore	3.5	F	Mortality	NOED	No Effect On Mortality
Anthracene								
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	3.4	I	Mortality	NOEL	Survival - No effect. 76.2 mW/cm2 UV-A
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	6.3		Mortality	NOEL	Survival - No effect. 33.6 mW/cm2 UV-A
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	14		Mortality	NOEL	Survival - No effect. 16.4 mW/cm2 UV-A
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	52		Mortality	NOEL	Survival - No effect. No UV-A(dark)
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	6.3	I	Mortality	LOEL	Survival - Reduced. 76.2 mW/cm2 UV-A; median time to death, 96 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	14		Mortality	LOEL	Survival - Reduced. 76.2 mW/cm2 UV-A; median time to death, 40 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	14		Mortality	LOEL	Survival - Reduced. 33.6 mW/cm2 UV-A; median time to death, 96 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	27		Mortality	LOEL	Survival - Reduced. 76.2 mW/cm2 UV-A; median time to death, 15 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	27		Mortality	LOEL	Survival - Reduced. 33.6 mW/cm2 UV-A; median time to death, 80 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	27		Mortality	LOEL	Survival - Reduced. 16.4 mW/cm2 UV-A; median time to death, 96 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	52		Mortality	LOEL	Survival - Reduced. 76.2 mW/cm2 UV-A; median time to death, 10 - 15 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	52		Mortality	LOEL	Survival - Reduced. 33.6 mW/cm2 UV-A; median time to death, 15 - 30 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	52		Mortality	LOEL	Survival - Reduced. 16.4 mW/cm2 UV-A; median time to death, 75 h
Benz[a]anthracene								
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	0.6	I	Mortality	NOED	4th of 4 statistically significant compounds taken up
Leuciscus idus	Golden ide	Fresh	bottom feeder	18	F	Mortality	NOED	No effect on survivorship in 3 days.
Benzo[a]pyrene								
Mercenaria mercenaria	Clam - Quahog	Salt	filter feeder	0.0022		Mortality	NOED	No Effect On Mortality, Exp_conc = <0.001
Sphaerium corneum	Clam - Fingernail	Fresh	filter feeder	1.3		Mortality	NOED	No effect on survivorship in 120 hours.
Chironomus riparius	Midge	Fresh	detritivore	1.9		Mortality	NOED	No effect on survivorship in 120 hours.
Asterias rubens	Sea star	Salt	predator	10		Mortality	NOED	No Effect On Mortality

TABLE G-2
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PAHs

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	10		Mortality	NOEL	Survival - No effect. Radiotracer study; *BaP+metabolites, since BaP is volatile residues may include metabolites
Leucisus idus	Golden ide	Fresh	bottom feeder	24	F	Mortality	NOED	No effect on survivorship in 3 days.
Asterias rubens	Sea star	Salt	predator	40	I	Mortality	NOED	No Effect On Mortality
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	12	F	Growth	LOEL	Growth - Reduced. Radiotracer study; *BaP+metabolites, since BaP is volatile residues may include metabolites
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	1.9	F	Reproduction	NA	Hatchability Not Significantly Reduced
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	7.2		Reproduction	NA	Hatchability Not Significantly Reduced
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	10		Reproduction	NA	Hatchability Not Significantly Reduced
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	12		Reproduction	NA	Hatchability Not Significantly Reduced
Mytilus edulis	Mussel - Blue	Salt	filter feeder	0.3	I	Reproduction	LOED	Abnormal Gametogenesis
Psettichthys melanostictus	Sand Sole	Salt	bottom feeder	2.1	F	Reproduction	ED50	Reduced Hatching Success
Chrysene								
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	0.93		Mortality	NOED	
Diporeia spp.	Amphipod	Fresh	detritivore	2.6	I	Mortality	NOED	No increase in mortality in 96 hours.
Fluoranthene								
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	1.3		Mortality	NOED	Rep count not in paper EPA method cited has standards
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	13		Mortality	NOED	No increase in mortality when exposed to UV light. Exposure to fluoranthene in dark for 4 days followed by exposure to 75.2 uW/cm2 UV light for 4 days.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	13		Mortality	NOEL	Survival - No effect. UV-A exposure 75.2 µW/cm2
Leptocheirus plumosus	Amphipod	Estuarine	detritivore	16		Mortality	NOED	Exposure to water containing 77nmol/L, tissue residue converted from 78 nmol/g.
Hyalella azteca	Amphipod	Fresh	detritivore	24	I	Mortality	NOED	Exposure to sediments containing 158 nmol/g for 30 days, tissue residue converted from 120 nmol/g..
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	25		Mortality	NOED	No increase in mortality when exposed to UV light. Exposure to fluoranthene in dark for 4 days followed by exposure to 33.5 uW/cm2 UV light for 4 days.

TABLE G-2
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PAHs

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	25	Mortality	NOEL	Survival - No effect. UV-A exposure 33.5 µW/cm2
Leptocheirus plumosus	Amphipod	Estuarine	detritivore	46	Mortality	NOED	Exposure to water containing 143 nmol/L, tissue residue converted from 226 nmol/g.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	84	Mortality	NOED	No increase in mortality when exposed to UV light. Exposure to fluoranthene in dark for 4 days followed by exposure to 16.6 uW/cm2 UV light for 4 days.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	84	Mortality	NOEL	Survival - No effect. UV-A exposure 16.6 µW/cm2
Hyalella azteca	Amphipod	Fresh	detritivore	142	Mortality	NOED	Exposure to sediments containing 634 nmol/g for 10 days, tissue residue converted from 700 nmol/g.
Hyalella azteca	Amphipod	Fresh	detritivore	142	Mortality	NOED	Exposure to sediments containing 1,267 nmol/g for 10 days, tissue residue converted from 700 nmol/g.
Diporeia spp.	Amphipod	Fresh	detritivore	223	Mortality	NOED	
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	250	Mortality	NOED	No increase in mortality. Animals exposed in the dark for 4 days.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	250	Mortality	NOEL	Survival - No effect. No UV-A exposure
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	25	Mortality	LD98	98% Mortality when exposed to UV light. Exposure to fluoranthene in dark for 4 days followed by exposure to 75.2 uW/cm2 UV light for 4 days.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	25	Mortality	LOEL	Survival - Reduced 98%. UV-A exposure 75.2 µW/cm2
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	41	Mortality	LD32	32% Mortality when exposed to UV light. Exposure to fluoranthene in dark for 4 days followed by exposure to 33.5 uW/cm2 UV light for 4 days.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	41	Mortality	LOEL	Survival - Reduced 32%. UV-A exposure 33.5 µW/cm2
Leptocheirus plumosus	Amphipod	Estuarine	detritivore	75	Mortality	LD7	Exposure to water containing 285 nmol/L; tissue residue converted from 369 nmol/g.

TABLE G-2
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PAHs

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	84	Mortality	LD100	100% Mortality when exposed to UV light. Exposure to fluoranthene in dark for 4 days followed by exposure to 33.5 uW/cm2 UV light for 4 days.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	84	Mortality	LOEL	Survival - Reduced 100%. UV-A exposure 33.5 µW/cm2
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	131	Mortality	LD52	52% Mortality when exposed to UV light. Exposure to fluoranthene in dark for 4 days followed by exposure to 16.6 uW/cm2 UV light for 4 days.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	131	Mortality	LOEL	Survival - Reduced 52%. UV-A exposure 16.6 µW/cm2
Leptocheirus plumosus	Amphipod	Estuarine	detritivore	138	Mortality	LD50	Exposure to water containing 38 ug/L, tissue residue converted from 0.68 umol/g.
Hyalella azteca	Amphipod	Fresh	detritivore	142	Mortality	LD40	Exposure to sediments containing 634 nmol/g for 17 days, tissue residue converted from 700 nmol/g.
Leptocheirus plumosus	Amphipod	Estuarine	detritivore	146	Mortality	LD54	Tissue residue converted from 721 nmol/g.
Hyalella azteca	Amphipod	Fresh	detritivore	162	Mortality	LD35	Exposure to sediments containing 1,267 nmol/g for 17 days, tissue residue converted from 800 nmol/g.
Hyalella azteca	Amphipod	Fresh	detritivore	222	Mortality	LD65	Exposure to sediments containing 1,267 nmol/g for 30 days, tissue residue converted from 1100 nmol/g.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	250	Mortality	LD100	100% Mortality when exposed to UV light. Exposure to fluoranthene in dark for 4 days followed by exposure to 16.6 uW/cm2 UV light for 4 days.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	250	Mortality	LOEL	Survival - Reduced 100%. UV-A exposure 16.6 µW/cm2
Hyalella azteca	Amphipod	Fresh	detritivore	1190	Mortality	LD50	good paper but use of micromoles/g concentrations is non-standard
Mytilus edulis	Mussel - Blue	Salt	filter feeder	0.22	Reproduction	LOED	Abnormal Gametogenesis
Mytilus edulis	Mussel - Blue	Salt	filter feeder	1.5	Reproduction	LOED	Reduced gametogenesis, reproductive success rate.

TABLE G-2
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PAHs

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Fluorene								
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	189	I	Mortality	NOEL	Survival - No effect. UV-A exposure 76.2 µW/cm2
Naphthalene								
Fundulus heteroclitus	Mummichog	Estuarine	omnivore	17	F	Mortality	LOED	Increase in mortality at 23 and 33 ppt salinity.
1-methylnaphthalene								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2920	F	Mortality	LD50	Median Lethal Dose
Phenanthrene								
Nereis arenaceodentata	Polychaete	Estuarine	detritivore	0.78	F	Mortality	NOED	No increase in mortality.
Leucisus idus	Golden ide	Fresh	bottom feeder	88	I	Mortality	NOED	No effect on survivorship in 3 days.
Diporeia spp.	Amphipod	Fresh	detritivore	71	I	Mortality	LOED	12% Mortality. Residue at 17 days exposure.
Diporeia spp.	Amphipod	Fresh	detritivore	214		Mortality	LOED	12% Mortality. Residue at 17 days exposure.
Nereis arenaceodentata	Polychaete	Estuarine	detritivore	0.78	I	Growth	LOED	35% Decrease in weight.
Nereis arenaceodentata	Polychaete	Estuarine	detritivore	0.78	I	Reproduction	LOED	35% Decrease in fecundity. Increased in time to pairing and reproduction. Two fold increase in egg lipids.
Pyrene								
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	0.0008		Mortality	NOED	No increase in mortality.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	0.0008		Mortality	NOEL	Survival - No effect. Radiotracer study
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	1.1	I	Mortality	NOED	Reps in EPA method. This is an individual PAH component (we need a Total PAH" category as it is frequently used)"
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	10		Mortality	NOEL	Survival - No effect. 16.4 mW/cm2 UV-A
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	96		Mortality	NOEL	Survival - No effect. No UV-A (dark)
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	380		Mortality	NOED	No increase in mortality.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	380		Mortality	NOEL	Survival - No effect. Radiotracer study
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	10	I	Mortality	LOEL	Survival - Reduced. 76.2 mW/cm2 UV-A; median time to death, 24 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	10		Mortality	LOEL	Survival - Reduced. 33.6 mW/cm2 UV-A; median time to death, 96 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	19		Mortality	LOEL	Survival - Reduced. 33.6 mW/cm2 UV-A; median time to death, 30-40 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	19		Mortality	LOEL	Survival - Reduced. 16.4 mW/cm2 UV-A; median time to death, 96 h

TABLE G-2
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PAHs

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	20		Mortality	LOEL	Survival - Reduced. 76.2 mW/cm2 UV-A; median time to death, 17 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	30		Mortality	LOEL	Survival - Reduced. 16.4 mW/cm2 UV-A; median time to death, 70 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	38		Mortality	LOEL	Survival - Reduced. 33.6 mW/cm2 UV-A; median time to death, 25-28 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	38		Mortality	LOEL	Survival - Reduced. 16.4 mW/cm2 UV-A; median time to death, 50 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	48		Mortality	LOEL	Survival - Reduced. 76.2 mW/cm2 UV-A; median time to death, 10-12 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	62		Mortality	LOEL	Survival - Reduced. 33.6 mW/cm2 UV-A; median time to death, 20 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	62		Mortality	LOEL	Survival - Reduced. 16.4 mW/cm2 UV-A; median time to death, 30 h
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	96		Mortality	LOEL	Survival - Reduced. 76.2 mW/cm2UV-A; median time to death, < 10 h
Diporeia spp.	Amphipod	Fresh	detritivore	146		Mortality	LD50	50% mortality over a 28-day exposure.
Diporeia spp.	Amphipod	Fresh	detritivore	222		Mortality	LD50	50% mortality over a 14-day exposure.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	465		Mortality	LOED	17% increase in mortality.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	465		Mortality	LOEL	Survival - Reduced 17%. Radiotracer study
Diporeia spp.	Amphipod	Fresh	detritivore	1274		Mortality	LD50	50% mortality over a 28-day exposure.
Diporeia spp.	Amphipod	Fresh	detritivore	1901		Mortality	LD50	50% mortality over a 14-day exposure.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	465	I	Growth	LOED	Increased weight loss.
2-Methylnaphthalene								
Daphnia magna	Cladoceran	Fresh	filter feeder	1.8	F	Mortality	NOEL	Survival - No effect. Radiotracer study; Residues in surviving organisms, *48 h LC50
Daphnia magna	Cladoceran	Fresh	filter feeder	16	F	Mortality	LOEL	Survival - Reduced - Death. Radiotracer study; Residues in dead organisms, *48 h LC50
Daphnia magna	Cladoceran	Fresh	filter feeder	19		Mortality	LOEL	Survival - Reduced - Narcosis. Radiotracer study; Only narcotized animals were analyzed
Daphnia magna	Cladoceran	Fresh	filter feeder	21		Mortality	Immobolized	Survival - Immobolized. Radiotracer study; Residues in immobolized organisms, *48 h LC50

TABLE G-2
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PAHs

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments

Notes:
Concentration units in ug/g wet weight tissue unless otherwise specified.
Where available, NOAELs and LOAELs are identified separately for fish (F), invertebrates (I), and wildlife (W).
Information compiled from the following sources:
1. ACOE, 2002. Tissue Effects Database; Army Corps of Engineers, U.S. Waterways Experiment Station, Vicksburg, MS.
2. Jarvinen and Ankley, 1999.
3. USEPA, 2000. Bioaccumulation Summary; United States Environmental Protection Agency; EPA-823-R-00-002.

Prepared by: SGD
Checked by: NAR

TABLE G-3
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PESTICIDES

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Aldrin								
Chironomus sp.	Midge	Fresh	omnivore	0.096		Mortality	NOED	No increase in mortality in 3 days.
Daphnia magna	Water flea	Fresh	filter feeder	0.48		Mortality	NOED	No increase in mortality in 3 days.
Gambusia affinis	Mosquito fish	Fresh	invertivore	0.16		Mortality	NOED	No mortality in 3 days in model ecosystem.
Hexagenia bilineata	Mayfly	Fresh	detritivore	0.13	I	Mortality	NOED	No increase in mortality in 3 days.
Chironomus riparius	Midge	Fresh	omnivore	0.8	I	Mortality	LOED	Increased mortality. Residues 0.8 mg/kg aldrin and 1.1 mg/kg dieldrin. Assume wet weight.
Chlamydotheca arcuata	Ostracod	Fresh	planktivore	1		Mortality	LOED	Immobility, Mortality. Residue less than 1 mg/kg.
Benzene hexachloride (BHC, Technical grade)								
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.028	I	Mortality	LOEL	Survival - Reduced >50%. *Sum of alpha, gamma, beta and delta isomers; Residues in surviving organisms
Lagodon rhomboides	Pinfish	Salt	omnivore	49	F	Mortality	LOEL	Survival - Reduced >50%. *Sum of alpha, gamma, beta and delta isomers; Residues in surviving organisms
Hexachlorocyclohexane (alpha-isomer)								
Daphnia magna	Cladoceran	Fresh	filter feeder	2		Mortality	NOEL	Survival - No effect.
Artemia salina	Shrimp - Brine	Salt	filter feeder	4.5	I	Mortality	NOEL	Survival - No effect.
Poecilia reticulata	Guppy	Fresh	omnivore	25	F	Mortality	NOEL	Survival - No effect.
Artemia salina	Shrimp - Brine	Salt	filter feeder	45	I	Mortality	LOEL	Survival - Reduced. Residue calculated from BCF determined in the study
Poecilia reticulata	Guppy	Fresh	omnivore	170	F	Mortality	LOEL	Survival - Reduced - Death/Immobilization. *96 h EC50
Daphnia magna	Cladoceran	Fresh	filter feeder	250		Mortality	LOEL	Survival - Reduced - Death/Immobilization. *48 h EC50
Poecilia reticulata	Guppy	Fresh	omnivore	700		Mortality	LOEL	Survival - Reduced. *96 h EC50, mortality and immobilization
Lindane								
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	2		Mortality	NOED	No Effect On Mortality
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	6.1	F	Mortality	NOED	No Effect On Survival
Chironomus riparius	Midge	Fresh	omnivore	0.072	I	Mortality	LD50	Survival - Reduced 50%. Radiotracer study; *24 h LC50, pH 8
Chironomus riparius	Midge	Fresh	omnivore	0.075		Mortality	LD50	Survival - Reduced 50%. Radiotracer study; *24 h LC50, pH 6
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	79	F	Mortality	ED50	Estimate From Table

TABLE G-3
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PESTICIDES

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	79		Mortality	LOEL	Survival - Reduced >50%. Residues in surviving organisms
Lagodon rhomboides	Pinfish	Salt	omnivore	5.2		Mortality	ED50	Estimate From Table
Lagodon rhomboides	Pinfish	Salt	omnivore	39		Mortality	ED50	Total BHC/ Estimate From Table
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.19		Mortality	ED50	Estimate From Table
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.022		Mortality	ED50	Estimate From Table
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.028		Mortality	ED50	Total BHC/ Estimate From Table
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.033		Mortality	LOEL	Survival - Reduced >50%. Residues in surviving organisms
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	9.5		Mortality	LOED	Reduced Survival
Chlorella pyrenoidosa	Algae - Green	Fresh	primary producer	6.2		Growth	LOED	40-50% Retardation of population growth rate.
Chlordane								
Leiostomus xanthurus	Spot	Salt	omnivore	0.01	F	Mortality	NOED	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	0.6		Mortality	NOED	Estimated Noed - No Statistical Summary In Text
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.71	I	Mortality	NOED	Estimated Noed - No Statistical Summary In Text
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	1.4		Mortality	NOED	
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	4.8		Mortality	NOED	Estimated Noed - No Statistical Summary In Text
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	87		Mortality	NOED	Estimated Noed - No Statistical Summary In Text
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	0.01	F	Mortality	ED5	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	0.019		Mortality	ED5	Exposure Media 65% Heptachlor (technical Grade)
Leiostomus xanthurus	Spot	Salt	omnivore	0.16		Mortality	ED25	Exposure Media 65% Heptachlor (technical Grade)
Leiostomus xanthurus	Spot	Salt	omnivore	0.22		Mortality	ED35	Exposure Media 65% Heptachlor (technical Grade)
Leiostomus xanthurus	Spot	Salt	omnivore	0.55		Mortality	ED25	Exposure Media 65% Heptachlor (technical Grade)
Leiostomus xanthurus	Spot	Salt	omnivore	0.7		Mortality	ED85	Exposure Media 65% Heptachlor (technical Grade)
Leiostomus xanthurus	Spot	Salt	omnivore	0.89		Mortality	ED35	Exposure Media 65% Heptachlor (technical Grade)
Leiostomus xanthurus	Spot	Salt	omnivore	0.94		Mortality	ED40	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	1.2		Mortality	ED35	Exposure Media 65% Heptachlor (technical Grade)
Leiostomus xanthurus	Spot	Salt	omnivore	1.6		Mortality	ED70	Exposure Media 65% Heptachlor (technical Grade)
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	1.7	I	Mortality	LOED	Estimated Loed - No Statistical Summary In Text
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	2		Mortality	ED50	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	3.2		Mortality	LOED	
Leiostomus xanthurus	Spot	Salt	omnivore	3.3		Mortality	ED40	Exposure Media 65% Heptachlor (technical Grade)
Leiostomus xanthurus	Spot	Salt	omnivore	3.5		Mortality	ED85	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	3.9		Mortality	ED60	Exposure Media 65% Heptachlor (technical Grade)
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	4.5		Mortality	LOED	Estimated Loed - No Statistical Summary In Text
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	6.1		Mortality	ED85	Exposure Media 65% Heptachlor (technical Grade)

TABLE G-3
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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Leiostomus xanthurus	Spot	Salt	omnivore	7.1		Mortality	ED70	Exposure Media 65% Heptachlor (technical Grade)
Lagodon rhomboides	Pinfish	Salt	omnivore	17		Mortality	LOED	Estimated Loed - No Statistical Summary In Text
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	18		Mortality	ED50	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	32		Mortality	ED60	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	47		Mortality	ED85	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	281		Mortality	LOED	Estimated Loed - No Statistical Summary In Text
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	909		Mortality	ED35	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	0.022	I	Growth	NOED	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	11		Growth	NOED	Estimated Noed - No Statistical Summary In Text
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	0.02	I	Growth	ED18	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	0.075		Growth	ED30	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	0.3		Growth	ED28	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	0.6		Growth	ED30	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	0.78		Growth	ED33	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	1.9		Growth	ED78	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	2.2		Growth	ED28	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	5.6		Growth	ED95	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	6.5		Growth	ED33	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	14		Growth	ED78	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	27		Growth	LOED	Estimated Loed - No Statistical Summary In Text
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	47		Growth	ED95	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	1.4	F	Reproduction	NOED	Hatching Success Of Fry From Exposed Parents
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	3.2	F	Reproduction	LOED	Hatching Success Of Fry From Exposed Parents
4,4'-DDD								
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.008	F	Mortality	NOEL	Survival - No effect.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	1		Mortality	NOEL	Survival - No effect. Radiotracer study; *1/wk/4wks
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	5		Mortality	NOED	1.25 mg/g injected once a week for 4 weeks to attain 5 mg/kg body burden of p,p'-DDT related compounds plus .25 mg/kg injection of p,p'-DDT at fifth week..
Gambusia affinis	Mosquito fish	Fresh	invertivore	5.3		Mortality	NOED	No mortality in 3 days in model ecosystem. Residue includes metabolites.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.9	F	Mortality	LOED	Survival of fry reduced.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	1		Growth	NOEL	Growth - No effect. Radiotracer study; *1/wk/4wks

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	5	F	Growth	NOED	No significant difference in total weight, liver/body weight ratio, or lipid content. 1.25 mg/kg injected once a week for 4 weeks to attain 5 mg/kg body burden of p,p'-DDT related compounds plus .25 mg/kg injection of p,p'-DDT in fifth week.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.6	F	Reproduction	LOED	Sig. Different From Control (p = 0.05)
4,4'-DDE								
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.042	F	Mortality	NOEL	Survival - No effect.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	1		Mortality	NOEL	Survival - No effect. Radiotracer study; *1/wk/4 wks
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	5		Mortality	NOED	1.25 mg/g injected once a week for 4 weeks to attain 5 mg/kg body burden of p,p'-DDT related compounds plus .25 mg/kg injection of p,p'-DDT at fifth week.
Gambusia affinis	Mosquito fish	Fresh	invertivore	29		Mortality	NOED	No mortality in 3 days in model ecosystem. Residue includes metabolites.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.29	F	Mortality	LOED	Significant increase in mortality. Exposure to 1.8 ng/L in water and 0.26 ug/g in diet.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.74		Mortality	LOED	Survival of fry reduced. Calculated residue based on residue in egg and weight of fry at yolk absorption. Parents exposed to DDT in field.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	1.1		Mortality	LOED	Survival of fry reduced. Calculated residue based on residue in egg and weight of fry at yolk absorption. Parents exposed to DDT in field.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	2.5		Mortality	LOED	Survival of fry reduced. Calculated residue based on residue in egg and weight of fry at yolk absorption. Parents exposed to DDT in field.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	1		Growth	NOEL	Growth - No effect. Radiotracer study; *1/wk/4 wks
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	2.7		Growth	NOED	No significant difference in weight gain. Exposure to 32.7 ng/L in water and 2.32 ug/g in diet.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	5	F	Growth	NOED	No significant difference in total weight, liver/body weight ratio, or lipid content. 1.25 mg/kg injected once a week for 4 weeks to attain 5 mg/kg body burden of p,p'-DDT related compounds plus .25 mg/kg injection of p,p'-DDT in fifth week.

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Pimephales promelas	Minnow - Fathead	Fresh	omnivore	20	F	Reproduction	LOED	Sig. Different From Control (p = 0.05)
4,4`-DDT								
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.008		Mortality	NOEL	Survival - No effect.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.009		Mortality	NOEL	Survival - No effect.
Libellula sp.	Dragonfly	Fresh	omnivore	0.014		Mortality	NOED	No increase in mortality in 3 days.
Notemigonus crysoleucas	Golden shiner	Fresh	omnivore	0.025		Mortality	NOEL	Survival - No effect. Radiotracer study; *Residue converted from dry to wet wt. using factor given in paper; Residues = DDT + metabolites
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.026		Mortality	NOED	No increase in mortality. Residues include DDT and metabolites. Radiotracer study. Assume wet weight.
Orconectes nais	Crayfish	Fresh	omnivore	0.047		Mortality	NOED	No increase in mortality in 3 days.
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.06		Mortality	NOEL	Survival - No effect. Residues = DDT + metabolites
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.064		Mortality	NOEL	Survival - No effect. Residues = DDT + metabolites
Ischnura verticalis	Damselfly	Fresh	omnivore	0.075		Mortality	NOED	No increase in mortality in 3 days.
Palaemonetes kadiakensis	Shrimp - Grass	Estuarine	omnivore	0.1		Mortality	NOED	No increase in mortality in 3 days.
Squalus acanthias	Spiny Dogfish	Salt	piscivore	0.1		Mortality	NOED	No Effect On Mortality In 24 Hours
Callinectes sapidus	Crab - Blue	Salt	predator	0.13		Mortality	NOED	No increase in mortality Residue includes DDT and metabolites. Four weekly feedings of 0.53 ug DDT in diet.
Callinectes sapidus	Crab - Blue	Salt	predator	0.13	I	Mortality	NOEL	Survival - No effect. *4 feedings/wk; Residues = DDT + metabolites
Siphlonurus sp.	Mayfly	Fresh	detritivore	0.22		Mortality	NOED	No increase in mortality in 3 days.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.26	F	Mortality	NOED	No difference in survival of fry to 15 weeks post-hatch. Male parent only exposed to 2 mg DDT/kg/week in diet. Assume wet weight for residues. Residues include DDT and metabolites.
Gammarus fasciatus	Amphipod	Fresh	detritivore	0.34		Mortality	NOED	No increase in mortality in 3 days.
Hexagenia bilineata	Mayfly	Fresh	detritivore	0.34		Mortality	NOED	No increase in mortality in 3 days.
Chironomus sp.	Midge	Fresh	omnivore	0.44		Mortality	NOED	No increase in mortality in 3 days.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	1		Mortality	NOEL	Survival - No effect. Radiotracer study; *1/wk/4wks
Fundulus heteroclitus	Mummichog	Estuarine	omnivore	1.5		Mortality	NOEL	Survival - No effect. Radiotracer study; Residues = DDT + metabolites
Pseudopleuronectes americanu	Flounder - Winter	Estuarine	bottom feeder	1.6		Mortality	NOEL	Survival - No effect. Residues = DDT + DDE
Daphnia magna	Water flea	Fresh	filter feeder	1.8		Mortality	NOED	No increase in mortality in 3 days.

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Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	1.9	Mortality	NOED	No increase in mortality. Residues include DDT and metabolites. Radiotracer study. Assume wet weight.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	1.9	Mortality	NOEL	Survival - No effect. Radiotracer study; Residues = DDT + metabolites
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	2.8	Mortality	NOEL	Survival - No effect. Residues = DDT + metabolites
Ephemera danica	Mayfly	Fresh	detritivore	3.1	Mortality	NOEL	Survival - No effect. Residues = DDT + metabolites
Notemigonus crysoleucas	Golden shiner	Fresh	omnivore	3.6	Mortality	NOEL	Survival - No effect. Radiotracer study; *Residue converted from dry to wet wt. using factor given in paper; Residues = DDT + metabolites
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	4.7	Mortality	NOEL	Survival - No effect. Radiotracer study; Residues = DDT + metabolites
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	5	Mortality	NOED	1.25 mg/g injected once a week for 4 weeks to attain 5 mg/kg body burden of p,p'-DDT related compounds plus .25 mg/kg injection of p,p'-DDT at fifth week.
Heteromastus filiformis	Polychaete	Salt	detritivore	5.9	Mortality	NOED	No increase in mortality. Residue includes DDT and metabolites.
Heteromastus filiformis	Polychaete	Salt	detritivore	5.9	Mortality	NOEL	Survival - No effect. Radiotracer study; *Residue value converted from lipid wt. basis to whole body; Residues = DDT + metabolites
Ephemera danica	Mayfly	Fresh	detritivore	6	Mortality	NOED	Survival - No effect. Residues = DDT + metabolites
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	6.7	Mortality	NOED	No increase in mortality. No difference in hatchability. Parents exposed to 0.35 ug/L for up to 266 days. Residue = DDT and metabolites.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	7.6	Mortality	NOED	No increase in mortality. DDT exposure in diet of 2 mg/kg/week. Assume wet weight for residues. Residues include DDT and metabolites.
Gambusia affinis	Mosquito fish	Fresh	invertivore	19	Mortality	NOED	No mortality in 3 days in model ecosystem. Residue includes metabolites.
Diporeia spp.	Amphipod	Fresh	detritivore	20	Mortality	NOED	No increase in mortality in 96 hours.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	26	Mortality	NOEL	Survival - No effect. Radiotracer study; Residues = DDT + metabolites
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	40	Mortality	NOED	Residue = DDT and metabolites.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	40	Mortality	NOEL	Survival - No effect. Residues = DDT + metabolites
Poecilia latipinna	Sailfin molly	Estuarine	omnivore	43	Mortality	NOEL	Survival - No effect. Residues = DDT + metabolites

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Poecilia latipinna	Sailfin molly	Estuarine	omnivore	43	Mortality	NOED	No increase in mortality. Residue includes o,p'-DDT and metabolites.
Gambusia affinis	Mosquito fish	Fresh	invertivore	54	Mortality	NOED	No mortality in 3 days in model ecosystem. Residue includes metabolites.
Carassius auratus	Goldfish	Fresh	omnivore	130	Mortality	NOEL	Survival - No effect. Radiotracer study; Residues = DDT + metabolites
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.15 I	Mortality	LOEL	Survival - Reduced. Residues = DDT + metabolites; Residues in surviving organisms
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.46 F	Mortality	LOEL	Survival - Reduced 70 - 90%. Residues = DDT + metabolites
Oncorhynchus clarki	Trout - Cutthroat	Fresh	predator	0.57	Mortality	LOEL	Survival - Reduced 30%. Residues = DDT + metabolites
Callinectes sapidus	Crab - Blue	Salt	predator	1	Mortality	LOED	Increase in mortality. Residue includes DDT and metabolites. Three weekly feedings of 3.2 ug DDT in diet.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	1.1	Mortality	LOEL	Survival - Reduced 90%. Residues = DDT + metabolites
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	2	Mortality	LOEL	Survival of fry reduced.
Pseudopleuronectes americanu	Flounder - Winter	Estuarine	bottom feeder	2.5	Mortality	LOEL	Survival - Reduced 91-99%. Residues = DDT + DDE
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	2.9	Mortality	LOED	Significant increase in mortality of fry to 15 weeks post-hatch. Female parent only exposed to 2 mg DDT/kg/week in diet. Assume wet weight for residues. Residues include DDT and metabolites.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	2.9	Mortality	LOED	Survival of fry reduced. Calculated residue based on residue in egg and weight of fry at yolk absorption. Parents exposed to DDT in field.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	2.9	Mortality	LOEL	Survival - Reduced.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	3.0	Mortality	LOED	Survival of fry reduced. Calculated residue based on residue in egg and weight of fry at yolk absorption. Parents exposed to DDT in field.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	3.7	Mortality	LOEL	Survival of fry reduced.
Lepomis cyanellus	Green sunfish	Fresh	invertivore	24	Mortality	LOED	Lethal body burden. Fish exposed in outdoor artificial pool.
Lepomis gibbosus	Pumpkinseed	Fresh	invertivore	24	Mortality	LOED	Lethal body burden. Fish exposed in outdoor artificial pool.

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Pimephales promelas	Minnow - Fathead	Fresh	omnivore	24	Mortality	LOED	Decreased hatchability. Parents exposed to 1.53 ug/L for up to 266 days. Residue = DDT and metabolites.
Lepomis cyanellus & L. gibbosu	Green sunfish & pumj	Fresh	invertivore	24	Mortality	LOEL	Survival - Reduced - Death. Residues = DDT + metabolites
Gambusia affinis	Mosquito fish	Fresh	invertivore	27	Mortality	LD50	Survival - Reduced 50%. Fish had a total DDT residue level of 1.62 ug/g at the start of the study; Residues = DDT + metabolites
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	57	Mortality	LD25	25% increase in mortality. Residue = DDT and metabolites.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	57	Mortality	LOEL	Survival - Reduced 25%. Residues = DDT + metabolites
Poecilia latipinna	Sailfin molly	Estuarine	omnivore	77	Mortality	LOEL	Survival - Reduced. Residues = DDT + metabolites
Poecilia latipinna	Sailfin molly	Estuarine	omnivore	77	Mortality	LOED	78% Mortality. Residue includes o,p'-DDT and metabolites.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	86	Mortality	LD26	26% increase in mortality. Diet contained 45.6 ug/g DDT. Residue = DDT and metabolites.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	86	Mortality	LOEL	Survival - Reduced 26%. Residues = DDT + metabolites
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	88	Mortality	LOEL	Survival - Reduced 100%. Residues = DDT + metabolites
Oncorhynchus kisutch	Salmon - Coho	Anadromous	piscivore	95	Mortality	LD50	50% Mortality In 31 Days
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	160	Mortality	LD50	50% increase in mortality. Residue = DDT and metabolites.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	160	Mortality	LD50	Survival - Reduced 50%. Residues = DDT + metabolites
Carassius auratus	Goldfish	Fresh	omnivore	200	Mortality	LOEL	Survival - Reduced>20%. Radiotracer study; Residues = DDT + metabolites
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	209	Mortality	LD79	79% increase in mortality. Diet contained 45.6 ug/g DDT. Residue = DDT and metabolites.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	209	Mortality	LOEL	Survival - Reduced 79%. Residues = DDT + metabolites
Carassius auratus	Goldfish	Fresh	omnivore	400	Mortality	LOEL	Survival - Reduced>80%. Radiotracer study; Residues = DDT + metabolites
Daphnia magna	Cladoceran	Fresh	filter feeder	1150	Mortality	LD50	Survival - Reduced 50%.

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Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	1		Growth	NOEL	Growth - No effect. Radiotracer study; *1/wk/4wks
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	2.8		Growth	NOEL	Growth - No effect. Residues = DDT + metabolites
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	4.7		Growth	NOEL	Growth - No effect. Radiotracer study; Residues = DDT + metabolites
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	5	F	Growth	NOED	No significant difference in total weight, liver/body weight ratio, or lipid content. 1.25 mg/kg injected once a week for 4 weeks to attain 5 mg/kg body burden of p,p'-DDT related compounds plus .25 mg/kg injection of p.p'-DDT in fifth week.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	7.6		Growth	NOED	No significant difference in weight gain. DDT exposure in diet of 2 mg/kg/week. Assume wet weight for residues. Residues includes DDT and metabolites.
Brevoortia tyrannus	Atlantic menhaden	Salt	filter feeder	24		Growth	NOEL	Growth - No effect. Radiotracer study; Residues = DDT + metabolites
Poecilia latipinna	Sailfin molly	Estuarine	omnivore	43		Growth	NOEL	Growth - No effect. Residues = DDT + metabolites
Poecilia latipinna	Sailfin molly	Estuarine	omnivore	43		Growth	NOED	No significant difference in weight gain. Residue includes o,p'-DDT and metabolites.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	58		Growth	NOED	No difference in length. Diet contained 45.6 ug/g DDT. Parents exposed to 0.35 ug/L in water and 45.6 ug/g in food for up to 266 days. Residue = DDT and metabolites.
Callinectes sapidus	Crab - Blue	Salt	predator	0.82	I	Growth	LOED	Decrease in carapace thickness:width ratio. Residue includes DDT and metabolites. Three weekly feedings of 3.2 ug DDT in diet.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	7.6	F	Growth	LOED	Males significantly longer than females. DDT exposure in diet of 2 mg/kg/week. Assume wet weight for residues. Residues includes DDT and metabolites.
Poecilia latipinna	Sailfin molly	Estuarine	omnivore	77		Growth	LOEL	Growth - Reduced. Residues = DDT + metabolites
Poecilia latipinna	Sailfin molly	Estuarine	omnivore	77		Growth	LOED	Significant decrease in weight gain. Residue includes o.p'-DDT and metabolites.

TABLE G-3
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PESTICIDES

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	2.9	F	Reproduction	NA	Significant increase in number of egg per female. DDT exposure in diet of 1 mg/kg/week. Assume wet weight for residues. Residues include DDT and metabolites.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	3.8	F	Reproduction	LOED	Sig. Different From Control (p = 0.05)
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	7.6		Reproduction	LOED	Significant decrease in number of egg per female. DDT exposure in diet of 2 mg/kg/week. Assume wet weight for residues. Residues include DDT and metabolites.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	24		Reproduction	LOED	Sig. Different From Control (p = 0.05)
Dieldrin								
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.01	I	Mortality	NOED	Estimated NOED - no statistical summary in text.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.09		Mortality	NOED	Estimated NOED - no statistical summary in text.
Rana pipiens	Leopard frog	Fresh	invertivore	0.4		Mortality	NOED	24-day exposure (0.4+-0.1 se)
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.55		Mortality	NOEL	Survival - No effect.
Xenopus laevis	African clawed frog	Fresh	invertivore	0.8		Mortality	NOED	24-day exposure (0.8+-0.2 se)
Squalus acanthias	Spiny Dogfish	Salt	piscivore	1	F	Mortality	NOED	No Effect On Mortality In 24 Hours
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2.1		Mortality	NOEL	Survival - No effect. Radiotracer study
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	13		Mortality	NOED	Estimated NOED - no statistical summary in text.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	19		Mortality	NOED	No Effect On Mortality Within 168 Hours
Gambusia affinis	Mosquito fish	Fresh	invertivore	28		Mortality	NOED	No mortality in 3 days in model ecosystem.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	107		Mortality	NOED	No increase in mortality.
Leucisus idus	Golden ide	Fresh	bottom feeder	151		Mortality	NOED	No effect on survivorship in 3 days.
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.08	I	Mortality	LOED	Estimated LOED - no statistical summary in text.
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.23		Mortality	ED50	ED50 via Spearman Karber 1.5 (msl).
Chlamydotheca arcuata	Ostracod	Fresh	planktivore	1		Mortality	LOED	Immobility, mortality. Residue less than 1 mg/kg.
Chlamydotheca arcuata	Ostracod	Estuarine	planktivore	1		Mortality	LOED	Estimated NOED - no statistical summary in text.
Chironomus riparius	Midge	Fresh	omnivore	1.1		Mortality	LD50	Increased mortality. Exposure to 20 ug/L aldrin. Residues 0.8 mg/kg aldrin and 1.1 mg/kg dieldrin. Assume wet weight.
Pseudopleuronectes americanu	Flounder - Winter	Estuarine	bottom feeder	1.2	F	Mortality	LOEL	Survival - Reduced 98 - 100%.
Xenopus laevis	African clawed frog	Fresh	invertivore	1.5		Mortality	LOED	24-day exposure (1.5+-0.5 se)
Rana pipiens	Leopard frog	Fresh	invertivore	1.7		Mortality	LC50	24-day exposure; LC50 tissue dieldrin estimated by graphical extrapolation.
Xenopus laevis	African clawed frog	Fresh	invertivore	1.8		Mortality	LC50	24-day exposure; LC50 tissue dieldrin estimated by graphical extrapolation.

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Chironomus riparius	Midge	Fresh	omnivore	1.9		Mortality	LD100	All Larvae Moribund In 2 Hours. Assume wet weight.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	2.1		Mortality	LOED	Estimated LOED - no statistical summary in text.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	5.7		Mortality	LOEL	Survival - Reduced > 50%. *96 h LC50 was 0.62 µg/L
Cyprinodon variegatus	Minnow - Sheepshea(	Estuarine	omnivore	34		Mortality	LOED	Estimated LOED - no statistical summary in text.
Cyprinodon variegatus	Minnow - Sheepshea(	Estuarine	omnivore	53		Mortality	ED50	ED50 via Spearman Karber 1.5 (msl).
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.36		Growth	NOEL	Growth - No effect. Fish fed at 2% of body wt.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	1.4		Growth	NOEL	Growth - No effect. Fish fed at 4% of body wt.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2.13	F	Growth	NOEL	Growth - No effect. Radiotracer study
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	13.9	I	Growth	NOED	Estimated NOED - no statistical summary in text.
Poecilia reticulata	Guppy	Fresh	omnivore	10.7	F	Growth	LOED	Decreased biomass of guppy population in laboratory ecosystem.
Endosulfan								
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.065	I	Mortality	NOED	Sum Of Detected Endo I, II, And Sulfate
Schilbe mystus	Fish	Fresh	omnivore	0.14	F	Mortality	NOEL	Survival - No effect.
Clarias gariepinus + Clarias nga	Fish	Fresh	piscivore	0.14		Mortality	NOEL	Survival - No effect.
Sarotherodon macrochir	Fish	Fresh	omnivore	0.16		Mortality	NOEL	Survival - No effect.
Lagodon rhomboides	Pinfish	Salt	omnivore	0.20		Mortality	NOED	Sum Of Detected Endo I, II, And Sulfate
Hepsetus odoë	Pike	Fresh	piscivore	0.8		Mortality	NOEL	Survival - No effect.
Marcusenius macrolepidotus	Fish	Fresh	invertivore	1		Mortality	NOEL	Survival - No effect.
Hepsetus odoë	Pike	Fresh	piscivore	6.7		Mortality	NOEL	Survival - No effect. Residues in surviving fish
Mytilus edulis	Mussel - Blue	Salt	filter feeder	8.1		Mortality	NOED	
Mytilus edulis	Mussel - Blue	Salt	filter feeder	8.1		Mortality	NOEL	Survival - No effect.
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.01	I	Mortality	ED90	Detection Limit Of Cmpd Used, Sum Of Detected Endo I, II, And Sulfate
Leiostomus xanthurus	Spot	Salt	omnivore	0.031	F	Mortality	ED35	Sum Of Detected Endo I, II, And Sulfate
Leiostomus xanthurus	Spot	Salt	omnivore	0.068		Mortality	ED45	Sum Of Detected Endo I, II, And Sulfate
Clarias spp.	Fish	Fresh	piscivore	0.07		Mortality	LOEL	Survival - Reduced - Death. Residues in dead fish
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.08		Mortality	ED10	Sum Of Detected Endo I, II, And Sulfate
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.21		Mortality	ED35	Sum Of Detected Endo I, II, And Sulfate
Leiostomus xanthurus	Spot	Salt	omnivore	0.26		Mortality	ED90	Sum Of Detected Endo I, II, And Sulfate
Lagodon rhomboides	Pinfish	Salt	omnivore	0.27		Mortality	ED35	Sum Of Detected Endo I, II, And Sulfate
Mugil cephalus	Mullet - Striped	Salt	bottom feeder	0.36		Mortality	ED40	Only Endosulfan Sulfate Detected In Tissues
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.48		Mortality	ED65	Sum Of Detected Endo I, II, And Sulfate
Mugil cephalus	Mullet - Striped	Salt	bottom feeder	0.49		Mortality	ED90	Only Endosulfan Sulfate Detected In Tissues

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Mugil cephalus	Mullet - Striped	Salt	bottom feeder	0.49		Mortality	ED90	Only Endosulfan Sulfate Detected In Tissues
Hepsetus odoë	Pike	Fresh	piscivore	0.74		Mortality	LOEL	Survival - Reduced - Death. Residues in dead fish
Haplochromis spp.	Fish	Fresh	zooplanktivore	1.1		Mortality	LOEL	Survival - Reduced - Death. Residues in dead fish
Tilapia + Sarotherodon spp.	Fish	Fresh	omnivore	1.1		Mortality	LOEL	Survival - Reduced - Death. Residues in dead fish
Serranochromis spp.	Fish	Fresh	piscivore	1.2		Mortality	LOEL	Survival - Reduced - Death. Residues in dead fish
Pseudocrenilabrus philander	Fish	Fresh	invertivore	1.5		Mortality	LOEL	Survival - Reduced - Death. Residues in dead fish
Endrin								
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.02	I	Mortality	NOED	Residues From Animals Alive At End Of Test
Rana sphenocephala	Southern Leopard Fro	Fresh	predator	0.02		Mortality	NOEL	Survival - No effect.
Rana sphenocephala	Southern Leopard Fro	Fresh	predator	0.06		Mortality	NOED	Residue in surviving animals.
Lepomis macrochirus	Bluegill	Fresh	invertivore	0.08		Mortality	NOED	No increase in mortality.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.08		Mortality	NOEL	Survival - No effect. Residue calculated from BCF determined in the study
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	0.11		Mortality	NOED	Greater Than One Life Cycle; No Significant Reduction In Survival Of Juveniles With Exposure From Egg To Adult To Juvenile (28 Day Post Hatch); Tissue Burden From Juvenile
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	0.11		Mortality	NOEL	Survival - No effect.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.18		Mortality	NOEL	Survival - No effect. Residue calculated from BCF determined in the study
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.22		Mortality	NOED	No Effect On Mortality. Whole body residue calculated from fat residue.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.23	F	Mortality	NOEL	Survival - No effect.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	0.26		Mortality	NOED	No Significant Decrease In Survival Duration
Poecilia latipinna	Sailfin molly	Estuarine	omnivore	0.26		Mortality	NOED	Residues From Animals Alive At End Of Test
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	0.26		Mortality	NOED	Average Residue In Dead Oysters
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	0.3		Mortality	NOED	Residues From Animals Alive At End Of Test
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	0.31		Mortality	NOED	No Measureable Effect On Mortality
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	0.41		Mortality	NOED	No Significant Mortality Or Hypersensitivity
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.67		Mortality	NOEL	Survival - No effect.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	0.94		Mortality	NA	No Significant Effect On Survival At Highest Test Concentration
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	1		Mortality	NOEL	Survival - No effect.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	1.8		Mortality	NOED	No Significant Reduction In Survival Of Juveniles From Exposed Adults; Tissue Conc. Is From Eggs
Jordanella floridae	American flagfish	Fresh	bottom feeder	2.1		Mortality	NOEL	Survival - No effect.

TAB . G-3

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Jordanella floridae	American flagfish	Fresh	bottom feeder	2.2	Mortality	NOEL	Survival - No effect. *Residue calculated from mean BCF determined in the study because of apparent outlier at this concentration
Jordanella floridae	American flagfish	Fresh	bottom feeder	3.6	Mortality	NOEL	Survival - No effect.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	4.3	Mortality	NOEL	Survival - No effect. Residue calculated from 29 d BCF determined in the study
Limnodrilus hoffmeisteri	Oligochaete	Estuarine	detritivore	12	Mortality	NOED	No Effect On Mortality
Stylodrilus heringianus	Oligochaete	Fresh	detritivore	31	Mortality	NOED	Calculated residue using BCF of 67. BCFs for study ranged from 34 to 67 (dry weight).
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.01 I	Mortality	ED30	Residues From Animals Alive At End Of Test
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.02	Mortality	ED60	Residues From Animals Alive At End Of Test
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.025	Mortality	ED30	Residues From Animals Alive At End Of Test
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.067	Mortality	ED80	Residues From Animals Alive At End Of Test
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.07	Mortality	ED5	Residues From Animals Alive At End Of Test
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.18	Mortality	LOEL	Survival - Reduced. Residue calculated from BCF determined in the study
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.19	Mortality	ED25	Residues From Animals Alive At End Of Test
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.24 F	Mortality	LOEL	Survival - Reduced.
Lepomis macrochirus	Bluegill	Fresh	invertivore	0.3	Mortality	LOED	Increase in mortality.
Rana sphenocephala	Southern Leopard Frc	Fresh	predator	0.43	Mortality	LOED	Lethal body burden during 96 hours exposure.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.61	Mortality	LOEL	Survival - Reduced. Residue calculated from BCF determined in the study
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	0.7	Mortality	LOEL	Survival - Reduced - Death.
Cyprinodon variegatus	Minnow - Sheepshea(	Estuarine	omnivore	0.88	Mortality	LOED	Greater Than One Life Cycle; Significantly Reduced Survival Of Juveniles With Exposure From Egg To Adult To Juvenile (28 Day Post Hatch); Tissue Burden From Juvenile
Cyprinodon variegatus	Minnow - Sheepshea(	Estuarine	omnivore	0.94	Mortality	LOED	Significantly Shorter Survival Duration
Notemigonus crysoleucas	Golden shiner	Fresh	omnivore	0.97	Mortality	LD100	100% Mortality in 8 hours. Sensitive population.
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	1	Mortality	ED100	100% Of Fish Died By Day 41
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	1.2	Mortality	LOEL	Survival - Reduced 22%.
Cyprinodon variegatus	Minnow - Sheepshea(	Estuarine	omnivore	1.5	Mortality	ED20	Residues From Animals Alive At End Of Test
Poecilia latipinna	Sailfin molly	Estuarine	omnivore	1.7	Mortality	ED47	Residues From Animals Alive At End Of Test
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	1.8	Mortality	LOEL	Survival - Reduced 60%.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	2	Mortality	LOEL	Survival - Reduced 95%.

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Jordanella floridae	American flagfish	Fresh	bottom feeder	2.8		Mortality	LOEL	Survival - Reduced. Residue calculated from 15 d BCF determined in the study
Gambusia affinis	Mosquito fish	Fresh	invertivore	3.4		Mortality	LOED	Mortality within hours. Exposure in model ecosystem.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	16		Mortality	LOED	Average Residue In Dead Oysters
Notemigonus crysoleucas	Golden shiner	Fresh	omnivore	35		Mortality	LD80	80% Mortality in 9 hours. Resistant population.
Stylodrilus heringianus	Oligochaete	Fresh	detritivore	78		Mortality	LOED	19% Increase in mortality. Calculated residue using BCF of 34. BCFs for study ranged from 34 to 67 (dry weight).
Limnodrilus hoffmeisteri	Oligochaete	Estuarine	detritivore	148		Mortality	LOED	77% Mortality
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.05	I	Growth	NOEL	Growth - No effect. Residue calculated from BCF determined in the study
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.12	F	Growth	NOED	No Effect On Growth measured as weight. Whole body residue calculated from fat residue.
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	0.31		Growth	NOED	No Measureable Effect On Growth
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	0.94		Growth	NA	No Significant Effect On Growth At Highest Test Concentration
Jordanella floridae	American flagfish	Fresh	bottom feeder	1.6		Growth	NOEL	Growth - No effect.
Jordanella floridae	American flagfish	Fresh	bottom feeder	2.2		Growth	NOEL	Growth - No effect. *Residue calculated from mean BCF determined in the study because of apparent outlier at this concentration
Jordanella floridae	American flagfish	Fresh	bottom feeder	3.6		Growth	NOEL	Growth - No effect.
Limnodrilus hoffmeisteri	Oligochaete	Estuarine	detritivore	12		Growth	NOED	No Effect On Growth
Stylodrilus heringianus	Oligochaete	Fresh	detritivore	31		Growth	NOED	No significant difference in weight. Calculated residue using BCF of 67. BCFs for study ranged from 34 to 67 (dry weight).
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.08	I	Growth	LOEL	Growth - Reduced. Residue calculated from BCF determined in the study
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.22	F	Growth	ED50	50% Reduction in growth rate measured as weight. Whole body residue calculated from fat residue.
Jordanella floridae	American flagfish	Fresh	bottom feeder	2.1		Growth	LOEL	Growth - Reduced.
Jordanella floridae	American flagfish	Fresh	bottom feeder	2.8		Growth	LOEL	Growth - Reduced. Residue calculated from 15 d BCF determined in the study
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	5.8		Growth	ED40	Residues From Animals Alive At End Of Test
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	20		Growth	ED47	Residues From Animals Alive At End Of Test

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Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	52		Growth	ED67	Residues From Animals Alive At End Of Test
Stylodrilus heringianus	Oligochaete	Fresh	detritivore	78		Growth	LOED	Significant decrease in weight. Calculated residue using BCF of 34. BCFs for study ranged from 34 to 67 (dry weight).
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	124		Growth	ED87	Residues From Animals Alive At End Of Test
Limnodrilus hoffmeisteri	Oligochaete	Estuarine	detritivore	148		Growth	LOED	Reduced weight gain.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	0.01	I	Reproduction	NOED	Residues From Animals Alive At End Of Test
Cyprinodon variegatus	Minnow - Sheepshea(	Estuarine	omnivore	0.26		Reproduction	NOED	No Significant Reduction In Egg Fertility (%) From Exposed Adults; Endrin Conc. In Eggs 0.87 Ug/g Wet
Cyprinodon variegatus	Minnow - Sheepshea(	Estuarine	omnivore	0.26	F	Reproduction	NOEL	Reproduction - No effect.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	1.3		(egg production	NOEL	Reproduction (egg production and hatchability) - No effect. Residue calculated from BCF determined in the study
Jordanella floridae	American flagfish	Fresh	bottom feeder	1.6		Reproduction	NOEL	Reproduction - No effect.
Jordanella floridae	American flagfish	Fresh	bottom feeder	1.7		Reproduction	NOEL	Reproduction - No effect. Residue calculated from 15 d BCF determined in the study
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	2		Reproduction	NOEL	Reproduction - No effect.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.05	I	ing delayed, fe	LOEL	Reproduction (spawning delayed, few females spawning) - Reduced. Residue calculated from BCF determined in the study
Cyprinodon variegatus	Minnow - Sheepshea(	Estuarine	omnivore	0.94	F	Reproduction	LOED	Significantly Reduced Egg Fertility (%) From Exposed Adults; Endrin Conc. In Eggs 1.8 Ug/g Wet
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	1.4		Reproduction	ED13	Residues From Animals Alive At End Of Test
Jordanella floridae	American flagfish	Fresh	bottom feeder	2.1		Reproduction	LOEL	Reproduction - Reduced.
Jordanella floridae	American flagfish	Fresh	bottom feeder	2.2		Reproduction	LOEL	Reproduction - Reduced. *Residue calculated from mean BCF determined in the study because of apparent outlier at this concentration
Heptachlor								
Leiostomus xanthurus	Spot	Salt	omnivore	0.01	F	Mortality	NOED	Exposure Media 65% Heptachlor (technical Grade)
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.01	I	Mortality	NOED	Exposure Media 65% Heptachlor (technical Grade)
Palaemonetes vulgaris	Shrimp - Grass	Estuarine	omnivore	0.062		Mortality	NOED	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea(	Estuarine	omnivore	4.8		Mortality	NOED	No significant effect on mortality.
Leiostomus xanthurus	Spot	Salt	omnivore	5.3		Mortality	NOEL	Survival - No effect. *Does not include 3.7 µg/g heptachlor epoxide

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Lagodon rhomboides	Pinfish	Salt	omnivore	5.7		Mortality	NOED	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	0.022	F	Mortality	ED5	Exposure Media 65% Heptachlor (technical Grade)
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.033	I	Mortality	ED82	Exposure Media 65% Heptachlor (technical Grade)
Palaemonetes vulgaris	Shrimp - Grass	Estuarine	omnivore	0.2		Mortality	ED13	Exposure Media 65% Heptachlor (technical Grade)
Leiostomus xanthurus	Spot	Salt	omnivore	0.64		Mortality	LD25	
Palaemonetes vulgaris	Shrimp - Grass	Estuarine	omnivore	0.97		Mortality	ED70	Exposure Media 65% Heptachlor (technical Grade)
Leiostomus xanthurus	Spot	Salt	omnivore	1.5		Mortality	ED25	Exposure Media 65% Heptachlor (technical Grade)
Leiostomus xanthurus	Spot	Salt	omnivore	1.7		Mortality	LD35	
Leiostomus xanthurus	Spot	Salt	omnivore	2.3		Mortality	ED35	Exposure Media 65% Heptachlor (technical Grade)
Leiostomus xanthurus	Spot	Salt	omnivore	2.6		Mortality	ED40	Exposure Media 65% Heptachlor (technical Grade)
Palaemonetes vulgaris	Shrimp - Grass	Estuarine	omnivore	3.6		Mortality	ED95	Exposure Media 65% Heptachlor (technical Grade)
Leiostomus xanthurus	Spot	Salt	omnivore	9.8		Mortality	ED85	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	10		Mortality	LD39	39% decline in survivorship.
Leiostomus xanthurus	Spot	Salt	omnivore	12		Mortality	LOEL	d BCF determined in the study
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	16		Mortality	LOED	Increased fry mortality.
Leiostomus xanthurus	Spot	Salt	omnivore	17		Mortality	ED70	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	20		Mortality	ED35	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	34		Mortality	ED50	Exposure Media 65% Heptachlor (technical Grade)
Lagodon rhomboides	Pinfish	Salt	omnivore	34		Mortality	ED50	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	85		Mortality	ED60	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	133		Mortality	ED85	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	0.016	I	Growth	NOED	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	0.021	I	Growth	ED18	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	0.43		Growth	ED30	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	3.1		Growth	ED28	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	11.25	Salt	filter feeder	7.7		Growth	ED33	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	18		Growth	ED78	Exposure Media 65% Heptachlor (technical Grade)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	55		Growth	ED95	Exposure Media 65% Heptachlor (technical Grade)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	26	F	Reproduction	LOED	Decreased egg production of adults.
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	211		Reproduction	LOED	Decreased fertility of eggs produced by adults.

TABLE G-3
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PESTICIDES

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Heptachlor epoxide								
Leiostomus xanthurus	Spot	Salt	omnivore	0.01		Mortality	NOED	Exposure Media Heptachlor Epoxide (Conc. NS)
Leiostomus xanthurus	Spot	Salt	omnivore	0.016	F	Mortality	NOED	Exposure Media Heptachlor Epoxide (Conc. NS)
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.054	I	Mortality	NOED	Exposure Media Heptachlor Epoxide (Conc. NS)
Palaemonetes vulgaris	Shrimp - Grass	Estuarine	omnivore	0.26		Mortality	NOED	Exposure Media Heptachlor Epoxide (Conc. NS)
Lagodon rhomboides	Pinfish	Salt	omnivore	3.2		Mortality	NOED	Exposure Media Heptachlor Epoxide (Conc. NS)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	0.02	F	Mortality	ED5	Exposure Media Heptachlor Epoxide (Conc. NS)
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.18	I	Mortality	ED82	Exposure Media Heptachlor Epoxide (Conc. NS)
Leiostomus xanthurus	Spot	Salt	omnivore	0.58		Mortality	ED25	Exposure Media Heptachlor Epoxide (Conc. NS)
Leiostomus xanthurus	Spot	Salt	omnivore	0.72		Mortality	ED35	Exposure Media Heptachlor Epoxide (Conc. NS)
Leiostomus xanthurus	Spot	Salt	omnivore	2.1		Mortality	ED85	Exposure Media Heptachlor Epoxide (Conc. NS)
Leiostomus xanthurus	Spot	Salt	omnivore	2.5		Mortality	ED40	Exposure Media Heptachlor Epoxide (Conc. NS)
Palaemonetes vulgaris	Shrimp - Grass	Estuarine	omnivore	2.5		Mortality	ED70	Exposure Media Heptachlor Epoxide (Conc. NS)
Leiostomus xanthurus	Spot	Salt	omnivore	4		Mortality	ED70	Exposure Media Heptachlor Epoxide (Conc. NS)
Palaemonetes vulgaris	Shrimp - Grass	Estuarine	omnivore	6.1		Mortality	ED95	Exposure Media Heptachlor Epoxide (Conc. NS)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	6.7		Mortality	ED35	Exposure Media Heptachlor Epoxide (Conc. NS)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	9.6		Mortality	ED50	Exposure Media Heptachlor Epoxide (Conc. NS)
Lagodon rhomboides	Pinfish	Salt	omnivore	11		Mortality	ED50	Exposure Media Heptachlor Epoxide (Conc. NS)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	18		Mortality	ED60	Exposure Media Heptachlor Epoxide (Conc. NS)
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	26		Mortality	ED85	Exposure Media Heptachlor Epoxide (Conc. NS)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	0.01	I	Growth	NOED	Exposure Media Heptachlor Epoxide (Conc. NS)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	0.01	I	Growth	ED18	Exposure Media Heptachlor Epoxide (Conc. NS)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	0.14		Growth	ED30	Exposure Media Heptachlor Epoxide (Conc. NS)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	0.48		Growth	ED28	Exposure Media Heptachlor Epoxide (Conc. NS)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	0.78		Growth	ED33	Exposure Media Heptachlor Epoxide (Conc. NS)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	1.9		Growth	ED78	Exposure Media Heptachlor Epoxide (Conc. NS)
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	8		Growth	ED95	Exposure Media Heptachlor Epoxide (Conc. NS)

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Methoxychlor								
Callinectes sapidus	Crab - Blue	Salt	predator	0.1	I	Mortality	NOEL	Survival - No effect.
Cancer magister	Crab - Dungeness	Salt	predator	0.11		Mortality	NOED	No increased mortality
Gambusia affinis	Mosquito fish	Fresh	invertivore	0.17		Mortality	NOED	No mortality in 3 days in model ecosystem. Residue includes metabolites.
Rhithropanopeus harrisii	Crab - Mud	Salt	predator	0.4		Mortality	NOED	No Effect On Survival To Megalopa Stage
Gambusia affinis	Mosquito fish	Fresh	invertivore	0.52		Mortality	NOED	No mortality in 3 days in model ecosystem. Piperonyl butoxide concentration in water of 0.0568 mg/L. Residue includes metabolites.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.71		Mortality	NOEL	Survival - No effect. Radiotracer study
Cancer magister	Crab - Dungeness	Salt	predator	0.82		Mortality	NOEL	Survival - No effect.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	2.5		Mortality	NOEL	Survival - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2.8		Mortality	NOEL	Survival - No effect. Radiotracer study
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	6.07	F	Mortality	NOEL	Survival - No effect*. Radiotracer study; *10% mortality, all fish showed behavioral signs of toxicity
Pteronarcys dorsata	Giant Black Stonefly	Fresh	omnivore	8		Mortality	NOEL	Survival - No effect. Radiotracer study
Callinectes sapidus	Crab - Blue	Salt	predator	0.1	I	Mortality	ED25	25% Reduction In Larval Survival
Rhithropanopeus harrisii	Crab - Mud	Salt	predator	0.51		Mortality	LD16	16% Reduction In Survival To Megalopa Stage
Callinectes sapidus	Crab - Blue	Salt	predator	0.52		Mortality	LOEL	Survival - Reduced 74%.
Cancer magister	Crab - Dungeness	Salt	predator	0.57		Mortality	LOEL	Survival - Reduced - Death. Residues in dead crabs that had recently molted
Rhithropanopeus harrisii	Crab - Mud	Salt	predator	0.59		Mortality	LD47	47% Reduction In Survival To Megalopa Stage
Callinectes sapidus	Crab - Blue	Salt	predator	0.76		Mortality	LOEL	Survival - Reduced >90%.
Cancer magister	Crab - Dungeness	Salt	predator	0.88		Mortality	LOED	Mortality Of Juveniles
Rhithropanopeus harrisii	Crab - Mud	Salt	predator	1.28		Mortality	LOEL	Survival - Reduced 80%.
Cancer magister	Crab - Dungeness	Salt	predator	1.59		Mortality	LOEL	Survival - Reduced - Death. Residues in dead crabs that had not recently molted.
Callinectes sapidus	Crab - Blue	Salt	predator	2.62		Mortality	LD77	77% Reduction In Larval Survival
Callinectes sapidus	Crab - Blue	Salt	predator	2.87		Mortality	LD40	40% Reduction In Larval Survival
Pteronarcys dorsata	Giant Black Stonefly	Fresh	omnivore	15.3		Mortality	LOEL	Survival - Reduced. Radiotracer study
Chironomus tentans	Midge	Fresh	omnivore	20		Mortality	LOEL	Survival - Reduced 36%. Radiotracer study
Chironomus tentans	Midge	Fresh	omnivore	300		Mortality	LOEL	Survival - Reduced 98%. Radiotracer study
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	2.5	F	Growth	NOEL	Growth - No effect.

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Parathion								
Homarus americanus	Lobster	Salt	omnivore	0.05		Mortality	NOED	1 of 1 injected animal survived.
Homarus americanus	Lobster	Salt	omnivore	0.1	I	Mortality	NOED	1 of 1 injected animal survived.
Homarus americanus	Lobster	Salt	omnivore	0.2	I	Mortality	LOED	1 of 3 injected animals died.
Homarus americanus	Lobster	Salt	omnivore	0.3		Mortality	LD50	1 of 2 injected animals died.
Homarus americanus	Lobster	Salt	omnivore	0.4		Mortality	LD67	2 of 3 injected animals died.
Homarus americanus	Lobster	Salt	omnivore	0.5		Mortality	LD100	100% Mortality
Poecilia reticulata	Guppy	Fresh	omnivore	408	F	Mortality	ED100	Lifestage: 2-3 Months
Poecilia reticulata	Guppy	Fresh	omnivore	1750		Mortality	ED100	Lifestage: 2-3 Months
Trifluralin								
Helisoma sp.	Snail	Fresh	herbivore	5.6		Mortality	NOEL	Survival - No effect. Radiotracer study
Daphnia magna	Cladoceran	Fresh	filter feeder	20		Mortality	NOEL	Survival - No effect. Radiotracer study
Helisoma sp.	Snail	Fresh	herbivore	33	I	Mortality	NOEL	Survival - No effect. Radiotracer study
Gambusia affinis	Mosquito fish	Fresh	invertivore	36		Mortality	NOEL	Survival - No effect. Radiotracer study
Gambusia affinis	Mosquito fish	Fresh	invertivore	121	F	Mortality	NOEL	Survival - No effect. Radiotracer study; Fish showed abnormal behavior and had deformities
Toxaphene								
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.4		Mortality	NOED	No significant difference in mortality.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.4		Mortality	NOEL	Survival - No effect.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.4	F	Mortality	NOEL	Survival - No effect.
Fundulus similis	Killifish - Longnose	Salt	omnivore	0.5		Mortality	NOED	Fish Are Adults
Lagodon rhomboides	Pinfish	Salt	omnivore	1.6		Mortality	NOED	Tissue Analyses On Survivors
Lagodon rhomboides	Pinfish	Salt	omnivore	1.6		Mortality	NOED	
Lagodon rhomboides	Pinfish	Salt	omnivore	1.6		Mortality	NOEL	Survival - No effect. Residues in surviving organisms
Fundulus similis	Killifish - Longnose	Salt	omnivore	2.1		Mortality	NOED	
Fundulus similis	Killifish - Longnose	Salt	omnivore	2.1		Mortality	NOEL	Survival - No effect. Residues in surviving organisms
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	2.4		Mortality	NOED	Tissue Analyses On Survivors
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	2.4		Mortality	NOED	
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	2.4		Mortality	NOEL	Survival - No effect. Residues in surviving organisms
Fundulus similis	Killifish - Longnose	Salt	omnivore	8		Mortality	NOED	Fish Are Fry (test 1)
Fundulus similis	Killifish - Longnose	Salt	omnivore	8		Mortality	NOED	
Fundulus similis	Killifish - Longnose	Salt	omnivore	8		Mortality	NOEL	Survival - No effect. Residues in surviving organisms

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Fundulus similis	Killifish - Longnose	Salt	omnivore	8.8		Mortality	NOED	Fish Are Fry (test 2)
Fundulus similis	Killifish - Longnose	Salt	omnivore	8.8		Mortality	NOEL	Survival - No effect. Residues in surviving organisms
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	10		Mortality	NOED	No effect on mortality.
Fundulus similis	Killifish - Longnose	Salt	omnivore	16		Mortality	NOED	
Fundulus similis	Killifish - Longnose	Salt	omnivore	16		Mortality	NOEL	Survival - No effect. Residues in surviving organisms
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	409		Mortality	NOEL	Survival - No effect.
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.36	I	Mortality	ED15	Tissue Analyses On Survivors
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.36		Mortality	LD15	
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.4	F	Mortality	LOED	32% Increase in mortality.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.4		Mortality	LOEL	Survival - Reduced.
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.54		Mortality	ED20	Tissue Analyses On Survivors
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.54		Mortality	LD20	
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.54		Mortality	LOEL	Survival - Reduced 20%. Residues in surviving organisms
Gambusia affinis	Mosquito fish	Fresh	invertivore	0.68		Mortality	LOEL	Survival - Reduced - Death. Radiotracer study
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.83		Mortality	ED65	Tissue Analyses On Survivors
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.83		Mortality	LD65	
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	0.83		Mortality	LOEL	Survival - Reduced >50%. Residues in suirviving organisms
Fundulus similis	Killifish - Longnose	Salt	omnivore	0.9		Mortality	ED25	Fish Are Adults
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.9		Mortality	LOEL	Survival - Reduced.
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	1.7		Mortality	ED90	Tissue Analyses On Survivors
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	1.7		Mortality	LD90	
Lagodon rhomboides	Pinfish	Salt	omnivore	1.9		Mortality	ED25	Tissue Analyses On Survivors
Lagodon rhomboides	Pinfish	Salt	omnivore	1.9		Mortality	LD25	
Lagodon rhomboides	Pinfish	Salt	omnivore	1.9		Mortality	LOEL	Survival - Reduced 25%. Residues in surviving organisms
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	2.4		Mortality	LD50	50% Mortality before and during spawning.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	2.4		Mortality	LD50	Survival - Reduced 50%.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	2.7		Mortality	ED25	Tissue Analyses On Survivors
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	2.7		Mortality	LD25	
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	2.7		Mortality	LOEL	Survival - Reduced 25%. Residues in surviving organisms

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	2.7	Mortality	LOEL	Survival - Reduced 25%. Residues in surviving organisms
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	3.3	Mortality	ED53	Tissue Analyses On Survivors
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	3.3	Mortality	LD53	
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	3.3	Mortality	LOEL	Survival - Reduced >50%. Residues in surviving organisms
Cyprinodon variegatus	Minnow - Sheepshea(	Estuarine	omnivore	4.1	Mortality	ED25	Tissue Analyses On Survivors
Cyprinodon variegatus	Minnow - Sheepshea(	Estuarine	omnivore	4.1	Mortality	LD25	
Cyprinodon variegatus	Minnow - Sheepshea(	Estuarine	omnivore	4.1	Mortality	LOEL	Survival - Reduced 25%. Residues in surviving organisms
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	4.8	Mortality	ED70	Tissue Analyses On Survivors
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	4.8	Mortality	LD70	
Fundulus similis	Killifish - Longnose	Salt	omnivore	6.1	Mortality	LD25	
Fundulus similis	Killifish - Longnose	Salt	omnivore	6.1	Mortality	LOEL	Survival - Reduced 25%. Residues in surviving organisms
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	8	Mortality	LD100	100% Mortality before and during spawning.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	8	Mortality	LOEL	Survival - Reduced - Death.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	8.1	Mortality	ED75	Tissue Analyses On Survivors
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	8.1	Mortality	LD75	
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	9.7	Mortality	ED68	Tissue Analyses On Survivors
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	9.7	Mortality	LD68	
Fundulus similis	Killifish - Longnose	Salt	omnivore	10	Mortality	ED17	Fish Are Fry (test 1)
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	18	Mortality	LD100	100% Mortality in 60 days.
Fundulus similis	Killifish - Longnose	Salt	omnivore	19	Mortality	ED15	Fish Are Fry (test 2)
Fundulus similis	Killifish - Longnose	Salt	omnivore	19	Mortality	LOEL	Survival - Reduced 15%. Residues in surviving organisms
Fundulus similis	Killifish - Longnose	Salt	omnivore	25	Mortality	ED35	Fish Are Juveniles
Fundulus similis	Killifish - Longnose	Salt	omnivore	25	Mortality	LD35	
Fundulus similis	Killifish - Longnose	Salt	omnivore	25	Mortality	LOEL	Survival - Reduced 35%. Residues in surviving organisms
Fundulus similis	Killifish - Longnose	Salt	omnivore	34	Mortality	ED53	Fish Are Fry (test 1)
Fundulus similis	Killifish - Longnose	Salt	omnivore	34	Mortality	LOED	
Fundulus similis	Killifish - Longnose	Salt	omnivore	34	Mortality	LOEL	Survival - Reduced 53%. Residues in surviving organisms
Cyprinodon variegatus	Minnow - Sheepshea(	Estuarine	omnivore	35	Mortality	ED85	Tissue Analyses On Survivors
Cyprinodon variegatus	Minnow - Sheepshea(	Estuarine	omnivore	35	Mortality	LD85	

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	35		Mortality	LOEL	Survival - Reduced 85%. Residues in surviving organisms
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	36		Mortality	LD90	90% mortality in 28 days.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	38		Mortality	LD100	100% mortality in 30 days. Residue at 15 days.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	38		Mortality	LD100	100% Mortality in 30 days.
Fundulus similis	Killifish - Longnose	Salt	omnivore	47		Mortality	ED35	Fish Are Fry (test 2)
Fundulus similis	Killifish - Longnose	Salt	omnivore	47		Mortality	LOEL	Survival - Reduced 35%. Residues in surviving organisms
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	52		Mortality	LOED	Increased mortality after 150 days.
Fundulus similis	Killifish - Longnose	Salt	omnivore	102		Mortality	ED95	Fish Are Juveniles
Fundulus similis	Killifish - Longnose	Salt	omnivore	102		Mortality	LOEL	Survival - Reduced 95%. Residues in surviving organisms
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.4		Growth	NOED	No significant difference in length and weight.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.4	F	Growth	NOEL	Growth - No effect.
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	0.8		Growth	NOEL	Growth - No effect. Fish fed diet containing 63 mg/kg vitamin C
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	0.8		Growth	NOED	No effect on growth.
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	1.2		Growth	NOED	No effect on growth.
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	3.3		Growth	NOED	No significant difference in growth. Diet contained 670 mg/kg Vitamin C.
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	3.3		Growth	NOEL	Growth - No effect. Fish fed diet containing 670 mg/kg vitamin C
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	4		Growth	NOEL	Growth - No effect. Fish fed diet containing 5000 mg/kg vitamin C
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	4.4		Growth	NOED	No significant difference in growth. Diet contained 5000 mg/kg Vitamin C.
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	5.4		Growth	NA	Reduction in growth.
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	14		Growth	NA	Reduction in growth.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.4	F	Growth	LOED	Significant decrease in weight and length. Residue at 60 days.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.4		Growth	LOED	Significant reduced length and weight. Residue at 60 days.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.4		Growth	LOEL	Growth - Reduced.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.9		Growth	LOED	Reduced growth of fry.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	1.4		Growth	LOED	Reduced growth of fry.

TABLE G-3
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PESTICIDES

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	1.8		Growth	LOED	Significant decrease in weight gain. Diet contained 63 mg/kg Vitamin C.
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	1.8		Growth	LOEL	Growth - Reduced. Fish fed diet containing 63 mg/kg vitamin C
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	1.8		Growth	LOED	Reduced growth of fry.
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	1.8		Growth	LOED	Reduction in growth.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	2.4		Growth	LOED	24% Decrease in weight. Decreased length.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	2.4		Growth	LOEL	Growth - Reduced.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	5.9		Growth	LOED	Significant Reduction In Growth, Both Length And Weight
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	8		Growth	ED43	43% Decrease in weight. Decreased length.
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	9.4		Growth	LOED	Significant decrease in weight gain. Diet contained 670 mg/kg Vitamin C.
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	9.4		Growth	LOEL	Growth - Reduced. Fish fed diet containing 670 mg/kg vitamin C
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	13		Growth	ED21	Significant Reduction In Length And 21% Reduction in Weight
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	22		Growth	LOED	Significant Reduction In Growth, Both Length And Weight
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	47	I	Growth	ED34	Tissue Analyses On Survivors
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	47		Growth	ED34	
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	52		Growth	LOED	Significant Reduction In Growth, Both Length And Weight
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	85		Growth	ED27	Tissue Analyses On Survivors
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	85		Growth	ED27	
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	199		Growth	ED64	Tissue Analyses On Survivors
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	199		Growth	ED64	
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	199		Growth	LOEL	Growth - Reduced >50%.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	409		Growth	ED96	Tissue Analyses On Survivors
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	409		Growth	ED96	
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.2		Reproduction	NOED	No decrease in # of eggs/spawn and eggs/female.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.2	F	Reproduction	NOEL	Reproduction - No effect.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.4	F	Reproduction	LOED	Non-significant decrease in # of eggs/spawn and eggs/female.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.4		roduction (egg vi	LOEL	Reproduction (egg viability) - Reduced.
2,4-D								

TABLE G-3
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PESTICIDES

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Squalus acanthias	Spiny Dogfish	Salt	piscivore	1	F	Mortality	NOED	No Effect On Mortality In 24 Hours
2,4,5-T								
Squalus acanthias	Spiny Dogfish	Salt	piscivore	1	F	Mortality	NOED	No Effect On Mortality In 24 Hours
Daphnia magna	Water flea	Fresh	filter feeder	1.4	I	Mortality	NOED	Model ecosystem exposure. No significant difference in population. Radiolabelled 2,4,5-T added to sediment and leached into water. Residue at 32 days.
Helisoma sp.	Snail	Fresh	herbivore	1.6		Mortality	NOED	Model ecosystem exposure. No significant difference in population. Radiolabelled 2,4,5-Tadded to sediment and leached into water. Residue at 15 days.
Gambusia affinis	Mosquito fish	Fresh	invertivore	3.7		Mortality	NOED	Model ecosystem exposure. No significant difference in population. Radiolabelled 2,4,5-T added to sediment and leached into water. Residue at 32 days.

Notes:
Concentration units in ug/g wet weight tissue unless otherwise specified.
Where available, NOAELs and LOAELs are identified separately for fish (F), invertebrates (I), and wildlife (W).
Information compiled from the following sources:
1. ACOE, 2002. Tissue Effects Database; Army Corps of Engineers, U.S. Waterways Experiment Station, Vicksburg, MS.
2. Jarvinen and Ankley, 1999.
3. USEPA, 2000. Bioaccumulation Summary; United States Environmental Protection Agency; EPA-823-R-00-002.

Prepared by: SGD
Checked by: NAR

TABLE G-4
EGG TISSUE RESIDUE EFFECT DATA SUMMARY - PESTICIDES

Baselilne Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
4,4`-DDD								
Falco peregrinus	Peregrine falcon	Terrestrial	predator	0.009	W	Reproduction	LOED	11.4% eggshell thinning; Kola Penninsula, Russia.
4,4`-DDE								
Phegadis chihi	White-faced ibis	Terrestrial	omnivore	1.0		Reproduction	NOED	1.8 young produced per active nest.
Egretta thula	Snowy egret	Terrestrial	omnivore	1.0		Reproduction	NOED	2.2 young produced per active nest (young produced no adjusted for sample egg collected).
Haliaeetus leucocephalus	Bald eagle	Terrestrial	predator	2.2		Reproduction	NOED	1.0 young produced per active nest.
Phegadis chihi	White-faced ibis	Terrestrial	omnivore	2.5		Reproduction	NOED	1.8 young produced per active nest.
Haliaeetus leucocephalus	Bald eagle	Terrestrial	predator	2.9		Reproduction	NOED	1.0 young produced per active nest.
Egretta thula	Snowy egret	Terrestrial	omnivore	3.0	W	Reproduction	NOED	2.4 young produced per active nest (young produced no adjusted for sample egg collected).
Falco peregrinus	Peregrine Falcon	Terrestrial	predator	15		Reproduction	NOED	1.8 - 2.0 young produced per active nest (young produced no adjusted for sample egg collected).
Aquila chrysaetos	Golden eagle	Terrestrial	predator	0.1		Reproduction	LOED	Mean % eggshell thinning = 7%.
Aquila chrysaetos	Golden eagle	Terrestrial	predator	0.1		Reproduction	LOED	Mean % eggshell thinning = 1%.
Aquila chrysaetos	Golden eagle	Terrestrial	predator	0.2		Reproduction	LOED	Mean % eggshell thinning = 3%.
Aquila chrysaetos	Golden eagle	Terrestrial	predator	0.3		Reproduction	LOED	Mean % eggshell thinning = 4%.
Aquila chrysaetos	Golden eagle	Terrestrial	predator	0.3		Reproduction	LOED	Mean % eggshell thinning = 5%.
Phegadis chihi	White-faced ibis	Terrestrial	omnivore	1.0		Reproduction	LOED	Mean % eggshell thinning = 8%.
Egretta thula	Snowy egret	Terrestrial	omnivore	1.0		Reproduction	LOED	Mean % eggshell thinning = 3%.
Phegadis chihi	White-faced ibis	Terrestrial	omnivore	2.0		Reproduction	LOED	Mean % eggshell thinning = 12%.
Egretta thula	Snowy egret	Terrestrial	omnivore	2.0		Reproduction	LOED	Mean % eggshell thinning = 12%.
Falco peregrinus	Peregrine Falcon	Terrestrial	predator	3.5		Reproduction	LOED	11.4% eggshell thinning; Kola Penninsula, Russia.
Ardea herodias	Great blue heron	Terrestrial	omnivore	4.0		Reproduction	LOED	Mean % eggshell thinning = 10%.
Haliaeetus leucocephalus	Bald eagle	Terrestrial	predator	4.9		Reproduction	LOED	0.5 young produced per active nest.
Ardea herodias	Great blue heron	Terrestrial	omnivore	5.0		Reproduction	LOED	Mean % eggshell thinning = 13%.
Phegadis chihi	White-faced ibis	Terrestrial	omnivore	6.0		Reproduction	LOED	1.3 young produced per active nest.
Egretta thula	Snowy egret	Terrestrial	omnivore	7.5		Reproduction	LOED	1.0 young produced per active nest (young produced no adjusted for sample egg collected).
Haliaeetus leucocephalus	Bald eagle	Terrestrial	predator	9.1		Reproduction	LOED	0.3 young produced per active nest.

TABLE G-4
EGG TISSUE RESIDUE EFFECT DATA SUMMARY - PESTICIDES

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Haliaeetus leucocephalus	Bald eagle	Terrestrial	predator	10		Reproduction	LOED	Mean % eggshell thinning = 10%.
Haliaeetus leucocephalus	Bald eagle	Terrestrial	predator	12		Reproduction	LOED	1.0 young produced per active nest.
Phegadis chihi	White-faced ibis	Terrestrial	omnivore	12		Reproduction	LOED	0.8 young produced per active nest.
Egretta thula	Snowy egret	Terrestrial	omnivore	15		Reproduction	LOED	1.0 young produced per active nest (young produced no adjusted for sample egg collected).
Phegadis chihi	White-faced ibis	Terrestrial	omnivore	16		Reproduction	LOED	0.6 young produced per active nest.
Sula bassensis	Northern gannet	Terrestrial	piscivore	19		Reproduction	LOED	Mean % eggshell thinning = 17%.
Falco peregrinus	Peregrine Falcon	Terrestrial	predator	30	W	Reproduction	LOED	1.0 young produced per active nest (young produced no adjusted for sample egg collected).
4,4`-DDT								
Fundulus heteroclitus	Mummichog	Estuarine	omnivore	0.16		Mortality	NOEL	Survival - No effect. Radiotracer study; Female fish exposed to DDT, eggs collected and fertilized 2 d after treatment; Residues = DDT + metabolites
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.2		Mortality	NOED	No difference in hatchability or mortality. Parental exposure to 0.05 mg DDT/kg/week in diet. Assume wet weight for residues. Residues include DDT and metabolites.
Fundulus heteroclitus	Mummichog	Estuarine	omnivore	0.25	F	Mortality	NOEL	Survival - No effect. Radiotracer study; Residues = DDT + metabolites
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	1.6	F	Mortality	LOED	Significant decrease in hatchability. Parental exposure to 1 mg DDT/kg/week in diet. Assume wet weight for residues. Residues include DDT and metabolites.
Falco peregrinus	Peregrine Falcon	Terrestrial	predator	0.022	W	Reproduction	LOED	11.4% eggshell thinning; Kola Penninsula, Russia.
Dieldrin								
Falco peregrinus	Peregrine Falcon	Terrestrial	predator	0.059	W	Reproduction	LOED	11.4% eggshell thinning; Kola Penninsula, Russia.
Heptachlor								
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	0.028	F	Mortality	LOED	Rearing mortality

TABLE G-4
EGG TISSUE RESIDUE EFFECT DATA SUMMARY - PESTICIDES

Baselilne Ecological Risk Assessment - Interim Final
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North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Toxaphene								
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.4	F	Mortality	NOED	No difference in egg viability. Parents exposed to 39 ng/L for up to 161 days.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.9	F	Mortality	LOED	Significant decrease in egg viability. Parents exposed to 68 ng/L for up to 161 days.

Notes:
Concentration units in ug/g wet weight tissue unless otherwise specified.
Where available, NOAELs and LOAELs are identified separately for fish (F), invertebrates (I), and wildlife (W).
Information compiled from the following sources:
1. ACOE, 2002. Tissue Effects Database; Army Corps of Engineers, U.S. Waterways Experiment Station, Vicksburg, MS.
2. Jarvinen and Ankley, 1999.
3. USEPA, 2000. Bioaccumulation Summary; United States Environmental Protection Agency; EPA-823-R-00-002.

Prepared by: SGD
Checked by: NAR

TABLE G-5
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - AROCLORS

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Aroclor 1016								
Lagodon rhomboides	Pinfish	Salt	omnivore	0.81		Mortality	NOED	No effect on fry mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	0.84	F	Mortality	NOED	No effect on adult mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	1.5		Mortality	NOED	No effect on adult mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	2.3		Mortality	NOED	No effect on juvenile mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	4.9		Mortality	NOED	No effect on fry mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	5.4		Mortality	NOED	No effect on adult mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	5.9		Mortality	NOED	No effect on fry mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	8.9		Mortality	NOED	No effect on juvenile mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	10		Mortality	NOED	No effect on juvenile mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	11		Mortality	NOED	No effect on juvenile mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	12		Mortality	NOED	No effect on adult mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	21		Mortality	NOED	No statistically significant increase in mortality
Lagodon rhomboides	Pinfish	Salt	omnivore	22		Mortality	NOED	No effect on fry mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	22		Mortality	NOED	No effect on adult mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	26		Mortality	NOED	No effect on fry mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	38		Mortality	NOED	No effect on fry mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	46		Mortality	NOED	No effect on adult mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	54		Mortality	NOED	No effect on juvenile mortality in 28 days.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	57		Mortality	NOEL	Survival - No effect.
Lagodon rhomboides	Pinfish	Salt	omnivore	57		Mortality	NOED	No effect on juvenile mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	66		Mortality	NOED	No effect on fry mortality in 28 days.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	77		Mortality	NOEL	Survival - No effect.
Lagodon rhomboides	Pinfish	Salt	omnivore	79		Mortality	NOED	No effect on juvenile mortality in 28 days.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	100		Mortality	NOEL	Survival - No effect.
Lagodon rhomboides	Pinfish	Salt	omnivore	100		Mortality	NOED	No effect on adult mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	110		Mortality	NOED	No effect on adult mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	111		Mortality	NOED	No statistically significant increase in mortality
Lagodon rhomboides	Pinfish	Salt	omnivore	170		Mortality	NOED	No statistically significant increase in mortality
Lagodon rhomboides	Pinfish	Salt	omnivore	220		Mortality	NOED	No effect on adult mortality in 28 days.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	230		Mortality	NOEL	Survival - No effect.
Lagodon rhomboides	Pinfish	Salt	omnivore	230		Mortality	NOED	No effect on juvenile mortality in 28 days.
Lagodon rhomboides	Pinfish	Salt	omnivore	1.1	F	Mortality	NA	38% mortality in 96 hours
Lagodon rhomboides	Pinfish	Salt	omnivore	2.2		Mortality	LOED	Statistically significant increase in mortality.
Lagodon rhomboides	Pinfish	Salt	omnivore	3.8		Mortality	NA	43% mortality in 96 hours
Limulus polyphemus	Horshoe crab	Estuarine	detritivore	11.2	I	Mortality	NA	Less than 50% mortality starting with T2-crabs.

TABLE G-5
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - AROCLORS

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Lagodon rhomboides	Pinfish	Salt	omnivore	22		Mortality	NA	93% mortality in 96 hours
Lagodon rhomboides	Pinfish	Salt	omnivore	44		Mortality	LOED	8% mortality in 96 hours
Lagodon rhomboides	Pinfish	Salt	omnivore	106		Mortality	NA	18% mortality in 96 hours.
Lagodon rhomboides	Pinfish	Salt	omnivore	111		Mortality	LOED	33% mortality in 96 hours
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	200		Mortality	LOEL	Survival - Reduced.
Lagodon rhomboides	Pinfish	Salt	omnivore	200		Mortality	LOED	88% juvenile mortality in 28 days
Lagodon rhomboides	Pinfish	Salt	omnivore	205		Mortality	LD50	50% mortality
Lagodon rhomboides	Pinfish	Salt	omnivore	205		Mortality	LOED	Statistically significant increase in mortality
Lagodon rhomboides	Pinfish	Salt	omnivore	620		Mortality	LOED	Statistically significant increase in mortality.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	1100		Mortality	LOEL	Survival - Reduced 88%.
Lagodon rhomboides	Pinfish	Salt	omnivore	1100		Mortality	LOED	Letahl to 86% of fry in 28 days
Crassostrea virginica	Oyster	Estuarine	filter-feeder	4	I	Growth	ED10	Reduction in shell growth
Limulus polyphemus	Horshoe crab	Estuarine	detritivore	11.2		Growth	NA	Delayed moulting: less than 50% molted after 96 days st
Limulus polyphemus	Horshoe crab	Estuarine	detritivore	31.9		Growth	NA	Delayed moulting: less than 50% molted after 96 days st
Aroclor 1232								
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	14	F	Mortality	NOEL	Survival - No effect. Radiotracer study
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	14	F	Growth	NOEL	Growth - No effect. Radiotracer study
Aroclor 1242								
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	11	F	Mortality	NOED	No effect on mortality
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	14		Mortality	NOED	No effect on mortality
Hyalella azteca	Amphipod	Fresh	detritivore	30		Mortality	NOED	Radiolabeled Compounds, Exp_conc = 3-100
Gammarus pseudolimnaeus	Amphipod	Fresh	detritivore	246	I	Mortality	NOEL	Survival - No effect.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	278		Mortality	NOEL	Survival - No effect.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	1.3	F	Mortality	LOEL	Survival - Reduced - Death. LBB affected by time of deat
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	1.3		Mortality	LOED	10% Mortality
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2.7		Mortality	LOEL	Survival - Reduced 75%*. *Possible mixture effect with 0
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	102		Mortality	LOEL	Survival - Reduced - Death. LBB affected by time of deat
Gammarus pseudolimnaeus	Amphipod	Fresh	detritivore	409	I	Mortality	LOEL	Survival - Reduced - Death.
Hyalella azteca	Amphipod	Fresh	detritivore	28	I	Growth	NOEL	Growth - No effect. Radiotracer study
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	278	F	Growth	NOEL	Growth - No effect.
Hyalella azteca	Amphipod	Fresh	detritivore	28		Reproduction	NOEL	Reproduction - No effect. Radiotracer study
Gammarus pseudolimnaeus	Amphipod	Fresh	detritivore	71	I	Reproduction	NOEL	Reproduction - No effect.
Gammarus pseudolimnaeus	Amphipod	Fresh	detritivore	246	I	Reproduction	LOEL	Reproduction - Reduced.

TABLE G-5
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - AROCLORS

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Aroclor 1248								
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	13		Mortality	NOEL	Survival - No effect. Radiotracer study
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	190	F	Mortality	NOEL	Survival - No effect. Female fish had the highest residues
Gammarus pseudolimnaeus	Amphipod	Fresh	detritivore	552	I	Mortality	NOEL	Survival - No effect.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	2.8	F	Growth	NOEL	Growth - No effect. Female fish had the highest residue l
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	13		Growth	NOEL	Growth - No effect. Radiotracer study
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	11	F	Growth	LOEL	Growth - Reduced. Female fish had the highest residue l
Gammarus pseudolimnaeus	Amphipod	Fresh	detritivore	127	I	Reproduction	NOEL	Reproduction - No effect.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	190	F	Reproduction	NOEL	Reproduction - No effect. Female fish had the highest res
Gammarus pseudolimnaeus	Amphipod	Fresh	detritivore	552	I	Reproduction	LOEL	Reproduction - Reduced.
Aroclor 1254								
Macoma nasuta	Clam - Bent nose	Salt	filter feeder	0.02		Mortality	NOED	100% survival; tissue burdens and toxicity were determin
Macoma nasuta	Clam - Bent nose	Salt	filter feeder	0.021		Mortality	NOED	100% survival; tissue burdens and toxicity were determin
Macoma nasuta	Clam - Bent nose	Salt	filter feeder	0.028		Mortality	NOED	100% survival; tissue burdens and toxicity were determin
Macoma nasuta	Clam - Bent nose	Salt	filter feeder	0.035		Mortality	NOED	100% survival; tissue burdens and toxicity were determin
Orconectes nais	Crayfish	Fresh	omnivore	0.04		Mortality	NOED	Radiolabeled Compound
Orconectes nais	Crayfish	Fresh	omnivore	0.14		Mortality	NOED	No effect on survival in 48 hours
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	0.26		Mortality	NOEL	Survival - No effect. Embryos hatched and larvae raised
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	0.26		Mortality	NOEL	Survival - No effect. Embryos hatched and larvae raised
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.42		Mortality	NOEL	Survival - No effect.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.42		Mortality	NOED	No significant increase in mortality in 90 days in field
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.42		Mortality	NOEL	Survival - No effect.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.5		Mortality	NOEL	Survival - No effect.
Macoma nasuta	Clam - Bent nose	Salt	filter feeder	0.98		Mortality	NOED	99% survival; tissue burdens and toxicity were determine
Lagodon rhomboides	Pinfish	Salt	omnivore	0.98	F	Mortality	NOED	No effect on survival in 48 hours
Corydalus cornutus	Midge	Fresh	omnivore	1.0		Mortality	NOED	Radiolabeled Compound
Chaoborus punctipennis	Midge	Fresh	omnivore	1.2		Mortality	NOED	Radiolabeled Compound
Orconectes nais	Crayfish	Fresh	omnivore	1.3		Mortality	NOED	No effect on survival in 48 hours
Pteronarcys dorsata	Giant Black Stonefly	Fresh	omnivore	1.4		Mortality	NOED	Radiolabeled Compound
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	2		Mortality	NOEL	Survival - No effect.
Palaemonetes kadiakensis	Shrimp - Grass	Estuarine	omnivore	3.2		Mortality	NOED	Radiolabeled Compound
Lagodon rhomboides	Pinfish	Salt	omnivore	3.8		Mortality	NOED	No effect on survival in 48 hours
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	5.4		Mortality	NOEL	Survival - No effect.
Culex tarsalis	Mosquito	Fresh	detritivore	5.4		Mortality	NOED	Radiolabeled Compound
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	5.4		Mortality	NOED	No significant increase in mortality in 7 days.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	5.4		Mortality	NOEL	Survival - No effect.

TABLE G-5
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - AROCLORS

Baseline Ecological Risk Assessment - Interim Final
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North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Gammarus pseudolimnaeus	Amphipod	Fresh	detritivore	7.8		Mortality	NOED	Radiolabeled Compound
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	8.2		Mortality	NOED	No increase in mortality.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	8.5		Mortality	NOEL	Survival - No effect.
Macoma nasuta	Clam - Bent nose	Salt	filter feeder	9.2		Mortality	NOED	99% survival; tissue burdens and toxicity were determine
Daphnia magna	Water flea	Fresh	filter feeder	10	I	Mortality	NOED	Radiolabeled Compound
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	17		Mortality	NOEL	Survival - No effect.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	17		Mortality	NOED	No significant increase in mortality in 35 days.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	17		Mortality	NOEL	Survival - No effect.
Leiostomus xanthurus	Spot	Salt	omnivore	17		Mortality	NOEL	Survival - No effect. Salinity, 10 - 34 ppt
Lagodon rhomboides	Pinfish	Salt	omnivore	17		Mortality	NOED	No effect on survival in 48 hours
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	18		Mortality	NOEL	Survival - No effect.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	18		Mortality	NOED	No significant increase in mortality in 16 days.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	18		Mortality	NOEL	Survival - No effect.
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	21		Mortality	NOEL	Survival - No effect. Radiotracer study
Callinectes sapidus	Crab - Blue	Salt	predator	23		Mortality	NOED	No effect on survival in 20 days
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	27		Mortality	NOEL	Survival - No effect. Embryos hatched in clean water
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	27		Mortality	NOEL	Survival - No effect. Embryos hatched in clean water
Orconectes nais	Crayfish	Fresh	omnivore	33		Mortality	NOED	No effect on survival in 48 hours
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	47		Mortality	NOED	No effect on survival observed.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	49		Mortality	NOEL	Survival - No effect.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	49		Mortality	NOEL	Survival - No effect.
Oncorhynchus kisutch	Salmon - Coho	Anadromous	piscivore	54		Mortality	NOEL	Survival - No effect. Radiotracer study
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	71		Mortality	NOEL	Survival - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	81		Mortality	NOEL	Survival - No effect.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	101		Mortality	NOED	No effect on mortality
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	425		Mortality	NOED	No effect on mortality
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	741		Mortality	NOEL	Survival - No effect.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	1.5	F	Mortality	LOED	Significant increase in mortality. Exposure to 20.8 ng/L i
Lagodon rhomboides	Pinfish	Salt	omnivore	14		Mortality	LOEL	Survival - Reduced 66%. Salinity, 20 - 32 ppt
Orconectes nais	Crayfish	Fresh	omnivore	16	I	Mortality	NA	Lethal to 18 of 25 fish in 20 days.
Macoma nasuta	Clam - Bent nose	Salt	filter feeder	18.6		Mortality	ED26	26% survival; tissue burdens and toxicity were determine
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	27		Mortality	LOEL	Survival - Reduced 45%.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	27		Mortality	LOED	45% Increase in mortality in 16 days.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	27		Mortality	LOEL	Survival - Reduced 45%.
Leiostomus xanthurus	Spot	Salt	omnivore	46		Mortality	LOEL	Survival - Reduced 51-53%. Salinity, 16 - 32 ppt
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	65		Mortality	LD60	60% Mortality in 7 days.

TABLE G-5
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - AROCLORS

Baseline Ecological Risk Assessment - Interim Final
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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	65		Mortality	LD60	60% Mortality in 7 days.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	65		Mortality	LOEL	Survival - Reduced 60%.
Lagodon rhomboides	Pinfish	Salt	omnivore	109		Mortality	LOEL	Survival - Reduced 41%. Salinity, 14 - 34 ppt
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	125		Mortality	LOED	18% increase in mortality.
Acheta domesticus	Cricket - House	Terrestrial	omnivore	144		Mortality	LOED	14-d soil bioassay; despite high mortality no significant di
Leiostomus xanthurus	Spot	Salt	omnivore	152		Mortality	LOEL	Survival - Reduced 62%. Salinity, 23 - 34 ppt
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	170		Mortality	LOEL	Survival - Reduced 27%. Embryos hatched in clean wate
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	170		Mortality	LOEL	Survival - Reduced 27%. Embryos hatched in clean wate
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	284		Mortality	LD50	50% Mortality.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	419		Mortality	LD100	100% Mortality in 127 days. Residue measured at 48 da
Oncorhynchus kisutch	Salmon - Coho	Anadromous	piscivore	645		Mortality	LOEL	Survival - Reduced - Death. Radiotracer study; All fish di
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	648		Mortality	LOEL	Survival - Reduced - Death.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	2		Growth	NOEL	Growth - No effect.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	8.1		Growth	NA	No effect on survival in 96 hours.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	8.2		Growth	NOED	No significant difference in total weight or in liver:body we
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	8.5		Growth	NOEL	Growth - No effect.
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	21		Growth	NOEL	Growth - No effect. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	26		Growth	NOED	No significant difference in weight gain. Exposure to 327
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	31		Growth	NOEL	Growth - No effect.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	33		Growth	NA	No effect on survival in 96 hours.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	47		Growth	NOED	No effect on weight observed.
Oncorhynchus kisutch	Salmon - Coho	Anadromous	piscivore	54	F	Growth	NOEL	Growth - No effect. Radiotracer study
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	81		Growth	NOEL	Growth - No effect.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	101		Growth	NOED	No effect on growth
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	741		Growth	NOEL	Growth - No effect.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	8.1	I	Growth	NA	19% reduction in rate of shell growth.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	33		Growth	NA	41% reduction in rate of shell growth.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	71	F	Growth	LOEL	Growth - Reduced.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	425		Growth	LOED	Reduced growth
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	12	F	Reproduction	NOED	No effect on reproductive parameters; measurement end
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	54		Reproduction	NOEL	Reproduction - No effect.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	14	F	Reproduction	LOED	Reproduction inhibited; frequency and fecundity 5-30% o
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	83		Reproduction	LOEL	Reproduction - Reduced.

TABLE G-5
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - AROCLORS

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Aroclor 1260								
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	32	F	Mortality	NOEL	Survival - No effect. Radiotracer study
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	350		Mortality	NOEL	Survival - No effect. Female fish had the highest residues
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.36	F	Mortality	LOEL	Survival - Reduced - Death. LBB affected by time of deat
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	161		Mortality	LOEL	Survival - Reduced - Death. LBB affected by time of deat
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	32		Growth	NOEL	Growth - No effect. Radiotracer study
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	350	F	Growth	NOEL	Growth - No effect. Female fish had the highest residues
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	350	F	Reproduction	NOEL	Reproduction - No effect. Female fish had the highest res
Aroclor 1268								
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.45	F	Mortality	LOEL	Survival - Reduced - Death.
PCBs								
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.1		Mortality	NOEL	Survival - No effect.
Mercenaria mercenaria	Clam - Quahog	Salt	filter feeder	0.12		Mortality	NOEL	Survival - No effect.
Corbicula fluminea	Clam - Asiatic	Fresh	filter feeder	0.45		Mortality	NOEL	Survival - No effect.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	0.56		Mortality	NOED	Residues in surviving second generation fry ranged from
Mytilus edulis	Mussel - Blue	Salt	filter feeder	0.6		Mortality	NOED	No significant difference in ability to survive anoxic stress
Nereis virens	Polychaete	Salt	detritivore	0.63		Mortality	NOEL	Survival - No effect.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.76		Mortality	NOED	PCB dosed with acetone carrier; no effect on mortality.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.76		Mortality	NOED	PCB dosed with no acetone carrier; no effect on mortality
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	1.3	I	Mortality	NOED	No Effect On Survival In 48 Hours
Ephemera danica	Mayfly	Fresh	detritivore	1.5		Mortality	NOED	
Macoma nasuta	Clam - Bent nose	Salt	filter feeder	1.7		Mortality	NOED	No Effect On Mortality
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	1.8		Mortality	NOED	PCB With No Acetone Carrier; No Effect On Mortality. C
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	2.1		Mortality	NOED	PCB dosed with no acetone carrier; no effect on mortality
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	2.3		Mortality	NOED	PCB dosed with acetone carrier; no effect on mortality.
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	11		Mortality	NOED	No Effect On Mortality
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	14		Mortality	NOED	No Effect On Mortality
Lagodon rhomboides	Pinfish	Salt	omnivore	17		Mortality	NOED	No Effect On Survival In 48 Hours
Callinectes sapidus	Crab - Blue	Salt	predator	23		Mortality	NOED	No Effect On Survival In 20 Days
Leiostomus xanthurus	Spot	Salt	omnivore	27		Mortality	NOED	Aroclor 1254 40mm animal length
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	30		Mortality	NOED	No Effect On Mortality
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	33		Mortality	NOED	No Effect On Survival In 96 Hours
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	40.3		Mortality	NOEL	Survival - No effect.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	49		Mortality	NOED	No effect on mortality.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	57		Mortality	NOED	No Effect On Fry Mortality In 28 Days
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	110		Mortality	NOED	No Effect On Adult Mortality In 28 Days

TABLE G-5
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - AROCLORS

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	230		Mortality	NOED	No Effect On Juvenile Mortality In 28 Days
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	425		Mortality	NOED	No increase in mortality.
Oncorhynchus kisutch	Salmon - Coho	Anadromous	piscivore	0.15	F	Mortality	LOED	Significant increase (6%) in mortality of smolts during se
Mytilus edulis	Mussel - Blue	Salt	filter feeder	1.4	I	Mortality	LOED	Significant decrease in ability to survive anoxic stress aft
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	3.9		Mortality	LD100	100% Mortality In 48 Hours
Lagodon rhomboides	Pinfish	Salt	omnivore	14		Mortality	LD65	Aroclor 1254 30mm animal length
Penaeus duorarum	Shrimp - Pink	Estuarine	omnivore	16		Mortality	LD72	72% Mortality in 20 days.
Leiostomus xanthurus	Spot	Salt	omnivore	17		Mortality	LD17	Aroclor 1254 25mm animal length
Leiostomus xanthurus	Spot	Salt	omnivore	46		Mortality	LD50	Aroclor 1254 24mm animal length
Lagodon rhomboides	Pinfish	Salt	omnivore	109		Mortality	LD40	Aroclor 1254 27mm animal length
Leiostomus xanthurus	Spot	Salt	omnivore	120		Mortality	LD53	Aroclor 1254 24mm animal length
Leiostomus xanthurus	Spot	Salt	omnivore	152		Mortality	LD64	Aroclor 1254 74mm animal length
Phoxinus phoxinus	Minnow	Estuarine	omnivore	170		Mortality	LOED	Doubling of mortality rate compared to controls after 300
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	200		Mortality	LOED	Lethal To 86% Of Fry In 28 Days
Carassius auratus	Goldfish	Fresh	omnivore	250		Mortality	LD50	50% mortality in 22 days.
Carassius auratus	Goldfish	Fresh	omnivore	253		Mortality	LD50	50% mortality in 22 days.
Carassius auratus	Goldfish	Fresh	omnivore	256		Mortality	LD50	50% mortality in 22 days.
Carassius auratus	Goldfish	Fresh	omnivore	271		Mortality	LD50	50% mortality in 22 days.
Carassius auratus	Goldfish	Fresh	omnivore	293		Mortality	LD50	50% mortality in 22 days.
Carassius auratus	Goldfish	Fresh	omnivore	293		Mortality	LD50	50% mortality in 22 days.
Carassius auratus	Goldfish	Fresh	omnivore	324		Mortality	LD50	50% mortality in 22 days.
Oncorhynchus kisutch	Salmon - Coho	Anadromous	piscivore	645		Mortality	ED100	Radiolabeled - Contam. Food Fed.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	1100		Mortality	LOED	88% Juvenile Mortality In 28 Days
Brachydanio rerio	Zebra fish	Fresh	omnivore	4300		Mortality	LOEL	Survival - Reduced 83%.
Oncorhynchus kisutch	Salmon - Coho	Anadromous	piscivore	0.6		Growth	NOED	No Effect On Growth (weight gain)
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.76		Growth	NOED	Pcb Dosed With and Without Acetone Carrier; No Effect
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.76	F	Growth	NOED	PCB with no acetone carrier; no effect on growth (weight
Ephemera danica	Mayfly	Fresh	detritivore	1.5		Growth	NOED	
Macoma nasuta	Clam - Bent nose	Salt	filter feeder	1.7	I	Growth	NOED	No difference in weight change.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	2.1		Growth	NOED	PCB with no acetone carrier; no effect on growth (weight
Oncorhynchus tschawytscha	Salmon - Chinook	Anadromous	piscivore	3.5		Growth	NOED	No effect on weight gain.
Morone saxatilis	Bass - Striped	Estuarine	piscivore	4.4		Growth	NOED	No significant difference in length and weight gain in larv
Oncorhynchus kisutch	Salmon - Coho	Anadromous	piscivore	14		Growth	NOED	No difference in hepatosomatic index.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	101		Growth	NOED	No effect on growth rate.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	1.8	F	Growth	LOED	PCB With No Acetone Carrier; Enhanced Growth (weight
Oncorhynchus kisutch	Salmon - Coho	Anadromous	piscivore	2.3		Growth	LOED	Significant increased rate of growth (weight gain).

TABLE G-5
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - AROCLORS

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	2.4		Growth	LOED	PCB Dosed With Acetone Carrier; Enhanced Growth (we
Pleuronectes americanus	Flounder - Winter	Estuarine	bottom feeder	7.1		Growth	LOED	Residue measured in eggs from wild fish. Reduced leng
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	8.1	I	Growth	ED19	19% Reduction In Rate Of Shell Growth
Oncorhynchus kisutch	Salmon - Coho	Anadromous	piscivore	9.8		Growth	LOED	Significant increase in hepatosomatic index. Concurrent
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	14		Growth	LOED	40% Reduction in body weight. Increased liver/body wei
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	33		Growth	ED41	41% Reduction In Rate Of Shell Growth
Oncorhynchus kisutch	Salmon - Coho	Anadromous	piscivore	43		Growth	LOED	Significant increase in hepatosomatic index.
Phoxinus phoxinus	Minnow	Estuarine	omnivore	170		Growth	LOED	Increased growth.
Phoxinus phoxinus	Minnow	Estuarine	omnivore	180		Growth	LOED	Significantly increased growth at 79 days. Residue meas
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	425		Growth	LOED	Reduced growth rate (weight and height).
Phoxinus phoxinus	Minnow	Estuarine	omnivore	1.6	F	Reproduction	NOED	No significant reduction in time to hatch. Residues meas
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	110		Reproduction	NOED	No effect on fertilization of eggs. Residue in eggs of 66 r
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	0.88	F	Reproduction	LOED	Increase in fecundity
Phoxinus phoxinus	Minnow	Estuarine	omnivore	15		Reproduction	LOED	Reduction in time to hatch. Fry death within 1 week of ha
Phoxinus phoxinus	Minnow	Estuarine	omnivore	170		Reproduction	ED85	85% reduction in hatchability of eggs.
Phoxinus phoxinus	Minnow	Estuarine	omnivore	170		Reproduction	ED83	83% Reduction in hatchability of eggs. Residues measu

Notes:
Concentration units in ug/g wet weight tissue unless otherwise specified.
Where available, NOAELs and LOAELs are identified separately for fish (F), invertebrates (I), and wildlife (W).
Information compiled from the following sources:
1. ACOE, 2002. Tissue Effects Database; Army Corps of Engineers. U.S. Waterways Experiment Station, Vicksburg, MS.
2. Jarvinen and Ankley, 1999.
3. USEPA, 2000. Bioaccumulation Summary; United States Environmental Protection Agency; EPA-823-R-00-002.

Prepared by: SGD
Checked by: NAR

TABLE G-6
EGG TISSUE RESIDUE EFFECT DATA SUMMARY - AROCLORS

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Aroclor 1242								
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	0.54	F	Mortality	ED75	Estimated Wet Weight; Eggs Obtained From Hatchery Stock. 41 Ug.g Lipid
Aroclor 1254								
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.5	F	Mortality	NOED	92% of eggs hatched.. Egg residue below detection limit. Parents had muscle residue of 0.32 ppm.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	78	F	Mortality	LOED	22% Decrease in hatching of eggs. Parents exposed to 0.2 ppm Arochlor 1254 for 21 days.
Pleuronectes americanus	Flounder - Winter	Estuarine	bottom feeder	0.0071	F	Growth	LOED	Reduced growth in length and weight.
PCBs								
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	0.88	F	Mortality	NOED	No increase in mortality in second generation. Parents exposed to 0.09 ug/L for 28 days.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	27		Mortality	NOED	No decrease in hatchability of eggs. Parents exposed to 1.1 ug/L for 28 days.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	66		Mortality	NOED	No Effect on Survival Of Embryos To Hatching, And Survival Of Fry Two Weeks After Hatching. Parents exposed to 3.4 ug/L for 28 days.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	5.1	F	Mortality	LD33	33% Mortality of second generation fry in first week after hatching. Parents exposed to 0.14 ug/L for 28 days.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	11		Mortality	LD74	74% Mortality of second generation fry in first week after hatching. Parents exposed to 0.39 ug/L for 28 days.
Cyprinodon variegatus	Minnow - Sheepshead	Estuarine	omnivore	170		Mortality	LOED	72% Decrease in hatchability of eggs. Parents exposed to 5.6 ug/L for 28 days.
Haliaeetus leucocephalus	Bald eagle	Terrestrial	piscivore	4	W	Reproduction	NOAEC	Diet of 0.14 ug/g fish tissue; egg lethality when exposed to diet of fish with tissue concentrations of 0.2 ug/g or 2.1 ug/g.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	1.5	F	Reproduction	LOED	
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.31		Reproduction	ED57	Egg hatchability reduced by 57% and fry survival reduced by 19% relative to control.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	1.5		Reproduction	LOED	

TABLE G-6
EGG TISSUE RESIDUE EFFECT DATA SUMMARY - AROCLORS

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Aroclor 1242							
Platichthys stellatus	Flounder - Starry	Estuarine	bottom feeder	0.2	Reproduction	LOED	Value reported less than; field-collected fish injected with carp pituitary extract to induce final stages of gametogenesis and spawning; in the field fish exposed to sediments contaminated with PCBs, PAHs, and DDT.

Notes:
Concentration units in ug/g wet weight tissue unless otherwise specified.
Where available, NOAELs and LOAELs are identified separately for fish (F), invertebrates (I), and wildlife (W).
Information compiled from the following sources:
1. ACOE, 2002. Tissue Effects Database; Army Corps of Engineers, U.S. Waterways Experiment Station, Vicksburg, MS.
2. Jarvinen and Ankley, 1999.
3. USEPA, 2000. Bioaccumulation Summary; United States Environmental Protection Agency; EPA-823-R-00-002.

Prepared by: SGD
Checked by: NAR

TABLE G-7

WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PCB CONGENERS

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
2,2'-Dichlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.20	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,3-Dichlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.16	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,5-Dichlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.051	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.18		Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
3,3'-Dichlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.032	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
3,5-Dichlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.064	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,2',5-Trichlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.083	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,4',5-Trichlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.096	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,2',3,3'-Tetrachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.089	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,2',3,4'-Tetrachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.091	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,2',4,6-Tetrachlorobiphenyl								
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	3.7	F	Mortality	LD28	
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	8.4		Mortality	LD87	
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	8.6		Mortality	LD74	
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	8.8		Mortality	LD17	
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	9.2		Mortality	LD50	

TABLE G-7
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PCB CONGENERS

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
2,2',5,5'-Tetrachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.08	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	1		Mortality	NOED	No increase in mortality. Larva hatched from eggs with residue of 3.72 mg/kg.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	1		Mortality	NOED	No increase in mortality. Larva hatched from eggs with residue of 3.72 mg/kg.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	3.7		Mortality	NOEL	Survival - No effect. Radiotracer study
Daphnia magna	Cladoceran	Fresh	filter feeder	4		Mortality	NOEL	Survival - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	4.2		Mortality	NOED	No increase in mortality. Residue at end of exposure period.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	4.8		Mortality	NOED	No increase in mortality. Residue at end of exposure period.
Daphnia magna	Cladoceran	Fresh	filter feeder	24		Mortality	NOEL	Survival - No effect.
Hyalella azteca	Amphipod	Fresh	detritivore	54	I	Mortality	NOEL	Survival - No effect.
Poecilia reticulata	Guppy	Fresh	omnivore	100		Mortality	NOEL	Survival - No effect.
Poecilia reticulata	Guppy	Fresh	omnivore	100		Mortality	NOEL	Survival - No effect.
Poecilia reticulata	Guppy	Fresh	omnivore	281	F	Mortality	LOEL	Survival - Reduced.
Daphnia magna	Cladoceran	Fresh	filter feeder	4		Growth	NOEL	Growth - No effect.
Daphnia magna	Cladoceran	Fresh	filter feeder	24		Growth	NOEL	Growth - No effect.
Hyalella azteca	Amphipod	Fresh	detritivore	54	I	Growth	NOEL	Growth - No effect.
Daphnia magna	Cladoceran	Fresh	filter feeder	4	I	Reproduction	NOEL	Reproduction - No effect.
Daphnia magna	Cladoceran	Fresh	filter feeder	24		Reproduction	NOEL	Reproduction - No effect.
Hyalella azteca	Amphipod	Fresh	detritivore	54		Reproduction	NOEL	Reproduction - No effect.
2,2',5,6'-Tetrachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.09	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,3,4,5-Tetrachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.091	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,3,5,6-Tetrachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.087	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,3',4,4'-Tetrachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.092	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5

TAB 3-7

WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PCB CONGENERS

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
2,3',5,5'-Tetrachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.087	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
3,3',4,4'-Tetrachlorobiphenyl								
Daphnia magna	Cladoceran	Fresh	filter feeder	0.000065		Mortality	NOEL	Survival - No effect.
Daphnia magna	Cladoceran	Fresh	filter feeder	0.00055		Mortality	NOEL	Survival - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.083		Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	1.7		Mortality	NOEL	Survival - No effect. *Two days in contaminated water with no food, then two days in clean water with food for a total of 33 d
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2	F	Mortality	NOED	Internal Dose Used As Tissue Concentration; No Mortality At 72 H At Highest Test Dose
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	3.4		Mortality	NOEL	Survival - No effect.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	4.3		Mortality	NOEL	Survival - No effect.
Daphnia magna	Cladoceran	Fresh	filter feeder	11		Mortality	NOEL	Survival - No effect.
Hyalella azteca	Amphipod	Fresh	detritivore	84	I	Mortality	NOEL	Survival - No effect.
Daphnia magna	Cladoceran	Fresh	filter feeder	0.000065	I	Growth	NOEL	Growth - Biomass increased.
Daphnia magna	Cladoceran	Fresh	filter feeder	1.3		Growth	NOEL	Growth - No effect.
Hyalella azteca	Amphipod	Fresh	detritivore	84		Growth	NOEL	Growth - No effect.
Daphnia magna	Cladoceran	Fresh	filter feeder	0.00055	I	Growth	LOEL	Growth - Decreased biomass.
Daphnia magna	Cladoceran	Fresh	filter feeder	11		Growth	LOEL	Growth - Reduced.
Daphnia magna	Cladoceran	Fresh	filter feeder	11	I	Reproduction	NOEL	Reproduction - No effect.
Hyalella azteca	Amphipod	Fresh	detritivore	83.7		Reproduction	NOEL	Reproduction - No effect.
Daphnia magna	Cladoceran	Fresh	filter feeder	0.000065		Reproduction	NOEL	Reproduction - No effect.
Daphnia magna	Cladoceran	Fresh	filter feeder	0.00055		Reproduction	NOEL	Reproduction - No effect.
2,2',3,4,5'-Pentachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.082	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,2',4,5,5'-Pentachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.061	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
Daphnia magna	Cladoceran	Fresh	filter feeder	11	I	Mortality	NOEL	Survival - No effect.
Daphnia magna	Cladoceran	Fresh	filter feeder	0.7	I	Growth	LOEL	Growth - Reduced.
Daphnia magna	Cladoceran	Fresh	filter feeder	11	I	Reproduction	NOEL	Reproduction - No effect.

TABLE G-7
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PCB CONGENERS

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
2,2',4,5',6-Pentachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.086	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,2',4,6,6'-Pentachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.043	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,3,4,5,6-Pentachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.088	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,3',4,4',5-Pentachlorobiphenyl								
Daphnia magna	Cladoceran	Fresh	filter feeder	0.00013		Mortality	NOEL	Survival - No effect.
Asterias rubens	Sea star	Salt	predator	3.3		Mortality	NOED	No effect on mortality.
Daphnia magna	Cladoceran	Fresh	filter feeder	27	I	Mortality	NOEL	Survival - No effect.
Daphnia magna	Cladoceran	Fresh	filter feeder	0.00013		Growth	NOEL	Growth - No reduction in biomass
Daphnia magna	Cladoceran	Fresh	filter feeder	27	I	Growth	NOEL	Growth - No effect.
Daphnia magna	Cladoceran	Fresh	filter feeder	0.00013		Reproduction	NOEL	Reproduction - No effect.
Daphnia magna	Cladoceran	Fresh	filter feeder	27	I	Reproduction	NOEL	Reproduction - No effect.
2,3',4,4',6-Pentachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.10	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,2',3,3',4,4'-Hexachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.086	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,2',3,4,4',5'-Hexachlorobiphenyl								
Daphnia magna	Cladoceran	Fresh	filter feeder	19	I	Mortality	NOEL	Survival - No effect.
Daphnia magna	Cladoceran	Fresh	filter feeder	19	I	Growth	NOEL	Growth - No effect.
Daphnia magna	Cladoceran	Fresh	filter feeder	19	I	Reproduction	NOEL	Reproduction - No effect.
2,2',3,4,4',6-Hexachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.096	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,2',3,4,5,5'-Hexachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.07	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5

TABL. 3-7

WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PCB CONGENERS

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
2,2',4,4',5,5'-Hexachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.04		Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.089		Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	2.7	F	Mortality	NOEL	Survival - No effect. Radiotracer study; *Initial residue and residue at 90 d, respectively
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	4.4		Mortality	NOEL	Survival - No effect. Radiotracer study; * Initial residue and residue at 90 d, respectively
Daphnia magna	Cladoceran	Fresh	filter feeder	14	I	Mortality	NOEL	Survival - No effect.
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	3.6	F	Mortality	LOEL	Survival - Reduced - Death. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	8.4		Mortality	LOEL	Survival - Reduced - Death. Radiotracer study
Daphnia magna	Cladoceran	Fresh	filter feeder	14	I	Growth	NOEL	Growth - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	18	F	Growth	NOEL	Growth - No effect.
Daphnia magna	Cladoceran	Fresh	filter feeder	14	I	Reproduction	NOEL	Reproduction - No effect.
2,2',4,4',6,6'-Hexachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.092	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,3,3',4,4',5-Hexachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.079	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
Falco peregrinus	Peregrine falcon	Terrestrial	predator	0.082	W	Reproduction	LOEL	Reproduction - 11.4% eggshell thinning.
3,3',4,4',5,5'-Hexachlorobiphenyl								
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	3.7	I	Mortality	NOEL	Survival - No effect.
2,2',3,3',4,4',5,5'-Octachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.065	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,2',3,3',4,4',6,6'-Octachlorobiphenyl								
Poecilia reticulata	Guppy	Fresh	omnivore	100	F	Mortality	NOEL	Survival - No effect.
Poecilia reticulata	Guppy	Fresh	omnivore	100		Mortality	NOEL	Survival - No effect.
Poecilia reticulata	Guppy	Fresh	omnivore	144	F	Mortality	LOEL	Survival - Reduced.

TABLE G-7
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - PCB CONGENERS

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.036	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.029	F	Mortality	NOEL	Survival - No effect. *31 PCB congeners in a single oral dose; Body residue on d 5
3,3',4,4',5-Pentachlorobiphenyl								
Mytilus edulis	Mussel - Blue	Salt	filter feeder	1.0		Mortality	NOEL	Survival - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2	F	Mortality	NOED	Internal Dose Used As Tissue Concentration; No Mortality At 72 H At Highest Test Dose
Asterias rubens	Sea star	Salt	predator	3.3	I	Mortality	NOED	No effect on mortality.
	White leghorn chicke	Terrestrial	graminivore	0.0004	W	Reproduction	LD50	Reproduction - 50 percent mortality (PCBs injected into the air cell of eggs from day 4 of incubation through hatching)
Falco peregrinus	Peregrine falcon	Terrestrial	predator	0.0013		Reproduction	LOEL	Reproduction - 11.4% eggshell thinning.
	White leghorn chicke	Terrestrial	graminivore	0.0026		Reproduction	LD50	Reproduction - 50 percent mortality (PCBs injected into the air cell of eggs from day 7 through day 10 of incubation)
Colinus virginianus	Bobwhite	Terrestrial	omnivore	0.024		Reproduction	LD50	Reproduction - 50% mortality (through hatching); PCBs were injected into the air cells of eggs
Sterna hirundo	Common tern	Salt	omnivore	0.045		Reproduction	LOEL	35% embryo mortality (through hatching); PCBs were injected into the air cell of eggs
Falco sparverius	American kestrel	Terrestrial	predator	0.065		Reproduction	LD50	Reproduction - 50% mortality (through hatching); PCBs were injected into the air cells of eggs

Notes:
Concentration units in ug/g wet weight tissue unless otherwise specified.
Where available, NOAELs and LOAELs are identified separately for fish (F), invertebrates (I), and wildlife (W).
Information compiled from the following sources:
1. ACOE, 2002. Tissue Effects Database; Army Corps of Engineers, U.S. Waterways Experiment Station, Vicksburg, MS.
2. Jarvinen and Ankley, 1999.
3. USEPA, 2000. Bioaccumulation Summary; United States Environmental Protection Agency; EPA-823-R-00-002.

Prepared by: SGD
Checked by: NAR

TABLE G-8
EGG TISSUE RESIDUE EFFECT DATA SUMMARY - PCB CONGENERS

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
3,3',4,4'-Tetrachlorobiphenyl (PCB 77)								
Falco peregrinus	Peregrine falcon	Terrestrial	predator	0.0015	W	Reproduction	LOEL	Reproduction - 11.4% eggshell thinning.
	White leghorn chicken	Terrestrial	graminivore	0.0026		Reproduction	LD50	Reproduction - 50 percent mortality (PCBs injected into the air cell of eggs)
	White leghorn chicken	Terrestrial	graminivore	0.0086		Reproduction	LD50	Reproduction - 50 percent mortality (PCBs injected into the air cell of eggs)
3,4,4',5-Tetrachlorobiphenyl (PCB 81)								
Falco peregrinus	Peregrine falcon	Terrestrial	predator	0.0014	W	Reproduction	LOEL	Reproduction - 11.4% eggshell thinning.
2,3,3',4,4'-Pentachlorobiphenyl (PCB 105)								
Falco peregrinus	Peregrine falcon	Terrestrial	predator	0.072	W	Reproduction	LOEL	Reproduction - 11.4% eggshell thinning.
	White leghorn chicken	Terrestrial	graminivore	2.2		Reproduction	LD50	into the air cell of eggs)
2,3',4,4',5 -Pentachlorobiphenyl (PCB 118)								
Falco peregrinus	Peregrine falcon	Terrestrial	predator	0.45	W	Reproduction	LOEL	Reproduction - 11.4% eggshell thinning.
3,3',4,4',5-Pentachlorobiphenyl (PCB 126)								
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.013	F	Mortality (sac fry)	NOEL	Survival (sac fry) - No effect. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.027	F	Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced 30%. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.035		Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced 75%. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.10		Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced 100%. Radiotracer study

Notes:
Concentration units in ug/g wet weight tissue unless otherwise specified.
Where available, NOAELs and LOAELs are identified separately for fish (F), invertebrates (I), and wildlife (W).
Information compiled from the following sources:
1. ACOE, 2002. Tissue Effects Database; Army Corps of Engineers, U.S. Waterways Experiment Station, Vicksburg, MS.
2. Jarvinen and Ankley, 1999.
3. USEPA, 2000. Bioaccumulation Summary; United States Environmental Protection Agency; EPA-823-R-00-002.

Prepared by: SGD
Checked by: NAR

TABLE G-9
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - 2,3,7,8-TCDD AND 2,3,7,8-TCDF

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
2,3,7,8 - TCDD							
Oncorhynchus kisutch	Salmon - Coho	Anadromous	piscivore	0.00013	Mortality	NOED	No Effect On Mortality. Residue measured after 114 days in clean water.
Perca flavescens	Perch -Yellow	Fresh	piscivore	0.00013	Mortality	NOED	No Effect On Mortality. Residue measured at end of exposure period.
Perca flavescens	Perch -Yellow	Fresh	piscivore	0.00014	Mortality	NOED	No Effect On Mortality. Residue measured at end of exposure period.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.00015 F	Mortality	NOEL	Survival - No effect. Radiotracer study
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00025	Mortality	NOED	No Effect On Mortality. Residue measured at end of exposure period.
Pacifastacus leniusculus	Crayfish	Fresh	omnivore	0.0003 I	Mortality	NOED	No Effect On Mortality
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00032	Mortality	NOED	No Effect On Mortality. Residue measured at end of exposure period.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00098	Mortality	NOEL	Survival - No effect*. Radiotracer study; *Survival determined at 28 d
Cyprinus carpio	Carp - Common	Fresh	bottom feeder	0.001	Mortality	NOED	No significant increase in mortality.
Ictalurus melas	Bullhead - Black	Fresh	bottom feeder	0.001	Mortality	NOED	No significant increase in mortality.
Lepomis macrochirus	Bluegill	Fresh	invertivore	0.001	Mortality	NOED	No significant increase in mortality.
Micropterus salmoides	Bass - Largemouth	Fresh	piscivore	0.001	Mortality	NOED	No significant increase in mortality.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.001	Mortality	NOED	No significant increase in mortality.
Perca flavescens	Perch -Yellow	Fresh	piscivore	0.001	Mortality	NOED	No significant increase in mortality.
Salvelinus fontinalis	Brook trout	Fresh	piscivore	0.0012	Mortality	NOED	No significant mortality at highest target body burden; TCDD-spiked diet to prduce desired body burden.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.0016	Mortality	NOED	No increase in mortality.
Oryzias laticeps	Japanese medaka	Fresh	omnivore	0.0024	Mortality	NOED	Radiolabelled Experiment; obvious signs of TCDD toxicity such as generalized edema, fin erosion, and discoloration of many of the exposed fish.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.005	Mortality	NOED	Internal Dose Used As Tissue Concentration; No Mortality At 72 H At Highest Test Dose
Daphnia magna	Water flea	Fresh	filter feeder	0.0086	Mortality	NOED	Model ecosystem exposure. No significant difference in population. Radiolabelled TCDD added to sediment and leached into water. Residue at 15 days.

TABLE G-9
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - 2,3,7,8-TCDD AND 2,3,7,8-TCDF

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Helisoma sp.	Snail	Fresh	herbivore	0.0097		Mortality	NOED	Model ecosystem exposure. No significant difference in population. Radiolabelled TCDD added to sediment and leached into water. Residue at 15 days.
Physa sp.	Snail	Fresh	herbivore	0.0097		Mortality	NOEL	Survival - No effect. Radiotracer study
Daphnia magna	Cladoceran	Fresh	filter feeder	0.017		Mortality	NOEL	Survival - No effect. Radiotracer study
Physa sp.	Snail	Fresh	herbivore	0.097		Mortality	NOED	Mesocosm study. Sediment treated with TCDD. Exposure concentration measured in water.
Chironomus tentans	Midge	Fresh	omnivore	0.14		Mortality	NOEL	Survival - No effect. Radiotracer study
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	0.14		Mortality	NOED	No effect on survival. Model ecosystem.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	0.17		Mortality	NOEL	Survival - No effect. Radiotracer study
Daphnia magna	Water flea	Fresh	filter feeder	0.17		Mortality	NOED	Mesocosm study. Sediment treated with TCDD. Exposure concentration measured in water.
Gambusia affinis	Mosquito fish	Fresh	invertivore	0.44		Mortality	NOED	No effect on survival. Model ecosystem.
Chironomus tentans	Midge	Fresh	omnivore	0.47		Mortality	NOED	Concentrations Are Lipid Normalized - Lipid As Wet Weight
Physa sp.	Snail	Fresh	herbivore	0.56		Mortality	NOED	No Effect On Survival. Model ecosystem.
Daphnia magna	Water flea	Fresh	filter feeder	2.1		Mortality	NOED	No effect on survival. Model ecosystem.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.00023	F	Mortality	LOEL	Survival - Reduced. Radiotracer study
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00065		Mortality	LOED	Lethal To 7 Of 90 Fish Over 139 Days
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00098		Mortality	LOEL	Survival - Reduced 45%*. Radiotracer study; *Survival determined at 56 d
Oncorhynchus klsutch	Salmon - Coho	Anadromous	piscivore	0.0022		Mortality	LOED	Reduced Survival. Residue measured after 114 days in clean water.
Cyprinus carpio	Carp - Common	Fresh	bottom feeder	0.0022		Mortality	LOEL	Survival - Reduced. Radiotracer study
Cyprinus carpio	Carp - Common	Fresh	bottom feeder	0.0022		Mortality	LOED	Increased mortality
Pacifastacus leniusculus	Crayfish	Fresh	omnivore	0.003	I	Mortality	LD25	25% Mortality After 40 Days
Cyprinus carpio	Carp - Common	Fresh	bottom feeder	0.003		Mortality	LD50	80 Day LD50 For Mortality
Perca flavescens	Perch -Yellow	Fresh	piscivore	0.003		Mortality	LD50	80 Day LD50 For Mortality
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	0.0044		Mortality	LD100	Model ecosystem exposure. 100% Mortality in 20 days.. Radiolabelled TCDD added to sediment and leached into water.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.0045		Mortality	ED50	Exp Conc Is The Mean of Measured Tcdd Conc
Ictalurus melas	Bullhead - Black	Fresh	bottom feeder	0.005		Mortality	LD50	80 Day LD50 For Mortality
Gambusia affinis	Mosquito fish	Fresh	invertivore	0.0067		Mortality	LD100	Mesocosm study. Sediment treated with TCDD. Exposure concentration measured in water.

TABLE G-9
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - 2,3,7,8-TCDD AND 2,3,7,8-TCDF

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Gambusia affinis	Mosquito fish	Fresh	invertivore	0.0072	Mortality	LD100	Model ecosystem exposure. 100% Mortality in 15 days.. Radiolabelled TCDD added to sediment and leached into water.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.01	Mortality	LD50	80 Day LD50 For Mortality
Micropterus salmoides	Bass - Largemouth	Fresh	piscivore	0.011	Mortality	LD50	80 Day LD50 For Mortality
Gambusia affinis	Mosquito fish	Fresh	invertivore	0.012	Mortality	LOEL	Survival - Reduced - Death. Radiotracer study
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.014	Mortality	LOEL	Survival - Reduced - Death. Radiotracer study; *28 d LC50
Lepomis macrochirus	Bluegill	Fresh	invertivore	0.016	Mortality	LD50	80 Day LD50 For Mortality
Pacifastacus leniusculus	Crayfish	Fresh	omnivore	0.03	Mortality	LD50	Lethargy, 50 - 66% Increase In Mortality
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	1.4	Mortality	LOED	Over 90% mortality.
Oncorhynchus kisutch	Salmon - Coho	Anadromous	piscivore	0.00013	Growth	NOED	No effect on weight gain. Residue measured after 114 days in clean water.
Perca flavescens	Perch -Yellow	Fresh	piscivore	0.00013	Growth	NOED	No Effect On Growth. Residue measured at end of exposure period.
Perca flavescens	Perch -Yellow	Fresh	piscivore	0.00014	Growth	NOED	No Effect On Growth. Residue measured at end of exposure period.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00025	Growth	NOED	No Effect On Growth. Residue measured at end of exposure period.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00032 F	Growth	NOED	No Effect On Growth. Residue measured at end of exposure period.
Salvelinus fontinalis	Brook trout	Fresh	piscivore	0.0012	Growth	NOED	No significant growth effect at highest target body burden; TCDD-spiked diet to prduce desired body burden.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.0016	Growth	NOED	No difference in growth (weight).
Oryzias laticeps	Japanese medaka	Fresh	omnivore	0.0024	Growth	NOED	Radiolabelled Experiment
Lemna minor	Duckweed	Fresh	primary producer	0.0061	Growth	NOED	No Effect On Growth. Model ecosystem.
Chironomus tentans	Midge	Fresh	omnivore	0.14	Growth	NOEL	Growth - No effect. Radiotracer study
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	0.17	Growth	NOEL	Growth - No effect. Radiotracer study
Chironomus tentans	Midge	Fresh	omnivore	0.47 I	Growth	NOED	Concentrations Are Lipid Normalized - Lipid As Wet Weight
Oedogonium cardiacum	Green algae	Fresh	primary producer	1.3	Growth	NOED	No Effect On Growth. Model ecosystem.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00065 F	Growth	LOED	Reduced Growth, Exposed Fish Weighed 50 G Vs. 130 G For Controls
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00065	Growth	LOED	Liver/body weight ratio nearly twice that of controls.

TABLE G-9
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - 2,3,7,8-TCDD AND 2,3,7,8-TCDF

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00098		Growth	LOEL	Growth - Reduced. Radiotracer study
Oncorhynchus kisutch	Salmon - Coho	Anadromous	piscivore	0.0022		Growth	LOED	Reduced weight gain. Residue measured after 114 days in clean water.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.005		Growth	LOED	Significant Reduction In Body Weight
Perca flavescens	Perch -Yellow	Fresh	piscivore	0.005		Growth	LOED	Significant Reduction In Body Weight
Lepomis macrochirus	Bluegill	Fresh	invertivore	0.005		Growth	LOED	Significant Reduction In Body Weight
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	1.4		Growth	LOED	Weight loss.
Salvelinus fontinalis	Brook trout	Fresh	piscivore	0.0006	F	Reproduction	NOED	No delay in spawning; TCDD-spiked diet to prduce desired body burden.
Chironomus tentans	Midge	Fresh	omnivore	0.14	I	Reproduction	NOEL	Reproduction - No effect. Radiotracer study
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	0.17		Reproduction	NOEL	Reproduction - No effect. Radiotracer study
Salvelinus fontinalis	Brook trout	Fresh	piscivore	0.0012	F	Reproduction	LOED	Significant delay in spawning; TCDD-spiked diet to prduce desired body burden.
Brachydanio rerio	Zebrafish	Fresh	omnivore	0.0083	I	Reproduction	LOEC	
2,3,7,8-TCDF								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.0076	F	Mortality	NOEC	Survival - No effect level (28-day exposure).
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00009		Growth	NOED	
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.0025	F	Growth	NOEC	Growth - No effect level (28-day exposure).

Notes:
Concentration units in ug/g wet weight tissue unless otherwise specified.
Where available, NOAELs and LOAELs are identified separately for fish (F), invertebrates (I), and wildlife (W).
Information compiled from the following sources:
1. ACOE, 2002. Tissue Effects Database; Army Corps of Engineers, U.S. Waterways Experiment Station, Vicksburg, MS.
2. Jarvinen and Ankley, 1999.
3. USEPA, 2000. Bioaccumulation Summary; United States Environmental Protection Agency; EPA-823-R-00-002.

Prepared by: SGD
Checked by: NAR

TAB[illegible]-10

AVIAN EGG TISSUE RESIDUE EFFECT DATA SUMMARY - DIOXINS FURANS

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
2,3,7,8-TCDD							
Sterna forsteri	Forster's tern	Terrestrial	omnivore	0.000008	Growth	NOAEL	Lake Poygan site
Ardea herodias	Great blue heron	Terrestrial	predator	0.00001	Growth	NOEL	Nicomekl site (reference); 10+-0.9 ng/kg.
Ardea herodias	Great blue heron	Terrestrial	predator	0.000011	Growth	LOEL	Crofton site: 11+-33.7 ng/kg; depression of growth compard to Nicomekl site; presence of edema.
Sterna forsteri	Forster's tern	Terrestrial	omnivore	0.000037	Growth	LOAEL	Green Bay site: birds had lower body weight and increased liver to body weight ratios
Ardea herodias	Great blue heron	Terrestrial	predator	0.00014	Growth	LOEL	Vancouver site: 135+-49.6 ng/kg; depression of growth compard to Nicomekl site; presence of edema.
Aix sponsa	Wood duck	Fresh	herbivore	0.00000001	Reproduction	NOED	Site 4 geometric mean concentration (<1 to 0.5); 93% eggs hatched (9.7 SE)
Sterna forsteri	Forster's tern	Terrestrial	omnivore	0.000008	Reproduction	NOAEL	Lake Poygan site
Aix sponsa	Wood duck	Fresh	herbivore	0.0000042	Reproduction	ED21	Site 3 geometric mean concentration (<1 to 19); 79% eggs hatched (3.8 SE)
Aix sponsa	Wood duck	Fresh	herbivore	0.000014	Reproduction	ED38	Site 2 geometric mean concentration (0.8 to 74); 62% eggs hatched (10.1 SE)
Aix sponsa	Wood duck	Fresh	herbivore	0.000036	Reproduction	ED53	Site 1 geometric mean concentration (1.6 to 482); 47% eggs hatched (9.7 SE)
Sterna forsteri	Forster's tern	Terrestrial	omnivore	0.000037	Reproduction	LOAEL	Green Bay site: birds had increased incubation period and reduced hatchability compared to Lake Poygan site.
Falco peregrinus	Peregrine falcon	Terrestrial	predator	0.011	Reproduction	LOEL	Reproduction - 11.4% eggshell thinning.
2,3,7,8-TCDF							
Ardea herodias	Great blue heron	Terrestrial	predator	0.000001	Growth	NOEL	Nicomekl site (reference); <1 ng/kg.
Ardea herodias	Great blue heron	Terrestrial	predator	0.000008	Growth	LOEL	Crofton site: 8+-2.3 ng/kg; depression of growth compard to Nicomekl site; presence of edema.
Ardea herodias	Great blue heron	Terrestrial	predator	0.000011	Growth	LOEL	Vancouver site: 11+-4.3 ng/kg; depression of growth compard to Nicomekl site; presence of edema.
Aix sponsa	Wood duck	Fresh	herbivore	0.0000003	Reproduction	NOED	Site 4 geometric mean concentration (<1 to 3.2); 93% eggs hatched (3.4 SE)
Aix sponsa	Wood duck	Fresh	herbivore	0.0000054	Reproduction	ED21	Site 3 geometric mean concentration (<1 to 22); 79% eggs hatched (3.8 SE)
Aix sponsa	Wood duck	Fresh	herbivore	0.000011	Reproduction	ED38	Site 2 geometric mean concentration (1.4 to 60); 62% eggs hatched (10.1 SE)
Aix sponsa	Wood duck	Fresh	herbivore	0.000026	Reproduction	ED53	Site 1 geometric mean concentration (2.4 to 244); 47% eggs hatched (9.7 SE)
Falco peregrinus	Peregrine falcon	Terrestrial	predator	0.03	Reproduction	LOEL	Reproduction - 11.4% eggshell thinning.

TABLE G-10
AVIAN EGG TISSUE RESIDUE EFFECT DATA SUMMARY - DIOXINS FURANS

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
1,2,3,4,7,8-HCDD							
Falco peregrinus	Peregrine falcon	Terrestrial	predator	0.0033	Reproduction	LOEL	Reproduction - 11.4% eggshell thinning.
1,2,3,7,8-PentaCDD							
Ardea herodias	Great blue heron	Terrestrial	predator	0.000006	Growth	NOEL	Nicomekl site (reference); 6+-2.2 ng/kg.
Ardea herodias	Great blue heron	Terrestrial	predator	0.000057	Growth	LOEL	Vancouver site: 57+-25.8 ng/kg; depression of growth compard to Nicomekl site; presence of edema.
Ardea herodias	Great blue heron	Terrestrial	predator	0.00026	Growth	LOEL	Crofton site: 263+-69.9 ng/kg; depression of growth compard to Nicomekl site; presence of edema.
Falco peregrinus	Peregrine falcon	Terrestrial	predator	0.011	Reproduction	LOEL	Reproduction - 11.4% eggshell thinning.
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)							
Ardea herodias	Great blue heron	Terrestrial	predator	0.000002	Growth	NOEL	Nicomekl site (reference); <2 ng/kg.
Ardea herodias	Great blue heron	Terrestrial	predator	0.000033	Growth	LOEL	Vancouver site: 33+-18.5 ng/kg; depression of growth compard to Nicomekl site; presence of edema.
Ardea herodias	Great blue heron	Terrestrial	predator	0.000033	Growth	LOEL	Crofton site: 33+-7.6 ng/kg; depression of growth compard to Nicomekl site; presence of edema.
Falco peregrinus	Peregrine falcon	Terrestrial	predator	0.004	Reproduction	LOEL	Reproduction - 11.4% eggshell thinning.
Falco peregrinus	Peregrine falcon	Terrestrial	predator	0.027	Reproduction	LOEL	Reproduction - 11.4% eggshell thinning.
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)							
Ardea herodias	Great blue heron	Terrestrial	predator	0.00001	Growth	NOEL	Nicomekl site (reference); 10+-3.4 ng/kg.
Ardea herodias	Great blue heron	Terrestrial	predator	0.000089	Growth	LOEL	Vancouver site: 89+-45.4 ng/kg; depression of growth compard to Nicomekl site; presence of edema.
Ardea herodias	Great blue heron	Terrestrial	predator	0.00043	Growth	LOEL	Crofton site: 430+-105.9 ng/kg; depression of growth compard to Nicomekl site; presence of edema.
Falco peregrinus	Peregrine falcon	Terrestrial	predator	0.0072	Reproduction	LOEL	Reproduction - 11.4% eggshell thinning.
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)							
Falco peregrinus	Peregrine falcon	Terrestrial	predator	0.0032	Reproduction	LOEL	Reproduction - 11.4% eggshell thinning.
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)							
Falco peregrinus	Peregrine falcon	Terrestrial	predator	0.0007	Reproduction	LOEL	Reproduction - 11.4% eggshell thinning.

Notes:
Concentration units in ug/g wet weight tissue unless otherwise specified.
Information compiled from the following sources:
1. ACOE, 2002. Tissue Effects Database; Army Corps of Engineers, U.S. Waterways Experiment Station, Vicksburg, MS.
2. Jarvinen and Ankley, 1999.
3. USEPA, 2000. Bioaccumulation Summary; United States Environmental Protection Agency; EPA-823-R-00-002.

Prepared by: SGD
Checked by: NAR

TABLE G-11
EGG TISSUE RESIDUE EFFECT DATA SUMMARY - 2,3,7,8-TCDD

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000015	Mortality	NOEL	Survival - No effect. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000023	Mortality	NOEL	Survival - No effect. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000033	Mortality	NOEL	Survival - No effect. Radiotracer study; *Not measured
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000034	Mortality	NOED	TCDD NOAEL for sac fry mortality.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000034	Mortality	NOEL	Survival - No effect. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000034	Mortality	NOED	No significant increase in mortality from fertilization to swim-up. Residue measured in eggs after exposure.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000034	Mortality	NOEL	Survival - No effect (48-hour). Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000034	Mortality	NOEL	Survival - No effect. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000035	Mortality	NOED	No effect on mortality of sac fry
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000044	Mortality	NOEL	Survival - No effect. Radiotracer study; *Not measured
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000044	Mortality	NOED	No significant increase in mortality from fertilization to swim-up. Residue measured in eggs after exposure.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00019	Mortality	NOEL	Survival - No effect. Radiotracer study; *Not measured
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00029	Mortality	NOED	No significant increase in mortality from fertilization to swim-up. Residue measured in eggs at up to 19 days post injection.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.00031	Mortality	NOEL	Survival - No effect. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.034	Mortality (sac fry)	NOEL	Survival (sac fry) - No effect. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.043	Mortality (sac fry)	NOEL	Survival (sac fry) - No effect. Radiotracer study
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.14	Mortality (sac fry)	NOEL	Survival (sac fry) - No effect. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.00004	Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.00004	Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000044	Mortality	LD50	50% Mortality of sac fry. LD50 range is 44 to 72 pg TCDD/g egg.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.00005	Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000055	Mortality	LOED	Significant increase in mortality from fertilization to swim-up. Residue measured in eggs after exposure.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000055	Mortality	LOEL	Survival - Reduced (48-hour). Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000055	Mortality	LOED	Lowest statistically significant increase in mortality of sac fry

TABLE G-11
EGG TISSUE RESIDUE EFFECT DATA SUMMARY - 2,3,7,8-TCDD

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000055	Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced. Radiotracer study; *Not measured
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000055	Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000058	Mortality	LOED	Significant increase in mortality from fertilization to swim-up. Residue measured in eggs after injection.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.00006	Mortality (sac fry)	LD50	Survival (sac fry) - Reduced 50%. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000065	Mortality	LD50	LD50 for increase in mortality from fertilization to swim-up. Residue measured in eggs after exposure.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000065	Mortality	LD50	Estimated LD50 for sac-fry mortality.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000065	Mortality	ED50	Lethal to 50% of sac fry.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000065	Mortality (sac fry)	LD50	Survival (sac fry) - Reduced 50%. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.00007	Mortality (sac fry)	LD50	Survival (sac fry) - Reduced 50%. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.00008	Mortality (sac fry)	LD50	Survival (sac fry) - Reduced 50%. Radiotracer study; *Not measured
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.00012	Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced - Death. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.00012	Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced - Death. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.00015	Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced - Death. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.00015	Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced - Death. Radiotracer study; *Not measured
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00017	Mortality	LD50	Estimated LD50s for sac fry mortality in 6 strains of rainbow trout. Residues ranged from 170 to 488 pg/g.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.0002	Mortality	LD50	Estimated LD50 for sac-fry mortality.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00028	Mortality	LOED	Significant increase in mortality from fertilization to swim-up. Residue measured in eggs at 5-days post exposure.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.0004	Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced - Death. Radiotracer study
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00042	Mortality	LD50	LD50 for increase in mortality from fertilization to swim-up. Residues measured in eggs at up to 19 days post injection.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00044	Mortality	LOED	Significant increase in mortality from fertilization to swim-up. Residue measured in eggs at up to 19 days post injection..

TABLE G-11
EGG TISSUE RESIDUE EFFECT DATA SUMMARY - 2,3,7,8-TCDD

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.00044	Mortality	LD50	LD50 for increase in mortality from fertilization to swim-up. Residue measured in eggs at 5-days post exposure.
Fundulus heteroclitus	Mummichog	Estuarine	omnivore	0.0006	Mortality	LOED	28% Decrease in hatchability.
Fundulus heteroclitus	Mummichog	Estuarine	omnivore	0.0023	Mortality	LD75	75% Decrease in hatchability.
Danio rerio	Zebrafish	Fresh		0.0025	Mortality	LD50	50% of eggs failed to produce fry.
Fundulus heteroclitus	Mummichog	Estuarine	omnivore	0.0068	Mortality	LD100	Failure of eggs to hatch.
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.055	Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.065	Mortality (sac fry)	LD50	Survival (sac fry) - Reduced 50%. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.072	Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced 20%. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.11	Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced - Death. Radiotracer study
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.19	Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.23	Mortality (hatchability)	LOEL	Survival (hatchability) - Reduced. Radiotracer study
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.23	Mortality (sac fry)	LD50	Survival (sac fry) - Reduced 50%. Radiotracer study
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.34	Mortality (sac fry)	LOEL	Survival (sac fry) - Reduced - Death. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000034	Growth	NOEL	Growth - No effect. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.000055	Growth	LOEL	Growth - Reduced. Radiotracer study
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.00023	Reproduction	LOEC	48-hr LOEC for hatchability
Salvelinus namaycush	Trout - Lake	Fresh	piscivore	0.00023	Reproduction	LOEC	Reduced hatchability of eggs

Notes:
Concentration units in ug/g wet weight tissue unless otherwise specified.
Information compiled from the following sources:
1. ACOE, 2002. Tissue Effects Database; Army Corps of Engineers, U.S. Waterways Experiment Station, Vicksburg, MS.
2. Jarvinen and Ankley, 1999.
3. USEPA, 2000. Bioaccumulation Summary; United States Environmental Protection Agency; EPA-823-R-00-002.

Prepared by: SGD
Checked by: NAR

TABLE G-12
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - METALS

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Aluminum								
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	1	F	Mortality	NOEL	Survival - No effect. Residues in surviving fish
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	8.5		Mortality	NOED	
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	8	F	Mortality	LOED	Mean Of Nominal Exposure Conc; Questionable Background Survival
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	8		Mortality	LOEL	Survival - Reduced <20%. Residues in surviving fish
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	20		Mortality	ED100	
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	20		Mortality	LOEL	Survival - Reduced - Death. Residues in dead fish
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	37		Mortality	LOEL	Survival - Reduced - Death. Residues in dead fish
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	8		Growth	NOEL	Growth - No effect.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	13	F	Growth	NOED	Significant Weight Relative to Other Exposures
Antimony								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	5	F	Mortality	NOEL	Survival - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	9	F	Mortality	LD50	Survival - Reduced 50%. Residues in surviving fish
Arsenic								
Lepomis macrochirus	Bluegill	Fresh	invertivore	0.52		Mortality	NOED	No Effect On Mortality
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	1		Mortality	NOEL	Survival - No effect. 5°C
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	1.2		Mortality	NOED	Estimated Wet Weight Arsanilic Acid
Lepomis macrochirus	Bluegill	Fresh	invertivore	1.8		Mortality	NOED	No increase in mortality. Weekly application of sodium arsenite herbicide in artificial pond.
Lepomis macrochirus	Bluegill	Fresh	invertivore	1.8		Mortality	NOEL	Survival - No effect. *Total amount of arsenic applied; 16 treatments at 0.4 mg/L/wk
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2		Mortality	NOEL	Survival - No effect. 5°C; Residues in surviving fish
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2	F	Mortality	NOEL	Survival - No effect. 15°C
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2.3		Mortality	NOED	Estimated Wet Weight Dimethylarsenic
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2.6		Mortality	NOEL	Survival - No effect.

TABLE G-12
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - METALS

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Stagnicola emarginatus	Snail	Fresh	herbivore	3.6	Mortality	NOED	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
Stagnicola emarginatus	Snail	Fresh	herbivore	3.6	Mortality	NOED	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
Stagnicola emarginatus	Snail	Fresh	herbivore	3.6	Mortality	NOED	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
Stagnicola emarginatus	Snail	Fresh	herbivore	3.6	Mortality	NOED	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
Daphnia magna	Water flea	Fresh	filter feeder	3.8	Mortality	NOED	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph, Tissues Exposed 21 D
Daphnia magna	Water flea	Fresh	filter feeder	4	Mortality	NOED	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph, Tissues Exposed 21 D
Helisoma campanulata	Snail	Fresh	herbivore	4	Mortality	NOED	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
Daphnia magna	Water flea	Fresh	filter feeder	4.4	Mortality	NOED	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph, Tissues Exposed 21 D
Lepomis macrochirus	Bluegill	Fresh	invertivore	5.5	Mortality	NOED	No increase in mortality. Monthly applications of sodium arsenite herbicide in artificial pond.
Lepomis macrochirus	Bluegill	Fresh	invertivore	5.5	Mortality	NOEL	Survival - No effect. *Total amount of arsenic applied; 4 treatments 1.2 mg/L/mo
Helisoma campanulata	Snail	Fresh	herbivore	5.8	Mortality	NOED	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
Pteronarcys dorsata	Giant Black Stonefly	Fresh	omnivore	6	Mortality	NOED	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	6.1	Mortality	NOEL	Survival - No effect. Organic form of arsenic was tested.
Pteronarcys dorsata	Giant Black Stonefly	Fresh	omnivore	7	Mortality	NOED	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
Pteronarcys dorsata	Giant Black Stonefly	Fresh	omnivore	8.4	Mortality	NOED	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
Pteronarcys dorsata	Giant Black Stonefly	Fresh	omnivore	8.4	Mortality	NOED	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	8.8	Mortality	NOEL	Survival - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	9.1	Mortality	NOEL	Survival - No effect.

TABLE G-12
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - METALS

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Daphnia magna	Water flea	Fresh	filter feeder	9.8		Mortality	NOED	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph, Tissues Exposed 21 D
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	11		Mortality	NOEL	Survival - No effect. Organic form of arsenic was tested.
Helisoma campanulata	Snail	Fresh	herbivore	16		Mortality	NOED	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2.2	F	Mortality	LD16	Estimated Wet Weight Disodium Arsenate
Lepomis macrochirus	Bluegill	Fresh	invertivore	2.2		Mortality	LOED	Increase in mortality. One application of sodium arsenite herbicide in artificial pond.
Lepomis macrochirus	Bluegill	Fresh	invertivore	2.2		Mortality	LOEL	Survival - Reduced. *Total amount of arsenic applied; Treatments varied from 1 at 4 mg/L to 16 treatments at 1.2 mg/L/wk
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	3		Mortality	LD50	Survival - Reduced 50%. 5°C
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	3.6		Mortality	LD12	Estimated Wet Weight
Helisoma campanulata	Snail	Fresh	herbivore	4.2	I	Mortality	ED16	Mixture Of 4 Arsenic Cmpds, Est Body Burden From Graph
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	4.7		Mortality	LOED	Pre-exposure to arsenic for 7 d produced significant increase in LC50 (reduced sensitivity to exposure) at shortest time interval tested.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	5.4		Mortality	LOEL	Survival - Reduced - Death. 5°C; Residues in dead fish
Lepomis cyanellus	Green sunfish	Fresh	invertivore	6.7		Mortality	LOEL	Survival - Reduced - Death. LT50 = 46 h; Residues in dead fish
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	11		Mortality	LOEL	Survival - Reduced < 20%.
Lepomis macrochirus	Bluegill	Fresh	invertivore	12		Mortality	LOED	Increased mortality. Weekly appplications of sodium arsenite herbicide in artificial pond.
Lepomis macrochirus	Bluegill	Fresh	invertivore	12		Mortality	LOEL	Survival - Reduced. *Total amount of arsenic applied; 16 treatments 1.2 mg/L/wk
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	18		Mortality	LOEL	Survival - Reduced < 20%.
Daphnia magna	Water flea	Fresh	filter feeder	87		Mortality	ED50	Lethal body burden after 21 d exposure.
Lepomis cyanellus	Green sunfish	Fresh	invertivore	108		Mortality	LOEL	Survival - Reduced - Death. LT50 = 17 h; Residues in dead fish
Lepomis cyanellus	Green sunfish	Fresh	invertivore	116		Mortality	LOEL	Survival - Reduced - Death. LT50 = 12 h; Residues in dead fish

TABLE G-12
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - METALS

Baseline Ecological Risk Assessment - Interim Final
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North Providence, Rhode Island

Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.9		Growth	NOEL	Growth - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.9	F	Growth	NOEL	Growth - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	1		Growth	NOEL	Growth - No effect. 5°C
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	1.0	I	Growth	NOED	No effect on growth rate.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	1.1		Growth	NOED	No effect on growth rate.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	1.2		Growth	NOED	No effect on growth rate.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	1.2		Growth	NOED	Estimated Wet Weight Arsanilic Acid
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	1.3		Growth	NOED	No effect on growth rate. Exposure to 10 ug/L arsenate in water and 14.6 ug/g in diet.
Lepomis macrochirus	Bluegill	Fresh	invertivore	1.8		Growth	NOED	No difference in weight gain. Weekly application of sodium arsenite herbicide in artificial pond.
Lepomis macrochirus	Bluegill	Fresh	invertivore	1.8		Growth	NOEL	Growth - No effect. *Total amount of arsenic applied; 16 treatments at 0.4 mg/L/wk
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2		Growth	NOEL	Growth - No effect. 15 ° C
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2.3		Growth	NOED	Estimated Wet Weight Dimethylarsenic
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2.6		Growth	NOEL	Growth - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	3		Growth	NOED	Exposure to arsenic for 21 d did not affect growth at the longest time interval tested.
Lepomis macrochirus	Bluegill	Fresh	invertivore	5.5		Growth	NOED	No difference in weight. Monthly applications of sodium arsenite herbicide in artificial pond.
Lepomis macrochirus	Bluegill	Fresh	invertivore	5.5		Growth	NOEL	Growth - No effect. *Total amount of arsenic applied; 4 treatments 1.2 mg/L/mo
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	6.1		Growth	NOEL	Growth - No effect. Organic form of arsenic was tested.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	11		Growth	NOEL	Growth - No effect. Organic form of arsenic was tested.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.62	F	Growth	LOED	Estimated Wet Weight Arsenic Trioxide
Lepomis macrochirus	Bluegill	Fresh	invertivore	2.2		Growth	LOED	Decrease in weight gain. One application of sodium arsenite herbicide in artificial pond.

TABLE G-12
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - METALS

Baseline Ecological Risk Assessment - Interim Final
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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Lepomis macrochirus	Bluegill	Fresh	invertivore	2.2		Growth	LOEL	Growth - Reduced. *Total amount of arsenic applied; Treatments varied from 1 at 4 mg/L to 16 treatments at 1.2 mg/L/wk
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	3		Growth	LOEL	Growth - Reduced. 5°C
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	3.1		Growth	LOEL	Growth - Reduced.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	6.9		Growth	LOEL	Growth - Reduced.
Lepomis macrochirus	Bluegill	Fresh	invertivore	12		Growth	LOED	Decrease in weight. Weekly appplications of sodium arsenite herbicide in artificial pond.
Lepomis macrochirus	Bluegill	Fresh	invertivore	12		Growth	LOEL	Growth - Reduced. *Total amount of arsenic applied; 16 treatments 1.2 mg/L/wk
Lepomis macrochirus	Bluegill	Fresh	invertivore	0.53	F	Reproduction	NOED	Normal ovary and oocyte development. Weekly applications of sodium arsenite herbicide in artificial pond.
Lepomis macrochirus	Bluegill	Fresh	invertivore	1.7	F	Reproduction	LOED	Abnormal ovary and oocyte development. Weekly applications of sodium arsenite herbicide in artificial pond.
Daphnia magna	Water flea	Fresh	filter feeder	87	I	Reproduction	ED10	10% reduction in number of offspring.
Barium								
Meretrix meretrix	Clam - Hard	Salt	filter feeder	0.41	I	Growth	LOED	Barium Hydroxide
Beryllium								
Lepomis macrochirus	Bluegill	Fresh	invertivore	5.1	F	Mortality	NOED	No Effect On Mortality
Cadmium								
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.026		Mortality	NOED	No effect on hatchability and survival of embryos. Parents exposed to 3.4 ug/L for up to 38 weeks.
Lepomis macrochirus	Bluegill	Fresh	invertivore	0.036		Mortality	NOEL	Survival - No effect.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.04		Mortality	NOEL	Survival - No effect. Third generation fish
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.042		Mortality	NOED	No effect on hatchability and survival of 3rd generation embryos. Parents exposed to 3.4 ug/L for up to 105 weeks.
Perca fluviatilis	Perch	Fresh	piscivore	0.075		Mortality	NOEL	Survival - No effect. Radiotracer study; Residue calculated from BCF determined in the study
Jordanella floridae	American flagfish	Fresh	bottom feeder	0.09		Mortality	NOED	Body Burden Est. From Graph, Fish Initially Exposed As Embryos

TABLE G-12
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - METALS

Baseline Ecological Risk Assessment - Interim Final
Centredale Manor Restoration Project Superfund Site
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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Gasterosteus aculeatus	Three-spined Sticklet	Fresh	invertivore	0.11	F	Mortality	NOEL	Survival - No effect. Residue estimated by authors by summation of individual tissue burdens
Leucaspius delineatus	Fish	Fresh	planktivore	0.15		Mortality	NOEL	Survival - No effect.
Hydropsyche sp.	Caddisfly	Fresh	detritivore	0.20	I	Mortality	NOED	No effect on mortality in one day.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.25		Mortality	NOED	No Significant Effect On Mortality. Residue calculated at 6 hours exposure.
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	0.25		Mortality	NOEL	Survival - No effect. 9.6°C
Hydropsyche sp.	Caddisfly	Fresh	detritivore	0.28		Mortality	NOED	No effect on mortality in one day.
Jordanella floridae	American flagfish	Fresh	bottom feeder	0.4		Mortality	NOED	Body Burden Est. From Graph. Fish Not Exposed As Embryos
Anguilla anguilla	Eel - European	Anadromous	predator	0.56		Mortality	NOEL	Survival - No effect.
Hyalella azteca	Amphipod	Fresh	detritivore	0.61		Mortality	NOEL	Survival - No effect.
Triborodon hakonensis	Dace	Fresh	omnivore	0.69		Mortality	NOEL	Survival - No effect.
Hexagenia rigida	Mayfly	Fresh	detritivore	0.7		Mortality	NOEL	Survival - No effect.
Poecilia reticulata	Guppy	Fresh	omnivore	0.8		Mortality	NOEL	Survival - No effect.
Orconectes virilis	Crayfish	Fresh	omnivore	0.9		Mortality	NOEL	Survival - No effect.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	0.9		Mortality	NOED	Estimated Wet Weight
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.96		Mortality	NOEL	Survival - No effect.
Poecilia reticulata	Guppy	Fresh	omnivore	1		Mortality	NOED	No increase in mortality.
Mysidopsis bahia	Shrimp - Mysid	Salt	invertivore	1.3		Mortality	NOED	No effect on mortality.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	1.6		Mortality	NOED	No increase in mortality. Salinity 30 ppt.
Jordanella floridae	American flagfish	Fresh	bottom feeder	2		Mortality	NOEL	Survival - No effect. Residues were higher at 30 d than 100 d. Range shown is for 100 and 30 d
Monoporeia affinis	Amphipod	Fresh	detritivore	2		Mortality	NOED	Body Burden Est. From Graph
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	2		Mortality	NOEL	Survival - No effect. 5°C
Hexagenia rigida	Mayfly	Fresh	detritivore	2.1		Mortality	NOEL	Survival - No effect.
Pontoporeia affinis	Amphipod	Fresh	detritivore	2.3		Mortality	NOEL	Survival - No effect.
Noemacheilus barbatulus	Stone loach	Fresh	piscivore	2.3		Mortality	NOEL	Survival - No effect.
Lates calcarifer	Seabass	Salt	piscivore	2.5		Mortality	NOEL	Survival - No effect.
Hyalella azteca	Amphipod	Fresh	detritivore	2.6		Mortality	NOEL	Survival - No effect. *8 HQ (8 - hydroxyquinoline) added
Mytilus edulis	Mussel - Blue	Salt	filter feeder	3.7		Mortality	NOEL	Survival - No effect.
Mytilus edulis	Mussel - Blue	Salt	filter feeder	3.7		Mortality	NA	Decreased anoxic survival time (Control 13 days).

TABLE G-12
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - METALS

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Elliptio complanata	Mussel	Fresh	filter feeder	4	Mortality	NOEL	Survival - No effect. Radiotracer study
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	4	Mortality	NOED	No increase in mortality.
Ambystoma gracile	Salamander	Fresh	predator	4.1	Mortality	NOED	No Significant Increase In Mortality At Highest Test Concentration
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	4.2	Mortality	NOEL	Survival - No effect.
Hyalella azteca	Amphipod	Fresh	detritivore	4.6	Mortality	NOEL	Survival - No effect.
Hyalella azteca	Amphipod	Fresh	detritivore	4.6	Mortality	NOEL	Survival - No effect. *EDTA added
Poecilia reticulata	Guppy	Fresh	omnivore	4.8	Mortality	NOEL	Survival - No effect.
Poecilia reticulata	Guppy	Fresh	omnivore	5	Mortality	NOED	No increase in mortality.
Leiostomus xanthurus	Spot	Salt	omnivore	5.4	Mortality	NOEL	Survival - No effect.
Chironomus riparius	Midge	Fresh	omnivore	5.6	Mortality	NOEL	Survival - No effect.
Chironomus riparius	Midge	Fresh	omnivore	5.6	Mortality	NOED	No increase in mortality.
Pontoporeia affinis	Amphipod	Fresh	detritivore	6	Mortality	NOEL	Survival - No effect.
Monoporeia affinis	Amphipod	Fresh	detritivore	6	Mortality	NOED	
Daphnia magna	Cladoceran	Fresh	filter feeder	6.4	Mortality	NOEL	Survival - No effect.
Hyalella azteca	Amphipod	Fresh	detritivore	6.4	Mortality	NOEL	Survival - No effect. *Humic acid added
Mytilus edulis	Mussel - Blue	Salt	filter feeder	6.5	Mortality	NOED	Estimated Wet Weight
Moina macrocopa	Cladoceran	Fresh	herbivore	7	Mortality	NOEL	Survival - No effect.
Belone belone	Garpike	Salt	piscivore	7	Mortality	NOEL	Survival - No effect.
Clupea harengus	Herring - Baltic	Salt	piscivore	7	Mortality (viable hatch)	NOEL	Survival (viable hatch) - No effect. Salinity 5 ppt
Nephtys caeca	Polychaete	Salt	detritivore	7.8	Mortality	NOEL	Survival - No effect.
Hyalella azteca	Amphipod	Fresh	detritivore	8.4	Mortality	NOEL	Survival - No effect. *90% distilled water added
Hyalella azteca	Amphipod	Fresh	detritivore	9.4	Mortality	NOEL	Survival - No effect. *Sediment A added
Physa integra	Snail	Fresh	herbivore	10	Mortality	NOEL	Survival - No effect.
Monoporeia affinis	Amphipod	Fresh	detritivore	10	Mortality	NOED	Body Burden Est. From Graph
Belone belone	Garpike	Salt	piscivore	10	Mortality (hatchabi	NOEL	Survival (hatchability) No effect.
Moina macrocopa	Cladoceran	Fresh	herbivore	11	Mortality	NOED	No Effect On Survival. Residue at 6 days.
Clupea harengus	Herring - Baltic	Salt	piscivore	11	Mortality (viable ha	NOEL	Survival (viable hatch) - No effect. Salinity 16 ppt
Hyalella azteca	Amphipod	Fresh	detritivore	12	Mortality	NOEL	Survival - No effect. *Sediment B added
Cambarus latimanus	Crayfish	Fresh	omnivore	15	Mortality	NOED	No significant increase in mortality. Feed contaminated with 0.17 ug Cd/g.
Hydropsyche sp.	Caddisfly	Fresh	detritivore	16	Mortality	NOED	No effect on mortality in one day.

TABLE G-12
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - METALS

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Elliptio complanata	Mussel	Fresh	filter feeder	18	Mortality	NOEL	Survival - No effect.
Chironomus riparius	Midge	Fresh	omnivore	18	Mortality	NOEL	Survival - No effect. No effects on generations one to five
Clupea harengus	Herring - Baltic	Salt	piscivore	19	Mortality	NOEL	Survival - No effect.
Glycera dibranchiata	Polychaete	Salt	detritivore	24	Mortality	NOEL	Survival - No effect.
Hydropsyche sp.	Caddisfly	Fresh	detritivore	25	Mortality	NOED	No effect on mortality in one day.
Saccostrea commercialis	Oyster - Sydney Rocl	Salt	filter feeder	25	Mortality	NOEL	Survival - No effect.
Pteronarcys dorsata	Giant Black Stonefly	Fresh	omnivore	29	Mortality	NOEL	Survival - No effect.
Clupea harengus	Herring - Baltic	Salt	piscivore	29	Mortality (viable ha	NOEL	Survival (viable hatch) - No effect. Salinity 25 and 30 ppt
Mytilus edulis	Mussel - Blue	Salt	filter feeder	30	Mortality	NOED	Highest Body Burden Reported
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	32	Mortality	NOEL	Survival - No effect.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	32	Mortality	NOED	No increase in mortality.
Jordanella floridae	American flagfish	Fresh	bottom feeder	35	Mortality	NOED	
Hydropsyche betteni	Caddisfly	Fresh	omnivore	40	Mortality	NOEL	Survival - No effect.
Hydropsyche sp.	Caddisfly	Fresh	detritivore	42	Mortality	NOED	No effect on mortality in one day.
Ambystoma gracile	Salamander	Fresh	predator	44	Mortality	NOED	No Significant Increase In Mortality At Highest Test Concentration
Gammarus fossarum	Amphipod	Fresh	detritivore	53	Mortality	NOED	No increase in mortality. Hard water 83-87 mg/L Ca ion, pH 8.3. Artificial stream system.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	58	Mortality	NOEL	Survival - No effect.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	58	Mortality	NOED	No increase in mortality.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	60	Mortality	NOEL	Survival - No effect.
Nereis arenaceodentata	Polychaete	Estuarine	detritivore	62	Mortality	NOED	No Effect On Survival
Nereis virens	Polychaete	Salt	detritivore	64	Mortality	NOEL	Survival - No effect.
Chironomus riparius	Midge	Fresh	omnivore	67	Mortality	NOEL	Survival - No effect.
Chlorella species	Algae - Green	Fresh	primary producer	68	Mortality	NOED	No effect on biomass.
Helisoma sp.	Snail	Fresh	herbivore	78	Mortality	NOEL	Survival - No effect.
Helisoma sp.	Snail	Fresh	herbivore	90	Mortality	NOEL	Survival - No effect.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	100	Mortality	NOEL	Survival - No effect.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	100	Mortality	NOED	No increase in mortality. Residue was determined from graph and is approximate.

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	114		Mortality	NOEL	Survival - No effect. Lower accumulation rate didn't result in mortality as observed at a similar body residue (108-120 µg/g) at 400 µg/L by 27d (see above)
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	114		Mortality	NOED	No increase in mortality.
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	138		Mortality	NOEL	Survival - No effect. Authors state that the high residue level may be caused by gut contents with biologically unavailable Cd bound to ingested particulates
Glyptotendipes pallens	Midge	Fresh	omnivore	138		Mortality	NOED	No Effect On Mortality In 96 Hours
Ambystoma gracile	Salamander	Fresh	predator	145		Mortality	NOED	No Significant Increase In Mortality At Highest Test Concentration
Artemia salina	Shrimp - Brine	Salt	filter feeder	194		Mortality	NOEL	Survival - No effect. Radiotracer study
Helisoma sp.	Snail	Fresh	herbivore	300		Mortality	NOED	No Effect On Mortality
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	310		Mortality	NOED	No Effect On Mortality
Helisoma sp.	Snail	Fresh	herbivore	460		Mortality	NOED	No Effect On Mortality
Orconectes propinquus	Crayfish	Fresh	omnivore	534		Mortality	NOED	No significant difference in mortality. Only 1 of 15 (7%) dead at end of exposure period (190.5 hours).
Hydropsyche sp.	Caddisfly	Fresh	detritivore	0.093	I	Mortality	LOED	Mortality in two days.
Hydropsyche sp.	Caddisfly	Fresh	detritivore	0.12		Mortality	LOED	Mortality in one day.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.14	F	Mortality	LOEL	Survival - Reduced 20%.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.21		Mortality	LOED	Hatching Alevins Unable To Break Free From Egg Membrane, Died
Gasterosteus aculeatus	Three-spined Stickleb	Fresh	invertivore	0.3		Mortality	LOEL	Survival - Reduced 5.6%. Residue estimated by authors by summation of individual tissue burdens
Lepomis macrochirus	Bluegill	Fresh	invertivore	0.35		Mortality	LOEL	Survival - Reduced.
Jordanella floridae	American flagfish	Fresh	bottom feeder	0.4		Mortality	LOED	Body Burden Est. From Graph, Fish Initially Exposed As Embryos
Jordanella floridae	American flagfish	Fresh	bottom feeder	0.4		Mortality	LOED	Body Burden Est. From Graph, Fish Not Exposed As Embryos
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.41		Mortality	LD50	Survival - Reduced 50%.
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	0.56		Mortality	LOEL	Survival - Reduced. 9.6°C

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Gasterosteus aculeatus	Three-spined Sticklet	Fresh	invertivore	0.75	Mortality	LOEL	Survival - Reduced 9.7%. Residue estimated by authors by summation of individual tissue burdens
Poecilia reticulata	Guppy	Fresh	omnivore	0.8	Mortality	LOEL	Survival - Reduced 16%.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.84	Mortality	LD100	Complete Mortality Of Alevins Within 320 Hours
Gasterosteus aculeatus	Three-spined Sticklet	Fresh	invertivore	0.9	Mortality	LOEL	Survival - Reduced 80%. Residues in control fish, 0.39 µg/g
Gasterosteus aculeatus	Three-spined Sticklet	Fresh	invertivore	0.9	Mortality	LOED	At least 80% mortality.
Poecilia reticulata	Guppy	Fresh	omnivore	1.2	Mortality	LOED	14% Reduction In Survival
Clioperla clio	Stonefly	Fresh	omnivore	1.4	Mortality	ED10	
Clioperla clio	Stonefly	Fresh	omnivore	1.7	Mortality	ED30	
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	1.8	Mortality	LOEL	Survival - Reduced 5% or less. Salinity 20 ppt
Clioperla clio	Stonefly	Fresh	omnivore	1.8	Mortality	ED50	
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2.2	Mortality	ED50	Hardness: 70 Mg/l Caco3
Mysidopsis bahia	Shrimp - Mysid	Salt	invertivore	2.4	Mortality	LD45	45% Increase in mortality.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	2.6	Mortality	LOED	20% Increase in mortality. Salinity 5 ppt.
Gasterosteus aculeatus	Three-spined Sticklet	Fresh	invertivore	2.9	Mortality	LOEL	Survival - Reduced 27.4%. Residue estimated by authors by summation of individual tissue burdens
Daphnia galeata mendotae	Cladoceran	Fresh	filter feeder	3.5	Mortality	LOED	430% Increase in prenatal mortality (aborted eggs and embryos); reduced longevity.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	3.7	Mortality	ED50	Hardness: 279 Mg/l Caco3
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	4	Mortality	LOEL	Survival - Reduced. 5°C
Jordanella floridae	American flagfish	Fresh	bottom feeder	4	Mortality	LOEL	Survival - Reduced. Residues were higher at 30 d than 100 d. Range shown is for 100 and 30 d.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	4	Mortality	ED50	Hardness: 70 Mg/l Caco3
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	4	Mortality	LD25	25% mortality at day 21.
Lates calcarifer	Seabass	Salt	piscivore	4.2	Mortality	LOEL	Survival - Reduced 10%. Residues in surviving fish
Mysidopsis bahia	Shrimp - Mysid	Salt	invertivore	4.4	Mortality	LD94	94% Increase in mortality.
Gammarus pulex	Amphipod	Fresh	detritivore	4.4	Mortality	LOEL	Survival - Reduced - Death.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	4.6	Mortality	LOEL	Survival - Reduced 10%. Salinity 10 ppt
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	4.6	Mortality	LOED	10% Increase in mortality. Salinity 10 ppt.

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Hyalella azteca	Amphipod	Fresh	detritivore	5.6	Mortality	LOEL	Survival - Reduced. *8 HQ (8 - hydroxyquinoline) added
Orconectes virilis	Crayfish	Fresh	omnivore	5.7	Mortality	LOEL	Survival - Reduced 25%.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	5.8	Mortality	LOED	22% Increase in mortality. Salinity 5 ppt.
Hyalella azteca	Amphipod	Fresh	detritivore	6	Mortality	LOEL	Survival - Reduced.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	6.4	Mortality	ED50	Hardness: 279 Mg/l Caco3
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	7	Mortality	LOED	25% Increase in mortality. Salinity 5 ppt.
Hyalella azteca	Amphipod	Fresh	detritivore	7.6	Mortality	LD50	Survival - Reduced 50%.
Chironomus riparius	Midge	Fresh	omnivore	7.6	Mortality	LOEL	Survival - Reduced.
Chironomus riparius	Midge	Fresh	omnivore	7.6	Mortality	LOED	Increased mortality.
Hyalella azteca	Amphipod	Fresh	detritivore	7.8	Mortality	LOEL	Survival - Reduced. *Humic acid added
Hyalella azteca	Amphipod	Fresh	detritivore	7.8	Mortality	LOEL	Survival - Reduced. *EDTA added
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	8	Mortality	LOEL	Survival - Reduced 20-25%. Salinity 5 ppt
Poecilia reticulata	Guppy	Fresh	omnivore	8	Mortality	LOEL	Survival - Reduced >50%.
Poecilia reticulata	Guppy	Fresh	omnivore	8	Mortality	LD50	50% Reduction In Survival
Leiostomus xanthurus	Spot	Salt	omnivore	8	Mortality	LD50	Survival - Reduced 50%. Residues in surviving fish
Lates calcarifer	Seabass	Salt	piscivore	8.3	Mortality	LOEL	Survival - Reduced <50%. Residues in surviving fish
Leiostomus xanthurus	Spot	Salt	omnivore	8.6	Mortality	LD50	Survival - Reduced 50%. Residues in surviving fish
Daphnia magna	Cladoceran	Fresh	filter feeder	8.8	Mortality	LOEL	Survival - Reduced.
Hyalella azteca	Amphipod	Fresh	detritivore	8.8	Mortality	LD50	Survival - Reduced 50%. *Humic acid added
Hyalella azteca	Amphipod	Fresh	detritivore	8.8	Mortality	LD50	Survival - Reduced 50%. *EDTA added
Moina macrocopa	Cladoceran	Fresh	herbivore	9	Mortality	LOEL	Survival - Reduced.
Hydropsyche sp.	Caddisfly	Fresh	detritivore	9.8	Mortality	LOED	Mortality in one day.
Belone belone	Garpike	Salt	piscivore	10	Mortality (hatchabi	LOEL	Survival (hatchability) Reduced.
Monoporeia affinis	Amphipod	Fresh	detritivore	11	Mortality	LOED	
Orconectes virilis	Crayfish	Fresh	omnivore	11	Mortality	LOEL	Survival - Reduced 74%.
Pontoporeia affinis	Amphipod	Fresh	detritivore	11	Mortality	LOEL	Survival - Reduced. One adult female that survived 265d had a body burden of 30 µg/g
Hyalella azteca	Amphipod	Fresh	detritivore	15	Mortality	LOEL	Survival - Reduced. *90% distilled water added
Pontoporeia affinis	Amphipod	Fresh	detritivore	16	Mortality	LOEL	Survival - Reduced.
Hyalella azteca	Amphipod	Fresh	detritivore	16	Mortality	LD50	Survival - Reduced 50%. *90% distilled water added

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WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - METALS

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Moina macrocopa	Cladoceran	Fresh	herbivore	16	Mortality	LOED	Reduced Survival. Residue at 6 days.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	16	Mortality	LD100	Complete Mortality Of Alevins Within 10 Hours
Hyalella azteca	Amphipod	Fresh	detritivore	17	Mortality	LD50	Survival - Reduced 50%. *Sediment A added
Hyalella azteca	Amphipod	Fresh	detritivore	17	Mortality	LOEL	Survival - Reduced. *Sediment A added
Hydropsyche sp.	Caddisfly	Fresh	detritivore	17	Mortality	LOED	Mortality in two days.
Orconectes virilis	Crayfish	Fresh	omnivore	18	Mortality	LOEL	Survival - Reduced - Death.
Belone belone	Garpike	Salt	piscivore	18	Mortality	LOEL	Survival - Reduced.
Clupea harengus	Herring - Baltic	Salt	piscivore	19	Mortality (viable ha	LOEL	Survival (viable hatch) - Reduced. Salinity 16 ppt
Hyalella azteca	Amphipod	Fresh	detritivore	20	Mortality	LD50	Survival - Reduced 50%. *Sediment B added
Orconectes virilis	Crayfish	Fresh	omnivore	20	Mortality	LOEL	Survival - Reduced - Death.
Eohaustorius estuarius	Amphipod	Fresh	detritivore	20	Mortality	LD50	Survival - Reduced 50%. Organisms held in the lab for 121 d before testing
Lates calcarifer	Seabass	Salt	piscivore	20	Mortality	LD50	Survival - Reduced 50%. Residues in surviving fish
Cambarus latimanus	Crayfish	Fresh	omnivore	22	Mortality	LOED	Significant increase in mortality. Feed contaminated with 0.17 ug Cd/g.
Chironomus riparius	Midge	Fresh	omnivore	23	Mortality	LOEL	Survival - Reduced 55%.
Leiostomus xanthurus	Spot	Salt	omnivore	24	Mortality	LD50	Survival - Reduced 50%. Residues in surviving fish
Clupea harengus	Herring - Baltic	Salt	piscivore	24	Mortality (viable ha	LOEL	Survival (viable hatch) - Reduced. Salinity 5 ppt
Hyalella azteca	Amphipod	Fresh	detritivore	30	Mortality	LOEL	Survival - Reduced. *Sediment B added
Hydropsyche sp.	Caddisfly	Fresh	detritivore	30	Mortality	LOED	Mortality in four days.
Physa integra	Snail	Fresh	herbivore	30	Mortality	LOEL	Survival - Reduced = 80%.
Chironomus riparius	Midge	Fresh	omnivore	33	Mortality	LOEL	Survival - Reduced. Survival reduced by third generation, reproduction after the fourth generation
Leiostomus xanthurus	Spot	Salt	omnivore	34	Mortality	LD50	Survival - Reduced 50%. Residues in surviving fish
Allorchestes compressa	Amphipod	Fresh	detritivore	36	Mortality	LOEL	Survival - Reduced 57%.
Clupea harengus	Herring - Baltic	Salt	piscivore	36	Mortality	LOEL	Survival - Reduced.
Hyalella azteca	Amphipod	Fresh	detritivore	38	Mortality	ED50	Tap Water
Clupea harengus	Herring - Baltic	Salt	piscivore	38	Mortality (viable ha	LOEL	Survival (viable hatch) - Reduced. Salinity 25 and 30 ppt

TABLE G-12
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - METALS

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Leiostomus xanthurus	Spot	Salt	omnivore	42	Mortality	LD50	Survival - Reduced 50%. Residues in surviving fish
Chironomus riparius	Midge	Fresh	omnivore	43	Mortality	LOEL	Survival - Reduced 71%.
Hyalella azteca	Amphipod	Fresh	detritivore	44	Mortality	ED50	Tap Water With 20mg/l Humic Acid
Hyalella azteca	Amphipod	Fresh	detritivore	44	Mortality	ED50	Tap Water With 0.5 um EDTA
Saccostrea commercialis	Oyster - Sydney Rocl	Salt	filter feeder	48	Mortality	LOEL	Survival-Reduced 100% in 60 d.
Gammarus fossarum	Amphipod	Fresh	detritivore	48	Mortality	LOED	Increase in mortality. Soft water 4.4 mg/L Ca ion, pH 7.2. Artificial stream system.
Gammarus fossarum	Amphipod	Fresh	detritivore	53	Mortality	LOED	Increase in mortality. Hard water 83-87 mg/L Ca ion, pH 8.3. Artificial stream system.
Gammarus fossarum	Amphipod	Fresh	detritivore	53	Mortality	LOED	Increase in mortality. Soft water 4.4 mg/L Ca ion, pH 7.2. Artificial stream system.
Allorchestes compressa	Amphipod	Fresh	detritivore	60	Mortality	LOEL	Survival - Reduced >70%.
Chironomus riparius	Midge	Fresh	omnivore	66	Mortality	LOEL	Survival - Reduced. First generation survival reduced, reproduction reduced by the third generation
Eohaustorius estuarius	Amphipod	Fresh	detritivore	72	Mortality	LD50	Survival - Reduced 50%. Organisms held in the lab for 11-17 d before testing
Hyalella azteca	Amphipod	Fresh	detritivore	79	Mortality	ED50	Med:90% Distilled Water
Saccostrea commercialis	Oyster - Sydney Rocl	Salt	filter feeder	85	Mortality	LOEL	Survival-Reduced 100% in 28 d.
Hyalella azteca	Amphipod	Fresh	detritivore	86	Mortality	ED50	Sediment A
Hyalella azteca	Amphipod	Fresh	detritivore	98	Mortality	ED50	Sediment B
Gammarus fossarum	Amphipod	Fresh	detritivore	102	Mortality	LOED	Increase in mortality. Hard water 83-87 mg/L Ca ion, pH 8.3. Artificial stream system.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	108	Mortality	LD50	Survival - Reduced 50%. *LT50
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	108	Mortality	LD50	50% Mortality in 27 days.
Helisoma sp.	Snail	Fresh	herbivore	125	Mortality	LD50	Survival - Reduced 50%. Residues in surviving organisms
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	134	Mortality	LOEL	Survival - Reduced 40%. Residues in surviving organisms
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	144	Mortality	LOED	Significantly Reduced Survival At Lowest Test Concentration, Exp_conc = <3.6
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	160	Mortality	LOEL	Survival - Reduced 96%.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	160	Mortality	LD96	96% Mortality in 27 days.

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Gammarus fossarum	Amphipod	Fresh	detritivore	216		Mortality	LD100	100% Mortality in 10 days. Soft water 4.4 mg/L Ca ion, pH 7.2. Artificial stream system.
Helisoma sp.	Snail	Fresh	herbivore	625		Mortality	LD50	50% Mortality
Lumbriculus variegatus	Oligochaete	Fresh	detritivore	670		Mortality	LD40	40% Mortality
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	0.06	F	Growth	NOEL	Growth - No effect. 9.6°C
Mysidopsis bahia	Shrimp - Mysid	Salt	invertivore	0.08		Growth	NOEL	Growth - No effect.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.13		Growth	NOEL	Growth - No effect. Third generation fish
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	0.3		Growth	NOEL	Growth - No effect. 5°C
Lepomis macrochirus	Bluegill	Fresh	invertivore	0.35		Growth	NOEL	Growth - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.47		Growth	NOEL	Growth - No effect.
Poecilia reticulata	Guppy	Fresh	omnivore	0.5		Growth	NOED	No difference in body length.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.54		Growth	NOEL	Growth - No effect.
Triborodon hakonensis	Dace	Fresh	omnivore	0.69		Growth	NOEL	Growth - No effect.
Hexagenia rigida	Mayfly	Fresh	detritivore	0.7		Growth	NOEL	Growth - No effect.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.75		Growth	NOEL	Growth - No effect.
Poecilia reticulata	Guppy	Fresh	omnivore	0.8		Growth	NOEL	Growth - No effect.
Neanthes arenaceodentata	Polychaete	Salt	detritivore	1.1		Growth	NOED	No difference in weight. Residue value taken from graph and is approximate. Radiotracer study.
Neanthes arenaceodentata	Polychaete	Salt	detritivore	1.1		Growth	NOEL	Growth - No effect. *Cd activity; Radiotracer study
Ambystoma gracile	Salamander	Fresh	predator	1.6		Growth	NOED	No Significant Reduction In Length Or Weight
Jordanella floridae	American flagfish	Fresh	bottom feeder	2		Growth	NOEL	Growth - No effect. Residues were higher at 30 d than 100 d. Range shown is for 100 and 30 d
Hexagenia rigida	Mayfly	Fresh	detritivore	2.1		Growth	NOEL	Growth - No effect.
Ambystoma gracile	Salamander	Fresh	predator	3.8		Growth	NOED	No Significant Reduction In Length Or Weight
Palaemonstes pugio	Shrimp - Grass	Estuarine	omnivore	4.6		Growth	NOEL	Growth - No effect*. *Molting stimulated; Salinity 10 ppt
Poecilia reticulata	Guppy	Fresh	omnivore	4.8		Growth	NOEL	Growth - No effect.
Poecilia reticulata	Guppy	Fresh	omnivore	5		Growth	NOED	No difference in body length..
Jordanella floridae	American flagfish	Fresh	bottom feeder	6		Growth	NOED	Body Burden Est. From Graph
Jordanella floridae	American flagfish	Fresh	bottom feeder	6		Growth	NOED	Body Burden Est. From Graph
Moina macrocopa	Cladoceran	Fresh	herbivore	7		Growth	NOEL	Growth - No effect.
Chironomus riparius	Midge	Fresh	omnivore	7.6		Growth	NOEL	Growth - No effect.

TABLE G-12
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - METALS

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)	Effect	Endpoint	Comments
Chironomus riparius	Midge	Fresh	omnivore	7.6	Growth	NOED	No significant difference in weight gain measured in males as dry weight.
Daphnia galeata mendotae	Cladoceran	Fresh	filter feeder	8.6	Growth	NOED	No effect on individual weight.
Jordanella floridae	American flagfish	Fresh	bottom feeder	10	Growth	NOED	Total Length Of Females
Jordanella floridae	American flagfish	Fresh	bottom feeder	10	Growth	NOED	Total Length Of Females
Cambarus latimanus	Crayfish	Fresh	omnivore	15	Growth	NOED	No significant difference in length and weight. Feed contaminated with 0.17 ug Cd/g.
Pontoporeia affinis	Amphipod	Fresh	detritivore	16	Growth	NOEL	Growth - No effect.
Elliptio complanata	Mussel	Fresh	filter feeder	18	Growth	NOEL	Growth - No effect.
Glyptotendipes pallens	Midge	Fresh	omnivore	18	Growth	NOED	No effect on biomass.
Glyptotendipes pallens	Midge	Fresh	omnivore	20	Growth	NOED	No significant difference in larval weight or population biomass.
Cambarus latimanus	Crayfish	Fresh	omnivore	22	Growth	NOED	No significant difference in length and weight. Feed contaminated with 0.17 ug Cd/g.
Mytilus edulis	Mussel - Blue	Salt	filter feeder	30	Growth	NOED	
Ambystoma gracile	Salamander	Fresh	predator	44	Growth	NOED	No Significant Reduction In Length Or Weight At Highest Test Concentration
Ambystoma gracile	Salamander	Fresh	predator	145	Growth	NOED	No Significant Reduction In Length Or Weight At Highest Test Concentration
Scenedesmus obliquus	Algae - Freshwater C	Fresh	primary producer	3030	Growth	NOED	No Significant Inhibition Of Population Doubling
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	0.12 F	Growth	LOEL	Growth - Reduced. 9.6°C
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.25	Growth	LOEL	Growth - Reduced. Third generation fish
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	0.25	Growth	LOED	Decreased weight gain at 12 weeks.
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	0.4	Growth	LOEL	Growth - Reduced. 5°C
Cyprinodon variegatus	Minnow - Sheepshea	Estuarine	omnivore	0.5	Growth	LOED	Significant decrease in length.
Poecilia reticulata	Guppy	Fresh	omnivore	0.8	Growth	LOED	Reduction In Body Length Within 10 Days
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.96	Growth	LOEL	Growth - Reduced.
Mysidopsis bahia	Shrimp - Mysid	Salt	invertivore	1.3 I	Growth	LOED	17% Significant Reduction In Growth, Mean Dry Weight Of Animals
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	1.6	Growth	LOEL	Growth - Reduced.
Mysidopsis bahia	Shrimp - Mysid	Salt	invertivore	2.4	Growth	ED15	15% Significant Reduction In Growth, Mean Dry Weight Of Animals

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Jordanella floridae	American flagfish	Fresh	bottom feeder	4		Growth	LOEL	Growth - Reduced. Residues were higher at 30 d than 100 d. Range shown is for 100 and 30 d.
Mysidopsis bahia	Shrimp - Mysid	Salt	invertivore	4.4		Growth	ED28	28% Significant Reduction In Growth, Mean Dry Weight Of Animals
Ambystoma gracile	Salamander	Fresh	predator	4.7		Growth	LOED	Significant Reduction In Both Length And Weight
Ambystoma gracile	Salamander	Fresh	predator	6.3		Growth	LOED	Significant Reduction In Both Length And Weight
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	8		Growth	LOEL	Growth - Reduced*. *Molting inhibited; Salinity 5 ppt
Moina macrocopa	Cladoceran	Fresh	herbivore	9		Growth	LOEL	Growth - Reduced.
Daphnia galeata mendotae	Cladoceran	Fresh	filter feeder	10		Growth	LOED	Increased weight of individual animals.
Moina macrocopa	Cladoceran	Fresh	herbivore	16		Growth	LOED	Reduced length. Residue at 6 days.
Neanthes arenaceodentata	Polychaete	Salt	detritivore	17		Growth	LOED	Significant decrease in weight. Residue value taken from graph and is approximate. Radiotracer study.
Neanthes arenaceodentata	Polychaete	Salt	detritivore	17		Growth	LOEL	Growth - Reduced. *Cd activity; Radiotracer study
Jordanella floridae	American flagfish	Fresh	bottom feeder	20		Growth	LOED	Total Length Of Females
Jordanella floridae	American flagfish	Fresh	bottom feeder	20		Growth	LOED	Total Length Of Females
Glyptotendipes pallens	Midge	Fresh	omnivore	26		Growth	LOED	Significant decrease in larval weight and population biomass.
Allorchestes compressa	Amphipod	Fresh	detritivore	60		Growth	LOEL	Growth - Reduced >70%.
Scenedesmus obliquus	Algae - Freshwater C	Fresh	primary producer	658		Growth	LOED	Significant inhibition of growth (39% decrease in population doublings).
Scenedesmus obliquus	Algae - Freshwater C	Fresh	primary producer	2340		Growth	LOED	Significant Inhibition Of Growth (27% decrease in population doublings)
Daphnia magna	Cladoceran	Fresh	filter feeder	0.27		Reproduction	NOEL	Reproduction - No effect.
Jordanella floridae	American flagfish	Fresh	bottom feeder	1.2	F	Reproduction	NOEL	Reproduction - No effect.
Monoporeia affinis	Amphipod	Fresh	detritivore	3		Reproduction	NOED	Percent Malformed Eggs
Nereis arenaceodentata	Polychaete	Estuarine	detritivore	3.8		Reproduction	NOED	No significant difference in number of eggs/pair or length of time from pairing to egg laying.
Neanthes arenaceodentata	Polychaete	Salt	detritivore	4.5	I	Reproduction	NOEL	Reproduction - No effect. *Cd activity; Radiotracer study

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Moina macrocopa	Cladoceran	Fresh	herbivore	7	Reproduction	NOEL	Reproduction - No effect.
Chironomus riparius	Midge	Fresh	omnivore	7.6	Reproduction	NOEL	Reproduction - No effect.
Chironomus riparius	Midge	Fresh	omnivore	7.6	Reproduction	NOED	No significant difference in number of eggs per female.
Moina macrocopa	Cladoceran	Fresh	herbivore	8	Reproduction	NOED	No Effect On Brood Size. Residue at 6 days.
Pontoporeia affinis	Amphipod	Fresh	detritivore	11	eproduction (no. eggs	NOEL	Reproduction (no. eggs/female)-No effect.
Chironomus riparius	Midge	Fresh	omnivore	18	Reproduction	NOEL	Reproduction - No effect. No effects on generations one to five
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	18	Reproduction	NOED	No increased abnormalities in embryos from exposed parents.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	54	Reproduction	NOED	No significant difference in fecundity.
Jordanella floridae	American flagfish	Fresh	bottom feeder	2	F Reproduction	LOEL	Reproduction - Reduced. Mean spawnings per female and total number of embryos produced were decreased.
Monoporeia affinis	Amphipod	Fresh	detritivore	6	Reproduction	LOED	Percent Malformed Eggs
Daphnia magna	Cladoceran	Fresh	filter feeder	6.4	Reproduction	LOEL	Reproduction - Reduced.
Moina macrocopa	Cladoceran	Fresh	herbivore	9	Reproduction	LOEL	Reproduction - Reduced.
Moina macrocopa	Cladoceran	Fresh	herbivore	10.6	Reproduction	LOED	Reduced Brood Size. Residue at 6 days.
Moina macrocopa	Cladoceran	Fresh	herbivore	16	Reproduction	ED100	No Reproduction After 12 Days. Residue at 6 days.
Chironomus riparius	Midge	Fresh	omnivore	33	Reproduction	LOEL	Reproduction - Reduced. Survival reduced by third generation, reproduction after the fourth generation
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	54	Reproduction	LOED	24% Increase in abnormal embryos from exposed parents.
Neanthes arenaceodentata	Polychaete	Salt	detritivore	62	Reproduction	LOEL	Reproduction - Reduced. *Cd activity; Radiotracer study
Nereis arenaceodentata	Polychaete	Estuarine	detritivore	62	Reproduction	ED100	Reproductive failure. No eggs produced.
Chironomus riparius	Midge	Fresh	omnivore	66	Reproduction	LOEL	Reproduction - Reduced. First generation survival reduced, reproduction reduced by the third generation
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	101	Reproduction	ED100	Complete Mortality Of Eggs Within 32 Hours

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Chromium VI								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2.3		Mortality	NOED	Ph 7.8; No mortality.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2.3		Mortality	NOED	100% survival; pH = 6.5, exposure concentration 5.0 mg/L.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	5.5		Mortality	NOED	Ph 6.5; No mortality.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	5.5	F	Mortality	NOED	100% survival; pH = 7.8, exposure concentration 5.0 mg/L.
Allorchestes compressa	Amphipod	Fresh	detritivore	9.2	I	Mortality	NOEL	Survival - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	8.7	F	Mortality	LD75	Ph 6.5; 75% Mortality
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	8.7		Mortality	LD75	25% survival; pH = 6.5, exposure concentration 16.5 mg/L.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	8.9		Mortality	LD37	63% survival; pH = 7.8, exposure concentration 16.5 mg/L.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	11		Mortality	LD50	Ph 7.8; 50% Mortality
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	11		Mortality	LD50	50% survival; pH = 7.8, exposure concentration 50 mg/L.
Portunus pelagicus	Crab - Sand	Salt	predator	1		Growth	NOEL	Growth - No effect*. *2 instar stage
Portunus pelagicus	Crab - Sand	Salt	predator	3.2		Growth	NOEL	Growth - Reduced*. *2 instar stage
Portunus pelagicus	Crab - Sand	Salt	predator	3.2	I	Growth	NOEL	Growth - No effect*. *3 - 6 instar stage
Allorchestes compressa	Amphipod	Fresh	detritivore	9.2		Growth	NOEL	Growth - No effect.
Portunus pelagicus	Crab - Sand	Salt	predator	6.3	I	Growth	LOEL	Growth - Reduced*. *3 - 6 instar stage
Neanthes arenaceodentata	Polychaete	Salt	detritivore	4.4	I	Reproduction	NOEL	Reproduction - No effect.
Neanthes arenaceodentata	Polychaete	Salt	detritivore	8.3		Reproduction	NOEL	Reproduction - No effect*. *Poor control reproduction and high variability may be the reason for lack of significant effect
Neanthes arenaceodentata	Polychaete	Salt	detritivore	6.0	I	Reproduction	LOEL	Reproduction - Reduced.
Copper								
Neanthes arenaceodentata	Polychaete	Salt	detritivore	6.3	I	Mortality	NOEL	Survival - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	7		Mortality	NA	Pre-exposure for 21 days produced increased tolerance to lethal concentration of copper -- 70% survival in 570 ug/L for 6 days after pre-exposure.
Cyprinus carpio	Carp - Common	Fresh	bottom feeder	7.6		Mortality	NOED	Larval Mort, Ph 7.6, Body Burd From Graph
Protothaca staminea	Clam	Salt	filter feeder	9.3		Mortality	NOEL	Survival - No effect.
Macoma balthica	Clam - Burrowing	Salt	filter feeder	18		Mortality	NOEL	Survival - No effect. M. balthica is a deposit feeder

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Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	20		Mortality	NOEL	Survival - No effect.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	20		Mortality	NOED	No increase in mortality.
Orconectes rusticus	Crayfish	Fresh	omnivore	26		Mortality	NOED	No Effect On Survivorship
Hyalella azteca	Amphipod	Fresh	detritivore	29		Mortality	NOEL	Survival - No effect.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	30		Mortality	NOEL	Survival - No effect.
Hyalella azteca	Amphipod	Fresh	detritivore	30		Mortality	NOED	calc wet from dry using default % moisture
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	32		Mortality	NOEL	Survival - No effect.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	32		Mortality	NOED	No increase in mortality. Residue was determined from graph and is approximate.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	40		Mortality	NOEL	Survival - No effect.
Phyllodoce maculata	Phyllodoce maculata	Salt	detritivore	46		Mortality	NOEL	Survival - No effect. Rate of uptake more important than total body burden; *converted from dry wt. to wet wt. using factor determined by the authors
Hyalella azteca	Amphipod	Fresh	detritivore	49		Mortality	NOED	calc wet from dry using default % moisture
Orconectes rusticus	Crayfish	Fresh	omnivore	50		Mortality	NOEL	Survival - No effect.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	80		Mortality	NOED	No increased mortality.
Chironomus decorus	Midge	Fresh	omnivore	85		Mortality	NOED	No Effect On Mortality
Chironomus decorus	Midge	Fresh	omnivore	90		Mortality	NOED	No Effect On Mortality
Chironomus decorus	Midge	Fresh	omnivore	116		Mortality	NOED	No Effect On Mortality in 20 hours.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	1.6	F	Mortality	LD100	100% Mortality
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2.2		Mortality	LD50	50% Mortality In 7 Hours. Residue calculated at 6 hours exposure.
Cerastoderma edule	Clam	Salt	filter feeder	5	I	Mortality	LOEL	Survival - Reduced. C. edule is a suspension feeder
Mytilus edulis	Mussel - Blue	Salt	filter feeder	12		Mortality	LD50	Lethal body burden.
Cyprinus carpio	Carp - Common	Fresh	bottom feeder	12		Mortality	LOED	Larval Mort, Ph 6.3, Body Burd From Graph
Cyprinus carpio	Carp - Common	Fresh	bottom feeder	12		Mortality	LOED	Larval Mort, Ph 7.6, Body Burd From Graph
Hyalella azteca	Amphipod	Fresh	detritivore	13		Mortality	LD25	calc wet from dry using default % moisture
Macoma balthica	Clam - Burrowing	Salt	filter feeder	16		Mortality	LOEL	Survival - Reduced 45%. Animals not fed
Hyalella azteca	Amphipod	Fresh	detritivore	17		Mortality	LD50	calc wet from dry using default % moisture
Macoma balthica	Clam - Burrowing	Salt	filter feeder	22		Mortality	LOEL	Survival - Reduced.
Macoma balthica	Clam - Burrowing	Salt	filter feeder	22		Mortality	LOEL	Survival - Reduced 32%. *Animals fed Cu enriched algae that were held in 2 - 5 µg/L water
Mytilus edulis	Mussel - Blue	Salt	filter feeder	22		Mortality	LOEL	Survival - Reduced.

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Hyalella azteca	Amphipod	Fresh	detritivore	24	Mortality	LD25	calc wet from dry using default % moisture
Hyalella azteca	Amphipod	Fresh	detritivore	33	Mortality	LOEL	Survival - Reduced 55%.
Mytilus edulis	Mussel - Blue	Salt	filter feeder	34	Mortality	LD50	50% Mortality in 14 days.
Hyalella azteca	Amphipod	Fresh	detritivore	42	Mortality	LD25	calc wet from dry using default % moisture
Mytilus edulis	Mussel - Blue	Salt	filter feeder	50	Mortality	LD50	50% Mortality in 7-8 days.
Hyalella azteca	Amphipod	Fresh	detritivore	52	Mortality	LD50	calc wet from dry using default % moisture
Neanthes arenaceodentata	Polychaete	Salt	detritivore	54	Mortality	LOEL	Survival - Reduced - Death. No sediment; LT50 = 7.8d
Phyllodoce maculata	Phyllodoce maculata	Salt	detritivore	68	Mortality	LD50	Survival - Reduced 50%. Rate of uptake more important than total body burden; *converted from dry wt to wet wt. using factor determined by the authors
Daphnia magna	Water flea	Fresh	filter feeder	68	Mortality	ED50	Lethal body burden after 21 day exposure.
Hyalella azteca	Amphipod	Fresh	detritivore	80	Mortality	LD94	6% survival.
Hyalella azteca	Amphipod	Fresh	detritivore	81	Mortality	LOEL	Survival - Reduced - Death.
Hyalella azteca	Amphipod	Fresh	detritivore	81	Mortality	LD100	calc wet from dry using default % moisture
Chironomus decorus	Midge	Fresh	omnivore	87	Mortality	LOED	10 to 15% Mortality in 48 hours.
Hyalella azteca	Amphipod	Fresh	detritivore	88	Mortality	LD71	29% survival.
Hyalella azteca	Amphipod	Fresh	detritivore	91	Mortality	LD46	54% survival.
Hyalella azteca	Amphipod	Fresh	detritivore	92	Mortality	LD50	50% survival.
Hyalella azteca	Amphipod	Fresh	detritivore	95	Mortality	LD60	40% survival.
Chironomus decorus	Midge	Fresh	omnivore	126	Mortality	LD25	25% Mortality in 72 hours.
Chironomus decorus	Midge	Fresh	omnivore	142	Mortality	LD50	50% Mortality in 48 hours.
Hyalella azteca	Amphipod	Fresh	detritivore	148	Mortality	LD100	calc wet from dry using default % moisture
Chironomus decorus	Midge	Fresh	omnivore	155	Mortality	LD50	50% Mortality in 72 hours.
Chironomus decorus	Midge	Fresh	omnivore	190	Mortality	LD85	85% Mortality in 72 hours.
Neanthes arenaceodentata	Polychaete	Salt	detritivore	199	Mortality	LOEL	Survival - Reduced - Death. Sand sediment; LT50 = 36.5d
Meretrix casta	Clam - marine	Salt	filter feeder	201	Mortality	LOED	Average lethal body burden for all exposure concentrations up to 184 hours.
Neanthes arenaceodentata	Polychaete	Salt	detritivore	209	Mortality	LOEL	Survival - Reduced - Death. Sand and mud sediment; LT50 = 54.5d
Neanthes arenaceodentata	Polychaete	Salt	detritivore	293	Mortality	LOEL	Survival - Reduced - Death. Mud sediment; LT50 = 50d
Themisto abyssorum	Amphipod - Mesoplar	Salt	detritivore	374	Mortality	LD50	
Themisto libellula	Amphipod - Mesoplar	Salt	detritivore	374	Mortality	LD50	

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Chironomus decorus	Midge	Fresh	omnivore	1000		Mortality	LD100	100% Mortality
Calanus hyperboreus	Calanoid copepod	Salt	herbivore	1320		Mortality	LD50	low concentration exposure
Calanus hyperboreus	Calanoid copepod	Salt	herbivore	2440		Mortality	LD50	High concentration exposure
Hyalella azteca	Amphipod	Fresh	detritivore	30	I	Growth	NOEL	Growth - No effect.
Mytilus edulis	Mussel - Blue	Salt	filter feeder	34		Growth	NOED	No significant difference in shell length.
Hyalella azteca	Amphipod	Fresh	detritivore	13	I	Growth	ED25	Growth as weight calc wet from dry using default % moisture
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	18	F	Growth	ED25	
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	18		Growth	ED45	
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	21		Growth	ED25	
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	21		Growth	ED10	
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	21		Growth	ED25	
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	26		Growth	ED50	
Hyalella azteca	Amphipod	Fresh	detritivore	29		Growth	LOEL	Growth - Reduced.
Mytilus edulis	Mussel - Blue	Salt	filter feeder	50		Growth	LOED	Significant decrease in shell length.
Allorchestes compressa	Amphipod	Fresh	detritivore	100		Growth	LOEL	Growth - Reduced. Survival data were not used because of inconsistency
Hydra littoralis	Hydra	Fresh	predator	3.4	I	Reproduction	NOEL	Reproduction - No effect.
Cyprinus carpio	Carp - Common	Fresh	bottom feeder	12	F	Reproduction	NOED	Egg Mortality, Ph 7.6, Body Burd From Graph
Cyprinus carpio	Carp - Common	Fresh	bottom feeder	12		Reproduction	NOED	Egg Mortality, Ph 6.3, Body Burd From Graph
Hydra littoralis	Hydra	Fresh	predator	4.4	I	Reproduction	LOEL	Reproduction - Reduced.
Daphnia magna	Water flea	Fresh	filter feeder	5.8		Reproduction	ED10	10% reduction in number of offspring.
Cyprinus carpio	Carp - Common	Fresh	bottom feeder	24	F	Reproduction	LOED	Egg Mortality, Ph 6.3, Body Burd From Graph
Lead								
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	2.3		Mortality	NOED	No increase in mortality.
Monoporeia affinis	Amphipod	Fresh	detritivore	4		Mortality	NOED	Body Burden Est. From Graph
Monoporeia affinis	Amphipod	Fresh	detritivore	4	I	Mortality	NOED	Body Burden Est. From Graph
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	35		Mortality	NOED	No Effect On Mortality
Physa integra	Snail	Fresh	herbivore	200		Mortality	NOEL	Survival - No effect.
Brachycentrus sp.	Caddisfly	Fresh	omnivore	260		Mortality	NOEL	Survival - No effect.
Pteronarcys dorsata	Giant Black Stonefly	Fresh	omnivore	340		Mortality	NOEL	Survival - No effect.
Hyalella azteca	Amphipod	Fresh	detritivore	5.8	I	Mortality	LD40	60% survival.
Hyalella azteca	Amphipod	Fresh	detritivore	7.1		Mortality	LD35	65% survival.
Hyalella azteca	Amphipod	Fresh	detritivore	16		Mortality	LD52	48% survival.
Hyalella azteca	Amphipod	Fresh	detritivore	19		Mortality	LD69	31% survival.
Hyalella azteca	Amphipod	Fresh	detritivore	21		Mortality	LD96	4% survival.

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Hyalella azteca	Amphipod	Fresh	detritivore	30		Mortality	LD89	11% survival.
Calanus hyperboreus	Calanoid copepod	Salt	herbivore	41		Mortality	LD50	Clearly written paper
Themisto abyssorum	Amphipod - Mesoplar	Salt	detritivore	63		Mortality	LD50	
Themisto libellula	Amphipod - Mesoplar	Salt	detritivore	63		Mortality	LD50	
Hyalella azteca	Amphipod	Fresh	detritivore	70		Mortality	LD50	50% Mortality (estimate).
Hyalella azteca	Amphipod	Fresh	detritivore	90		Mortality	LD50	50% Mortality (estimate).
Gammarus pseudolimnaeus	Amphipod	Fresh	detritivore	98		Mortality	LOEL	Survival - Reduced >50%.
Hyalella azteca	Amphipod	Fresh	detritivore	115		Mortality	LD50	50% Mortality (estimate). Pre-exposed to 100 nM Pb for 4 weeks.
Hyalella azteca	Amphipod	Fresh	detritivore	160		Mortality	LD50	50% Mortality (estimate).
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	200		Mortality	LOED	52% Mortality
Daphnia magna	Cladoceran	Fresh	filter feeder	5040		Mortality	LD50	Lethal body burden after 21-day exposure.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	1.6		Growth	NOED	No effect on weight gain.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	2.3	I	Growth	NOED	No significant difference in weight gain.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	2.5		Growth	NOEL	Growth - No effect. Third generation fish
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	2.6	F	Growth	NOED	No effect on weight gain in third generation. First and second generation exposed to 58 ug/L for up to 2 years.
Chironomus gr. thummi	Midge	Fresh	omnivore	13		Growth	NOED	Normal 4rth instar larvae.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	35		Growth	NOED	No effect on weight gain in surviving mussels.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	4.0	F	Growth	LOED	Reduced weight gain in third generation. First and second generations exposed to 119 ug/L for up to 2 years.
Chironomus gr. thummi	Midge	Fresh	omnivore	16		Growth	LOED	Deformed 4rth instar larvae.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	200		Growth	LOED	Decreased weight gain in surviving mussels.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	2.6	I	Reproduction	NOED	No effect on larva viability or development.
Daphnia magna	Cladoceran	Fresh	filter feeder	1880	I	Reproduction	ED10	10% reduction in number of offspring.
Manganese								
Macoma balthica	Clam - Burrowing	Salt	filter feeder	16		Mortality	NOEL	Survival - No effect.
Mytilus edulis	Mussel - Blue	Salt	filter feeder	18	I	Mortality	NOEL	Survival - No effect.
Mercury								
Squalus acanthias	Spiny Dogfish	Salt	piscivore	0.093	F	Mortality	NOED	No Effect On Mortality In 24 Hours
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.14		Mortality	NOED	No Effect On Mortality
Poecilia reticulata	Guppy	Fresh	omnivore	0.2		Mortality	NOED	No increase in mortality.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.47		Mortality	NOED	No Effect On Mortality

TABLE G-12
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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Anguilla anguilla	Eel - European	Anadromous	predator	0.56		Mortality	NOED	No increase in mortality. Freshwater eel adapted to seawater for test.
Daphnia magna	Water flea	Fresh	filter feeder	0.86		Mortality	NOED	No Effect On Mortality
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	1.1		Mortality	NOEL	Survival - No effect.
Daphnia magna	Water flea	Fresh	filter feeder	1.5		Mortality	NOED	No Effect On Mortality
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	1.6		Mortality	NOED	No Statistically Significant Increase In Mortality
Daphnia magna	Water flea	Fresh	filter feeder	1.6		Mortality	NOED	No Effect On Mortality
Hexagenia rigida	Mayfly-Burrowing	Fresh	detritivore	2		Mortality	NOED	Residues ranged from 2 to 2.4 mg/kg for the following test condition combinations: pH 5 or pH 7.5, temperatures of 10, 18, or 26C, and photoperiods of 6, 12, or 18 hours per day.
Daphnia magna	Water flea	Fresh	filter feeder	2.3		Mortality	NOED	No Effect On Mortality
Stizostedion vitreum	Walleye	Fresh	piscivore	2.4		Mortality	NOED	No Statistically Significant Increase In Mortality
Hexagenia rigida	Mayfly-Burrowing	Fresh	detritivore	2.7		Mortality	NOED	Residues ranged from 2.7 to 4.5 mg/kg for the following test condition combinations: pH 5 or pH 7.5, temperatures of 10, 18, or 26C, and photoperiods of 6, 12, or 18 hours per day.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	2.8		Mortality	NOED	
Elliptio complanata	Mussel	Fresh	filter feeder	3.0		Mortality	NOEL	Survival - No effect.
Daphnia magna	Water flea	Fresh	filter feeder	4.7		Mortality	NOED	No Effect On Mortality
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	4.8		Mortality	NOED	Increased in mortality.
Viviparus georgianus	Snail	Fresh	herbivore	6		Mortality	NOEL	Survival - No effect.
Carassius auratus	Goldfish	Fresh	omnivore	6.2		Mortality	NOED	No significant increase in mortality.
Daphnia magna	Water flea	Fresh	filter feeder	7.6	I	Mortality	NOED	No Effect On Mortality
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	7.6		Mortality	NOED	
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	28		Mortality	NOEL	Survival - No effect. *Flow-through for 12h (daylight), static with Hg added for 12h (nighttime)
Chironomus riparius	Midge	Fresh	omnivore	40		Mortality	NOED	No mortality. No effect on emergence of adults.
Chironomus riparius	Midge	Fresh	omnivore	108		Mortality	NOED	No mortality in 4th instar larvae.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.04	F	Mortality	LOEL	Survival - Reduced - 55%.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.27		Mortality	LOEL	Survival - Reduced - 77%.
Ictalurus punctatus	Catfish - Channel	Fresh	bottom feeder	0.34		Mortality	LOEL	Survival - Reduced 49%.

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Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.9		Mortality	LOEL	Survival - Reduced - Death.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2		Mortality	LOED	Increase in mortality.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	4.2		Mortality	LOED	
Pleuronectes americanus	Flounder - Winter	Estuarine	bottom feeder	5		Mortality	LD50	50% Mortality in 16 hours.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	5.1		Mortality	LD50	15 Day LD50 For Single Intraperitoneal Injection
Carassius auratus	Goldfish	Fresh	omnivore	5.6		Mortality	LD80	Residues measured in surviving fish only.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	6.9		Mortality	LOED	Increase in mortality.
Carassius auratus	Goldfish	Fresh	omnivore	7		Mortality	LD100	No fish with residues above 7 mg/kg survived.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	10		Mortality	LOED	Increase in mortality. Residue is injected dose (i.p.).
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	15		Mortality	LD100	100% Mortality In 15 Days
Anguilla anguilla	Eel - European	Anadromous	predator	15		Mortality	LD25	No increase in mortality. Freshwater eel adapted to seawater for test.
Daphnia magna	Water flea	Fresh	filter feeder	18	I	Mortality	ED25	25% Reduction In Survival Compared To Controls In 21 Days
Rangia cuneata	Clam - Marsh	Salt	filter feeder	20		Mortality	LD50	50% Mortality in clams that had been pre-exposed to 1 ppb Hg for 2 weeks prior to test.
Rangia cuneata	Clam - Marsh	Salt	filter feeder	20		Mortality	LD50	50% Mortality
Rangia cuneata	Clam - Marsh	Salt	filter feeder	73		Mortality	LOED	Lethal Body Burden. Initial water concentration of 10 mg Hg/L. At 96 hr, 0.176 mg Hg/L.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	97		Mortality	LOEL	Survival - Reduced - Death.
Crassostrea virginica	Oyster - Eastern	Salt	filter feeder	141		Mortality	LOEL	Survival - Reduced 65%. *Flow-through for 12h (daytime), static with Hg added for 12h (nighttime)
Hexagenia rigida	Mayfly	Fresh	detritivore	0.04		Growth	NOEL	Growth - No effect. Radiotracer study
Stizostedion vitreum	Walleye	Fresh	piscivore	0.25		Growth	NOED	No Effect On Length Or Weight
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.32		Growth	NOED	30-day Exposure: Progeny Of Exposed Fish
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.32		Growth	NOED	Weight Of Females
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.8	F	Growth	NOED	

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Hexagenia rigida	Mayfly-Burrowing	Fresh	detritivore	2		Growth	NOED	No significant difference in weight gain. Residues ranged from 2 to 2.4 mg/kg for the following test condition combinations: pH 5 or pH 7.5, temperatures of 10, 18, or 26C, and photoperiods of 6, 12, or 18 hours per day.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	2.6		Growth	NOED	
Hexagenia rigida	Mayfly-Burrowing	Fresh	detritivore	2.7		Growth	NOED	No significant difference in weight gain. Residues ranged from 2.7 to 4.5 mg/kg for the following test condition combinations: pH 5 or pH 7.5, temperatures of 10, 18, or 26C, and photoperiods of 6, 12, or 18 hours per day.
Elliptio complanata	Mussel	Fresh	filter feeder	3		Growth	NOEL	Growth - No effect.
Hexagenia rigida	Mayfly	Fresh	detritivore	3.8		Growth	NOEL	Growth - No effect. Radiotracer study
Viviparus georgianus	Snail	Fresh	herbivore	6	I	Growth	NOEL	Growth - No effect.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	9.4		Growth	NOED	Weight Of Males
Crepidula fornicata	Slipper limpet	Salt	herbivore	10		Growth	NOEL	Growth - No effect.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	1.3	F	Growth	LOED	
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	1.4		Growth	LOED	30-day Exposure: Progeny Of Exposed Fish
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	1.4		Growth	LOED	Weight Of Females
Stizostedion vitreum	Walleye	Fresh	piscivore	2.4		Growth	LOED	Significant Reduction In Length And Weight Of Males, But Not Females
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	4.8		Growth	LOED	
Crepidula fornicata	Slipper Limpet	Salt	herbivore	8	I	Growth	ED25	25% Reduction in weight gain. Algal food source contaminated with mercury.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	19		Growth	LOED	Weight Of Males
Crepidula fornicata	Slipper limpet	Salt	herbivore	22		Growth	LOEL	Growth - Reduced.
Daphnia magna	Water flea	Fresh	filter feeder	0.86		Reproduction	NOED	No significant difference in number of neonates produced in 21 days.
Daphnia magna	Water flea	Fresh	filter feeder	1.5	I	Reproduction	NOED	No significant difference in number of neonates produced in 21 days.
Crepidula fornicata	Slipper limpet	Salt	herbivore	4		Reproduction	NOEL	Reproduction - No effect.
Crepidula fornicata	Slipper Limpet	Salt	herbivore	8		Reproduction	NOED	No significant effect on fecundity (number of larva released). Algal food source contaminated with mercury.

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Crepidula fornicata	Slipper Limpet	Salt	herbivore	22		Reproduction	NOED	No significant effect on time to maturity and spawning, spawning frequency, or egg incubation time. Algal food source contaminated with mercury.
Daphnia magna	Water flea	Fresh	filter feeder	1.6	I	Reproduction	ED35	35% Reduction In Number Of Neonates Produced In 21 Days
Daphnia magna	Water flea	Fresh	filter feeder	2.3		Reproduction	LOED	32% Reduction In Number Of Neonates Produced In 21 Days
Daphnia magna	Water flea	Fresh	filter feeder	4.7		Reproduction	ED62	62% Reduction In Number Of Neonates Produced In 21 Days
Daphnia magna	Water flea	Fresh	filter feeder	7.6		Reproduction	ED63	63% Reduction In Number Of Neonates Produced In 21 Days
Crepidula fornicata	Slipper limpet	Salt	herbivore	10		Reproduction (fecur	LOEL	Reproduction (fecundity) - Reduced.
Crepidula fornicata	Slipper Limpet	Salt	herbivore	16		Reproduction	LOED	Significant effect on fecundity (number of larva released). Algal food source contaminated with mercury.
Daphnia magna	Water flea	Fresh	filter feeder	18		Reproduction	ED99	99% Reduction In Number Of Neonates Produced In 21 Days
Mercury (Methyl)								
Pyganodon grandis	Mussel - Floater	Fresh	filter feeder	0.045		Mortality	NOEL	Survival - No effect.
Squalus acanthias	Spiny Dogfish	Salt	piscivore	0.093		Mortality	NOED	No effect on mortality in 24 hours.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.14		Mortality	NOED	No effect on mortality.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.47		Mortality	NOED	No effect on mortality.
Daphnia magna	Water flea	Fresh	filter feeder	0.86		Mortality	NOED	No effect on mortality
Hexagenia rigida	Mayfly	Fresh	detritivore	1		Mortality	NOEL	Survival - No effect.
Daphnia magna	Water flea	Fresh	filter feeder	1.5		Mortality	NOED	No effect on mortality
Daphnia magna	Water flea	Fresh	filter feeder	1.6		Mortality	NOED	No effect on mortality
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	1.9	F	Mortality	NOEL	Survival - No effect. 0% mortality
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2		Mortality	NOED	No mortality in 15 days.
Palaemonetes pugio	Shrimp - Grass	Estuarine	omnivore	2.1		Mortality	NOED	No statistically significant increase in mortality.
Daphnia magna	Water flea	Fresh	filter feeder	2.3		Mortality	NOED	No effect on mortality
Stizostedion vitreum	Walleye	Fresh	piscivore	2.4		Mortality	NOED	No Statistically Significant Increase In Mortality
Hexagenia rigida	Mayfly	Fresh	detritivore	2.6		Mortality	NOEL	Survival - No effect. Tested at 10, 18, and 26°C

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Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	3.4	Mortality	NOEL	Survival - No effect. Second generation fish
Daphnia magna	Water flea	Fresh	filter feeder	4.7	Mortality	NOED	No effect on mortality
Daphnia pulex	Cladoceran	Fresh	filter feeder	5	Mortality	NOEL	Survival - No effect. *Residues were determined in separate water or diet 3 d studies that showed 4.6 µg/g uptake from the water and 0.8 µg/g from the food
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	5	Mortality	NOEL	Survival - No effect.
Rangia cuneata	Clam - Marsh	Estuarine	filter feeder	6	Mortality	NOED	No effect on mortality
Daphnia magna	Water flea	Fresh	filter feeder	7.6	Mortality	NOED	No effect on mortality
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	7.6	Mortality	NOEL	Survival - No effect. *Compared to 0 mg/kg, 1%/d fixed ration control
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	8.6	Mortality	NOEL	Survival - No effect. *Compared to 0 mg/kg, 2%/d fixed ration control
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	10	Mortality	NOEL	Survival - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	11	Mortality	NOEL	Survival - No effect. *Compared to 0 mg/kg, ad libitum ration control
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	11	Mortality	NOEL	Survival - No effect. Radiotracer study; 2 d interval between doses
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	12	Mortality	NOEL	Survival - No effect.
Hexagenia rigida	Mayfly	Fresh	detritivore	16	Mortality	NOEL	Survival - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	29	Mortality	NOEL	Survival - No effect. *Compared to 0 mg/kg, 1%/d fixed ration control
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	35	Mortality	NOEL	Survival - No effect. *Compared to 0 mg/kg, 2%/d fixed ration control
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2 F	Mortality	LOED	33% mortality in 15 days.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2.0	Mortality	LD50	30 day ED50 for eye.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	2.2	Mortality	LOEL	Survival - Reduced - Death. Third generation fish, alevins died within 3 wks of hatch
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	3.7	Mortality	LOEL	Survival - Reduced 13%.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	3.9	Mortality	LD50	30 day ED50 for muscle.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	4	Mortality	LOED	13% mortality in 15 days.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	4.8	Mortality	LD50	30 day ED50 for brain.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	5	Mortality	LOED	83% mortality in 15 days.
Pleuronectes americanus	Flounder - Winter	Estuarine	bottom feeder	5	Mortality	LD50	50% Mortality in 16 hours.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	5.1	Mortality	LD50	Survival - Reduced 50%.

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Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	5.7		Mortality	LD50	15 day ED50 for single intraperitoneal injection.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	6		Mortality	LD50	50% mortality in 15 days.
Lepomis macrochirus	Bluegill	Fresh	invertivore	6.5		Mortality	LOEL	Survival - Reduced - Death. Radiotracer study; 9° C
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	8		Mortality	LOED	67% mortality in 15 days.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	9.4		Mortality	LOEL	Survival - Reduced. Second generation fish
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	10		Mortality	LOED	83% mortality in 15 days.
Lepomis macrochirus	Bluegill	Fresh	invertivore	11		Mortality	LOEL	Survival - Reduced - Death. Radiotracer study; 21° C
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	11		Mortality	LOEL	Survival - Reduced - Death. Mean d to death. 24.2
Rangia cuneata	Clam - Marsh	Estuarine	filter feeder	12	I	Mortality	LD50	Lethal to 50% of clams in 7 days.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	12		Mortality	LOEL	Survival - Reduced - Death. Radiotracer study; Authors state that the fish died from suffocation
Esox lucius	Pike	Fresh	piscivore	13		Mortality	LOEL	Survival - Reduced - Death. Radiotracer study; *Ionic form of methylmercury
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	15		Mortality	LD100	100% mortality in 15 days.
Daphnia magna	Water flea	Fresh	filter feeder	18		Mortality	ED25	25% reduction in survival compared to controls in 21 days.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	20		Mortality	LD100	100% mortality in 15 days.
Esox lucius	Pike	Fresh	piscivore	23		Mortality	LOEL	Survival - Reduced - Death. Radiotracer study; *Cow liver
Esox lucius	Pike	Fresh	piscivore	23		Mortality	LOEL	Survival - Reduced - Death. Radiotracer study; *Cow liver
Rangia cuneata	Clam - Marsh	Estuarine	filter feeder	28		Mortality	LD50	Lethal to 50% of clams in 7 days.
Lepomis macrochirus	Bluegill	Fresh	invertivore	37		Mortality	LOEL	Survival - Reduced - Death. Radiotracer study; 33° C
Rangia cuneata	Clam - Marsh	Estuarine	filter feeder	73		Mortality	LOED	Lethal body burden.
Daphnia magna	Water flea	Fresh	filter feeder	91		Mortality	LD50	Lethal body burden at 21 days exposure.
Pyganodon grandis	Mussel - Floater	Fresh	filter feeder	0.045	I	Growth	NOEL	Growth - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.14		Growth	NOED	No effect on growth.
Stizostedion vitreum	Walleye	Fresh	piscivore	0.25		Growth	NOED	No Effect On Length Or Weight
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.46		Growth	NOED	No effect on growth.
Hexagenia rigida	Mayfly	Fresh	detritivore	1		Growth	NOEL	Growth - No effect.

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Hexagenia rigida	Mayfly	Fresh	detritivore	2.1		Growth	NOEL	Growth - No effect. Radiotracer study
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	2.3	F	Growth	NOEL	Growth - No effect.
Hexagenia rigida	Mayfly	Fresh	detritivore	2.6		Growth	NOEL	Growth - No effect. Tested at 10, 18, and 26°C
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	3.4		Growth	NOEL	Growth - No effect. Second generation fish
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	5		Growth	NOEL	Growth - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	5.7		Growth	NOEL	Growth - No effect.
Hexagenia rigida	Mayfly	Fresh	detritivore	7.5		Growth	NOEL	Growth - No effect. Radiotracer study
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	7.6		Growth	NOEL	Growth - No effect. *Compared to 0 mg/kg, 1%/d fixed ration control
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	8.6		Growth	NOEL	Growth - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	10		Growth	NOEL	Growth - No effect.
Hexagenia rigida	Mayfly	Fresh	detritivore	16		Growth	NOEL	Growth - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	29		Growth	NOEL	Growth - No effect. *Compared to 0 mg/kg, 1%/d fixed ration control
Elliptio complanata	Mussel - Freshwater	Fresh	filter feeder	0.043	I	Growth	ED97	Relative to least contaminated station (17.9 ug/g, dry total Hg in sediment vs 0.07 ug/g, dry), whole animal ww was reduced by 97 percent.
Stizostedion vitreum	Walleye	Fresh	piscivore	2.4	F	Growth	LOED	Significant Reduction In Length And Weight Of Males, But Not Females
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	8.6		Growth	LOEL	Growth - Reduced. *Compared to 0 mg/kg, 2%/d fixed ration control
Crepidula fornicata	Slipper limpet	Marine	filter feeder	9		Growth	ED25	Approximate 25% reduction in growth at lowest test concentration; algal food contained mercury at approximately 2.9 ug/L in addition to water concentration.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	9.4		Growth	LOEL	Growth - Reduced. Second generation fish
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	11		Growth	LOEL	Growth - Reduced. *Compared to 0 mg/kg, ad libitum ration control
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	35		Growth	LOEL	Growth - Reduced. *Compared to 0 mg/kg, 2%/d fixed ration control
Pyganodon grandis	Mussel - Floater	Fresh	filter feeder	0.045	I	Reproduction	NOEL	Reproduction - No effect.
Daphnia magna	Water flea	Fresh	filter feeder	0.86		Reproduction	NOED	No significant reproductive impairment.
Daphnia magna	Water flea	Fresh	filter feeder	1.5		Reproduction	NOED	No significant reproductive impairment.

TABLE G-12
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - METALS

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	3.4	F	Reproduction	NOEL	Reproduction - No effect. Second generation fish
Daphnia pulex	Cladoceran	Fresh	filter feeder	5		Reproduction	NOEL	Reproduction - No effect. *Residues were determined in separate water or diet 3 d studies that showed 4.6 µg/g uptake from the water and 0.8 µg/g from the food
Crepidula fornicata	Slipper limpet	Marine	filter feeder	9		Reproduction	NOED	No significant effect on fecundity (number of gametes); exposure includes mercury in food at approximately 2.9 ug/L.
Crepidula fornicata	Slipper limpet	Marine	filter feeder	30		Reproduction	NOED	No significant effect on ability to produced gametes; exposure includes mercury in food at approximately 31 ug/L.
Daphnia magna	Water flea	Fresh	filter feeder	0.79	I	Reproduction	ED10	10% reduction in number of offspring.
Daphnia magna	Water flea	Fresh	filter feeder	1.6		Reproduction	ED35	35% reduction in number of neonates produced in 21 days.
Daphnia magna	Water flea	Fresh	filter feeder	2.3		Reproduction	ED32	32% reduction in number of neonates produced in 21 days.
Daphnia magna	Water flea	Fresh	filter feeder	4.7		Reproduction	ED62	62% reduction in number of neonates produced in 21 days.
Daphnia magna	Water flea	Fresh	filter feeder	7.6		Reproduction	ED63	63% reduction in number of neonates produced in 21 days.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	9.4	F	Reproduction	LOEL	Reproduction - Reduced. Second generation fish
Crepidula fornicata	Slipper limpet	Marine	filter feeder	15		Reproduction	LOED	Significant effect on fecundity (number of gametes); exposure includes mercury in food at approximately 9.5 ug/L.
Daphnia magna	Water flea	Fresh	filter feeder	18		Reproduction	ED99	99% reduction in number of neonates produced in 21 days.
Nickel								
Neanthes arenaceodentata	Polychaete	Salt	detritivore	0.59	I	Mortality	NOED	No mortality; converted from molar concentration (0.01 umol/g)
Cerastoderma edule	Clam	Salt	filter feeder	79		Mortality	NOED	No significant increase in mortality. Residue measured at 16 days.
Neanthes arenaceodentata	Polychaete	Salt	detritivore	0.59	I	Mortality	LOED	13% mortality; converted from molar concentration (0.01 umol/g).

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Cerastoderma edule	Clam	Salt	filter feeder	57		Mortality	LD50	Estimated body residue by regression from other data values, number of replicates is 2 to 5.
Daphnia magna	Water flea	Fresh	filter feeder	223		Mortality	LD50	Lethal body burden after 21-day exposure.
Cerastoderma edule	Clam	Salt	filter feeder	575		Mortality	LOED	Significant increase in mortality. Mortality started after 8 days. Residue measured at 8 days.
Cerastoderma edule	Clam	Salt	filter feeder	575	I	Growth	NOED	No significant difference in body condition measured as ratios of tissue weight and shell weight or volume. Residue measured at 8 days.
Selenium								
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.28		Mortality	NOEL	Survival - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.32		Mortality	NOEL	Survival - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.32		Mortality	NOED	Significant increase in mortality. Residue measured at 24 weeks.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.44		Mortality	NOEL	Survival - No effect. *Estimated by authors from individual tissues and weights (see below)
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	0.52		Mortality	NOED	No Effect On Survival In 90 Days
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.8		Mortality	NOEL	Survival - No effect. High carbohydrate diet
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	0.8		Mortality	NOED	No Effect On Survival In 90 Days
Lepomis macrochirus	Bluegill	Fresh	invertivore	0.8		Mortality	NOEL	Survival - No effect.
Lepomis macrochirus	Bluegill	Fresh	invertivore	0.8	F	Mortality	NOEL	Survival - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.9		Mortality	NOEL	Survival - No effect. Low carbohydrate diet
Lepomis macrochirus	Bluegill	Fresh	invertivore	1.2		Mortality	NOEL	Survival - No effect. 20°C
Daphnia magna	Cladoceran	Fresh	filter feeder	1.4		Mortality	NOEL	Survival - No effect. 9.63 mg/L sulfate added (sulfate hinders bioaccumulation of Se)
Lepomis macrochirus	Bluegill	Fresh	invertivore	1.6		Mortality	NOED	No increase in mortality. Exposure at 20 degrees C. Concurrent epxosure to 5 ug inorganic Se/L in water and 5.1 ug Seleno-L-Methionine/g in food.
Daphnia magna	Water flea	Fresh	filter feeder	1.8		Mortality	NOEL	Survival - No effect. Radiotracer study
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	2.1		Mortality	NOED	No Effect On Survival In 60 Days
Lepomis macrochirus	Bluegill	Fresh	invertivore	2.4		Mortality	NOED	No Effect On Mortality
Daphnia magna	Water flea	Fresh	filter feeder	2.4		Mortality	NOEL	Survival - No effect. Radiotracer study

TABLE G-12
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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Micropterus salmoides	Bass - Largemouth	Fresh	piscivore	2.7		Mortality	NOEL	Survival - No effect.
Lepomis macrochirus	Bluegill	Fresh	invertivore	2.7		Mortality	NOEL	Survival - No effect.
Micropterus salmoides	Bass - Largemouth	Fresh	piscivore	3.1		Mortality	NOED	No mortality at 20 or 30 degrees C in soft or hard water.
Daphnia magna	Water flea	Fresh	filter feeder	4.4		Mortality	NOEL	Survival - No effect. Radiotracer study
Lepomis macrochirus	Bluegill	Fresh	invertivore	4.4		Mortality	NOEL	Survival - No effect.
Lepomis macrochirus	Bluegill	Fresh	invertivore	4.5		Mortality	NOEL	Survival - No effect. Slightly lower survival than controls, but not significant. Control survival was only 50%.
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	4.6		Mortality	NOED	No Effect On Survival In 120 Days
Lepomis macrochirus	Bluegill	Fresh	invertivore	4.7		Mortality	NOED	No mortality at 20 or 30 degrees C in soft or hard water.
Chironomus decorus	Midge	Fresh	omnivore	5.1		Mortality	NOEL	Survival - No effect. Selenium: sulfur ratios 1:1 to 1:25
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	5.8		Mortality	NOED	No Effect On Survival In 120 Days
Daphnia magna	Water flea	Fresh	filter feeder	6.6		Mortality	NOEL	Survival, No effect. Selenium: sulfur ratio 1:15
Daphnia magna	Water flea	Fresh	filter feeder	10		Mortality	NOED	No Effect On Mortality
Daphnia magna	Cladoceran	Fresh	filter feeder	10		Mortality	NOEL	Survival - No effect.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	12		Mortality	NOED	No Effect On Mortality Larva uptake was 1.46 ng Se per day.
Daphnia magna	Water flea	Fresh	filter feeder	13		Mortality	NOEL	Survival - No effect. Radiotracer study
Lepomis macrochirus	Bluegill	Fresh	invertivore	17		Mortality	NOEL	Survival - No effect. *Female and male, respectively
Lepomis macrochirus	Bluegill	Fresh	invertivore	19		Mortality	NOEL	Survival - No effect.
Daphnia magna	Water flea	Fresh	filter feeder	20		Mortality	NOEL	Survival - No effect. Radiotracer study
Daphnia magna	Water flea	Fresh	filter feeder	0.22	I	Mortality	LOEL	Survival - Reduced. Radiotracer study
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.92	F	Mortality	LOEL	Survival - Reduced.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.92		Mortality	LOED	Significant increase in mortality. Residue measured at 12 weeks.
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	1.1		Mortality	LOED	Reduced Survival In 90 Days
Lepomis macrochirus	Bluegill	Fresh	invertivore	1.1		Mortality	LD50	Survival - Reduced 50%.
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	1.3		Mortality	LOED	Reduced Survival In 90 Days
Lepomis macrochirus	Bluegill	Fresh	invertivore	1.5		Mortality	LOEL	Survival - Reduced. 4°C (Simulated winter stress)

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Lepomis macrochirus	Bluegill	Fresh	invertivore	1.6	Mortality	LOED	35% Increase in mortality. Exposure at 4 degrees C. Concurrent epxosure to 5 ug inorganic Se/L in water and 5.1 ug Seleno-L-Methionine/g in food.
Daphnia magna	Cladoceran	Fresh	filter feeder	3.4	Mortality	LOEL	Survival - Reduced 95%. No sulfate added
Lepomis macrochirus	Bluegill	Fresh	invertivore	4.6	Mortality	LOED	
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	4.7	Mortality	LOED	37% Reduced Survival In 60 Days
Chironomus decorus	Midge	Fresh	omnivore	13	Mortality	LD50	Lethal To 50% Of Animals In 48 Hours
Brachionus calyciflorus	Rotifer	Fresh	zooplanktivore	15	Mortality	LD100	100% Mortality in 10 days.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	15	Mortality	LOEL	Survival - Reduced.
Daphnia magna	Water flea	Fresh	filter feeder	15	Mortality	LOEL	Survival - Reduced >50%*. *Immobilized; selenium: sulfur ratio 1:3
Chironomus decorus	Midge	Fresh	omnivore	17	Mortality	LD50	Lethal To 50% Of Animals In 48 Hours
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	18	Mortality	LOED	Mortality
Daphnia magna	Water flea	Fresh	filter feeder	25	Mortality	LOED	Mortality measured as decreased biomass.
Daphnia magna	Water flea	Fresh	filter feeder	30	Mortality	LOED	Mortality measured as decreased biomass.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.08	Growth	NOEL	Growth - No effect.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.12	Growth	NOED	No difference in weight gain.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.12	Growth	NOEL	Growth - No effect. Radiotracer study
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.14 F	Growth	NOEL	Growth - No effect. Low carbohydrate diet
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.24	Growth	NOED	No significant difference in weight gain.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.24	Growth	NOEL	Growth - No effect. Radiotracer study
Daphnia magna	Cladoceran	Fresh	filter feeder	0.26	Growth	NOEL	Growth - No effect. *A conservative residue value (see footnote*)
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.28	Growth	NOEL	Growth - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.32	Growth	NOED	No difference in weight gain. Residue measured at 24 weeks.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.44	Growth	NOEL	Growth - No effect. *Estimated by authors from individual tissues and weights (see below)
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.44	Growth	NOED	No significant difference in weight gain. Exposure to 43.5 ug/L in water and 7.32 ug/g in diet.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.44	Growth	NOEL	Growth - No effect. Radiotracer study
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	0.54	Growth	NOED	No Effect On Weight Or Length Gain In 90 Days

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	0.72		Growth	NOED	No Effect On Weight Gain After 120 Days
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	1		Growth	NOEL	Growth - No effect.
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	1.0		Growth	NOED	No Effect On Weight Or Length Gain In 30 Days
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	1.1		Growth	NOED	No Effect On Weight Or Length Gain In 60 Days
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	1.1		Growth	NOED	No Effect On Weight Or Length Gain In 90 Days
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	1.1		Growth	NOED	No significant difference in body weight.
Lepomis macrochirus	Bluegill	Fresh	invertivore	1.2		Growth	NOED	No difference in body weight to length ratio. Exposure at 20 degrees C. Concurrent epxosure to 5 ug inorganic Se/L in water and 5.1 ug Seleno-L-Methionine/g in food.
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	1.6		Growth	NOED	No Effect On Length After 120 Days
Daphnia magna	Water flea	Fresh	filter feeder	1.8		Growth	NOEL	Growth - No effect. Radiotracer study
Daphnia magna	Water flea	Fresh	filter feeder	2.4		Growth	NOEL	Growth - No effect. Radiotracer study
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	2.5		Growth	NOED	No Effect On Lenght And Weight Gain
Daphnia magna	Water flea	Fresh	filter feeder	4.2		Growth	NOED	No Effect On Growth (weight)
Daphnia magna	Water flea	Fresh	filter feeder	4.4		Growth	NOEL	Growth - No effect. Radiotracer study
Lepomis macrochirus	Bluegill	Fresh	invertivore	4.5		Growth	NOEL	Growth - No effect. Slightly lower survival than controls, but not significant. Control survival was only 50%.
Lepomis macrochirus	Bluegill	Fresh	invertivore	4.6		Growth	NA	
Daphnia magna	Water flea	Fresh	filter feeder	13		Growth	NOEL	Growth - No effect. Radiotracer study
Lepomis macrochirus	Bluegill	Fresh	invertivore	17		Growth	NOEL	Growth - No effect. *Female and male, respectively
Lepomis macrochirus	Bluegill	Fresh	invertivore	19		Growth	NOEL	Growth - No effect.
Daphnia magna	Water flea	Fresh	filter feeder	20		Growth	NOEL	Growth - No effect. Radiotracer study
Daphnia magna	Water flea	Fresh	filter feeder	20		Growth	NOED	No difference in biomass compared to controls.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	0.18	F	Growth	LOED	Decrease weight gain.
Chironomus decorus	Midge	Fresh	omnivore	0.2	I	Growth	ED40	40% Decreased body weight
Daphnia magna	Water flea	Fresh	filter feeder	0.22		Growth	LOEL	Growth - Reduced. Radiotracer study
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.32		Growth	LOEL	Growth - Reduced.
Chironomus decorus	Midge	Fresh	omnivore	0.51		Growth	LOED	Reduction In Growth (weight)
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	0.66		Growth	LOED	Reduced Weight And Length Gain In 60 Days

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Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	0.68	Growth	LOED	Reduced Weight And Length Gain In 30 Days
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.8	Growth	LOEL	Growth - Reduced. High carbohydrate diet
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	0.8	Growth	LOED	Reduced Weight And Length Gain In 60 Days
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.9	Growth	LOEL	Growth - Reduced. Low carbohydrate diet
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.92	Growth	LOEL	Growth - Reduced.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.92	Growth	LOED	Significant decrease in weight gain. Residue measured at 12 weeks.
Lepomis macrochirus	Bluegill	Fresh	invertivore	1.2	Growth	LOED	Reduced weight to length ratio. Exposure at 4 degrees C. Concurrent epxosure to 5 ug inorganic Se/L in water and 5.1 ug Seleno-L-Methionine/g in food.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	1.2	Growth	LOEL	Growth - Reduced.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	1.4	Growth	LOED	Significant decrease in body weight gain.
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	1.6	Growth	LOED	Reduced Weight Gain After 120 Days
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	1.7	Growth	LOED	Reduced Weight And Length Gain In 30 Days
Chironomus decorus	Midge	Fresh	omnivore	2.0	Growth	ED54	54% Decreased body weight
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	2.0	Growth	LOED	Reduced Weight And Length Gain In 60 Days
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	2.2	Growth	LOED	Reduced Weight And Length Gain
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	2.9	Growth	LOED	Reduced Length After 120 Days
Daphnia magna	Water flea	Fresh	filter feeder	2.9	Growth	LOED	24% Decrease in weight gain.
Daphnia magna	Water flea	Fresh	filter feeder	3.0	Growth	LOED	Significant increase in biomass over controls - a hormetic effect at lowest dose.
Chironomus decorus	Midge	Fresh	omnivore	4.4	Growth	ED68	68% Decreased body weight
Oncorhynchus tshawytscha	Salmon - Chinook	Anadromous	piscivore	4.6	Growth	LOED	Reduced Weight And Length Gain In 120 Days
Daphnia magna	Water flea	Fresh	filter feeder	6.3	Growth	ED36	36% Decrease in weight gain.
Daphnia magna	Cladoceran	Fresh	filter feeder	6.3	Growth	LOEL	Growth - Reduced.
Brachionus calyciflorus	Rotifer	Fresh	zooplanktivore	6.5	Growth	LOED	Significant Reduction In Population Biomass
Chlorella vulgaris	Algae - Green	Fresh	primary producer	7.4	Growth	LOED	Reduced growth.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	9	Growth	LOED	46% Reduction in weight gain. Larval uptake was 1.46 ng selenium per day.
Chlorella vulgaris	Algae - Green	Fresh	primary producer	9	Growth	LOED	Significant reduction in population biomass.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	10	Growth	LOEL	Growth - Reduced.
Daphnia magna	Water flea	Fresh	filter feeder	10	Growth	ED42	42% Decrease in weight gain.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	10	Growth	ED28	28% Reduction in weight gain. Larval uptake of 1.46 ng selenium per day.

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Brachionus calyciflorus	Rotifer	Fresh	zooplanktivore	12		Growth	LOED	Significant Reduction In Population Biomass
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	12		Growth	LOED	Significant reduction in weight.
Brachionus calyciflorus	Rotifer	Fresh	zooplanktivore	12		Growth	LOEL	Growth - Reduced.
Daphnia magna	Water flea	Fresh	filter feeder	30		Growth	LOEL	Growth - Reduced. Radiotracer study
Daphnia magna	Cladoceran	Fresh	filter feeder	0.26		Reproduction	NOEL	Reproduction - No effect. *A conservative residue value (see footnote°)
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	1.5		Reproduction	NOED	No significant difference in # spawns per pair and eggs per spawn.
Pimephales promelas	Minnow - Fathead	Fresh	omnivore	1.5		Reproduction	NOEL	Reproduction - No effect.
Daphnia magna	Water flea	Fresh	filter feeder	2.9	I	Reproduction	NOED	*No effect on number of total young and time to* first brood.
Lepomis macrochirus	Bluegill	Fresh	invertivore	4.5	F	Reproduction	NOEL	Reproduction - No effect. Slightly lower survival than controls, but not significant. Control survival was only 50%.
Lepomis macrochirus	Bluegill	Fresh	invertivore	4.6		Reproduction	NA	Measurable But Not Statistically Significant Reduced Survival Of Embryos And Larvae
Lepomis macrochirus	Bluegill	Fresh	invertivore	4.6		Reproduction	NA	Measurable But Not Statistically Significant Reduced Survival Of Embryos And Larvae
Lepomis macrochirus	Bluegill	Fresh	invertivore	17		Reproduction	NOEL	Reproduction - No effect. *Female and male, respectively
Lepomis macrochirus	Bluegill	Fresh	invertivore	19		Reproduction	NOEL	Reproduction - No effect.
Daphnia magna	Water flea	Fresh	filter feeder	6.3	I	Reproduction	LOED	Decrease in total young and young per female. Delayed time to first brood.
Daphnia magna	Cladoceran	Fresh	filter feeder	6.34		Reproduction	LOEL	Reproduction - Reduced.
Daphnia magna	Water flea	Fresh	filter feeder	10		Reproduction	ED70	Over 70% decrease in total young and young per female. Delayed time to first brood.
Silver								
Lepomis macrochirus	Bluegill	Fresh	invertivore	0.06		Mortality	NOEL	Survival - No effect.
Corbicula fluminea	Clam - Asiatic	Fresh	filter feeder	1650	I	Mortality	NOED	No Effect On Survival
Corbicula fluminea	Clam - Asiatic	Fresh	filter feeder	2510	I	Mortality	LOED	Reduced Survival
Lepomis macrochirus	Bluegill	Fresh	invertivore	0.06		Growth	NOEL	Growth - No effect.
Corbicula fluminea	Clam - Asiatic	Fresh	filter feeder	800	I	Growth	NOED	No Effect On Growth measured as weight.
Corbicula fluminea	Clam - Asiatic	Fresh	filter feeder	1650	I	Growth	LOED	Reduction In Growth measured as weight
Crepidula fornicata	Slipper limpet	Salt	herbivore	4.5		Reproduction	NOEL	Reproduction - No effect. Only 24 mo residues were determined

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Crepidula fornicata	Slipper limpet	Salt	herbivore	5.4	I	Reproduction	NOEL	Reproduction - No effect. Body residues were 54.1 and 44.9 µg/g at 6 and 12 mo, respectively. Residue shown is at 24 mo
Thallium								
Lepomis macrochirus	Bluegill	Fresh	invertivore	2.7	F	Mortality	NOED	No Effect On Mortality
Vanadium								
Marthasterias glacialis	Starfish	Salt	predator	0.3		Mortality	NOED	No Effect On Mortality Or Feeding
Lysmata seticaudata	Shrimp	Estuarine	filter feeder	0.58		Mortality	NOED	No Effect On Mortality After 3 Weeks
Carcinus maenas	Crab - Green	Salt	predator	0.6		Mortality	NOED	No Effect On Mortality After 3 Weeks
Paracentrotus lividus	Sea Urchin	Salt	predator	0.74		Mortality	NOED	No Effect On Mortality Or Feeding
Holothuria forskali	Sea Cucumber	Salt	herbivore	0.8	I	Mortality	NOED	No Effect On Mortality Or Feeding
Jordanella floridae	American flagfish	Fresh	bottom feeder	2.4	F	Mortality	NOEL	Survival - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	5.3		Mortality	NOED	No Effect On Mortality
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	5.3		Mortality	NOEL	Survival - No effect.
Jordanella floridae	American flagfish	Fresh	bottom feeder	5.7		Mortality	NOEL	Survival - No effect.
Jordanella floridae	American flagfish	Fresh	bottom feeder	3.1	F	Mortality	LOEL	Survival - Reduced 73%.
Jordanella floridae	American flagfish	Fresh	bottom feeder	3.1		Mortality	LOEL	Survival - Reduced 60%.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.02	F	Growth	NOEL	Growth - No effect.
Jordanella floridae	American flagfish	Fresh	bottom feeder	0.57		Growth	NOEL	Growth - No effect.
Jordanella floridae	American flagfish	Fresh	bottom feeder	0.68		Growth	NOED	No Effect On Growth in second generation. Parents exposed to 0.041 mg/L for up to 86 days.
Jordanella floridae	American flagfish	Fresh	bottom feeder	5.7		Growth	NOEL	Growth - No effect.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.41	F	Growth	LOED	Reduced Feeding And Body Weight, Digestive Tract Distress
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	0.41		Growth	LOEL	Growth - Reduced.
Jordanella floridae	American flagfish	Fresh	bottom feeder	2.2		Growth	LOEL	Growth - Reduced.
Jordanella floridae	American flagfish	Fresh	bottom feeder	2.7		Growth	LOED	Reduced growth in second generation. Parents exposed to 0.17 mg/L for up to 86 days.
Oncorhynchus mykiss	Trout - Rainbow	Fresh	piscivore	5.3		Growth	ED70	70% Reduction in Body Weight, Digestive Tract Distress
Jordanella floridae	American flagfish	Fresh	bottom feeder	5.7	F	Reproduction	NOEL	Reproduction - No effect.

TABLE G-12
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - METALS

Baseline Ecological Risk Assessment - Interim Final
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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Zinc								
Poecilia reticulata	Guppy	Fresh	omnivore	0.28		Mortality	NOED	
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	3.9	F	Mortality	NOED	No reduction in percentage of eggs hatching in second generation. Residue in newly hatched larva.
Orconectes virilis	Crayfish	Fresh	omnivore	13		Mortality	NOED	No significant increase in mortality.
Orconectes virilis	Crayfish	Fresh	omnivore	13	I	Mortality	NOEL	Survival - No effect. Authors state that the crayfish may have been adapted to low concentrations of zinc prior to testing
Allorchestes compressa	Amphipod	Fresh	detritivore	26		Mortality	NOEL	Survival - No effect.
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	37		Mortality	NOED	No Effect On Survivorship
Jordanella floridae	American flagfish	Fresh	bottom feeder	40		Mortality	NOEL	Survival - No effect. Larvae not previously exposed as embryos
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	40		Mortality	NOED	No effect on mortality.
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	42		Mortality	NOED	No Effect On Survivorship
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	46		Mortality	NOED	No effect on mortality.
Jordanella floridae	American flagfish	Fresh	bottom feeder	50		Mortality	NOED	Body Burden Est. From Graph
Hyalella azteca	Amphipod	Fresh	detritivore	54		Mortality	NOED	calc wet from dry using default % moisture
Hyalella azteca	Amphipod	Fresh	detritivore	54		Mortality	NOEL	Survival - No effect.
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	60		Mortality	NOED	No Effect On Survivorship
Jordanella floridae	American flagfish	Fresh	bottom feeder	60		Mortality	NOEL	Survival - No effect. Increased mortality (25%) but was not significant
Hyalella azteca	Amphipod	Fresh	detritivore	61		Mortality	NOED	calc wet from dry using default % moisture
Mytilus edulis	Mussel - Blue	Salt	filter feeder	71		Mortality	NA	7.5% Mortality In 14 Days
Mytilus edulis	Mussel - Blue	Salt	filter feeder	78		Mortality	NOEL	Survival - No effect.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	120		Mortality	NOED	No increase in mortality. Residue was determined from graph and is approximate.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	122		Mortality	NOEL	Survival - No effect.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	130		Mortality	NOED	No effect on mortality.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	140		Mortality	NOED	No Effect On Mortality
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	150		Mortality	NOEL	Survival - No effect.
Jordanella floridae	American flagfish	Fresh	bottom feeder	220		Mortality	NOED	Body Burd. Est. From Graph
Jordanella floridae	American flagfish	Fresh	bottom feeder	300		Mortality	NOED	Body Burd. Est. From Graph
Chironomus riparius	Midge	Fresh	omnivore	524		Mortality	NOEL	Survival - No effect. Development was significantly retarded

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	4.5	F	Mortality	LOED	Reduction in percentage of hatchability in second generation eggs. Residue in newly hatched larva.
Hyalella azteca	Amphipod	Fresh	detritivore	20	I	Mortality	LD25	calc wet from dry using default % moisture
Allorchestes compressa	Amphipod	Fresh	detritivore	24		Mortality	LOEL	Survival - Reduced 90%. Residues in surviving organisms
Allorchestes compressa	Amphipod	Fresh	detritivore	30		Mortality	LOEL	Survival - Reduced 30%. Residues in surviving organisms
Orconectes virilis	Crayfish	Fresh	omnivore	35.2		Mortality	LD23	23% Significant increase in mortality.
Orconectes virilis	Crayfish	Fresh	omnivore	35		Mortality	LOEL	Survival - Reduced 22%. Authors state that the crayfish may have been adapted to low concentrations of zinc prior to testing
Orconectes virilis	Crayfish	Fresh	omnivore	38		Mortality	LD43	43% Increase in mortality.
Orconectes virilis	Crayfish	Fresh	omnivore	38		Mortality	LOEL	Survival - Reduced 42%. Authors state that the crayfish may have been adapted to low concentrations of zinc prior to testing
Hyalella azteca	Amphipod	Fresh	detritivore	40		Mortality	LD25	calc wet from dry using default % moisture
Jordanella floridae	American flagfish	Fresh	bottom feeder	44		Mortality	LOEL	Survival - Reduced 80%. Larvae not previously exposed as embryos
Jordanella floridae	American flagfish	Fresh	bottom feeder	50		Mortality	LOED	Body Burden Est. From Graph
Hyalella azteca	Amphipod	Fresh	detritivore	50		Mortality	LD50	calc wet from dry using default % moisture
Jordanella floridae	American flagfish	Fresh	bottom feeder	60		Mortality (30 da	LOEL	Survival (30 day)- Reduced.
Hyalella azteca	Amphipod	Fresh	detritivore	61		Mortality	LD67	calc wet from dry using default % moisture
Hyalella azteca	Amphipod	Fresh	detritivore	61		Mortality	LOEL	Survival - Reduced.
Hyalella azteca	Amphipod	Fresh	detritivore	66		Mortality	LD50	50% survival.
Orconectes virilis	Crayfish	Fresh	omnivore	69.2		Mortality	LD61	61% Increase in mortality.
Orconectes virilis	Crayfish	Fresh	omnivore	69		Mortality	LOEL	Survival - Reduced 61%. Authors state that the crayfish may have been adapted to low concentrations of zinc prior to testing
Hyalella azteca	Amphipod	Fresh	detritivore	73		Mortality	LD25	calc wet from dry using default % moisture
Hyalella azteca	Amphipod	Fresh	detritivore	85		Mortality	LD44	56% survival.
Hyalella azteca	Amphipod	Fresh	detritivore	91		Mortality	LD50	calc wet from dry using default % moisture
Hyalella azteca	Amphipod	Fresh	detritivore	106		Mortality	LD100	calc wet from dry using default % moisture
Hyalella azteca	Amphipod	Fresh	detritivore	118		Mortality	LD100	calc wet from dry using default % moisture
Hyalella azteca	Amphipod	Fresh	detritivore	118		Mortality	LD40	calc wet from dry using default % moisture
Hyalella azteca	Amphipod	Fresh	detritivore	118		Mortality	LOEL	Survival - Reduced - Death.

TABLE G-12
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - METALS

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Hyalella azteca	Amphipod	Fresh	detritivore	126		Mortality	LD49	51% survival.
Mytilus edulis	Mussel - Blue	Salt	filter feeder	130		Mortality	LD100	100% Mortality In 14 Days
Hyalella azteca	Amphipod	Fresh	detritivore	136		Mortality	LD65	35% survival.
Hyalella azteca	Amphipod	Fresh	detritivore	167		Mortality	LD94	6% survival.
Hyalella azteca	Amphipod	Fresh	detritivore	167		Mortality	LD97	3% survival.
Jordanella floridae	American flagfish	Fresh	bottom feeder	220		Mortality	LOED	Body Burd. Est. From Graph
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	600		Mortality	LOEL	Survival - Reduced >50%.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	621		Mortality	LOED	56% Mortality
Themisto abyssorum	Amphipod - Mesoplar	Salt	detritivore	951		Mortality	LD50	
Themisto libellula	Amphipod - Mesoplar	Salt	detritivore	951		Mortality	LD50	
Calanus hyperboreus	Calanoid copepod	Salt	herbivore	1750		Mortality	LD50	low concentration exposure
Daphnia magna	Water flea	Fresh	filter feeder	2690		Mortality	LD50	Lethal body burden at 21 days exposure.
Calanus hyperboreus	Calanoid copepod	Salt	herbivore	2980		Mortality	LD50	High concentration exposure
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	22	I	Growth	NOED	No effect on weight gain of suviving musseis.
Jordanella floridae	American flagfish	Fresh	bottom feeder	34		Growth	NOEL	Growth - No effect. Larvae not previously exposed as embryos
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	37	F	Growth	NOED	No Effect On Weight Gain
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	40		Growth	NOED	No effect on weight gain of suviving mussels.
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	42		Growth	NOED	No Effect On Weight Gain
Jordanella floridae	American flagfish	Fresh	bottom feeder	44		Growth	NOEL	Growth - No effect.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	46		Growth	NOED	No effect on weight gain of suviving mussels.
Jordanella floridae	American flagfish	Fresh	bottom feeder	58		Growth	NOED	Body Burden Est. From Graph
Salmo salar	Salmon - Atlantic	Anadromous	piscivore	60		Growth	NOED	No Effect On Weight Gain
Hyalella azteca	Amphipod	Fresh	detritivore	60.8		Growth	NOEL	Growth - No effect.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	130		Growth	NOED	No effect on weight gain of suviving mussels.
Jordanella floridae	American flagfish	Fresh	bottom feeder	190		Growth	NOED	Body Burd. Est. From Graph, Total Length Of Females
Jordanella floridae	American flagfish	Fresh	bottom feeder	230		Growth	NOED	Body Burd. Est. From Graph, Total Length Of Males
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	600		Growth	NOEL	Growth - No effect.
Dreissena polymorpha	Mussel - Zebra	Fresh	filter feeder	621		Growth	NOED	No Effect On Weight Gain Of Surviving Mussels

TABLE G-12
WHOLE BODY TISSUE RESIDUE EFFECT DATA SUMMARY - METALS

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Species	Common Name	Water Type	Trophic Level	Conc (mg/Kg)		Effect	Endpoint	Comments
Allorchestes compressa	Amphipod	Fresh	detritivore	24	I	Growth	LOEL	Growth - Reduced. Residues in surviving organisms
Jordanella floridae	American flagfish	Fresh	bottom feeder	40	F	owth (female fi	LOEL	Growth (female fish) - Reduced. Larvae not previously exposed as embryos
Jordanella floridae	American flagfish	Fresh	bottom feeder	60		Growth	LOEL	Growth - Reduced.
Jordanella floridae	American flagfish	Fresh	bottom feeder	220		Growth	LOED	Body Burd. Est. From Graph, Total Length Of Females
Jordanella floridae	American flagfish	Fresh	bottom feeder	220		Growth	LOED	Body Burden Est. From Graph; total length of females.
Jordanella floridae	American flagfish	Fresh	bottom feeder	300		Growth	LOED	Body Burd. Est. From Graph, Total Length Of Males
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	6.7		Reproduction	NOED	No reduction in percentage of eggs hatching in second generation. Residue in newly hatched larva.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	15		Reproduction	NOED	No reduction in percentage of eggs hatching in second generation. Residue in newly hatched larva.
Salvelinus fontinalis	Trout - Brook	Fresh	piscivore	19		Reproduction	NOED	No reduction in percentage of eggs hatching in second generation. Residue in newly hatched larva.
Jordanella floridae	American flagfish	Fresh	bottom feeder	58	F	Reproduction	NOED	Body Burden Est. From Graph
Daphnia magna	Water flea	Fresh	filter feeder	1340	I	Reproduction	ED10	10% reduction in number of offspring.

Notes:
Information compiled from the following sources:
Where available, NOAELs and LOAELs are identified separately for fish (F), invertebrates (I), and wildlife (W).
1. ACOE, 2002. Tissue Effects Database; Army Corps of Engineers, U.S. Waterways Experiment Station, Vicksburg, MS.
2. Jarvinen and Ankley, 1999.
3. USEPA, 2000. Bioaccumulation Summary; United States Environmental Protection Agency; EPA-823-R-00-002.

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Checked by: NAR

APPENDIX H

EARLY LIFE STAGE TOXICITY REPORT

Chronic Effects on Early Life Stage Survival and Growth of Channel Catfish (*Ictalurus punctatus*) Exposed in the Laboratory to Waterborne Mixtures of 2,3,7,8-Tetrachlorodibenzo-*p*-Dioxin (TCDD), PCB Congeners #77, #126, and 1,2,4,5,7,8-Hexachloroxanthene (HCX)

Draft Final Report

Centredale Manor Restoration Project Superfund Site
North Providence, Rhode Island

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1.0 Introduction

1.1 Background

The U.S. Environmental Protection Agency Region 1 – New England (EPA-NE) is currently conducting a baseline ecological risk assessment (BERA) of the Centredale Manor Restoration Superfund Site located in North Providence, Rhode Island. The scope of the work is presented in the Human Health and Ecological Risk Assessment Work Plan (Harding ESE and Battelle 2001). A draft conceptual model was developed in support of the BERA to identify ecological communities or guilds potentially at risk, describe suspected chemical stressor characteristics, and identify potential exposure pathways.

Assessment and measurement endpoints were developed to characterize potential risks to six different receptor guilds defined by ecological niche and species trophic status. This study of early life-stage (ELS) fish development comprises one of four lines of evidence to address Assessment Endpoint #2: potential risk to demersal, omnivorous fish from contaminants associated with sub-aqueous sediment in Allendale and Lyman Mill Ponds in the Woonasquatucket River, Centredale Manor Restoration Project Superfund Site (the study area) (**Figure 1.1**).

An initial environmental risk evaluation of the study area (Tetra Tech NUS 2000) identified contaminants of potential concern (COPCs) in sediment including 2,3,7,8-tetrachloro-dibenzo-*p*-dioxin (TCDD), polychlorinated biphenyl (PCB) congeners #77 (PCB-77; 3,3,4,4'-tetrachlorobiphenyl), #126 (PCB-126; 3,3,4,4',5-pentachlorobiphenyl), and hexachloroxanthene (HCX). The present study was implemented because these COPCs are known or suspected of having "dioxin-like" activities (Van den Berg et al. 1998, Viswanathan and Kleopfer 1986, Zabel and Peterson 1996) and were detected in fish and/or sediment in the study area. No toxicological data were available for HCX in fish. Using mammalian cytotoxicity (Viswanathan et al. 1987) and pathological lesions as a measure of toxicity (DeCaprio et al. 1987), HCX appeared to be less toxic than TCDD. In contrast, Zabel and Peterson (1996) identified tetrachloroxanthene (a congener of HCX) as more toxic than TCDD, but this form of xanthene was never detected in fish and/or sediment in the study area (MACTEC 2003).

1.2 Study Objectives

The goal of the present study was to develop concentration-effects data for both lethal and explore sub-lethal endpoints under controlled conditions in the laboratory using channel catfish (*Ictalurus punctatus*) egg exposure methods adapted from Elonen et al. (1998). Results would be provided on whole egg wet weight basis in units of toxicity equivalence concentration (TEC) using methods in Van den Berg et al. (1998) and USEPA (1993).

The project goal was met by the following objectives.

- Using chemical data from gravid demersal fish tissue, eggs *in-vivo*, and sediment from the study area, develop a relative proportion of COPCs reflective of maternal egg exposure, and

prepare stock solutions for dosing fish eggs by waterborne route during early embryonic development.

- Evaluate toxicity by grouping COPC exposures with HCX or without HCX.
- Adapt methods of ELS fish bioassay (Elonen et al. 1998) to (1) measure effects on hatching success at 10-days, (2) assess fry survival and growth (length or weight) at 32-days, and (3) evaluate anatomical development at 32-days.
- Perform a 17-day preliminary test to range-find and bracket effect concentration (EC) or inhibition concentration (IC) values for these measures of effect.
- Confirm that methods adapted from Elonen et al. (1998) for waterborne exposure of eggs achieve a range of effects on the basis of egg residues.
- Design the tests to allow chemistry to be performed on samples of dosed water, eggs and fry, and for biological effects to be measured throughout the duration of the tests or upon their completion at 32-days.

1.3 Study Approach

TCDD was chosen as a COPC in this study because it is a principle contaminant in the study area and is known for its toxic potency. PCB-77 and PCB-126 were selected because they occur in the study area and have toxic activity most like TCDD of the 209 PCB congeners (Van den Berg et al. 1998, EPA 1993). PCB congeners not evaluated in the study were also detected in sediment and/or fish at lower concentrations and would contribute considerably less effect. The initial plans for this study involved testing the toxicity of the complete organic chemical mixture detected in site fish. This idea was dropped when it was determined to be unfeasible based on the amount of fish tissue required for residue analyses. HCX was included because it is a principle contaminant in the study area and has molecular structure suggestive of "dioxin-like" toxic activity or potency (Viswanathan et al. 1987).

The ELS study was conducted to estimate the potential effects of transfer of COPCs from contaminated female fish in the study area to their eggs and developing young. Channel catfish were chosen as a test species because published data indicated that this species was on the sensitive side of moderately sensitive to TCDD relative to several other species (Elonen et al. 1998). It was also selected as a surrogate for the brown bullhead (*Ictalurus nebulosus*) which was reported to be absent from Allendale and Lyman Ponds in the Woonasquatucket River. The ELS experimental design is presented in Section 2 and the Quality Assurance Project Plan (QAPP) (Battelle 2001).

Relative ratios of TCDD, PCB-77 and PCB-126 dosed to water within egg exposure jars at the start of the tests were established from tissue chemistry performed on one resident gravid, female white sucker (*Catosomus commersoni*) collected in the Lyman Mill Pond reach of the study area. The female was ripe with eggs and only hours from spawning. TCDD, PCB-77 and PCB-126 were detected in samples of muscle and egg tissues by high-resolution mass spectroscopy (USACE 2002b, 2003). Using the results, relative proportions of approximately 16:39:45 of TCDD:PCB-77:PCB-126 (respectively) were used to synthesize mixtures of these COPCs. However, because HCX was not detected in muscle or egg tissues, a 5:1 ratio of HCX:TCDD was used in the mixtures containing HCX based on observed proportions of HCX to TCDD in Allendale Pond sediment (Rosiu 2002).

Eggs in the ELS tests were dosed within two treatment groups as follows:

- TCDD, PCB-77 and PCB-126 in proportion without HCX
- Same COPCs but with HCX added at a 5:1 ratio of HCX to TCDD.

The study was performed using these treatment groupings because it was deemed important to estimate the combined "dioxin-like" effects of these chemical mixtures and to determine if HCX would add to the toxicity posed by the other aryl hydrocarbon receptor (AHR) agonists.

1.4 Measures of Effect

The ELS study was designed principally to measure chronic effects on developing channel catfish in COPC exposures with HCX or without HCX, including hatching success at 10-days incubation, and fry survival or growth (length and weight) at 32-days post-exposure. Effects were reported as EC or IC values for 10, 25, 50, 75, or 95% of the laboratory-exposed population. The EC and IC values describe egg concentration-response relationships that can then be used to estimate risks and back-calculate COPC concentrations in maternal tissue and sediment that would protect against ELS toxicity (MACTEC 2003).

Qualitative data were also generated on time to hatch (length of gestation), and developmental malformations (gross pathological lesions) in surviving fry. Lesions in the laboratory-exposed ELS fish were compared to those of resident ELS fish caught in the study area in an effort to verify evidence of cause and effect in toxicological data from the laboratory (Hillman 2003). Field verification of developmental malformations observed in the laboratory could provide another level of support to the findings generated by the experiment.

The quantitative and qualitative measures of effect used in the ELS study can be summarized as follows:

- Time to hatch (days)
- Hatching success at 10-days (%)
- Fry survival at 32-days (%)
- Fry growth, mean length (cm) or weight (g)
- Developmental malformations (gross pathological lesions)

1.5 Organization of the Report

Section 2 defines the study materials and methods. Section 3 presents study results and Section 4 discusses those results in the context of baseline ecological risk assessment. Section 5 are the conclusions and recommendations of the study, and appendices contain all other data relevant to the ELS study data including ancillary studies by others (Hahn 2001, Hillman 2003) and data analysis outputs.

2.0 Materials and Methods

2.1 Reagents

Reagent grade, ≥98% purity, 3,3',4,4'-tetrachlorobiphenyl (PCB-77, Cat.# PCB-77-CS), 3,3',4,4',5-pentachlorobiphenyl (PCB-126, Cat.# PCB-126-CS), and 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD, Cat# ED-901) was obtained from Cambridge Isotope Laboratories (CIL) of Andover, Massachusetts **(Appendix A)**. CIL synthesized and shipped in dry crystalline (neat) form, 1,2,4,5,7,8-Hexachloroxanthene (HCX, Cat. #ULM-6074, $C_{13}H_4C_{16}O$) sealed in glass ampulates. HCX was certified ≥98% purity with <0.001% TCDD as impurity. PCB-77 and PCB-126 were *solubilized in isooctane, TCDD in n-nonane, and HCX in acetone, and* were combined in acetone stock solutions at two different strengths in order to accurately micropipette waterborne COPC dosages to channel catfish eggs in the laboratory.

2.2 Stock Solutions Used in Waterborne Exposures

Because HCX was not detected in field-collected white sucker eggs but was present in sediment in the study area, it was decided to dose channel catfish eggs by two exposure treatment groups: COPCs with HCX or without HCX. The treatment group without HCX contained TCDD, PCB-77, and PCB-126 at relative proportions detected in eggs from a gravid female white sucker collected in the field. The treatment group with HCX was the same except that HCX was added in a quantity five times greater than TCDD based on an observed ratio 5:1 HCX to TCDD in Allendale Pond sediment (Rosiu 2002). The study was performed using these treatment groupings because it was deemed important to estimate the combined "dioxin-like" effects of these chemical mixtures and to determine if HCX would add to the toxicity posed by the other AHR agonists. Tissue chemistry performed in April 2001 on the white sucker eggs identified relative proportions of 15.9% TCDD, 38.6% PCB-77, and 45.5% PCB-126 (340 pg/g TCDD, 824 pg/g PCB-77, and 972 pg/g PCB-126pg/g wet weight, respectively) (USACE 2002b, 2003). These concentrations were approximately a factor of 0.35 less than those detected in whole body tissue of the female white sucker absent the eggs.

2.3 Chemical Analysis of Stock Solutions

Concentrations of TCDD and HCX in the stock solutions were verified by confirmatory chemistry, and again nine months later prior to use **(Table 2.1)**. Reanalysis confirmed initial concentrations of TCDD and HCX after storage at -20° C in acetone in glass vials sealed with Teflon™ tape and again sealed in a polyethylene plastic bags. A decane solvent blank was run with the reanalysis to ensure that appropriate treatment group solutions did or did not contain HCX. Results of the reanalysis are presented in **Appendix B**.

2.4 Laboratory Test Species

Based on the criteria outlined in this section, the channel catfish (*Ictalurus punctatus*) was the

selected test species. Elonen et al. (1998) described its sensitivity to TCDD as being on the sensitive side of moderately sensitive, when compared to other species. The culture techniques for this species have become increasingly standardized. Fertilized eggs are readily available in late spring and summer. Life cycle and time-to-hatch durations were short enough to complete the study and meet the project schedule, yet long enough to allow experimental manipulations, samplings and observations.

Species selection was also based on practical concerns (DeWitt et al. 1989) and the need to evaluate demersal omnivorous fish species similar to brown bullhead (*Ictalurus nebulosus*) or yellow bullhead (*Ictalurus natalis)* as an assessment endpoint (Harding ESE and Battelle 2001). These catfish species are documented in the Woonasquatucket River drainage, but their abundance is much less than elsewhere in the river (Libby 2001). However, fishing techniques used by the Massachusetts Division of Fish and Wildlife could have biased low the number of catfish species surveyed.

2.5 Static and Flow-Through Exposure Systems

ELS exposures and testing were conducted at Battelle Marine Sciences Laboratory in Sequim, Washington. Stock solutions were used to produce waterborne serial doses of catfish eggs. The dose series in the rangefinding test was designed to bracket a range of COPC concentrations that included those detected in the field-collected white sucker eggs (340 pg/g TCDD) (USACE 2002b, 2003) and published as TCDD LC50 data (644 pg/g TCDD) for larval channel catfish (Elonen et al. 1998).

Newly-fertilized channel catfish eggs were dosed with COPC concentration mixtures through waterborne exposure in 1-L glass beakers under static conditions (no water flow-through) during the first 24 hours of the rangefinding and 32-day tests. In both tests, stock solutions (COPCs in acetone) were micropipetted directly into 850 mL of culture water covering catfish eggs. Solvent controls were run by dosing eggs with the same volume of acetone (850 uL acetone minus the COPCs) as in all test beakers. Each beaker of eggs in treatment groups (with and without HCX), control (no acetone), and solvent control (acetone) contained 20 individual eggs.

After the 24-hour static waterborne exposure, the eggs were transferred from the exposure beakers to a separate water flow-through system for incubation, hatching, and larval culture to the 32-day fry stage. To transfer the eggs from the static system to the flow-through system, the overlying water was first decanted from the exposure beaker into a waste collection barrel through a fine mesh net, leaving the eggs in approximately 100 mL of solution. Eggs and remaining solution then were poured into flow-through containers placed on the test table and consisting of acid-washed, modified Mason jars. The containers were reconnected to air and filled with approximately 700 mL of water each. In this manner, eggs were incubated for approximately 10 days until hatching, and larvae were cultured another 7 days (17-day rangefinding test) or larvae/fry another 12 days (32-day definitive test). The lighting regime in both tests was 16 hours light and 8 hours darkness per 24-hour period.

The required water quality for both 17-day rangefinding and 32-day definitive tests were developed

through preliminary testing and literature review (Table 2.2) (ASTM 1992, M. Pena pers. com., Tucker and Robinson 1990, USEPA 1996). Water flow was maintained at 60 $\pm$ 4 mL/minute and aeration was sufficient to cause bubbles to break the surface.

Water quality in the 17 and 32-day tests were measured for dissolved oxygen, pH, and salinity on test day 0 (initiation) and upon termination. In addition, these parameters were measured daily in flow-through jars designated for water quality testing throughout the experiment. Alkalinity and hardness were measured on test day 0 and at termination in the head tank to the flow-through system. Ammonia was measured in test jars on test days 0 and 1, and in control jars on test day 1.

2.6 Initial Rangefinding

The rangefinding test incorporated a wide concentration series to ensure that an LC_{50} was bracketed for both treatment groups (**Figure 2.1**). No chemistry was performed on eggs or larval tissues Therefore, only nominal TCDD waterborne concentrations were used to report the rangefinding results. Eggs were dosed in seven COPC concentration mixtures (A:0.003, B:0.005, C:0.008, D:0.01, E:0.014, F:0.018; G:0.024 ng/mL nominal TCDD waterborne concentration) grouped in two treatments plus controls and acetone solvent controls, with three replicates each. This arrangement resulted in 54 jars with 20 eggs/larvae each. Eggs were randomized within each of the two treatment groups, and containers of each were placed on opposite sides of the water table during testing, together with their respective controls. Six water quality monitoring containers (not shown in Figure 2.1) were also placed on the table, three on each side.

2.7 32-Day Test

The COPC concentration series used in the 32-day tests was based on the results of initial rangefinding (Section 3.2). Eggs were randomized and exposed in 1 L glass beakers under static conditions for the first 24 hours after which time eggs were collected for chemical analysis or were transferred to the flow-through system, as described above, and continued for an additional 31 days. The test design and exposure systems are shown in **Figure 2.2** or **Figures 2.3 and 2.4**.

Eggs were dosed in six nominal COPC concentration mixtures (A:0.002, B:0.003, C:0.005, D:0.008, E:0.012, F:0.018 ng/mL estimated TCDD waterborne concentration groupings) in two treatment groups plus controls and solvent controls, three or five (controls) replicates each This arrangement resulted in 58 jars with 20 eggs/larvae each. To ensure sufficient sample volume for chemical analyses, additional eggs were similarly randomized and dosed in nine replicates. Because the egg randomization procedure was used across the entire regime, separate control jars for the two treatment groups were unnecessary. Randomization assignments are presented in **Appendix C**. Positioning of the jars on the water tables during testing was also randomized across both treatment groups.

The control and solvent control each included five replicates which were carried through the 32-day toxicity testing, and the control included an additional nine replicates for chemistry analysis.

Therefore, the test comprised a total of 163 test jars with 20 eggs/larvae each. In addition, five water quality-monitoring jars were on the table throughout the 32-day test. Nine additional growth (length and weight) measurement jars were also initiated with the test, and terminated at intervals to calculate growth for the purpose of assessing feeding requirements. (Water quality monitoring and growth measurement containers are not shown in Figure 2.2.)

2.8 Positive Response to Reference Toxicant

A four-day reference toxicant exposure to copper (Cu) as copper sulfate ($CuSO_4$) was used to determine the sensitivity of the catfish larvae. A review of the literature suggested that potential effects could be expected between 0.054 and 7.56 mg/L (Straus and Tucker, 1993; Birge and Black, 1979). The most comparable evaluation to the proposed exposure (Straus and Tucker 1993) in terms of life stage and test exposure length, suggested an expected LC50 value for Cu as $CuSO_4$ between approximately 0.54 and 1.39 mg/L with channel catfish fingerlings under static renewal conditions in a four-day test (hardness 16-287 mg/L $CaCO_3$). Results from Birge and Black (1979) suggested an expected LC50 value for Cu as $CuSO_4$ between approximately 6.62 mg/L (at hatch) and 7.56 mg/L (four days post-hatch), using channel catfish eggs from fertilization to four days post-hatch under static renewal conditions (average hardness 100 mg/L $CaCO_3$).

The concentration series selected for the exposure based on the literature review was 0, 0.15, 0.3, 0.6, 1.2, 2.4, and 4.8 mg/L Cu as $CuSO_4$. Initial reference toxicant exposures did not produce an acceptable dose response due to high mortality in test organisms. Test-related interferences included poor survival when organisms were fed or when the test was conducted under static conditions without renewal. Two experimental reference toxicant exposures were ultimately evaluated: exposure of fry to the toxicant for four days under static renewal conditions with renewal at 24-hour intervals, and exposure for one day under static conditions followed by three days under flow-through conditions with no additional exposure. Hatched fry from the batch of eggs tested in the 32-day test were used in the reference toxicant test. The fry were approximately 22-days post-hatch at test initiation and averaged 107 mg wet weight. The test tables and test containers used were the same as those in the rangefinding and 32-day tests: 1-L glass beakers for the exposures (and static renewals), and modified Mason jars for the flow-through system.

2.9 HCX in Waterborne Exposures

Analytical chemistry on eggs 24 hours after dosing, and fry tissue 31 days later, detected very little HCX relative to TCDD concentrations. This prompted a chemical study of HCX in the waterborne dosing system described below. A small experimental system was designed to replicate a subset of the exposures in the 32-day test, with the exception that organisms were excluded. The experimental system consisted of five, 1-L glass beakers. Three beakers functioned as replicates, and were held at the same light conditions in effect during the 32-day test (16 hours light and 8 hours dark). The fourth beaker was kept in darkness. The fifth beaker was an unspiked control. This experiment was conducted at Battelle-Columbus Laboratories, using water and glassware shipped from the Battelle Marine Sciences Laboratory in Sequim, Washington to ensure replication of conditions present in the

32-day tests.

The TCDD/HCX solution used in the 32-day test and stored during the intervening months was spiked into 850mL of water in each of the four test beakers at the same level that it was spiked into the highest concentration in the 32-day test1. The beakers were held overnight in the same temperature and aeration conditions in effect during the 32-day test. The water in the beakers was analyzed for HCX and TCDD after a 24-hour static exposure identical to that in the 32-day test,. In addition, each beaker and its corresponding aeration pipette and lid were solvent-rinsed. This rinsate was also analyzed for HCX and TCDD. The solvent rinses consisted of a 3 x 30 mL methylene chloride rinse of the 1000 mL beakers, a 3 x 10 mL methylene chloride rinse of the beaker covers and a 1 x 10 mL methylene chloride rinse of the air pipette. Methylene chloride was used to rinse glassware because it has excellent properties of organic solvation as evidenced by its use in liquid / liquid extractions of dioxin from water, and glassware preparation for dioxin analyses. Results of the chemical analysis are discussed in Section 4.

2.10 Sampling Eggs for Chemistry

Following the 24-hour static exposure on 7/14/01, eggs in replicate beakers were sampled by compositing them into EPA clean-certified glass jars with Teflon-lined lids. The nine test beakers were collected from the water tables where the exposures had occurred. The overlying water from each beaker was decanted into a collection barrel through a fine mesh net, leaving the eggs and a small amount of solution in the beakers. Eggs were then rinsed 3 to 4 times in fresh culture water within a stainless steel bowl. Using inoculation loops, eggs were transferred into labeled, clean-certified glass jars. Quality control checks of labels were made throughout to ensure that eggs were composited correctly using randomization assignments developed prior to dosing.

Twenty eggs in each of the nine replicates test beakers were composited by COPC concentration mixture and by treatment group into three replicates per treatment, each containing 60 eggs each for chemical analysis. A total of 39 samples were collected, including three controls.

The 39 sample jars were packed into a cardboard shipping box. They were held at room temperature until all the samples had been collected. This process took 91-minutes. The samples were then frozen at -20 $\pm$ 4 °C for three days, shipped to Battelle-Columbus at 1500 hours on 7/16/01 on ice, received at 1000 hours on 7/17/01 at 2.0 °C in good condition, logged in and frozen at $\leq$-20 °C until extraction on 10/17/01. Chain of Custody forms are provided in **Appendix D**.

1 The spike level of the highest concentration in the 32-day test was 640 µL of stock solution #1 in 850 mL of water. The spike amount was adjusted by a factor of 1.607 for this test based on the recovery in the most recent analysis of the standard solution (see section 2.3).

2.11 Commercial Supply and Maintenance of Catfish Eggs

Fertilized channel catfish eggs were obtained from Osage Catfisheries, Inc. (Osage Beach, Missouri) for rangefinding and 32-day tests. Chain of Custody forms documenting shipment and receipt of organisms are provided in Appendix D.

The supplier collected channel catfish eggs from cans spawned into and fertilized by broodstock designated for the study. The cans were cleaned and left in the pond overnight, after which time they were collected, treated with 0.5 mg/L iodine as an anti-fungal agent, and shipped overnight to Sequim, Washington. Therefore, the age of the eggs used in the tests were approximately 24 to 48-hours post-fertilization.

The eggs came shipped as a single mass. Upon receipt, they were acclimated to the test temperature (26 $\pm$ 2 °C). The initial weight per eggs was determined to be 31.3-mg in the mass tested in the rangefinding. To provide a uniform exposure, the mucoid layer surrounding the eggs was removed by submersion in a 0.1% sodium sulfite (Na_2SO_3) solution for 15-minutes followed by two fresh water rinses of five minutes each. Eggs were then dosed with the COPCs by waterborne exposure as described above.

In the 32-day test initiated on 7/13/02, embryos were visible without a microscope and could be seen moving on test day 2 (7/15/01. By test days 3 and 4 (7/16/01-7/17/01), most embryos had entered the eyed-stage of development. Mortalities and debris were removed from each test jar as necessary during each of the two daily observation periods, using a wide-bore glass pipette and light suction. This cleaning of the jars began on test day 10 (7/23/01), the day the hatched larvae began feeding. Cleaning was accomplished using rubber tubing and a clamp, so only light suction would be applied to siphon uneaten food and waste from the bottom of each jar. Jars were individually cleaned in this manner each morning and afternoon for the remainder of the 32-day test, and replaced weekly.

A growth measurement container was terminated on test day 10, when most of the larvae had absorbed their yolk sacs and reached the swim-up stage of development. The average weight of larvae in the container on test day 10 was 26.3-mg/organism. Larvae were fed to satiation using 105.0-mg salmon mash/jar/day, which is an amount exceeding 20% average body weight/day. The daily ration amount was divided and fed in 2 or 3 smaller feedings throughout the day.

On test day 19, another growth measurement container was terminated. The average weight of fry was 89.7-mg/ organism. Feeding was increased to 358.9-mg salmon mash/jar/day on test day 20 to maintain 20% average body weight/day. Two additional growth containers were terminated on test day 25, and the feeding rate remained unchanged as a result. The average weight of fry in one container was 184.2-mg/organism, and 183.3-mg/organism in the other. The total number of fry in the test jars had declined considerably at this point in the test, and feeding to satiation continued throughout the remainder of the test.

2.12 Test Monitoring

All eggs, larvae or fry were individually observed morning and afternoon throughout rangefinding and 32-day tests. Twice daily, dead eggs or moribund or dead larvae/fry were removed from jars and counted. Gross lesions and numbers were recorded, as were other comments such as food consumption, initiation of eyed-stage, transition time through swim-up stage development, activity level of larvae/fry, cleaning, and whether eggs remained after the majority had hatched. Larvae or fry that displayed gross lesions were not removed from jars, only those dead or moribund. Many of the organisms showing gross lesions were later preserved in fixative to be photograped and archived. However, despite twice-daily collection, some fish were too decomposed for preservation due to the warm culture water temperature of 26 °C ± 2°C.

Dissolved oxygen, pH, water temperature and salinity were measured in rangefinding and 32-day tests using a YSI Model 556 MPS Sonde and combination probe designated for use in freshwater testing. Hach kits were used to provide measure and monitor relative alkalinity and water hardness. Orion Model 920A meter and probe were used to measure concentrations of total ammonia.

2.13 Evaluations of Gross Pathological Lesions

Eggs and larvae/fry in the 32-day test that were preserved in fixative were photographed using a Nikon SMZ-U dissecting microscope with 1:10 zoom and Nikon 8008S camera. Photographs were sometimes taken of live larvae/fry from growth or water quality containers, and were euthanized with MS-222 (Tricaine methanesulfonate) beforehand, to allow comparisons to larvae/fry exposed to COPCs. Several photographs of each specimen were taken to ensure that a quality image was produced. Glass Petri dishes partially filled with culture water were used to hold specimens during photography, although plastic Petri dishes were used for a few of the earlier photographs.

The plain glass stage background, which photographed as black, was the primary background used for film rolls 42828-1 through -18. At roll 42828-19, the background was switched to a water layer between the Petri dish and the glass stage by adding a few drops of water between glass stage and Petri dish. This gave a much cleaner black background than plain glass.

Left lateral full-body and close-up views were standard and taken whenever possible. Some fish could not be positioned in this way because of their fins. Other aspects of the specimen were photographed when they were associated with lesions (e.g., ventral surface). In early stages of the study, photographs were taken at 1x and 2x magnification. Later on, as fry became larger, magnification was decreased to 0.75x for the whole image. Afterwards, specimens were preserved in a commercial fixative (Fish Fix™, blend of ethanol, formaldehyde and acetic acid) individually in vials for future reference and archive.

At the end of the study, fry were often so large that separate photographs had to be taken of anterior and posterior portions of each organism (film rolls 42828-29 to -37). At least one, and up to five fish from each COPC concentration mixture in both treatment groups, were preserved for photography

and archival purposes. The number of fish photographed at the end of the study was therefore a function of the number previously fixed in each COPC concentration mixture. A total of 37 rolls, 24-exposure each, were taken during the course of the study; however, many of the earliest pictures were only used to determine the most appropriate specimen lighting, magnification and focus.

Fry were individually assessed under the dissecting microscope at the end of the test. Gross lesions, if present, were recorded using the letter codes in **Table 2.3**.

Following the assessment of gross lesions, 632 fry that survived the 32-day test were individually blotted dry, and measured for length and weigh (wet weight) using clean techniques to preserve the chemical integrity of the tissue for chemical analysis. Fork length accurate to 0.5-mm was measured and recorded using rulers re-covered with Teflon between each COPC concentration mixture group of fry. Weights were recorded in grams to four significant digits on a laboratory analytical balance.

2.14 Test Termination

The 32-day test was terminated on 8/14/01. All survivors were sacrificed by adding 0.35-g MS-222 to 850-mL of culture water in the test jars, stirring briefly, and allowing the fry to become anaestethized over a 15-minute period. The solution was then decanted and the fry placed in a pre-labeled Petri dish containing a small amount of fresh water. The final number of fry in each Petri dish was recorded.

Growth measurement and water quality testing jars were terminated first, between 1020 hours and 1046 hours on 8/14/03. Fry from these jars were not analyzed for chemistry. The COPC concentration mixture, control, and solvent-control jars were terminated over the next two hours (1046 to 1247 hours). During this time period, gross lesions were noted microscopically, the lengths and weights were recorded, and the fry were separated into glass jars with Teflon-lined lids for chemistry and vials with fixative for archive. Each COPC concentration mixture was processed one at a time to ensure against mixing different fry. Length and weight measurements were completed at approximately 1900 hours.

After measuring lengths and weights, the fry were either preserved in fixative, or composited fresh in EPA clean-certified glass jars with Teflon-lined lids and frozen for shipment to a chemical analysis laboratory. This process produced fourteen jars for chemistry analysis (12 COPC concentration mixtures, control and solvent control), which were frozen at -20 ± 4 °C until shipment on ice to Battelle-Columbus at 1500 hours on 9/4/01. Fry were received at 1100 hours on 9/5/01 at 0.9 °C in good condition, logged in and frozen at $\leq$ -20 °C until extraction on 10/9/01. Chain of Custody forms are provided in Appendix D. (Earlier shipment of the fry would not have hastened the analysis, which was not funded at this time in the project cycle.)

At the end of the test, the fry were archived by first preserving them in Fish Fix™. It is uncertain how well the cellular architecture was preserved in each specimen because fixation sometimes occurred after there had been substantial post-mortem change (autolysis).

Appendix E presents an inventory of fry fixed throughout the 32-day test, and at test termination.

2.15 Chemical Analysis and Quality Assurance

Chemical analyses of eggs and fry tissue at Battelle-Columbus Laboratories were fully documented in a separate, third-party-validated report (USACE 2002a, b, 2003). Eggs and fry were analyzed for TCDD and HCX using high-resolution gas chromatography/mass spectrometry (GC/MS) and modified EPA Method 1613B. High-resolution GC/MS for PCB-77 and PCB-126 was performed by modified EPA Method 1668A. Lipids were extracted from the eggs using a methylene chloride and hexane solution. Percent lipids was determined by modified Method 1613B. Quality control samples analyzed with each batch of 20 or fewer samples included one laboratory method blank, one laboratory control sample (LCS), one matrix spike sample (MS), one laboratory duplicate, one standard reference material (SRM), and internal standards injected to each sample prior to processing (e.g. $^{13}C_{12}$-2,3,7,8-TCDD, $^{13}C_{12}$-1,2,3,7,8,9-HxCDF, and $^{37}Cl_4$-2,3,7,8-TCDD), and an internal standard added after extraction and prior to sample cleanup.

SRM for TCDD and PCB-77 and PCB-126 were analyzed as a measure of chemical lab analytical accuracy. Lab results were compared to certified values for the SRM and was reported in USACE (2002b, c, 2003). Relative percent difference (RPD) was calculated on the chemical data using methods in Battelle (2001) as a measure of chemical lab analytical precision.

2.16 Toxicity Data Analyses

Residue levels measured in eggs were used to perform toxicity data analyses by individual exposure unit (i.e., concentrations in eggs composited by replicate jar), not by the nominal COPC waterborne concentration. Actual concentrations measured in eggs were used in toxicity data analysis because they relate directly to egg exposure in terms of the concentration of the COPCs taken up into the eggs. These values can also be directly related with a minimum of uncertainty to any observed toxic effects. Furthermore, more precise measures of exposure were achieved for developing concentration-response relationships by using egg concentrations by individual exposure unit (jar) rather than the means of replicates grouped by nominal COPC waterborne concentration (see also Sections 3.1.1 and 3.2.1). In this way, the precision of the toxicological data was improved by a factor of 2 to 5.

Concentrations of the COPCs in eggs were converted to units of Toxicity Equivalence Concentration (TEC) using methods of Van den Berg et al. (1998) and EPA (1993). TECs were calculated using COPC-specific Toxicity Equivalence Factor (TEF) provided by Van den Berg et al. (1998). Since aTEF was not available for HCX, a relative potency factor (RPF) of 0.0002 was used based on a HCX *in-vitro* Ah-receptor trout cell bioassay performed by Wood Hole Oceanographic Institute (Hahn 2002, see Appendix H).

TECs were also calculated on a lipid-normalized basis because chemical hydrophobicity can be a

principle factor affecting COPC uptake into tissue of varying lipid oil content. It was expected that COPC uptake would be positively correlated with percent lipid in the eggs (Elonen 1998).

TECs were calculated as the sum of the individual TECs for each COPC in eggs on lipid-normalized basis using the equation:

$$TEC_{lipid-normalized} = \frac{(COPC(concentration) * TEF)}{\text{Fraction lipid}}$$

where,

COPC(concentration) = mean of triplicate COPC concentrations
TEF = toxicity equivalence factor (TEF) from Van den Berg et al. (1998) or RPF for HCX
Fraction lipid = % lipid/100

Non-lipid normalized TECs or lipid-normalized TECs with the corresponding effects data were entered into the ToxCalc™ version 5.0 toxicity data analysis software package (Tidepool Scientific Software, 1996). EC values were estimated using the Maximum Likelihood-Probit method for proportional/quantal data. IC effects on growth (fry length and weight) were explored using Linear Interpolation, for 10, 25, 50, 75, and 90% of the exposed laboratory population.

Prior to EC point estimates, Shapiro-Wilk's Test for data normality and then *t*-tests were performed to determine data distributions and see if control means (control and solvent control) were significantly different (Tidepool Scientific Software, 1996).

Lipid-normalized or non-normalized concentrations in eggs by individual exposure unit (jar) were plotted against measures of effect. Simple linear regressions were performed using General Linear Modeling (GLM) (SYSTAT 1998). GLM was used to determine if slopes of the concentration-response relationships for mean fry length or weight were significantly different from zero (no slope). Finally, a two-way analysis of variance (ANOVA) was used to identify any significant difference between treatments groups (i.e., with HCX and without) for quantitative lethal and sub-lethal measures of effect.

3.0 Results

This section presents the results of the study that pertain to quality assurance and quality control (QA/QC), chemistry, fish biology, pathology and toxicology.

3.1 QA/QC

All laboratory activities in support of the toxicity testing and collection and analysis of samples followed standard operating procedures (Battelle 2001), EPA methods or methods described in Elonen et al. (1998), Hahn (2002), or Hillman (2003).

3.1.1 Quality control data

QA/QC requirements (Battelle 2001) and results of tissue chemistry on eggs and fry are addressed in separate report or cover letters (USACE 2002a, b, c, 2003, Dahlen 2002a, b, c). Chemical data received Tier III data validation. A third party reviewed the data validation (USACE 2002b, c, 2003) The accuracy of the ELS study chemical, biological, and toxicological data presented in figures and tables was verified against entries to the project QA notebook (Battelle 2002) which included toxicity laboratory benchsheets.

Standard reference materials (SRM) for TCDD, PCB-77 and PCB-126 were analyzed to measure the analytical accuracy achieved by the chemical laboratory (Battelle 2001). The results were compared to certified values for the SRM and have been reported in USACE (2002b, c, 2003). Those results were 3.6 to 23.6% of the SRM for TCDD, 28.5% of the SRM for PCB-77, and 30% of the SRM for PCB-126.

As a measure of analytical precision, the relative percent difference (RPD) for the analytical data was calculated using methods described in Battelle (2001). The RPD values ranged from 1 to 22% for TCDD, 1 to 20% for PCB-77, and <20% for PCB-126 (USACE 2002b, c, 2003). However, when the RPD was calculated using egg TCDD data for three replicates grouped by nominal TCDD waterborne concentration, the RPD was from 2 to 5 times larger and therefore less precise (see Section 3.2.1).

This 2 to 5-fold difference included variability in egg TCDD concentrations that originated from both the toxicity and chemical laboratories. For example, the RPD measured between replicates grouped by nominal TCDD waterborne concentration also includes variability between jars from sources isolated to the toxicity laboratory, such as unintentional "operator error" while pipetting minute amounts of COPCs stock solution to replicate jars. This error is believed to be a large potential source of variability in egg TCDD between replicates. Because large numbers of eggs were composited from each jar, the apparent loss of analytical precision within each nominal TCDD waterborne concentration cannot be attributed to between-egg variability in TCDD uptake during the 24-hour egg exposure on day 1. The compositing of large numbers of eggs from each jar for

chemistry ensured that between-egg variability was accounted for in the resulting composite measure of egg TCDD.

Calculations using QC data and comparisons of RPD between chemical laboratories only and toxicity and chemical laboratories were used in deciding how to use the data to develop concentration-response relationships. Egg TCDD concentrations by individual exposure unit (jar) were used rather than the mean of three replicate jars grouped by nominal TCDD waterborne concentration because of greater precision and lower uncertainty (see Section 3.2.1).

3.1.2 Negative control toxicity tests

The minimum requirement of 65% or better mean control survival was met in both the 17-day rangefinding test (**Table 3.1**) and 32-day definitive test (**Table 3.2**). In rangefinding, mean control survival and mean solvent control survival were 97.5 and 95%, respectively. In the 32-day test, control survival ranged from 55 to 90% in the five replicates, with mean survival of 78%. The reason for low survival in one replicate could not be determined, however, survival in the other four replicates ranged from 80 to 90%, with a mean of 84%. Solvent control mean survival was 90%, with 85 to 100% survival in the five solvent control replicates. Negative control toxicity tests in both 17-day rangefinding and 32-day tests indicated that adding 850 ug/L acetone as a carrier in the 24-hour waterborne exposures did not adversely affect ELS survival.

Water quality parameters in the 17-day rangefinding test were within range for salinity and pH throughout the test. Water temperature was also within range throughout the test, with the exception of single out-of-range data points on 6/27/01 and 7/1/02. These deviations were likely due insufficient submergence of the probe in the test container. The measures were immediately repeated and were within range.

Dissolved oxygen (DO) was within range throughout the test. The probe acted out of range on 7/1/02 in one replicate. However, the value was immediately re-measured and fell within the acceptable range. Alkalinity measurements of head tank water at the beginning and end of the test ranged from 170 to 238 mg/L $CaCO_3$ and were within the target range of 100 to 300 mg/L (Table 2.2). Hardness averaged 205 mg/L as $CaCO_3$ and was also within the target range of 100 to 300 mg/L (Table 2.2). Measurements of total ammonia from control jars at the start of the exposure were all below the upper target range limit of 0.2 mg/L.

DO (with a few exceptions, see below), temperature, salinity, and pH all remained within acceptable ranges throughout the 32-day test. After several low DO measurements on 8/1/02, the membrane on the DO probe was changed and the meter was recalibrated. The measures were repeated and all fell within the acceptable range. Alkalinity of head tank water at the start and end of the test ranged from 170 to 204 mg/L $CaCO_3$ and fell within the specified range of 100 to 300 mg/L (Table 2.2).

Hardness measures varied from 150 to 205 mg/L $CaCO_3$ and also fell within the specified range of 100 to 300 mg/L (Table 2.2). Total ammonia measured in control jars at the start of the test was

below the upper target level of 0.2 mg/L, except for a single water quality measurement in one container that equaled 0.222 mg/L. This small deviation did not appear to affect the test organisms or results.

Summary tables of water quality monitoring data are provided in **Appendix F**.

3.1.3 Positive control reference toxicity

Two toxicity tests were performed using copper (Cu) as a reference toxicant. In the first test, catfish fry were exposed to Cu for four days under static conditions with renewal every 24 hours. In the second test, catfish fry were exposed to Cu for one day under static conditions, followed by three days under flow-through conditions in the absence of Cu. The concentration series for both exposures was 0, 0.15, 0.3, 0.6, 1.2, 2.4, and 4.8 mg/L Cu from copper sulfate ($CuSO_4$). Control survival was 100% in the static renewal test and 95% in the 24-hour static test followed by clean water flow-through conditions.

The static renewal test produced the dose-response shown in **Figure 3.1**. The four highest doses resulted in complete mortality, and the two lower doses resulted in survival of 30% (lowest concentration) and 60%. The 96 h LC50, obtained using the linear regression equation shown in Figure 3.1, equaled 0.244 mg/L Cu. Confidence intervals could not be calculated due to poor fit resulting from the high variability in the lower doses. This LC50 estimate is lower than but close to the range of 0.54-1.39 mg/L Cu reported by Straus and Tucker (1993), and well below the Birge and Black (1979) estimates of 6.62 mg/L Cu (10-day) and 7.56 mg/L Cu (6-day) exposures in embryo/larval tests for this species.

The 24-hour static exposure to Cu followed by flow-through in the absence of Cu for three days produced the dose-response shown in **Figure 3.2**. Less than 50% of the organisms died at the highest exposure concentration. A LC_{50} was calculated using the linear regression equation shown in Figure 3.2 and resulted in an extrapolated value of 6.37 mg/L Cu. One anomalous result (0.3 mg/L concentration response) was eliminated from the regression as an outlier. This LC50 value is higher than the range reported by Straus and Tucker (1993), and compares well to the Birge and Black estimates of 6.62 mg/L Cu (10-day) and 7.56 mg/L Cu (6-day) exposures in embryo/larval tests for this species.

The water quality monitoring data in the reference toxicity tests were within range for salinity and pH throughout the test. Water temperature was also within range, except for one anomaly on 8/11/01 which was likely due to the probe being insufficiently submerged in the test container. DO fell below the 5 mg/L criterion six times. However, on three of those occasions, DO was > 4.90 mg/L. This dip in DO did not occur regularly in any one replicate. Healthy catfish can survive for days at concentrations at or above 2 mg/L (Tucker and Robinson 1990). The occurrence of a small number of data points outside of the water quality monitoring limits was not expected to significantly affect survival in the reference toxicity tests.

Summary tables of water quality monitoring data are provided in Appendix F.

3.1.4 Early Life Stage (ELS) toxicity tests

QA assessments activities in the toxicity laboratory were conducted twice, once at termination of the rangefinding test and once during spiking of the 32-day test. During testing and data analysis, deviations were documented following MSL procedure MSL-A-005, Deviations from Established Requirements. Deviations from the protocol in Elonen et al. (1998) occurred primarily because the proposed experimental design for catfish ELS testing was developed for the subject research by EPA and Battelle scientists before its implementation at the Battelle MSL in 2001 (Attachment E in Battelle 2001). Deviations are documented in the project file. Those that affected the quality of the data are discussed in this section.

Four data recording errors were identified per 630 fry lengths (a 0.6% error rate) and two data recording errors were identified per 630 fry weights (a 0.3% error rate).

At four positions (#127, #129, #136, and #145), the number of lengths recorded was different from the number of live fry, by one. An investigation concluded that in three of these cases, one length measurement was not recorded and in one a length was recorded twice, and that other related termination data were not affected by the errors. Mean and median lengths and weights were available. As a result, the impact of the recording errors was determined to be relatively insignificant.

Two weights were also not recorded, one each in positions #144 and #149. No extra weights were recorded. An investigation concluded that other related termination data were not affected by the errors. The mean weights were calculated based on the number of weights recorded. Abnormalities for these positions were recorded correctly, and the data for these positions did not show any anomalies such as might be associated with weighing two fry at once (e.g., unusually high records). Therefore it is assumed that the two fry were inadvertently not recorded. The analytical method described above for lengths also applies to weights and it is therefore believed that the impact of the recording errors is insignificant.

Data for two test replicates (position #102 and #127) previously deleted in earlier analysis of the 32-day toxicity data were added back in this report because no written notation or rationale for their deletion was found on benchsheets or other documentation in the ELS study (Battelle 2002). In addition, toxicity data represented by those positions were not outliers, but were instead clearly within the bounds of other replicate survival for comparable egg concentrations.

3.2 Tissue Chemistry

In this section, results of analytical chemistry on eggs and fry are presented for COPCs and tissue lipid content. Egg data only were used to calculate the TEC achieved in each individual exposure unit (jar) using methods described in Section 2. TEC is the sum of the concentration of each COPC

in pg/g wet weight (for non-lipid normalized results) or pg/g lipid (for lipid normalized results) multiplied by a COPC-specific TEF or RPF (for HCX).

Analytical data for eggs and fry are presented in USACE (2002c, 2003) and in this section as a series of summary tables. Data are presented in order of COPC for each of two exposure treatments: waterborne exposure of eggs to TCDD, PCB-77 and PCB-126 only (i.e., without HCX) and waterborne exposure of eggs to TCDD, PCB-77, PCB-126, and HCX. Since the study design was completely randomized blind, controls served for both treatment groups, with HCX or without. Samples were submitted for chemical analysis blind using the exposure jar position number as a unique identifier. Appendix G presents decoding information for conversion of chemical laboratory sample numbering to the respective toxicity laboratory jar position numbering.

3.2.1 Tissue chemistry

The analytical data were Tier III validated, third-party validated, and then released as final in September 2002 (USACE 2002c, 2003). Exposed, fertilized, catfish eggs were analyzed for TCDD, PCB-77, PCB-126, HCX, and lipid content. Non-detect data (U, UJ) were used at one-half the detection limit listed if a COPC was detected in at least one of three replicate jars within a TCDD estimated waterborne exposure grouping. If all three replicates were non-detects, then each of the replicate values were reported as non-detect (ND) and were not used to calculate the TEC.

Fry were sampled at the end of the 32-day test to verify that the waterborne egg exposure design succeeded in an uptake of TCDD and HCX into eggs during the 24-hour exposures on day 1. TCDD ranged from non-detect in fry that survived for 32-days to a mean of 10.67 pg/g wet weight in the without HCX treatment (Tables 3.3 to 3.6). Exposures with HCX ranged from non-detect to a mean of 9.24 pg/g TCDD wet weight. TCDD was not detected in the control fry, but was detected at 3.29 pg/g TCDD wet weight in the solvent control fry. HCX was not detected in any of the fry samples. However, only a small number of fry were analyzed compared to the number of eggs composited and analyzed. Also, only survivors of the 32-day test were sampled absent those preserved for photography and archiving. Replicate samples were composited into a single sample for each TCDD estimated waterborne concentration by treatment group.

TCDD

The concentration of egg TCDD ranged from 84.68 to 1132.91 pg/g wet weight in waterborne exposures of eggs to TCDD, PCB-77 and PCB-126 (Table 3.7a). Concentrations were similar to those of 66.51 to 1254.24 pg/g TCDD wet weight in waterborne exposures of eggs to TCDD, PCB-77, PCB-126, and HCX (Table 3.7b). TCDD was always detected, including in control eggs. The concentration of TCDD in eggs varied considerably between replicate jars within groupings of nominal TCDD waterborne concentration.

Note that between-replicate RPD by nominal TCDD waterborne groupings for replicates 1, 2, and 3 (see $RPD_{1,2,3}$ shaded values in Tables 3.7a and b) ranged from approximately 6 to 113% without

HCX and 3 to 91% with HCX. $RPD_{1,2,3}$ was largest in control, 0.002, 0.012, and 0.018 ng/mL nominal TCDD groups without HCX, and control, 0.005 and 0.018 ng/mL nominal TCDD groups with HCX. These values of RPD are 2 to 5-fold larger than those reported by the chemical laboratory (1 to 22% RPD in USACE 2002c, 2003) as measures of laboratory analytical precision. It might be concluded that the toxicity laboratory was a significant source of data variability between replicates grouped by nominal TCDD waterborne concentration (see Section 3.1.1). The pattern of variation in egg TCDD was qualitatively similar to egg PCB-77 and egg PCB-126 for the same jars.

Egg concentrations from individual jars were used to analyze the toxicity data and develop concentration-response relationships for ELS channel catfish. This method of toxicity data analysis allowed for more precise measures of COPC egg uptake and exposure to relate to toxic effects. As a result, the precision of the toxicological data was much improved and the uncertainty reduced.

Fry surviving 32 days were analyzed for TCDD. The results of these analyses where compared to the levels of TCDD measured in eggs following waterborne TCDD exposure. The data provided some estimate of the persistence of TCDD in eggs and developing fry. The average fry mass at 32 days was about 13 times higher than the average mass of eggs on day 1(~400 mg versus ~31 mg). Hence, TCDD was 47 to 134 times higher in eggs (Tables 3.7a and b) than in fry (Tables 3.3 to 3.6).

HCX

As expected, HCX was not detected in eggs exposed for 24-hours to TCDD, PCB-77 and PCB-126 without HCX (Table 3.7a). However, eggs exposed to TCDD, PCB-77, PCB-126 and HCX demonstrated broad-shaped peaks in chromatographs that required considerable professional judgment to estimate the HCX non-detects (USACE 2002c, 2003). Egg HCX value was estimated at concentrations ranging from 42.75 to 365.79 pg/g wet weight (Table 3.7b).

Fry surviving 32 days were analyzed for HCX. Statistics were not conducted on the results of the tissue residue analyses because too many data were reported as non-detects. Such a pattern was expected for eggs exposed to COPCs without HCX, but not for eggs exposed to COPCs with HCX (Tables 3.3 to 3.6).

PCB-77 and PCB-126

In general, the concentration of PCB-77 and PCB-126 in eggs did not reach detection limits at lower exposure concentrations but were present above detection limits at higher exposure concentrations in both treatment groups. The PCBs were always detected, including in control eggs. The pattern of variation in egg PCB was similar in treatments with and without HCX (Tables 3.7a and b) and similar to patterns and magnitude of variation of egg TCDD for the same replicates (jars). Therefore, the concentration of PCB-77 and PCB-126 in eggs varied considerably between replicates when grouped by their nominal TCDD waterborne concentrations.

Lipid content

Percent lipid in the catfish eggs ranged from 1.22 to 4.56% (Tables 3.8 and 3.9). Eggs used in lipid determinations were 24 to 48-hours post-fertilization. These data were used to calculate the lipid-normalized TEC in Tables 3.7a and b.

3.2.2 TEFs, RFP, and calculation of TEC

TECs were calculated using concentrations of COPCs in eggs by individual exposure unit (jar) and COPC-specific TEFs from Van de Berg et al. (1998) or the RFP for HCX from Hahn (2001) (Appendix H), and using methods in Section 2.16. Results are presented in Table 3.7a (exposure without HCX) and Table 3.7b (exposure with HCX). TCDD accounted for nearly 99% of the TEC in both exposure treatments. This is not surprising given the high relative potency of TCDD toxicity compared to that of PCB-77, PCB-126 or HCX.

3.2.3 Fate of HCX and TCDD in waterborne egg exposure jars

HCX and TCDD was pipetted from the COPC stock solutions to waterborne egg exposure jars which included water but no eggs to determine the chemical stability and fate of these two compounds in exposures lasting 24-hours. The results of the chemical fate analyses are presented in Appendix I. HCX and TCDD were adequately recovered, with total recoveries (water + rinsate) in the four test jars ranging from 102-108% for TCDD, and 93-110% for HCX. The ratio of HCX to TCDD in the exposure water ranged from 7.28 to 10.43, with the lowest ratio occurring in the jar tested in total darkness. The ratio of HCX to TCDD in the rinsate ranged from 5.76 to 9.7.

Percent recoveries of the spiked TCDD were 47-71% for the water samples, while 36-56% of the spiked TCDD was recovered from the rinsate samples (walls of beaker, lid, and pipette). The lowest recovery of TCDD from the rinsate and highest recovery from the water occurred in the jar tested in total darkness. For HCX, 55-65% was recovered from the water, while 28-48% was recovered from the rinsate. Again, the lowest recovery of HCX was from the rinsate and highest recovery from the water of the jar tested in total darkness.

Study of the fate of HCX and TCDD in waterborne egg exposure jars suggested that the chemical stability of HCX was lower under normal test lighting conditions compared to total darkness. This pattern was evidenced by lower concentrations in water and on associated glass surfaces in illuminated tests compared to total darkness tests. Study results expressed as measured concentrations of TCDD and HCX in light or total darkness are presented in Figures 3.3 and 3.4, respectively.

3.3 17-Day Rangefinding Test

No egg or tissue chemical analyses were performed in 17-day rangefinding. Instead, the nominal TCDD concentrations in the exposure water were used to estimate concentration-response values.

The rangefinding series of estimated TCDD waterborne concentrations with HCX or without were associated with nearly identical concentration-response values (Figures 3.5a and b).

Rangefinding resulted in a revised exposure design for the 32-day test. The two highest concentrations in both exposure treatments resulted in 100% mortality, and survival in the third highest concentration was 8-11%. Rangefinding suggested that waterborne exposures should be lowered for the 32-day tests to bracket potential sub-lethal effects (e.g. length and weight) while maintaining one concentration high enough to cause 100% mortality.

3.4 Measures of Effect in 32-Day Tests

The following sections present results of the 32-day definitive test for lethal (survival) and sub-lethal (fry length and weight, fry developmental malformations) measures of effect.

ToxCalc™ version 5.0 software (Tidepool Scientific Software 1996) was used to derive the ECs for 10, 25, 50, 75 and 90% of the exposed population (EC10, EC25, EC50, EC75 and EC90, respectively) by the Maximum Likelihood - Probit method, or ICs for 10, 25 and 50% of the exposed population (IC10, IC25 and IC50, respectively) by the Linear Interpolation Method. Results of these analyses are summarized below. Additional details on the methodology were provided in Section 2.16. ToxCalc™ outputs are presented in Appendix J.

SYSTAT™ was used to generate scatterplot graphs of the concentration-response data, perform regression analysis by GLM, and perform ANOVAs. Regression analysis was used to identify the concentration-response slopes for each measure of effect that were inversely proportional but correlated and statistically significant ($P<0.05$). Two-way ANOVAs were used to explore whether concentration-response relationships between exposure treatments with HCX or without were significantly different, and if not significant at the 95% level ($P<0.05$), what significance level were treatments deemed different. SYSTAT™ outputs are presented in Appendix K.

3.4.1 Lethal effects

Time to hatch

Most of the exposed eggs, regardless of exposure treatment or waterborne egg exposure concentration, hatched 5 to 6-days after exposure (Figure 3.6). The vertical bar in each graph by nominal TCDD waterborne concentration with or without HCX indicates the observed approximate duration of hatching. The major exception to this general rule occurred at the highest nominal TCDD waterborne concentration where many eggs did not hatch until 7 days after exposure.

Hatching success at 10-days

Tables 3.10a and b present TEC (non-normalized and lipid-normalized) in eggs and effects on hatching success in treatments without HCX and with HCX, respectively. In general, hatching

success tended to diminish at higher TEC. Figures 3.7a and b depict non-normalized concentration-response scatterplots without HCX and with HCX, respectively (see Appendix K for lipid-normalized plots). Figures 3.7c and d are non-normalized ToxCalc™ plots without HCX and with HCX, respectively (see Appendix J for lipid-normalized ToxCalc™ plots).

Hatching success EC values are summarized for non-normalized and lipid-normalized chemical data in Tables 3.11a and b (respectively). Using the Maximum Likelihood-Probit method, a non-normalized EC50 for hatching success at 10-days was estimated at 1039 pg TEC/g wet weight without HCX, and 875 pg TEC/g wet weight with HCX. Using the same method of estimation, the lipid-normalized EC50 was 32514 pg TEC/g lipid wet weight without HCX, and 32794 pg TEC/g lipid wet weight with HCX. (ToxCalc™ outputs and all concentration-response plots are presented in Appendix J.) Two-way ANOVA indicated the numeric differences in EC50 values between treatments with or without HCX were statistically significant ($P<0.05$) (SYSTAT™ outputs are presented in Appendix K).

Fry survival at 32-days

Daily fry mortalities for each treatment and waterborne TCDD concentration are shown in Figure 3.6. The data indicated that fry mortality rose with increasing waterborne TCDD concentration. Also apparent at the three highest waterborne concentrations, peaks in fry mortality occurred sooner than at the lower concentrations. As waterborne TCDD concentrations increased, most fry mortalities moved from 24 to 28-days, to 10 to 11-days, and 7 to 11-days post-exposure.

Tables 3.10a and b also present TEC (non-normalized and lipid-normalized) in eggs and effects on fry survival at 32-days without HCX and with HCX, respectively. Fry survival decreased as TEC increased regardless of treatments with or without HCX. Figures 3.8a and b depict non-normalized concentration-response scatterplots of TEC versus fry survival without HCX and with HCX, respectively (see Appendix K for lipid-normalized plots). Figures 3.8c and d are non-normalized ToxCalc™ plots without HCX and with HCX, respectively (see Appendix J for lipid-normalized concentration-response plots).

Fry survival EC values are summarized for non-normalized and lipid-normalized chemical data in Tables 3.11a and b (respectively). Using the Maximum Likelihood-Probit method, a non-normalized EC50 for fry survival at 32-days was estimated at 636 pg TEC/g wet weight without HCX, and 734 pg TEC/g wet weight with HCX. Using the same method of estimation, the lipid-normalized EC50 was 26891 pg TEC/g lipid wet weight without HCX, and 28179 pg TEC/g lipid wet weight with HCX. (ToxCalc™ outputs are presented in Appendix J.) Two-way ANOVA indicatedthe numeric differences in EC50 values above between exposure treatments for fry survival at 32-days were statistically significant ($P<0.05$) (SYSTAT™ outputs are presented in Appendix K).

3.4.2 Sub-lethal effects

Length and weight of fry at 32-days

Tables 3.12a and b present mean lengths and weights of fry surviving at 32 days by jar versus non-normalized TEC in eggs without and with HCX, respectively (see Appendix J for lipid-normalized plots).

Only when eggs were exposed to TCDD, PCB-77 and PCB-126 without HCX were concentration-response slopes for fry length or weight significantly different from zero slope ($P<0.05$). An inverse relationship was observed between mean fry length and TEC without HCX (Figure 3.9a), but not in treatments with HCX (Figure 3.9b). As a result, IC values for fry length were only estimated without HCX (Figure 3.9c) using ToxCalc™ based on linear interpolation. An inverse relationship was also observed between mean fry weight and TEC without HCX (Figure 3.10a), but not in COPC exposures with HCX (Figure 3.10b). As a result, IC values for fry weight were only estimated for the exposures without HCX using ToxCalc™ by method of linear interpolation (Figure 3.10c).

Mean fry length and weight IC values are summarized for non-normalized and lipid-normalized chemical data in Tables 3.11a and b (respectively). The non-normalized IC50s without HCX were 948 pg TEC/g wet weight using mean fry length as measure of effect, and 925 pg TEC/g wet weight using mean fry weight as measure of effect. Lipid-normalized IC50s without HCX were 29808 pg TEC/g lipid using mean fry length as measure of effect, and 29793 pg TEC/g lipid using mean fry weight as measure of effect. IC75 and IC90 values could not be determined in exposures without HCX (see ToxCalc™ outputs in Appendix J). IC values could not be estimated in treatments with HCX because linear regression models had zero slope and therefore lacked a concentration-response relationship. However, data scatterplots in Figures 3.9a and b, and Figures 3.10a and b, and results of two-way ANOVA in Appendix K, indicated there were differences between treatments (with or without HCX) on the basis of mean fry length or weight.

3.4.3 Developmental malformations (gross pathological lesions)

This subsection describes gross pathological lesions reported in fish exposed to TCDD (Elonen et al. 1998) and observed in ELS channel catfish surviving 32-days following waterborne exposure of eggs to COPCs in this study. Lesions are described according to ELS development: eggs/early yolk-sac fry, yolk-sac fry, and post yolk-sac fry. These three developmental stages are represented in **Figures 3.11 through 3.13.** They include illustrations and descriptions of gross pathological lesions prevalent in channel catfish which experienced the highest and next highest TEC as embryos.

Embryos/early yolk-sac fry

The following abnormalities were prevalent in exposed embryos and early yolk-sac fry: hemorrhages in the tail and cranial region and on the surface of the yolk sac, distension of the yolk sac, and fluid retention (edema) in and around the yolk sac.

Yolk-sac fry

The following abnormalities were prevalent in exposed yolk-sac fry: hemorrhages in the isthmus region (possibly associated with thyroid tissue and sub-orbital facial hemorrhages); lack of normal epidermal pigment formation; distention of the yolk sac; edema around the yolk sac; spinal curvatures; facial and cranial malformations, including shortened head region, lack of normal articulation of upper and lower jaw, and cranial bulges; and entrainment of gas adjacent to or in the region of the air bladder.

Post yolk-sac fry

The following abnormalities were prevalent in exposed post yolk-sac fry: hemorrhages at the base of the pelvic and caudal fins and various areas on the body surface; distended air bladders; gas emboli entrained around the region of the air bladder; cranial and facial abnormalities including domed heads, shortened, flattened and wider than normal head shapes; cavitations in the visceral mass; distended abdomens; abnormally curved barbells; and lateral and vertical curvature of the spine.

Quantification of gross pathological lesions

Lesions were categorized by the following seven characteristics:

- Normal appearance
- Small or abnormal development
- Presence of hemorrhage
- Bent tail
- Short tail
- Cranial-facial malformations
- Short snout

Table 3.13 summarizes the prevalence of normal appearance or gross pathological lesions in fry surviving 32 days after exposures at the egg stage. Less data were available for fry with higher TEC because survival was lower.

The most prevalent lesions were small or abnormal development, presence of hemorrhage or bent tail. These lesions displayed a pattern of concentration dependence (**Figure 3.14**). However, other categories of lesions had $\leq$2% prevalence, and did not appear to be concentration dependent.

Most fry in controls and solvent controls appeared "normal" and very few had gross pathological lesions. Anywhere from 50 to 98% showed no signs or lesions. The prevalence of small or developmentally malformed fry was generally <10%, with only two observations at approximately 20%. The prevalence of hemorrhage was extremely variable, suggesting an "all or nothing" response. Across the range of exposures, hemorrhages were either nonexistent or exceeded 20%, with few intermediate responses. There was no apparent quantitative relationship between the

prevalence or magnitude of these lesions and COPC exposure concentrations with or without HCX.

3.4.4 Gross lesions in resident ELS fish collected in the study area

During early May and mid-June 2001, larval and juvenile fish (ichthyoplankton) were field-collected in designated sections of the study area by towing fine mesh nets. The goal was to identify the presence/absence of resident ELS fish species (Normandeau Associates 2002). Ichthyoplankton tows were conducted in reference ponds (Assapumpsett and Greystone Mill Ponds) located upgradient of the Superfund site and two other ponds that were significantly contaminated by COPCs (Lyman Mill and Allendale Ponds). A secondary objective was to determine if any lesions observed in channel catfish exposed to COPCs in the laboratory were also observable in resident ELS fish collected from the study area. **Appendix L** presents an evaluation of resident ELS fish collected in the study area by Hillman (2003) (Battelle letter report addressed to USACE dated April 28, 2003).

The results are summarized in **Table 3.14** and are as follows:

- Not a single fish egg was collected in ichthyoplankton tows from two COPC- contaminated ponds impacted by the site. More than one-third of 70 eggs collected and evaluated from the uncontaminated reference ponds showed signs of anomalies in the form of necrosis or lack of embryonic development. This was interpreted to mean that embryogenesis was either arrested early or eggs were never fertilized.

- Two larval fish but no juvenile fish collected from the two reference ponds showed signs of developmental malformations. Two larvae and a single juvenile collected from COPC contaminated ponds showed signs of developmental malformation. The single juvenile ELS fish (1 of 31 examined) with cranial-facial malformations was collected from the Allendale Pond tailrace, which was the most contaminated locale in the entire study area.

4.0 Discussion

This study, exposed eggs to TCDD, PCB-77 and PCB-126 with and without HCX and measured the toxic effects in developing channel catfish. It was successful in bracketing site-specific and previously-published TCDD toxic effect concentrations. In addition, COPC concentration ratios detected in the eggs of a resident white sucker collected from the study area were successfully duplicated in the laboratory.

The egg TCDD concentrations by individual exposure unit (jar) were used to calculate effective concentrations rather than the mean of three replicate jars grouped by nominal TCDD waterborne concentration because this method greatly improved data precision and decreased uncertainty (see Section 3.1.1). QC data calculations and comparisons of RPD between the chemical laboratory only and between the chemical and toxicity laboratories were used as a basis for deciding on this method of formatting the toxicological data for analysis.

Hatching success at 10 days post-exposure and fry survival at test termination (32 days post exposure) were sensitive measures of toxic effects in the laboratory (Tables 3.11a and b). The data indicated that exposures to COPCs without HCX (e.g., 1039 pg TEC/g wet weight for hatching success, and 636 pg TEC/g wet weight for fry survival in Table 3.11a) affected hatching success less but fry survival more, compared to exposures to COPCs with HCX (e.g., 875 pg TEC/g wet weight for hatching success, and 734 pg TEC/g wet weight for fry survival in Table 3.11a).

A two-way ANOVA of hatching success and fry survival indicated that the differences in EC50 values (while contradictory between measures of effect) were statistically different at the 95% confidence level ($P<0.05$, Appendix H). The data showed that the presence of HCX in COPC exposures of eggs was associated with lower hatching success, but with higher fry survival at 32 days post hatch. It is unclear what processes may have been responsible for this pattern.

Lethal effects of the COPCs were comparable to those reported by Elonen et al. (1998). In that study, an EC50 of 644 (576-721) pg TCDD/g wet weight was estimated for channel catfish fry survival 32 days after waterborne exposure of eggs to TCDD using the same general methods as in the present study. The results of the two studies are comparable because TCDD contributed over 98% of the TEC in both cases PCB-77, PCB-126 and HCX made a small contribution (<2%) to the TEC relative to TCDD (Tables 3.7a and b). Therefore, in terms of TCDD toxic equivalents and lethal effects described in the studies, ELS toxicity here was similar to that described for TCDD alone (Elonen et al. 1998).

The average TCDD concentration detected in the eggs from the white sucker collected in the study area (340 pg/g TCDD wet weight, US ACE 2002b) was compared to fry survival EC10 (319 pg TEC/g wet weight) and fry survival EC25 (442 pg TEC/g wet weight) values in Table 3.11a. This comparison suggested a low potential for effects on egg viability and developing fry of demersal species in the study area. The concentrations of TCDD measured in the field-collected white sucker

eggs were in between those associated with effects on 10% and 25% of the exposed population in the laboratory. However, they were below the no observed effect concentration of 385 pg TCDD/g wet weight reported by Elonen et al. (1998).

In the laboratory, gross pathological lesions of varying prevalence were observed in fry (Table 3.14). While the lesions were qualitative measures, they did suggest an association between magnitude of COPC exposure and increasing prevalence of developmental malformations in surviving fry. In particular, cranial-facial malformations are often described as diagnostic of TCDD exposure in fish, albeit with low prevalence (Cook, P. 2001, pers. Comm.; Elonen et al. 1998). In the current study, this lesion was observed at 0 to 2% prevalence in the lab (Table 3.13). It had a 0 to 5% prevalence in the field. One of 21 field-collected juvenile fish (approximately 5%) demonstrated cranial-facial malformation at the confluence of the tailrace and Woonasquatucket River in Allendale Pond (Table 3.14, Appendix L).

Fish were older in field samples from ichthyoplankton tows collected in 2001 as compared to the 32 day old fry in the laboratory (Appendix L). It is therefore possible that ELS fish in the field might have displayed gross lesions like those in the lab but perished before they were sampled. It is reasonable to assume that gross pathological lesions in ELS fish might result in higher vulnerability to predation, an inability to feed, general weakness, or increased susceptibility to diseases. If this were the case, those fish would have been removed from the population prior to sampling and were unreported.

Table 3.14 and Appendix L report low numbers of fish eggs from ichthyoplankton tows in early May 2001 from two impacted locations in the study area, relative to reference locations. This observation was particularly noteworthy because spring is spawning season for most fish. Low numbers of eggs in the COPC contaminated portions of the study area might indicate reproductive failure. Data in Appendix L suggests spawning could have occurred several weeks prior to sampling in early May. Therefore, chances might be less for egg dispersal from reference areas upstream into impacted Allendale or Lyman Mill Ponds. The prevalence of egg anomalies in samples from the Greystone Mill Pond reference location was unexpected. However, this reference pond receives surface water discharge from a wastewater treatment plant and other upstream sources. Contamination would consist mainly of toxic metals and various organic compounds, but not TCDD to any appreciable extent.

Sub-lethal measures of effect in the lab including mean length and weight of fry at 32-days post-exposure were of limited use in describing ELS toxicity because fry survival was low at the higher concentrations of the COPCs. Even so, concentration-responses in mean length and weight of fry in exposures to COPCs without HCX were statistically significant. That finding is equivocal because of high fry mortality at high TEC. With such lethality, sub-lethal effects are less demonstrable and supported by the data. In addition, mean length and weight of fry exposed to COPCs with HCX showed no significant concentration-response relationship. Elonen et al. (1998) found no evidence of TCDD effects on fry length or weight relative to control.

Most eggs hatched in 5 to 6-days. However, time to hatch was delayed approximately 1-day in eggs exposed to the highest nominal TCDD waterborne concentration with and without HCX (Figure 3.6). A significant complicating factor with the current study was the uncertainty surrounding the measured concentrations of HCX in the exposed catfish eggs. The analytical data indicated that the uptake of HCX did not increase as expected in the higher exposure concentrations. HCX was spiked in waterborne egg exposures at five times the concentration of TCDD, but was detected in eggs at levels far below that of TCDD. For example, HCX was detected at 207.13, 309.15, and 188.80 pg HCX/g wet weight in eggs that had the three highest TCDD concentrations (1254.24, 809, and 743.91 pg TCDD/g wet weight, respectively) in the with HCX treatment group (Table 3.7b).

Several factors were considered to explain this apparent absence of HCX. An analysis of the QC samples for the two batches of eggs indicated that the methods of chemical analysis were appropriate, although no published standards exist for HCX for comparison. Percent recoveries in the LCS were 67% and 127%; matrix spike recoveries were 187% and 139%; and recoveries of internal standards were within the 25-150% acceptance window for all but one sample (USACE 2002a). If anything, the three over-recoveries suggested that the data were biased high for the authentic samples (Dahlen 2002a), which would indicate that the actual concentrations of HCX in the eggs were even lower than the values reported here.

It is unlikely that the jars spiked with stock solutions for waterborne egg exposures resulted in error. The reason is that HCX was in the stock solution with TCDD, PCB-77 and PCB-126 and these COPCs were detected in waterborne exposed eggs. The stock solutions were analyzed on June 20, 2001 following preparation and then reanalyzed on March 15, 2002. Analytical recoveries in the high-concentration stock solution were 165.7% in 2001 and 160.7% in 2002 (Table 2.1), and 150% in the low-concentration stock solution in 2001 (the latter was not reanalyzed in 2002). Based on these data, error in preparing stock solutions was not a likely cause for low HCX:TCDD ratios in eggs and fry, and the fate of the HCX remains uncertainty.

There was no indication of a co-solvation effect reducing the relative uptake of the chemicals by the eggs in the exposure solutions containing the higher COPC concentrations (Walker et al., 1996). In addition, preliminary calculations suggested that about 0.2% of the TCDD in solution was taken up by the eggs. Based on the HCX concentrations measured in the eggs, only about 0.01% of the HCX in solution was taken up (Cook, P. 2004, pers. comm.). Several hypotheses can be put forward to explain this apparent discrepancy:

HCX could either be significantly more hydrophobic than TCDD or too large of a molecule to readily diffuse into the eggs. SPARC (SPARC Performs Automated Reasoning in Chemistry), an EPA quantitative structure activity model (USEPA 2003a, b) was used to derive log K_{ow} values for TCDD and HCX. The model predicted that HCX would be significantly more hydrophobic (log K_{ow} = 8.24) than TCDD (log K_{ow} = 6.66). This evidence indicates that there would be a much greater tendency for HCX to exceed solubility and thus be less available for uptake from solution by the eggs. There also appears to be insufficient information to define molecular weight or molecular shape limitations to determine the theoretical diffusion of HCX into fish eggs (Cook, P. 2004; pers.

comm.).

Acetone was used in this study to ensure that the concentrations of freely-dissolved water-insoluble COPCs were sufficient to allow contaminant uptake by the fish eggs during the initial 24-hour exposure period. The amount of acetone used in the exposure solutions was at the low end of the concentration range reported in other egg exposure studies. Given the extreme hydrophobicity of HCX as noted above, it is possible that much of the HCX may have formed micelles which remained in suspension in the exposure solutions, thereby preventing the molecules from diffusing into the eggs (Cook, P. 2004; pers. comm.).

Finally, if HCX had diffused into the fish eggs at the expected rate, then the small measured concentrations could only be explained by the biotransformation of this compound inside the embryo very early in development. While such a possibility cannot be discounted off hand, it is most speculative at this point in time due to a lack of information on chemical metabolism in fish embryos. The metabolism of HCX in fish may in fact represent an important limitation for the bioaccumulation of this compound, as demonstrated by the low or non-detectable concentrations measured in adult fish from the Woonasquatucket River. However, this empirical observation is insufficient to explain the low accumulation observed in catfish eggs following the 24-hour waterborne exposures (Cook, P. 2004, pers. comm.).

5.0 Conclusions and Recommendations

Waterborne exposure of channel catfish eggs in the laboratory to increasing concentrations of TCDD, PCB-77 and PCB-126, with and without HCX added at approximately 5-times the concentration of TCDD, were negatively correlated with hatching success and fry survival 32 days post-hatch. Use of lipid-normalized chemical data slightly improved the concentration-response relationships.

A risk range of 319 to 510 pg TEC/g egg wet weight could be suggested as a starting point to protect ELS survival and reproduction in demersal species of fish in the study area. This range represents estimated EC10 to EC25 values (respectively) for fry survival across exposures in channel catfish eggs to COPCs both with and without HCX.

The EC10 value of 319 pg total TEC/g egg wet weight calculated from this study was 25% lower (and therefore more protective) than that reported by Elonen et al. (1998) using similar methods with channel catfish. A portion of this difference could be the result of having included two PCB congeners in the egg exposure solution and also using a different dose-response model in the current study compared to that used in Elonen et al. (1998). It is also a challenge to be completely sure in a study of this nature that all the chemicals which may add to dioxin toxicity risk were in fact accounted. It is recognized that small amounts of other AHR agonists, besides the target compounds TCDD, PCB77 and PCB126, could have been present as impurities and hence exert some toxicity. It was noted, however, that the EC50 of 636 pg TEC/g egg wet weight in the present study was comparable to the LC50 value of 644 pg TEC/g egg reported by Elonen et al. (1998).

A certain amount of uncertainty is associated with the range of threshold values presented above. Elonen et al. (1998) indicated that the eggs from other fish species, particularly salmonids but also the fathead minnow, were more sensitive to TCDD exposures than channel catfish. Even though the channel catfish was a relevant surrogate for the demersal fish community in the Woonasquatucket River, it is unknown if it would be sufficiently sensitive to fully protect the full assemblage of demersal fish species at the site. Based on the available data, the suggested channel catfish risk range would most likely be protective of the white sucker because the LC50 for the sucker is about three times higher than for the catfish (Elonen et al., 1998).

It is well established that chronic toxicity can cause mortality in fish in the field that would not be predicted based only on short-term observations of overt ELS mortality in laboratory toxicity tests. In other words, long-term population impacts are possible at subchronic toxicant exposures (Peterson et al., 2003). This observation suggests caution when establishing a laboratory-derived species-specific threshold level protective of a wider assemblage of species.

Several studies summarized in Cook et al. (2003) have indicated that ecological concerns may be associated with exposures in trout to sublethal concentrations of TCDD for which laboratory toxicity data are not available. Such sublethal impairments may include cardiovascular dysfunction, reduced

energy for feeding, deficits in visual functions, difficulty with predator avoidance, or problems with the initiation of exogenous feeding. These types of subtle responses have the potential to result in long-term population-level responses even though they could not have been predicted based on laboratory exposure data alone.

To provide a reasonable level of protection to fry survival and the reproduction of demersal fish in the Woonasquatucket River, and based on the uncertainties highlighted above, it is recommended that the TEC in maternal whole fish tissue not exceed concentrations that would result in transfer of these COPCs to eggs that exceed 319 pg TEC/g egg. The suggested value is the estimated EC10 for fry survival in eggs exposed to the COPCs with HCX included.

It should be recognized that this threshold concentration may not be fully protective of fish species known or suspected to be significantly more sensitive to AHR agonists than the channel catfish. For example, the value would need to be adjusted downward in order to support the restoration of self-reproducing populations of trout in those sections of the Woonasquatucket River affected by the presence of AHR agonists.

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ACRONYMS

AHR	= aryl hydrocarbon receptor
ANOVA	= analysis of variance
ASTM	= American Society for testing and Materials
BERA	= baseline ecological risk assessment
CIL	= Cambridge Isotope Laboratories
COPC	= contaminant of potential concern
DO	= dissolved oxygen
EC	= effect concentration
ELS	= early life stage
EPA	= United States Environmental Protection Agency
EPA-NE	= United States Environmental Protection Agency Region 1 - New England
GLM	= general linear model
HCX	= hexachloroxanthene
IC	= inhibition concentration
LC	= lethal concentration
LCS	= laboratory control sample
MS	= matrix spike
ND	= non detect
ORD	= Office of Research and Development
PCB	= polychlorinated biphenyl
QA	= quality assurance
QC	= quality control
RPD	= relative percent difference
RPF	= relative potency factor
SPARC	= SPARC Performs Automated Reasoning in Chemistry
SRM	= standard reference material
TCDD	= tetrachloro-dibenzo-*p*-dioxin
TEC	= toxicity equivalence concentration
TEF	= toxicity equivalence factor
USACE	= United States Army Corps of Engineers
USACE	= United States Environmental Protection Agency

Figures

Figure 1.1 Study area on the Woonasquatucket River is comprised of Greystone and Assapumpset Ponds (references) upstream of Centredale Manor Restoration Project Superfund Site in North Providence, Rhode Island that is upstream of Allendale and Lyman Mill Ponds.

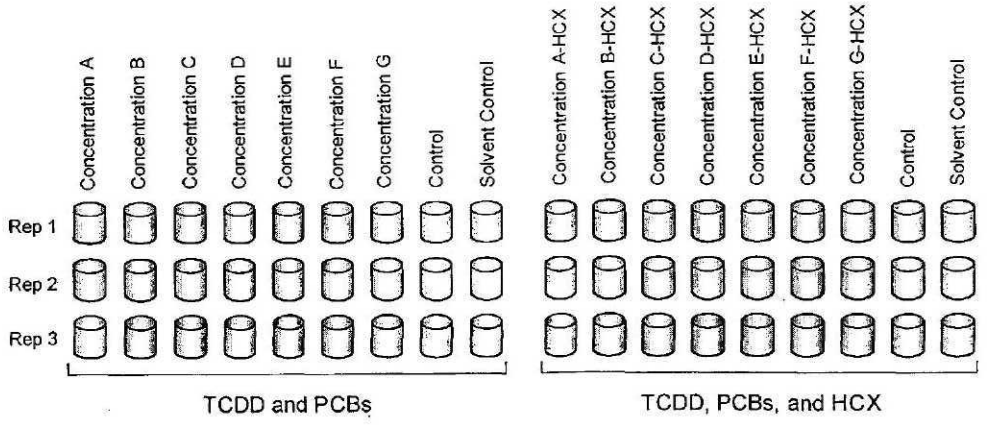


Figure 2.1. 17-Day rangefinding toxicity test design.

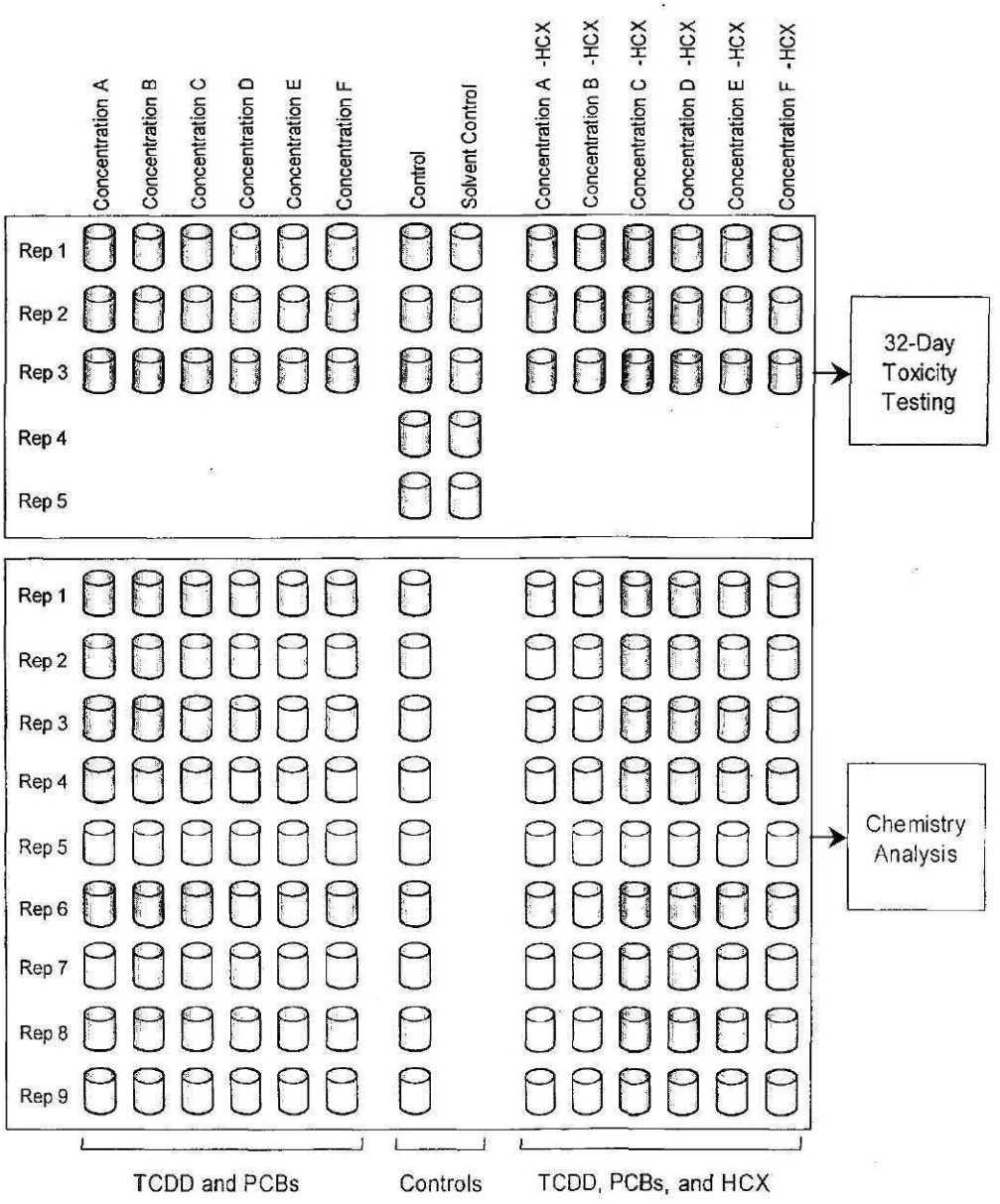


Figure 2.2. 32-Day ELS toxicity test design.

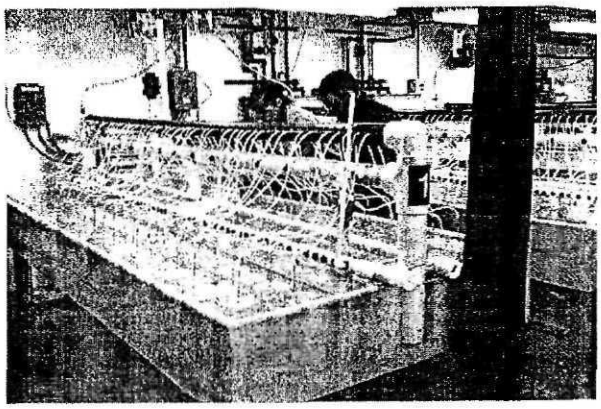


Figure 2.3. 32-Day test exposures: Two water tables.

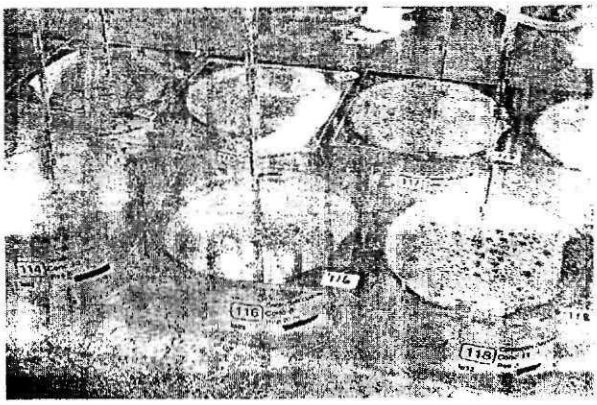


Figure 2.4. 32-day test exposures: Randomized design with replicate beakers.

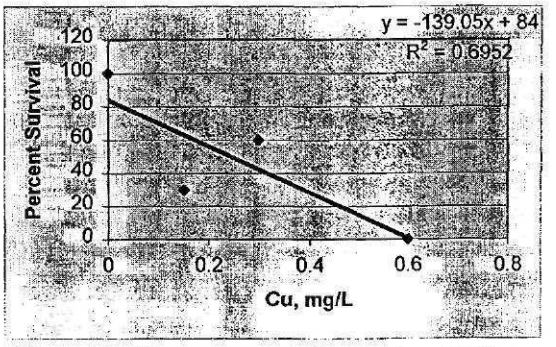


Figure 3.1. Dose-response and regression equation for 4 day static-renewal catfish reference toxicity test.

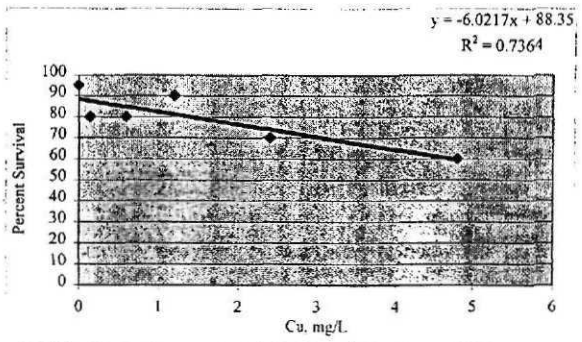


Figure 3.2. Dose-response and regression equation for 4 day combination static/flow-through catfish reference toxicity test.

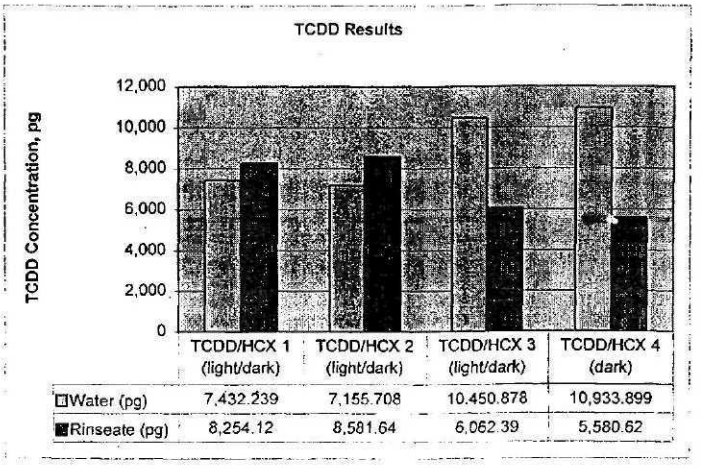


Figure 3.3. Results of fate of TCDD experiment
(see Appendix I for supporting data)

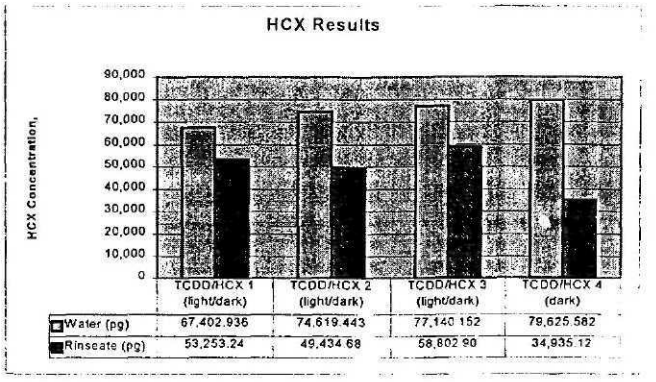
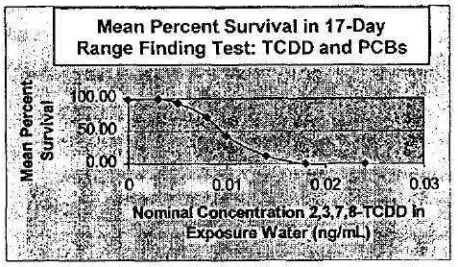
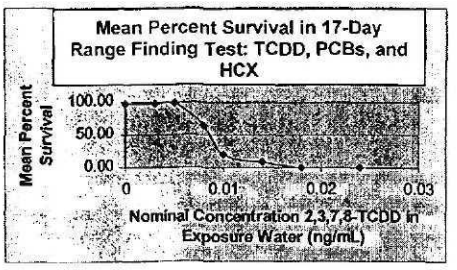


Figure 3.4. Results of fate of HCX experiment
(see Appendix I for supporting data)





Figures 3.5a and 3.5b. Mean percent survival in 17 day range finding test, without and with HCX.

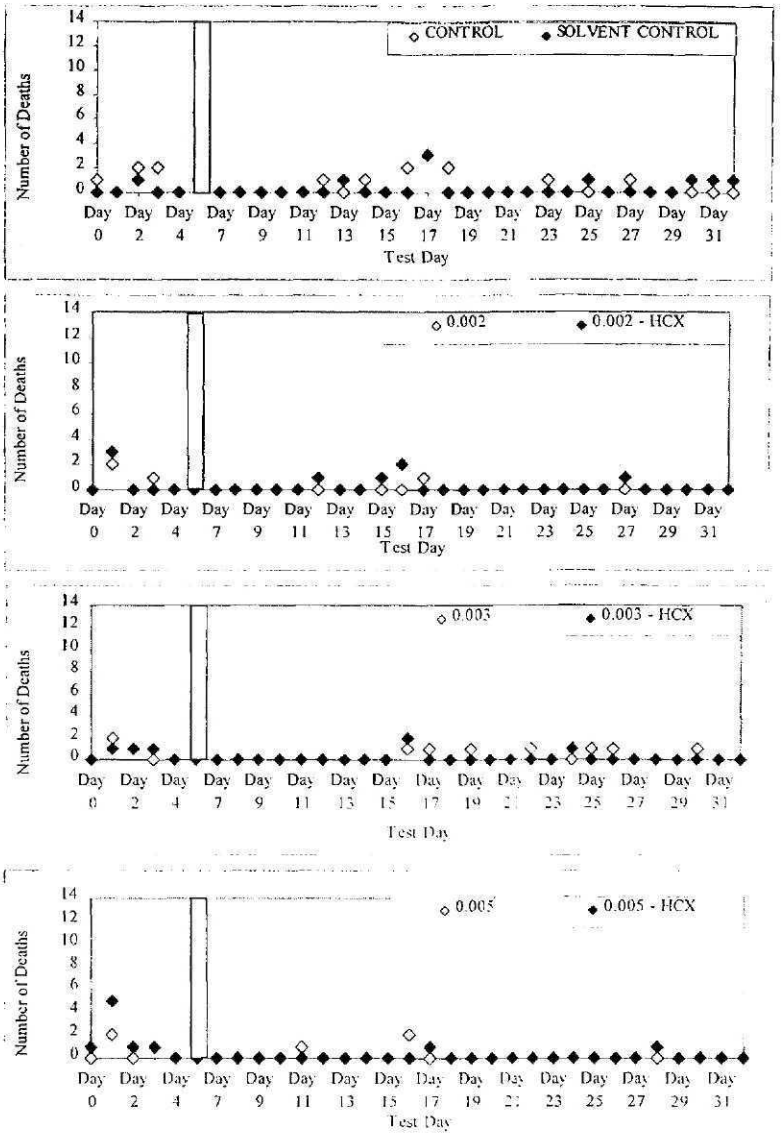
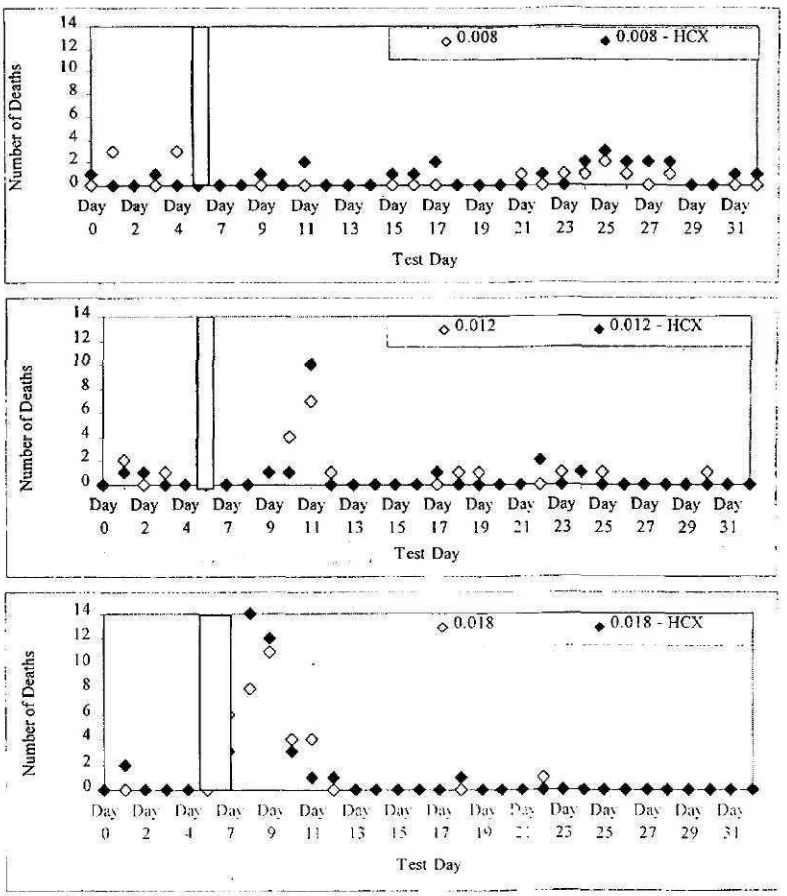


Figure 3.6. Mortalities per test day: control and lower nominal exposure concentrations (n=60) (values in text box represent nominal exposure concentrations without and with HCX in ng TCDD/ml; vertical bars indicate approximate hatching duration).



Figures 3.6 (cont'd). Mortalities per test day: higher nominal concentrations (n=60) (values in text box represent nominal exposure concentrations without and with HCX in ng TCDD/ml; vertical bars indicate approximate hatching duration).

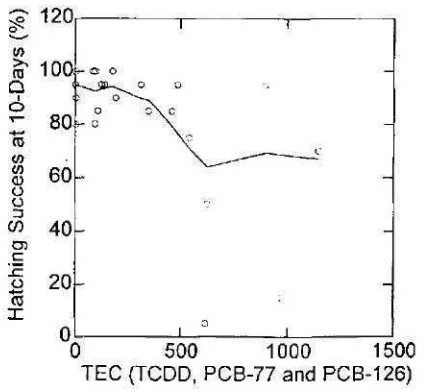


Figure 3.7a: Scatterplot of hatching success at 10 days versus non-lipid normalized total TEC in eggs exposed for 24 hours to TCDD, PCB-77 and PCB-126 only (line represents best fit of the general linear model).

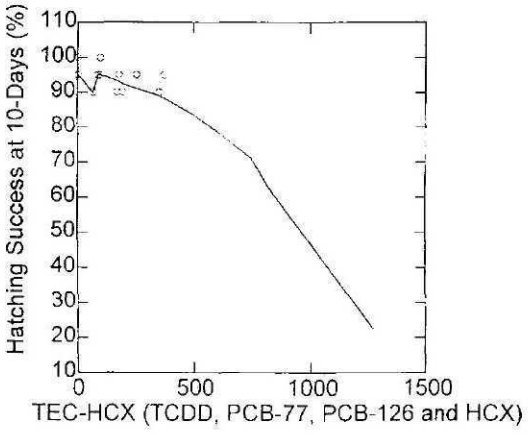


Figure 3.7b: Scatterplot of hatching success at 10 days versus non-lipid normalized total TEC in eggs exposed for 24 hours to TCDD, PCB-77, PCB-126 and HCX (line represents best fit of the general linear model).

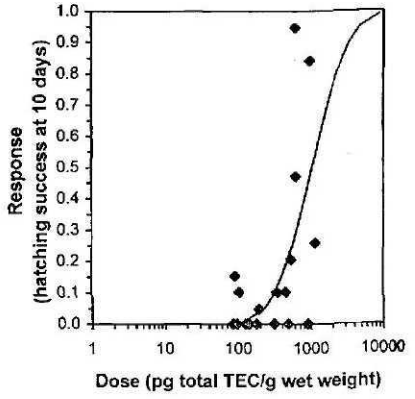


Figure 3.7c: Non-lipid normalized dose-response for total TEC in catfish eggs versus hatching success at 10 days in exposures without HCX (no 95% confidence intervals available)

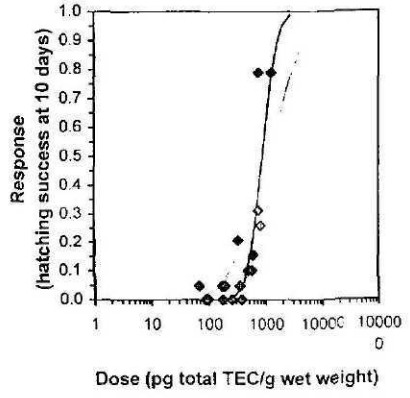


Figure 3.7d: Non-lipid normalized dose-response for total TEC in catfish eggs versus hatching success at 10 days in exposures with HCX (thin lines represent 95% confidence intervals around the Maximum Likelihood – Probit response).

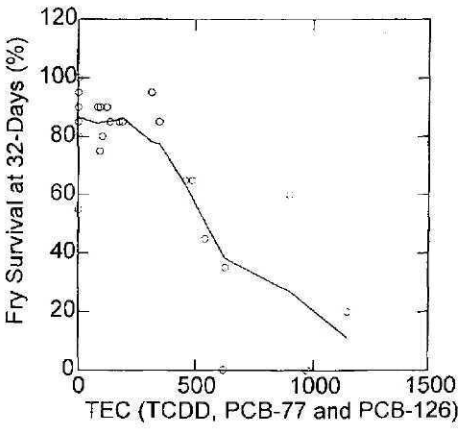


Figure 3.8a: Scatterplot of fry survival at 32 days versus non-lipid normalized total TEC in eggs exposed for 24 hours to TCDD. PCB-77 and PCB-126 only (line represents best fit of the general linear model).

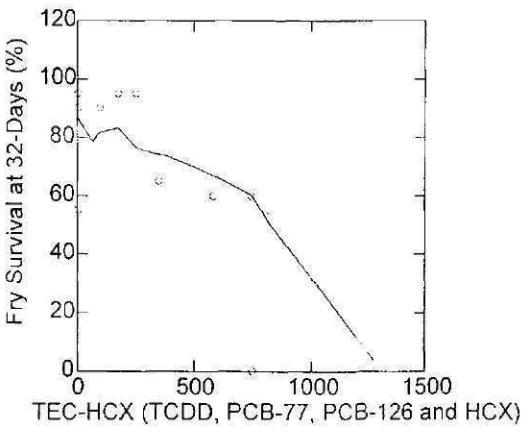


Figure 3.8b: Scatterplot of fry survival at 32 days versus non-lipid normalized total TEC in eggs exposed for 24 hours to TCDD. PCB-77, PCB-126 and HCX (line represents best fit of the general linear model).

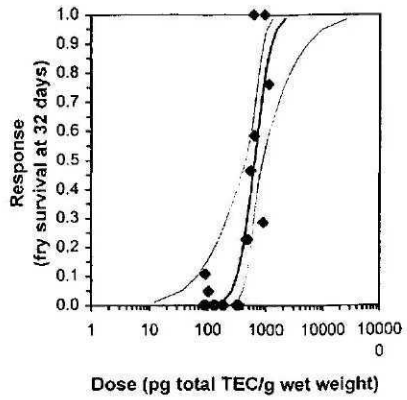


Figure 3.8c: Non-lipid normalized dose-response for total TEC in catfish eggs versus fry survival at 32 days in exposures without HCX (thin lines represent 95% confidence intervals around the Maximum Likelihood – Probit response).

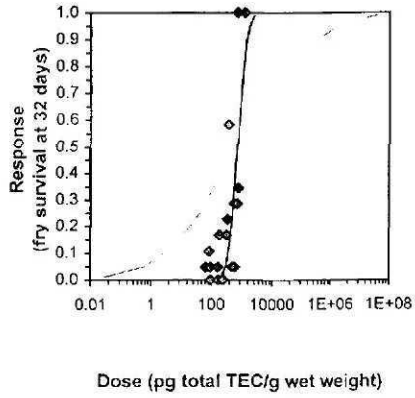


Figure 3.8d: Non-lipid normalized dose-response for total TEC in catfish eggs versus fry survival at 32 days in exposures with HCX (thin lines represent 95% confidence intervals around the Maximum Likelihood – Probit response).

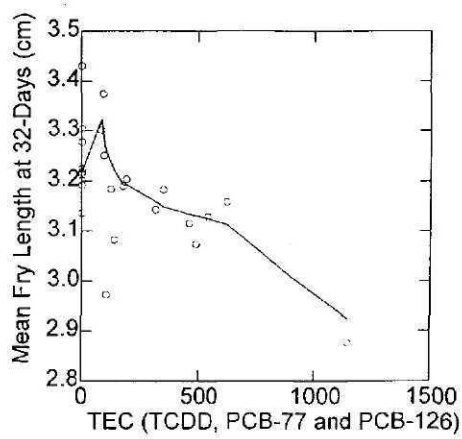


Figure 3.9a: Scatterplot of mean fry length at 32 days versus non-lipid normalized total TEC in eggs exposed for 24 hours to TCDD, PCB-77 and PCB-126 only (line represents best fit of the general linear model).

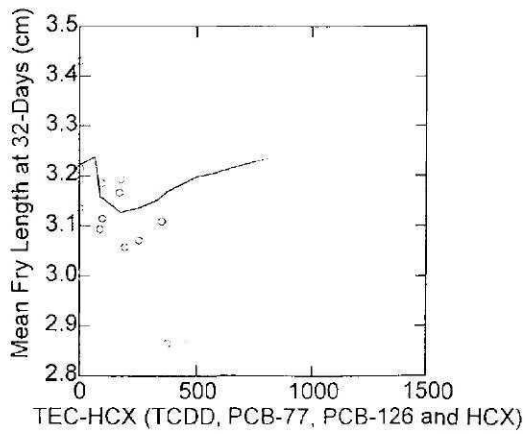


Figure 3.9b: Scatterplot of mean fry length at 32 days versus non-lipid normalized total TEC in eggs exposed for 24 hours to TCDD. PCB-77, PCB-126 and HCX (line represents best fit of the general linear model).

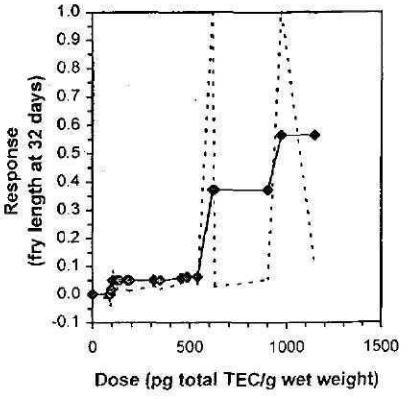


Figure 3.9c: Non-lipid normalized dose-response for total TEC in catfish eggs versus fry length at 32 days in exposures without HCX (dashed line represents best fit of linear interpolation method).

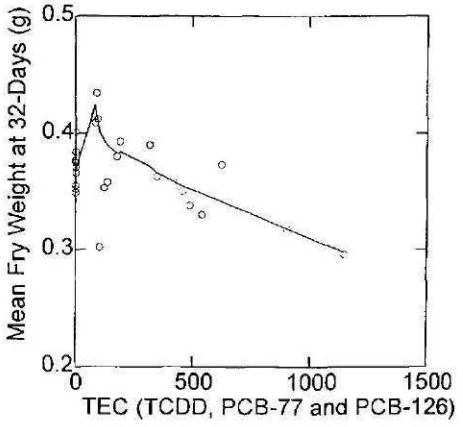


Figure 3.10a: Scatterplot of mean fry weight at 32 days versus non-lipid normalized total TEC in eggs exposed for 24 hours to TCDD, PCB-77 and PCB-126 only (line represents best fit of the general linear model).

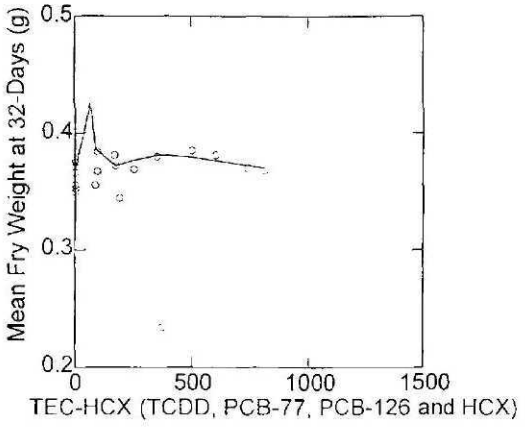


Figure 3.10b: Scatterplot of mean fry weight at 32 days versus non-lipid normalized total TEC in eggs exposed for 24 hours to TCDD, PCB-77, PCB-126 and HCX (line represents best fit of the general linear model).

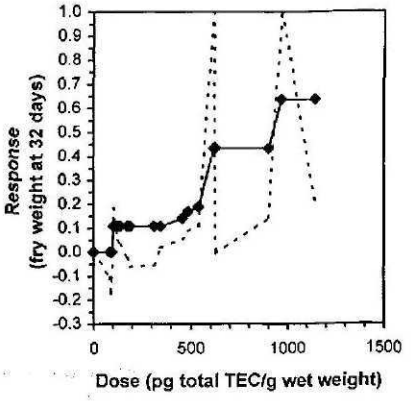


Figure 3.10c: Non-lipid normalized dose-response for total TEC in catfish eggs versus fry weight at 32 days in exposures without HCX (dashed line represents best fit of linear interpolation method).

Figure 3.11. 0.018 ng/mL nominal TCDD + PCB; 07-19-01 or 07-20-01 yolk-sac distention, fluid retention (edema)

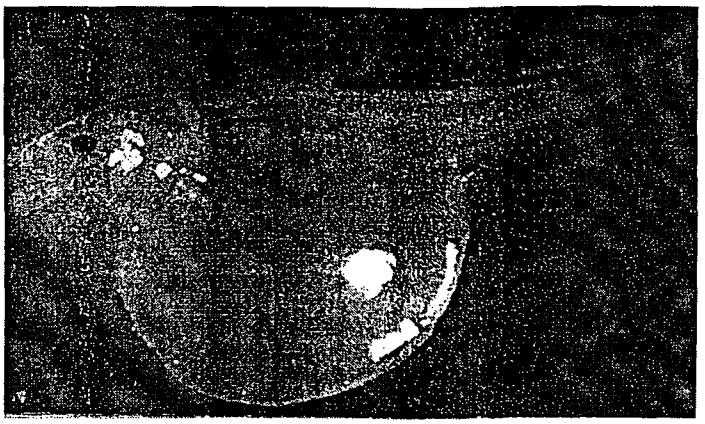


Figure 3.12. 0.012 ng/mL nominal TCDD + PCB; 07-24-01 distention of yolk-sac and associated edema

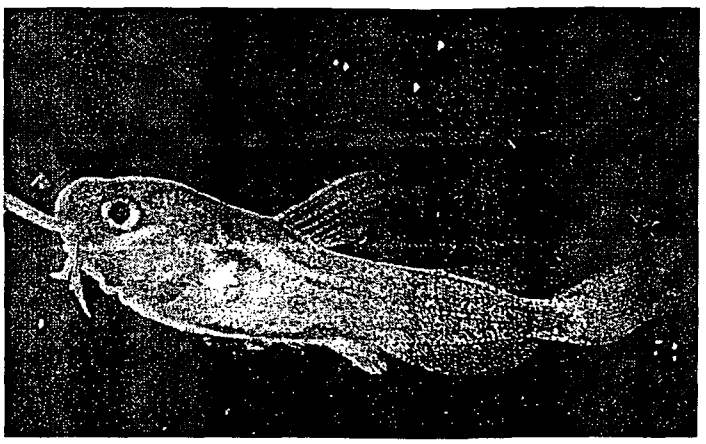


Figure 3.13. 0.012 ng/mL nominal TCDD + PCB + HCX; 08-15-01 cardiac and pectoral hemorrhage

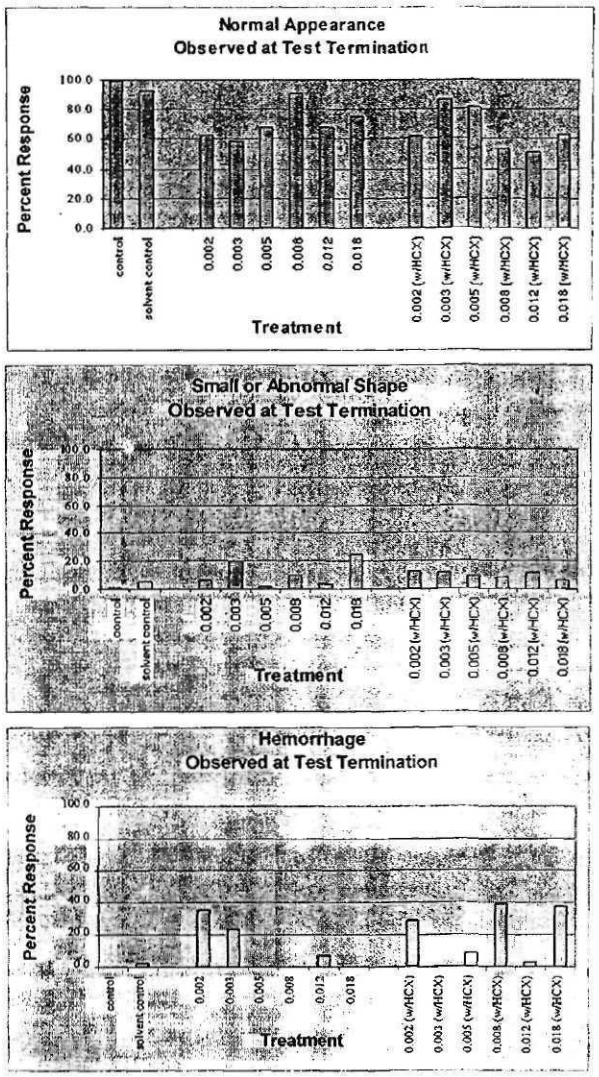


Figure 3.14. Summary of gross lesions observed on catfish fry at test termination (32 days).

Tables

Table 2.1. Composition of the standard solutions.

	2,3,7,8-TCDD (ng/mL)	PCB 77 (ng/mL)	PCB 126 (ng/mL)	1,2,4,5,7,8-HCX (ng/mL)
Stock Solution 1	24.0	58.3	68.7	0
Stock Solution 1 – with HCX	24.0	58.3	68.7	120.2
Stock Solution 2	14.0	34.0	40.9	0
Stock Solution 2 – with HCX	14.0	34.0	40.9	70.1

Table 2.2. Analyses of the standard solutions.

	Spike Concentration TCDD in Solution (total pg)	TCDD Percent Recovery June 2001	TCDD Percent Recovery March 2002	Spike Concentration HCX in Solution (total pg)	HCX Percent Recovery June 2001	HCX Percent Recovery March 2002
Stock Solution 1	240.35	85.6%	96.8%	0.0	NA	0.0
Stock Solution 1 –with HCX	240.35	92.6%	110.8%	1201.8	165.7%	160.7%
Stock Solution 2	140.25	93.8%	NA	0.0	NA	NA
Stock Solution 2 –with HCX	140.25	119.5%	NA	701.2	150.4%	NA

Table 2.3. Rangefinding and 32-day test concentration series.

Nominal 2,3,7,8-TCDD in exposure water (ng/mL)	Stock Solution	uL Stock Solution delivered	Acetone delivered for 850 uL total (0.1%)	Treatment number (without HCX)	Treatment number (with HCX)
Rangefinding Test					
0.003	2	180	670	1	1H
0.005	2	300	550	2	2H
0.008	2	490	360	3	3H
0.01	2	610	240	4	4H
0.014	2	850	0	5	5H
0.018	1	640	210	6	6H
0.024	1	850	0	7	7H
32-Day Test					
0.002	2	120	730	7	4
0.003	2	180	670	10	8
0.005	2	300	550	14	5
0.008	2	490	360	6	1
0.012	2	730	120	9	11
0.018	1	640	210	12	2

Table 2.4. Required Water Quality Ranges.

Temperature	26 °C ± 2°C
pH	6.0-9.0
Alkalinity	100-300 mg/L as $CaCO_3$
Dissolved Oxygen	> 5.0 ppm
Hardness	100 - 300 mg/L as $CaCO_3$
Salinity	0 ± 0.5 ppt
Total Ammonia	0-0.2 mg/L

Table 2.5. Gross lesions recorded at test termination.

Code	Lesion
B	Bent tail (twisted spine)
C	Cranial-facial malformation (jaw)
D	Domed head
E	Edema *(location)*
H	Hemorrhage *(location)*
N	Normal
P	Pigmentation *(hyper- or hypo-)*
S	Short snout
O	Other *(e.g., small or abnormal shape)*

Table 3.1. Control survivals in the 17 day range finding test.

Number of Eggs at Start of Test	Number of Organisms Alive at End of Test	Survival (%)	Mean Survival (%)	Standard Deviation
		CONTROLS		
20	18	90		
20	20	100		
20	19	95	97.5	4.18
20	20	100		
20	20	100		
20	20	100		
		SOLVENT CONTROLS		
20	19	95		
20	18	90		
20	17	85	95.0	6.32
20	20	100		
20	20	100		
20	20	100		

Table 3.2. Control survival of catfish fry in the 32 day test.

Number of Eggs at Start of Test	Number of Organisms Alive At End of Test	Survival (%)	Mean Survival (%)	Standard Deviation
		CONTROLS		
20	11	55		
20	16	80		
20	18	90	78.0	13.51
20	16	80		
20	17	85		
		SOLVENT CONTROLS		
20	20	100		
20	17	85		
20	17	85	90.0	7.07
20	17	85		
20	19	95		

Table 3.3. Mean concentration of TCDD in 32 day old catfish fry exposed as eggs for 24 hours to TCDD, PCB-77 and PCB-126 only.

Nominal TCDD Concentration In Exposure Water (ng/ml)	Mean Concentration of TCDD Measured in Fry (pg/g wet wt)	Minimum Tissue Detection Limit (pg/g wet wt)	Fry Sample Size (g wet wt)
Control	0.99UJ	2.26	2.22
Solvent Control	3.29	2.28	2.19
0.002	1.71UJ	2.41	2.07
0.003	2.59	2.35	2.13
0.005	4.22	2.15	2.33
0.008	5.85	2.36	2.12
0.012	10.67	2.36	2.12
0.018	9.14	5.70	0.88

Analyzed using Modified EPA Method 1613B.

Data Qualifier = UJ (not detected; sample-specific detection limit reported)

Table 3.4. Mean concentration of TCDD in 32 day old catfish fry exposed as eggs for 24 hours to TCDD, PCB-77, PCB-126 and HCX.

Nominal TCDD Concentration in Exposure water (ng/ml)	Mean Concentration of TCDD Measured in Fry (pg/g wet wt)	Minimum Tissue Detection Limit (pg/g wet wt)	Fry Sample Size (g wet wt)
Control	0.99UJ	2.26	2.22
Solvent Control	3.29	2.28	2.19
0.002	1.65J	2.31	2.16
0.003	3.14	2.39	2.10
0.005	3.76	2.28	2.19
0.008	6.59	2.37	2.11
0.012	9.24	2.27	2.20
0.018	6.44	2.42	2.07

Analyzed using Modified EPA Method 1613B.

Data Qualifier = J (detected below the detection limit; estimated value reported)

Table 3.5. Mean concentration of HCX in 32 day old catfish fry exposed as eggs for 24 hours to TCDD, PCB-77 and PCB-126 only.

Nominal TCDD Concentration in Exposure water (ng/ml)	Mean Concentration of HCX Measured in Fry (pg/g wet wt)	Minimum Tissue Detection Limit (pg/g wet wt)	Fry Sample Size (g wet wt)
Control	90.21UJ	90.21	2.22
Solvent Control	91.33UJ	91.33	2.19
0.002	96.53UJ	96.53	2.07
0.003	94.10UJ	94.10	2.13
0.005	85.81UJ	85.81	2.33
0.008	94.51UJ	94.51	2.12
0.012	94.46UJ	94.46	2.12
0.018	228.18UJ	228.18	0.88

Analyzed using Modified EPA Method 1613B.

Data Qualifier = UJ (not detected; sample-specific detection limit reported)

Table 3.6. Mean concentration of HCX in 32 day old catfish fry exposed as eggs for 24 hours to TCDD, PCB-77, PCB-126 and HCX.

Nominal TCDD Concentration in Exposure Water (ng/ml)	Mean Concentration of HCX Measured in Fry (pg/g wet wt)	Minimum Tissue Detection Limit (pg/g wet wt)	Fry Sample Size (g wet wt)
Control	90.21UJ	90.21	2.22
Solvent Control	91.33UJ	91.33	2.19
0.002	92.52UJ	92.52	2.16
0.003	95.43UJ	95.43	2.10
0.005	91.40UJ	91.40	2.19
0.008	94.99UJ	94.99	2.11
0.012	90.85UJ	90.85	2.20
0.018	96.67UJ	96.67	2.07

Analyzed using Modified EPA Method 1613B.

Data Qualifier = UJ (not detected; sample-specific detection limit reported)

Table 3.7a: Relative Percent Difference (RPD) between egg TCDD replicates, and COPCs and lipids in catfish eggs exposed 24-hours to TCDD, PCB77, and PCB-126, COPC-Specific Toxic Equivalance Factors (TEFs), calculation of Toxic Equivalance Concentrations (TECs), and percent TCDD contribution to the Total TEC.

Rep	Nominal TCDD (ng/mL)	Egg TCDD (pg/g wet)		TCDD TEF	Egg HCX[1] (pg/g wet)		HCX TEF	Egg PCB-126 (pg/g wet)		PCB-126 TEF	Egg PCB-77 (pg/g wet)		PCB-77 TEF	Total TEC (TCDD, PCBs)	TCDD TEC	Percent Lipid	Fraction Lipid	Non-normalized Total TEC (TCDD, PCBs)	Lipid-normalized Total TEC (TCDD, PCBs)
1	Control	1.57	J	1.0	189.61	U	0.0002	3.22	J	0.005	13.16	J	0.0001	1.59	1.57	2.07	0.0207	1.59	76.69
2	Control	4.17	J	1.0	503.02	U	0.0002	14.01	J	0.005	25.42	J	0.0001	4.24	4.17	2.54	0.0254	4.24	167.03
3	Control	3.01	J	1.0	246.28	U	0.0002	6.55	J	0.005	14.76	J	0.0001	3.04	3.01	3.58	0.0358	3.04	85.03
$RPD_{1,2,3}$ =		90.59		62.88															
1	0.002	91.47		1.0	226.17	U	0.0002	253.3	J	0.005	240.83	J	0.0001	92.76	91.47	2.18	0.0218	92.76	4255.07
2	0.002	84.68		1.0	188.80	U	0.0002	211.02	J	0.005	212.27	J	0.0001	85.76	84.68	1.99	0.0199	85.76	4309.36
3	0.002	123.46		1.0	248.73	U	0.0002	311.44	J	0.005	302.42	J	0.0001	125.05	123.46	2.84	0.0284	125.05	4403.08
$RPD_{1,2,3}$ =		7.71		29.77															
1	0.003	94.94		1.0	183.50	U	0.0002	244.73	J	0.005	217.15	J	0.0001	96.19	94.94	1.42	0.0142	96.19	6773.62
2	0.003	175.08		1.0	260.38	U	0.0002	471.07	J	0.005	444.74	J	0.0001	177.48	175.08	3.34	0.0334	177.48	5313.77
3	0.003	103.51		1.0	232.61	U	0.0002	267.61		0.005	250.35		0.0001	104.87	103.51	1.22	0.0122	104.87	8596.15
$RPD_{1,2,3}$ =		59.36		8.64															
1	0.005	311.88		1.0	235.79	U	0.0002	754.11	J	0.005	786.44		0.0001	315.73	311.88	3.07	0.0307	315.73	10284.34
2	0.005	137.33		1.0	182.18	U	0.0002	355.61	J	0.005	355.70	J	0.0001	139.14	137.33	1.28	0.0128	139.14	10870.60
3	0.005	188.89		1.0	231.19	U	0.0002	424.21	J	0.005	420.57	J	0.0001	191.05	188.89	2.43	0.0243	191.05	7862.27
$RPD_{1,2,3}$ =		77.71		49.12															
1	0.008	482.32		1.0	267.77	U	0.0002	1184.38	J	0.005	998.88		0.0001	488.34	482.32	3.38	0.0338	488.34	14447.98
2	0.008	452.9		1.0	257.47	U	0.0002	1068.58	J	0.005	955.91		0.0001	458.34	452.9	4.56	0.0456	458.34	10051.28
3	0.008	343.77		1.0	174.84	U	0.0002	874.51		0.005	718.95		0.0001	348.21	343.77	1.43	0.0143	348.21	24350.66
$RPD_{1,2,3}$ =		6.29		33.54															
1	0.012	535.43		1.0	226.17	U	0.0002	1084.91	J	0.005	1338.00		0.0001	540.99	535.43	2.67	0.0267	540.99	20261.74
2	0.012	619.65		1.0	211.93	U	0.0002	1460.03		0.005	1177.07		0.0001	627.07	619.65	2.11	0.0211	627.07	29718.86
3	0.012	889.99		1.0	258.60	U	0.0002	2249.44		0.005	1813.44		0.0001	901.42	889.99	3.41	0.0341	901.42	26434.56
$RPD_{1,2,3}$ =		14.58		49.75															
1	0.018	1132.91		1.0	240.88	U	0.0002	2782.78		0.005	2609.00		0.0001	1147.08	1132.91	3.15	0.0315	1147.08	36415.39
2	0.018	611.32		1.0	3188.52	U	0.0002	1420.16	J	0.005	1293.59	J	0.0001	618.55	611.32	1.44	0.0144	618.55	42954.87
3	0.018	959.53		1.0	253.90	U	0.0002	2476.43		0.005	2424.29		0.0001	972.15	959.53	3.26	0.0326	972.15	29820.69
$RPD_{1,2,3}$ =		59.8		16.57															
													Total:	7439.06	7347.81				
													Percent TCDD:		98.8				

NOTES:

$RPD_{1,2,3}$ = Relative Percent Difference of "Egg TCDD" data (Reps 1 and 2, Reps 2 and 3, or Reps 1 and 3) are 2 to 5-fold larger than 1-22% RPD reported in USACE (2002c, 2003).

[1] Eggs not exposed to HCX, it was not detected, and not used in Total TEC calculation

Rep = Exposure jar replicate by nominal (targeted) exposure grouping

J = Detected below detection limit. Whole value used in TEC calculation

U = Not detected; sample detection limit (DL) reported. 1/2 DL was used to calculate TEC unless not detected in any replicate

Table 3.7b: Relative Percent Difference (RPD) between egg TCDD replicates, and COPCs and lipids in catfish eggs exposed 24-hours to TCDD, PCB77, PCB-126, and HCX. COPC-Specific Toxic Equivalance Factors (TEFs), calculation of Toxic Equivalance Concentrations (TECs), and percent TCDD contribution to the Total TEC.

Rep	Nominal TCDD (ng/ml)	Egg TCDD (pg/g wet)		TCDD TEF	Egg HCX (pg/g wet)		HCX TEF	Egg PCB-126 (pg/g wet)		PCB-126 TEF	Egg PCB-77 (pg/g wet)		PCB-77 TEF	Total TEC (TCDD, PCBs, HCX	TCDD TEC	Percent Lipid	Fraction Lipid	Non-normalized Total TEC (TCDD, PCBs, HCX)	Lipid-normalized Total TEC (TCDD, PCBs, HCX)
1	Control	1.57	J	1.0	189.61	U	0.0002	3.22	J	0.005	13.16	J	0.0001	1.59	1.57	2.07	0.0207	1.59	76.69
2	Control	4.17	J	1.0	503.02	U	0.0002	14.01	J	0.005	25.42	J	0.0001	4.24	4.17	2.54	0.0254	4.24	167.03
3	Control	3.01	J	1.0	246.28	U	0.0002	6.55	J	0.005	14.76	J	0.0001	3.04	3.01	3.58	0.0358	3.04	85.03
$RPD_{1,2,3}$ =		90.59		67.88			32.31												
1	0.002	96.46		1.0	42.75	J	0.0002	257.38	J	0.005	259.64	J	0.0001	97.78	96.46	2.9	0.029	97.78	3371.77
2	0.002	66.51		1.0	164.08	U	0.0002	183.10	J	0.005	160.95	J	0.0001	67.46	66.51	1.4	0.014	67.46	4818.43
3	0.002	87.84		1.0	191.22	U	0.0002	218.21	J	0.005	223.53	J	0.0001	88.97	87.84	2.23	0.0223	88.97	3989.80
$RPD_{1,2,3}$ =		36.76		19.35			27.64												
1	0.003	95.24		1.0	200.22	U	0.0002	229.82	J	0.005	243.21	J	0.0001	96.41	95.24	2.25	0.0225	96.41	4285.04
2	0.003	168.97		1.0	247.01	U	0.0002	445.37	J	0.005	362.72	J	0.0001	171.23	168.97	3.54	0.0354	171.23	4837.09
3	0.003	174.67		1.0	195.98	U	0.0002	429.91	J	0.005	430.51	J	0.0001	176.86	174.67	2.72	0.0272	176.86	6502.30
$RPD_{1,2,3}$ =		33.81		58.86			3.32												
1	0.005	189.79		1.0	124.35	J	0.0002	518.40	J	0.005	403.50	J	0.0001	192.45	189.79	2.99	0.0299	192.45	6436.36
2	0.005	327.01		1.0	102.08	J	0.0002	927.42	J	0.005	807.16		0.0001	331.75	327.01	3.62	0.0362	331.75	9164.32
3	0.005	249.72		1.0	106.52	J	0.0002	722.15	J	0.005	611.51		0.0001	253.41	249.72	2.52	0.0252	253.41	10056.08
$RPD_{1,2,3}$ =		53.10		27.27			26.80												
1	0.008	346.79		1.0	86.13	J	0.0002	904.10	J	0.005	968.82		0.0001	351.42	346.79	3.37	0.0337	351.42	10428.03
2	0.008	369.72		1.0	312.03	J	0.0002	929.78	J	0.005	1070.00	J	0.0001	374.54	369.72	3.67	0.0367	374.54	10205.40
3	0.008	496.73		1.0	249.16	U	0.0002	1352.00		0.005	1322.82		0.0001	503.65	496.73	3.48	0.0348	503.65	14472.62
$RPD_{1,2,3}$ =		6.40		35.55			29.32												
1	0.012	743.91		1.0	188.80	U	0.0002	200.43		0.005	1602.19		0.0001	745.09	743.91	2.76	0.0276	745.09	26996.06
2	0.012	573.69		1.0	168.04	J	0.0002	2118.79		0.005	1689.25		0.0001	584.49	573.69	3.73	0.0373	584.49	15669.87
3	0.012	809.00		1.0	309.15	J	0.0002	1487.15		0.005	1413.71		0.0001	816.64	809	3.54	0.0354	816.64	23068.93
$RPD_{1,2,3}$ =		25.84		8.38			34.04												
1	0.018	738.13		1.0	171.21	J	0.0002	2011.30		0.005	1634.05		0.0001	748.38	738.13	1.92	0.0192	748.38	38978.34
2	0.018	599.84		1.0	365.79	J	0.0002	1525.14		0.005	1316.24		0.0001	607.67	599.84	3.72	0.0372	607.67	16335.23
3	0.018	1254.24		1.0	207.13	J	0.0002	3320.61		0.005	2869.54		0.0001	1271.17	1254.24	1.99	0.0199	1271.17	63877.96
$RPD_{1,2,3}$ =		20.67		51.81			70.59												
													Total:	7488.26	7397.01				
													Percent TCDD:		98.8				

NOTES:

$RPD_{1,2,3}$ = Relative Percent Difference of "Egg TCDD" data (Reps 1 and 2, Reps 2 and 3, or Reps 1 and 3) are 2 to 5-fold larger than 1-22% RPD reported in USACE (2002c, 2003).

Rep = Exposure jar replicate by nominal (targeted) exposure grouping

J = Detected below detection limit. Whole value used in TEC calculation

U = Not detected; sample detection limit (DL) reported. 1/2 DL was used to calculate TEC unless not detected in any replicate

Table 3.8. Percent lipids in catfish eggs exposed for 24 hours to TCDD, PCB-77 and PCB-126 only.

Nominal TCDD Concentration in Exposure Water (ng/ml)	Concentration of Lipids in Eggs (% wet wt)	Mean Lipid Concentration (%wet wt)	Standard Deviation	Egg Sample Size (g wet wt)
	2.07			1.05
Control	2.54	2.73	0.77	0.40
	3.58			0.81
	2.18			0.88
0.002	1.99	2.34	0.45	1.06
	2.84			0.80
	1.42			1.09
0.003	3.34	1.99	1.17	0.77
	1.22			0.86
	3.07			0.85
0.005	1.28	2.26	0.91	1.10
	2.43			0.87
	3.38			0.75
0.008	4.56	3.12	1.58	0.78
	1.43			1.14
	2.67			0.88
0.012	2.11	2.73	0.65	0.94
	3.41			0.77
	3.15			0.83
0.018	1.44	2.62	1.02	0.25
	3.26			0.79

Table 3.9. Percent lipids in catfish eggs exposed for 24 hours to TCDD, PCB-77, PCB-126 and HCX.

Nominal TCDD Concentration in Exposure Water (ng/ml)	Concentration of Lipids in Eggs (% wet wt)	Mean Lipid Concentration (% wet wt)	Standard Deviation	Egg Sample Size (g wet wt)
	2.90			0.81
0.002	1.40	2.18	0.75	1.22
	2.23			1.05
	2.25			1.00
0.003	3.54	2.84	0.65	0.81
	2.72			1.02
	2.99			0.83
0.005	3.62	3.04	0.55	0.77
	2.52			0.91
	3.37			0.82
0.008	3.67	3.51	0.15	0.43
	3.48			0.80
	2.76			0.79
0.012	3.73	3.34	0.51	0.73
	3.54			0.78
	1.92			1.02
0.018	3.72	2.54	1.02	0.39
	1.99			1.04

Table 3.10a. Total TEC measured in eggs versus 10 day hatching success and 32 day survival in catfish exposed as eggs for 24 hours to TCDD, PCB-77 and PCB-126 only.

Position Number	Non-Lipid Normalized Total TEC (pg TCDD/g wet wt)	Lipid Normalized Total TEC (pg TCDD/g lipid)	Number Hatched at 10 Days[a]	10-Day Hatching Success (%)	Number Alive at 32 Days[a]	32-Day Fry Survival (%)
			CONTROLS			
133	1.59	76.69	20	100	18	90
124	4.24	167.03	18	90	16	80
148	3.04	85.03	18	90	17	85
136	NA[b]	NA	19	95	16	80
105	NA	NA	16	80	11	55
			SOLVENT CONTROLS			
122	NA	NA	20	100	17	85
100	NA	NA	20	100	20	100
155	NA	NA	20	100	17	85
156	NA	NA	20	100	19	95
114	NA	NA	18	90	17	85
			EXPOSURES			
107	85.76	4309.36	20	100	18	90
111	92.76	4255.07	16	80	15	75
145	96.19	6773.62	20	100	18	90
102	104.87	8596.15	17	85	16	80
150	125.05	4403.08	19	95	18	90
154	139.14	10870.60	19	95	17	85
135	177.48	5313.77	20	100	17	85
109	191.05	7862.27	18	90	17	85
121	315.73	10284.34	19	95	19	95
115	348.21	24350.66	17	85	17	85
116	458.34	10051.28	17	85	13	65
131	488.34	14447.98	19	95	13	65
132	540.99	20261.74	15	75	9	45
138	618.55	42954.87	1	5	0	0
120	627.07	29718.86	10	50	7	35
127	901.42	26434.56	19	95	12	60
137	972.15	29820.69	3	15	0	0
101	1147.08	36415.39	14	70	4	20

[a]Each position number started with 20 fertilized catfish eggs at the beginning of the test
[b] eggs not analyzed for residues

Table 3.10b. Total TEC measured in eggs versus 10 day hatching success and 32 day survival in catfish exposed as eggs for 24 hours to TCDD, PCB-77, PCB-126 and HCX.

Position Number	Non-Lipid Normalized Total TEC (pg TCDD/g wet wt)	Lipid Normalized Total TEC (pg TCDD/g lipid)	Number Hatched at 10 Days[a]	10-Day Hatching Success (%)	Number Alive at 32 Days[a]	32-day Fry Survival (%)
			CONTROLS			
133	1.59	76.69	20	100	18	90
124	4.24	167.03	18	90	16	80
148	3.04	85.03	18	90	17	85
136	NA[b]	NA	19	95	16	80
105	NA	NA	16	80	11	55
			SOLVENT CONTROLS			
122	NA	NA	20	100	17	85
100	NA	NA	20	100	20	100
155	NA	NA	20	100	17	85
156	NA	NA	20	100	19	95
114	NA	NA	18	90	17	85
			EXPOSURES			
123	67.46	4818.43	18	90	16	80
152	88.97	3989.80	19	95	15	75
144	96.41	4285.04	19	95	16	80
108	97.78	3371.77	20	100	18	90
134	171.23	4837.09	18	90	16	80
125	176.86	6502.30	19	95	19	95
147	192.45	6436.36	18	90	14	70
149	253.41	10056.08	19	95	19	95
129	331.75	9164.32	15	75	14	70
139	351.42	10428.03	18	90	13	65
104	374.54	10205.40	19	95	7	35
119	503.65	14472.62	17	85	16	80
130	584.49	15669.87	17	85	12	60
128	607.67	16335.23	16	80	16	80
153	745.09	26996.06	13	65	12	60
117	748.38	38978.34	4	20	0	0
118	816.64	23068.93	14	70	11	55
140	1271.17	63877.96	4	20	0	0

[a] Each position number started with 20 fertilized catfish eggs at the beginning of the test
[b] eggs not analyzed for residues

Table 3.11a. Non-lipid normalized effect/inhibition concentrations for hatching success, survival, and growth by catfish exposed as eggs to a TCDD and PCB mixture without and with HCX

Measure of Effect	EC/IC_{10}	EC/IC_{25}	EC/IC_{50}	EC/IC_{75}	EC/IC_{90}
Fry from Eggs Exposed for 24 Hours to TCDD, PCB-77 and PCB-126 Only					
Hatching Success (%) at 10 Days	318	557	1039	1938	3398
Fry Survival (%) at 32 Days	319	442	636	916	1271
Length of Fry Surviving at 32 Days	551	588	948	NA[a]	NA
Weight of Fry Surviving at 32 Days	104	561	925	NA	NA
Fry from Eggs Exposed for 24 Hours to TCDD, PCB-77, PCB-126 and HCX					
Hatching Success (%) at 10 Days	465	628	875	1221	1647
Fry Survival (%) at 32 Days	368	510	734	1056	1465
Length of Fry Surviving at 32 Days	NA	NA	NA	NA	NA
Weight of Fry Surviving at 32 Days	NA	NA	NA	NA	NA

Notes:
Units are in non-lipid normalized total TEC (pg TCDD/g wet wt) measured in eggs after 24 hours of exposure
EC/IC = effect or inhibitive concentrations for 10, 25, 50, 75 or 90% of the exposed population
[a] NA = value not available (slope of linear regression model was not significantly different from zero, $P > 0.05$)

Table 3.11b. Lipid normalized effect/inhibition concentrations for hatching success, survival, and growth by catfish exposed as eggs to a TCDD and PCB mixture without and with HCX

Measure of Effect	EC/IC_{10}	EC/IC_{25}	EC/IC_{50}	EC/IC_{75}	EC/IC_{90}
Fry from Eggs Exposed for 24 Hours to TCDD, PCB-77 and PCB-126 Only					
Hatching Success (%) at 10 Days	21257	25997	32514	40663	49731
Fry Survival (%) at 32 Days	18384	22013	26891	32851	39336
Length of Fry Surviving at 32 Days	29727	29757	29808	NA	NA
Weight of Fry Surviving at 32 Days	8300	29740	29793	NA	NA
Fry from Eggs Exposed for 24 Hours to TCDD, PCB-77, PCB-126 and HCX					
Hatching Success (%) at 10 Days	13899	20873	32794	51522	77372
Fry Survival (%) at 32 Days	22811	25213	28179	31495	34811
Length of Fry Surviving at 32 Days	NA	NA	NA	NA	NA
Weight of Fry Surviving at 32 Days	NA	NA	NA	NA	NA

Notes:
Units are in lipid normalized total TEC (pg TCDD/g lipid) measured in eggs after 24 hours of exposure
EC/IC = effective or inhibitive concentrations for 10, 25, 50, 75 or 90% of the exposed population
[a] NA = value not available (slope of linear regression model was not significantly different from zero, $P > 0.05$)

Table 3.12a. Total TEC measured in eggs versus mean length and mean weight of 32 day old catfish fry exposed as eggs for 24 hours to TCDD, PCB-77 and PCB-126 only.

Position Number	Non-Lipid Normalized Total TEC (pg TCDD/g wet wt)	Lipid Normalized Total TEC (pg TCDD/g lipid)	Mean Length (cm)	Mean Weight (g)
		CONTROLS		
133	1.59	76.69	0.384	3.303
124	4.24	167.03	0.355	3.191
148	3.04	85.03	0.352	3.200
136	NA[a]	NA	0.371	3.277
105	NA	NA	0.401	3.430
		SOLVENT CONTROLS		
122	NA	NA	0.349	3.135
100	NA	NA	0.366	3.215
155	NA	NA	0.375	3.224
156	NA	NA	0.377	3.218
114	NA	NA	0.371	3.212
		EXPOSURES		
107	85.76	4309.36	0.409	3.300
111	92.76	4255.07	0.434	3.373
145	96.19	6773.62	0.412	3.250
102	104.87	8596.15	0.302	2.972
150	125.05	4403.08	0.353	3.183
154	139.14	10870.60	0.358	3.082
135	177.48	5313.77	0.380	3.189
109	191.05	7862.27	0.393	3.203
121	315.73	10284.34	0.390	3.142
115	348.21	24350.66	0.363	3.182
116	458.34	10051.28	0.350	3.115
131	488.34	14447.98	0.338	3.073
132	540.99	20261.74	0.330	3.128
138	618.55	42954.87	No survival	No survival
120	627.07	29718.86	0.373	3.157
127	901.42	26434.56	0.318	3.068
137	972.15	29820.69	No survival	No survival
101	1147.08	36415.39	0.296	2.875

[a] eggs not analyzed for residues

Table 3.12b. Total TEC measured in eggs versus mean weight and length of 32 day old catfish fry exposed as eggs for 24 hours to TCDD, PCB-77, PCB-126 and HCX.

Position Number	Non-Lipid Normalized Total TEC (pg TCDD/g wet wt)	Lipid Normalized Total TEC (pg TCDD/g lipid)	Mean Length (cm)	Mean Weight (g)
		CONTROLS		
133	1.59	76.69	0.384	3.303
124	4.24	167.03	0.355	3.191
148	3.04	85.03	0.352	3.200
136	NA	NA	0.371	3.277
105	NA	NA	0.401	3.430
		SOLVENT CONTROLS		
122	NA	NA	0.349	3.135
100	NA	NA	0.366	3.215
155	NA	NA	0.375	3.224
156	NA	NA	0.377	3.218
114	NA	NA	0.371	3.212
		EXPOSURES		
123	67.46	4818.43	0.428	3.250
152	88.97	3989.80	0.355	3.093
144	96.41	4285.04	0.384	3.184
108	97.78	3371.77	0.367	3.114
134	171.23	4837.09	0.381	3.166
125	176.86	6502.30	0.372	3.192
147	192.45	6436.36	0.344	3.057
149	253.41	10056.08	0.369	3.071
129	331.75	9164.32	0.404	3.231
139	351.42	10428.03	0.380	3.108
104	374.54	10205.40	0.234	2.864
119	503.65	14472.62	0.385	3.225
130	584.49	15669.87	0.275	2.917
128	607.67	16335.23	0.381	3.269
153	745.09	26996.06	0.370	3.196
117	748.38	38978.34	No survival	No survival
118	816.64	23068.93	0.368	3.223
140	1271.17	63877.96	No survival	No survival

[a] eggs not analyzed for residues

Table 3.13. Summary of morphological observations made on catfish fry alive at the end of the 32 day test.

Nominal Conc. of TCDD (ng/mL)	Non-Lipid Normalized Total TEC in Eggs (pg TCDD/g wet wt)	Number of Fry Alive at 32 Days	Normal		Small or Abnormal		Hemorrhage		Bent Tail		Short Tail		Craniofacial Malformations		Short Snout	
			Count	%	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Control	2.96	78	77	98.7	1	1.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Solvent Control	no data	90	83	92.2	5	5.6	2	2.2	0	0.0	0	0.0	0	0.0	0	0.0
Fry from Eggs Exposed for 24 hours to TCDD, PCB-77 and PCB-126 Only																
0.002	101.19	51	32	62.7	3	5.9	18	35.3	0	0.0	0	0.0	0	0.0	0	0.0
0.003	126.18	51	30	58.8	10	19.6	12	23.5	1	2.0	1	2.0	1	2.0	0	0.0
0.005	215.31	53	36	67.9	1	1.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
0.008	431.63	43	39	90.7	4	9.3	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
0.012	689.82	28	19	67.9	1	3.6	2	7.1	0	0.0	0	0.0	0	0.0	0	0.0
0.018	912.60	4	3	75.0	1	25.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Fry from Eggs Exposed for 24 hours to TCDD, PCB-77, PCB-126 and HCX																
0.002	84.74	49	30	61.2	6	12.2	14	28.6	1	2.0	0	0.0	0	0.0	0	0.0
0.003	148.17	51	44	86.3	6	11.8	0	0.0	0	0.0	0	0.0	0	0.0	1	2.0
0.005	259.20	47	38	80.9	4	8.5	4	8.5	0	0.0	1	2.1	0	0.0	1	2.1
0.008	409.88	36	19	52.8	3	8.3	14	38.9	1	2.8	0	0.0	0	0.0	0	0.0
0.012	715.41	35	18	51.4	4	11.4	1	2.9	0	0.0	0	0.0	0	0.0	0	0.0
0.018	875.74	16	10	62.5	1	6.3	6	37.5	0	0.0	0	0.0	0	0.0	0	0.0

Table 3.14. Counts of gross lesions in ichthyoplankton collected from reference and TCDD-impacted locations at the Centredale Manor Restoration Superfund Site

Sampling Location	Date Collected	Eggs			Larvae[a]			Juveniles[b]		
		Number Examined	Number of Anomalies	Percent Anomalies	Number Examined	Number of Anomalies	Percent Anomalies	Number Examined	Number of Anomalies	Percent Anomalies
Reference Locations (Upstream from Site and Relatively Uncontaminated by TCDD)										
Assapumpsett Pond	May 2 & 3, 2001	28	7	25%	7	0	0%	9	0	0%
Greystone Mill Pond	May 3 & 8, 2001	41	19	46%	36	1	3%	2	0	0%
	June 12 & 13, 2001	1	0	0%	6	1	17%	0	-	-
GRANDTOTALS		**70**	**26**	**37%**	**49**	**2**	**4%**	**11**	**0**	**0%**
Impacted Locations (Downstream from Site and Contaminated by TCDD)										
Lyman Mill Pond	May 8 & 9, 2001	0	-	-	20	0	0%	0	-	-
	June 13, 2001	0	-	-	36	2	6%	0	-	-
Allendale Reach Tailrace	May 9, 2001	0	-	-	0	-	-	10	0	0%
	June 13, 2001	0	-	-	10	0	0%	21	1[c]	5%
GRAND TOTALS		**0**	**-**	**-**	**66**	**2**	**3%**	**31**	**1**	**3%**

Source: Letter Report by R.E. Hillman, Battelle, to B. Lawrence, U.S. Army Corps of Engineers, dated April 28, 2003 (Appendix M).

[a] Larvae are post yolk-sac fry, the majority of which were determined to be well beyond the 32-day post-hatch stage.
[b] Juveniles are several weeks older than larvae.
[c] This individual was observed to have craniofacial malformations, a diagnostic sign of TCDD toxicity

Appendix A - Certifications of Reagent Purity

CIL

48514-51-12,13
Rec'd 6/11/01 Exp 6/11/06
RT

Certificate of Analysis

Product Description:	Unlabeled PCB Solution
Catalog Number:	PCB-77-CS
Lot Number:	PR-10472
Solvent:	Isooctane
Volume per Ampoule:	1.2 ml
Storage Conditions:	Store at room temperature, protect from light.
Intended Use:	For laboratory use only.

Component[1]	PCB #[2]	Purity[3]	Target Concentration[4]
3,3',4,4'-TetraCB	77	≥98%	100 µg/ml

[1] CB = chlorobiphenyl.
[2] For more information regarding this numbering system see K. Ballschmiter and M. Zell, "Analysis of Polychlorinated Biphenyls by Capillary Gas Chromatography," Fresenius Z. Analytical Chemistry, 302, 20-31 (1980).
[3] Chemical purity was determined using the analytical methods listed in Reference Material for Environmental Analysis, "The Preparation and Validation of Isotope Dilution Standards: A Case Study in PCBs"; Daniel L. Bolt; Joel C. Bradley; 1997; Chap. 2, p. 15-23.
[4] The specified concentration for the component listed displays an error of <1% based on the tolerances of the NIST traceable equipment used in the process.

Cambridge Isotope Laboratories certifies that this product meets the target specification stated above. Accuracy is ensured by calibrating all balances used for gravimetric measurements against NIST traceable weights. Volumetric measurements are made with Class A grade glassware and syringes that are traceable to NIST. See attached pages and Reference Material for Environmental Analysis, "The Preparation and Validation of Isotope Dilution Standards: A Case Study in PCBs", Daniel L. Bolt; Joel C. Bradley; 1997; Chap. 2, p. 15-23.

Authorized Signature: _____
Quality Assurance

manufacturer: CIL

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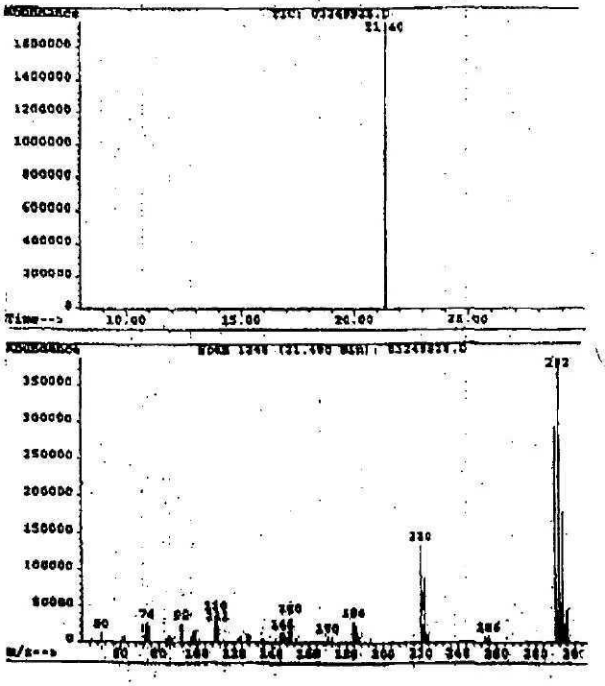
Cambridge Isotope Laboratories, Inc.
50 Frontage Road, Andover, MA
PH: 800.322.1174 (USA) PH: 978.749.8000
FAX: 978.749.2768 URL: http://www.isotope.com

Technical Data Package

Sample Name	: Unlabeled PCB Solution
Catalog Number	: PCB-77-CS (corresponds to IUPAC number PCB 77)
Lot Number	: PR-10472
Instrument	: HP 5890 GC/ HP 5970 MS
Date reported	: March 25, 1999
Column Type	: HP-5ms, 30m x 0.25 mm ID, 0.25 µm film thickness
Temp. Program	: 100° C to 250° C @ 10° C/min
Injector Temp.	: 280° C
Carrier Gas	: Helium
Flow Rate (mL/min)	: 1.0 ml/min
Transfer Line Temp.	: 280° C
Scan Range	: 20 – 420 m/z

Peak Number	PCB #
1	77



Data from Analysis of 3,3',4,4'-Tetrachlorobiphenyl Certified Standard Preparation.

3/12/99. TJE

100ul Injections.

	Solution A	Solution B	Solution C
Peak Areas	1732070	1681408	1711088
	1750685	1682108	1707964
	1746883	1648423	1705874
	1752266	1683369	1709117
	1738789	1685744	1710354
	1754525	1674753	1709579
	1750177	1679164	1713851
	1754316	1679781	1723585
	1745243	1684096	1710687
	1749605	1680603	1713577
Mean	1747476	1677945	1711569
Std. Deviation	7154	10807	4848
% RSD	0.41	0.64	0.28
Upper 95% CL	1752594	1685676	1715037
Lower 95% CL	1742358	1670214	1708101
Upper 95% CL as percentage of mean.	100.29	100.46	100.20
Lower 95% CL as percentage of mean.	99.71	99.54	99.80
Confidence Interval (%)	+/- 0.29	+/- 0.46	+/- 0.20

Statistics for (A+B+C)

Mean	1712330
Std. Dev.	29868
% RSD	1.75

The %RSD values for the individual solutions and their aggregate are all smaller than the 5% limit specified.

$$Confidence\ Limit = \bar{x} \mp \frac{t\,s}{\sqrt{n}} \qquad Std\ Dev = \sqrt{\frac{n\sum(x) - \sum(x^2)}{n(n-1)}}$$

Confidence limits were calculated using values from the Student's t-distribution.

CIL

4X514-51-23,24
RT
Recd 6/18/11

Certificate of Analysis

Product Description:	Unlabeled PCB Solution
Catalog Number:	PCB-126-CS
Lot Number:	PR-11167
Solvent:	*Isooctane*
Volume per Ampoule:	Approximately 1.2 ml
Storage Conditions:	Store at room temperature, protect from light.
Intended Use:	For laboratory use only.
Expiration Date:	December 1999

Component[1]	PCB #[2]	Purity[3]	Target Concentration[4]
3,3',4,4',5-PentaCB	126	≥98%	100 µg/ml

[1] CB = chlorobiphenyl.
[2] For more information regarding this numbering system see K. Ballschmiter and M. Zell, "Analysis of Polychlorinated Biphenyls by Capillary Gas Chromatography," Fresenius Z. Analytical Chemistry, 302, 20-31 (1980).
[3] Chemical purity was determined using the analytical methods listed in Reference Material for Environmental Analysis, "The Preparation and Validation of Isotope Dilution Standards: A Case Study in PCBs", Daniel L. Bolt; Joel C. Bradley; 1997; Chap. 2, p. 15-23.
[4] The specified concentration for the component listed displays an error of <3% based on the tolerances of the NIST traceable equipment used in the process.

Cambridge Isotope Laboratories certifies that this product meets the target specification stated above. Accuracy is ensured by calibrating all balances used for gravimetric measurements against NIST traceable weights. Volumetric measurements are made with Class A grade glassware and syringes that are traceable to NIST. See attached pages and Reference Material for Environmental Analysis, "The Preparation and Validation of Isotope Dilution Standards: A Case Study in PCBs", Daniel L. Bolt; Joel C. Bradley; 1997; Chap. 2, p. 15-23.

Authorized Signature: Steve C. Young
Quality Assurance

manufacturer: CIL

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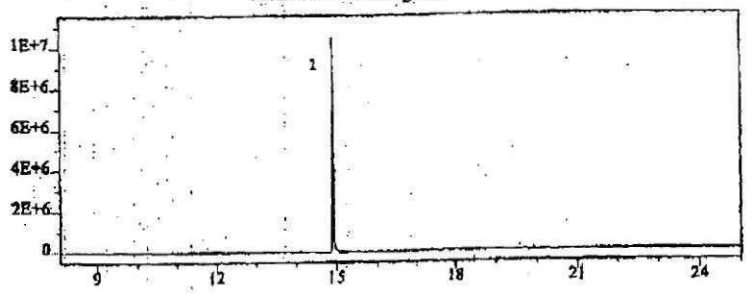
FAX: 978.749.2768 URL: http://www.isotopc.com

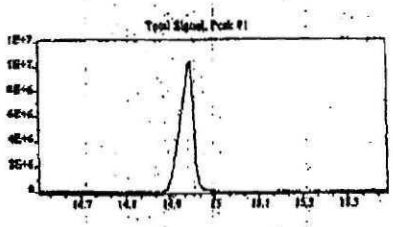
Technical Data Package

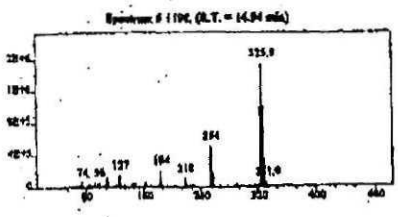
Sample Name	: Unlabeled PCB Solution
Catalog Number	: PCB-126-CS
Lot Number	: PR-11167
Instrument	: HP 6890 GC/ HP 5973 MS
Date reported	: September 24, 1998
Column Type	: HP-5ms, 30m x 0.25 mm ID, 0.25 µm film thickness
Temp. Program	: 100° C to 250° C @ 10° C/min
Injector Temp.	: 280° C
Carrier Gas	: Helium
Flow Rate (mL/min)	: 1.3 mL/min
Transfer Line Temp.	: 280° C
Scan Range	: 50-550 m/z

Total Ion Chromatogram



Peak Number	PCB #
1	126



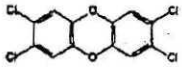


Cambridge Isotope Laboratories, Inc.

Certificate of Analysis

2,3,7,8-Tetrachlorodibenzo-p-dioxin

Catalog Number: ED-901
Solution Lot: 33377-74
Solvent: n-Nonane
Amount per Ampule: 1.2 mL
Storage: Protect from light, store at room temperature.
Handling: We advise laboratories to use measured volumes of this standard solution before diluting to the desired concentration.
Intended Use: For laboratory use only. This product is a quantitative standard useful for calibration, quality control, and other general applications requiring accurate solutions.



Component	Purity[1]	Prepared Concentration[2]	Analyzed Concentration[3]
2,3,7,8-Tetrachlorodibenzo-p-dioxin	98%	50.00 ± 1.55 µg/mL	49.97 ± 0.27 µg/mL

Standard Solution Comparability

Standard Solution	Lot Number	Concentration[3] (µg/mL)	% Difference from Target
New Lot	33377-74	49.97	-0.1
Previous Lot	R890	49.49	-1.0

Standard Solution Homogeneity

Ampuling Position	Concentration[3] (µg/mL)	Mean	% RSD
Early	50.31		
Middle	49.87		
Late	49.73	49.97	0.6

[1] Chemical purity was determined by chromatographic analysis. See following pages for more information.
[2] The range of the prepared concentration is determined by statistical process control of our production and analysis systems with a 95% confidence.
[3] Concentration values are determined by comparison to an independent calibration curve. We suggest using the prepared concentration value for dilutions. The concentration range is calculated from the distribution of multiple analyses of the new standard with a 95% degree of confidence.

Radian International certifies that this standard meets or exceeds the specifications stated in this data sheet. Accuracy is ensured by exhaustive purity determinations and gravimetric preparation calibrated with NIST traceable weights. Precision is guaranteed by multiple weighings/triplicate analysis and comparison to previous lots (when available). Finally, homogeneity is demonstrated by random analysis of the ampuled standard.

Authorized Signature:

Joseph B. Rettinger, Quality Control Manager

Cambridge Isotope
Laboratories, Inc.

Standard Solution Assay Parameters

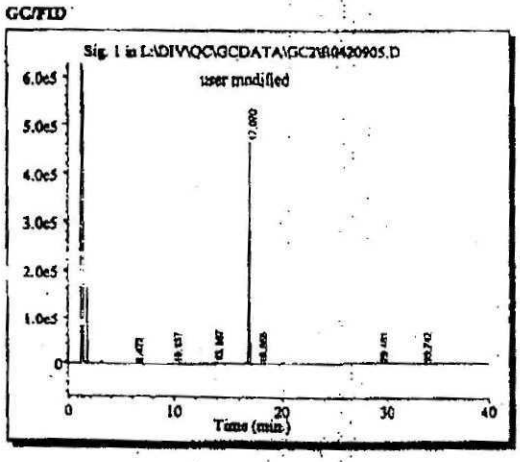
Analysis Method:	GC/FID	**Calibration Curve:**	Linear Regression
Column:	DB-5ms 30 m x 0.53 mm ID, 1.5 um film thickness	**Number of Points:**	4
Temp Program:	70°C to 300°C at 20°C/min hold 8.5 min	**Linearity (r^2):**	0.999
Injector Temp:	Cool-on-Column	*Each point analyzed in triplicate*	
Detector Temp:	325°C		

Neat Material Data

Compound Name:	2,3,7,8-Tetrachlorodibenzo-p-dioxin	**Chemical Formula:**	$C_{12}H_4O_2Cl_4$
Compound Lot:	33383-89	**CAS Number:**	1746-01-6
Chemical Purity:	98%	**Molecular Weight:**	321.97

Spectral and Physical Data

GC/FID

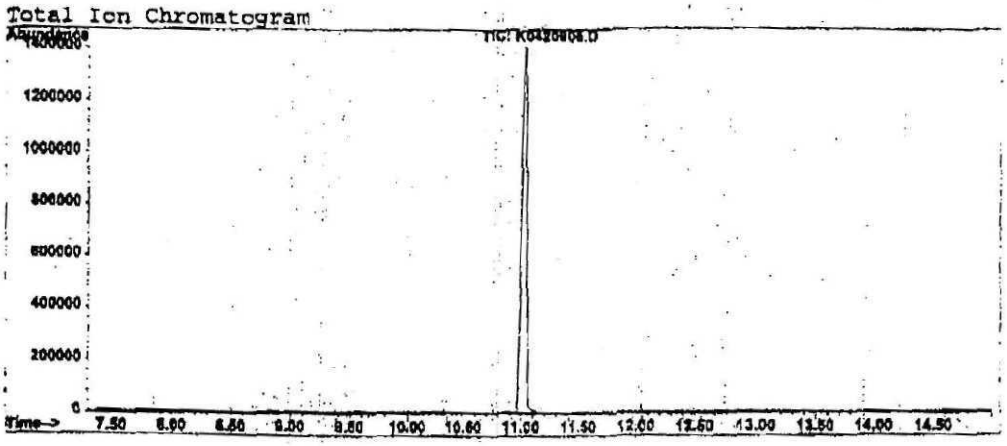


Column:	DB-5ms. 30 m x 0.53 mm ID, 1.5 um film thickness
Temp Program:	40°C to 180°C at 50°C/min 180°C to 300°C at 5°C/min hold 12.5 min
Injector Temp:	Cool-on-Column
Detector Temp:	325°C
Data File Name:	L:\DIV\QC\GCDATA\GC2\B0420905.D
Operator:	CJJ
Instrument:	GC#2
Sample Name:	33383-89
Method File:	B03F.MTH
Acquired:	April 20, 1999 1:49 PM

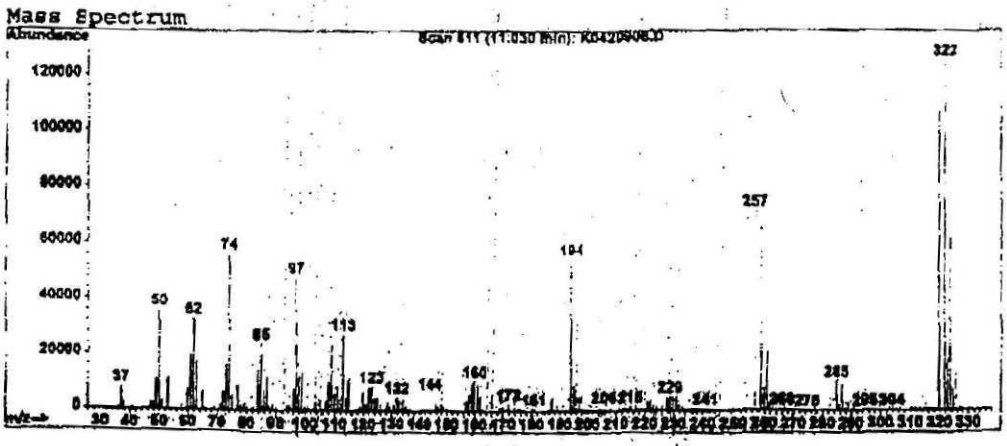
Peak #	Ret Time	Area	Height	Area %
1	6.47	1211	122	0.05
2	10.14	1543	47	0.06
3	13.09	25154	4448	0.94
4	17.07	2627701	467159	98.38
5	18.07	2755	520	0.10
6	29.46	1191	187	0.04
7	33.74	11380	925	0.43

Compound Name	: 2,3,7,8-Tetrachlorodibenzo-p-dioxin
Lot Number	: 33383-89
Instrument	: HP 5971 MS/HP 5890 II GC
Operator-Inst ID	: CJJ - A147434
Date Reported	: Wed Jan 05 09:24:50 2000
Column Type	: DB-5ms, 30m x 0.25mm ID, 0.25um film thickness
Temp. Program	: 50°C to 200°C @ 40°C/min, 200°C to 310°C @ 10°C/min
Injector Temp.	: Cool on-column
Carrier Gas	: Helium
Flow Rate (mL\min)	: 0.80 mL/min
Transfer Line Temp.	: 280°C
Scan Range	: 35-550

Total Ion Chromatogram



Mass Spectrum



Technical Data Sheet

Product: 1,2,4,5,7,8-Hexachloroxanthene, Unlabeled

Catalog Number: ULM-6074
Lot Number: BP-299
Chemical Purity: 98%
Storage Conditions: Store refrigerated, protect from light.
Intended Use: For laboratory use only.
Date Prepared: June, 2001

High Resolution GC/MS analysis of this lot of material has shown that the cumulative TEQ from all seventeen 2,3,7,8-substituted TCDD's was found to be not greater than 3.14ppm.* Fifteen of the isomers were not observed at the detection limits of the method. Please see attached table.

This analysis was contracted to an outside testing laboratory. All inquiries should be directed to Cambridge Isotope Labs.

* Using the ND = DL/2 calculation.

manufacturer: Cambridge Isotopes Laboratory

Sample ID: 8290 — Method 1613

Client Data		Sample Data		Laboratory Data			
Name:	CIL	Matrix:	Chemical	Project No.:	P1480	Date Received:	1 Jun 01
Project ID:	Q-3520	Weight/Volume:	1.00 ug	Sample ID:	P1480_377_002	Date Extracted:	n/a
Date Collected:	n/a			QC Batch No.:	377	Date Analyzed:	3 Jun 01

Analyte	Conc. ug/g	DL ug/g	EMPC ug/g	Qualifier
2,3,7,8-TCDD	ND	0.489		
1,2,3,7,8-PeCDD	ND	0.389		
1,2,3,4,7,8-HxCDD	ND	1.14		
1,2,3,6,7,8-HxCDD	ND	1.24		
1,2,3,7,8,9-HxCDD	EMPC		21	A
1,2,3,4,6,7,8-HpCDD	ND	0.916		
OCDD	ND	0.819		
2,3,7,8-TCDF	ND	1.05		
1,2,3,7,8-PeCDF	ND	1.55		
2,3,4,7,8-PeCDF	ND	1.43		
1,2,3,4,7,8-HxCDF	ND	0.56		
1,2,3,6,7,8-HxCDF	ND	0.539		
2,3,4,6,7,8-HxCDF	ND	0.464		
1,2,3,7,8,9-HxCDF	ND	0.822		
1,2,3,4,6,7,8-HpCDF	ND	0.251		
1,2,3,4,7,8,9-HpCDF	ND	0.371		
OCDF	2.35			A
TEQ (ND=0)	0.00235		2.10	ITEF
TEQ (ND=DL/2)	1.04		3.14	ITEF

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North Carolina 28405
USA

Tel: 910 794-1613
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e-mail: ytondeur@cs.com
web: www.ultratrace.com

Reviewer CL
Date 6 Jun 03

Appendix B - Stock Solution Analysis

6/20/01 ANALYSIS OF STOCK SOLUTIONS-HCX

48514-56-10 Solution 1 (w/ HCX)

	Area 1	Area 2	Sum of Areas
HCX Native areas =	1.0906154.E+07	8.61429100.E+06	1.95204450E+07
HCX IS ares =	4.4149428.E+07	8.3718312 E+07	1.27867740E+08
HCX IS Conc (total pg) =	2000	HCX* Nat*IS conc =	3.9040890000E+10
HCX Rf =	0.1533	HCX IS Area* Rf =	1.960212454E+07
HCX Conc (total pg) =	1991.67	HCX Spike Conc =	1201.8
		% Recovery =	**165.7**

48514-56-20 Solution 2 (w/ HCX)

	Area 1	Area 2	Sum of Areas
HCX Native areas =	9.7782350.E+06	7.9707975.E+06	1.77490325E+07
HCX IS ares =	7.6492104.E+07	1.43021620.E+08	2.19513724E+08
HCX IS Conc (total pg) =	2000	HCX* Nat*IS conc =	3.5498065000E+10
HCX Rf =	0.1533	HCX IS Area* Rf =	3.365145389E+07
HCX Conc (total pg) =	1054.87	HCX Spike Conc =	701.2
		% Recovery =	**150.4**

6/20/01 ANALYSIS OF STOCK SOLUTIONS-TCDD

48514-56-10 Solution 1 (w/ HCX)

	Area 1	Area 2	Sum of Areas
TCDD Native areas =	5.2866120E+06	6.9092315E+06	1.21958435E+07
TCDD IS ares =	5.2594980E+07	6.5708796E+07	1.18303776E+08
TCDD IS Conc (total pg) =	2000	TDCC Nat*IS conc =	2.4391687000E+10
TCDD Rf =	0.9259	TDCC IS Area* Rf =	1.095374662E+08
TCDD Conc (total pg) =	222.68	TCDD Spike Conc =	240.35
		% Recovery =	**92.6**

48514-56-20 Solution 2 (w/ HCX)

	Area 1	Area 2	Sum of Areas
TCDD Native areas =	3.8377645E+06	4.9686785E+06	8.806443E+06
TCDD IS ares =	5.1544212E+07	6.1997900E+07	1.13542112E+08
TCDD IS Conc (total pg) =	2000	TDCC Nat*IS conc =	1.7612886000E+10
TCDD Rf =	0.9259	TDCC IS Area* Rf =	1.051286415E+08
TCDD Conc (total pg) =	167.54	TCDD Spike Conc =	140.25
		% Recovery =	**119.5**

48514-57-10 Solution 1 (w/o HCX)

	Area 1	Area 2	Sum of Areas
TCDD Native areas =	6.5007590E+06	8.7265860E+06	1.52273345E+07
TCDD IS ares =	7.1216624E+07	8.8649800E+07	1.59866424E+08
TCDD IS Conc (total pg) =	2000	TDCC Nat*IS conc =	3.0454690000E+10
TCDD Rf =	0.9259	TDCC IS Area* Rf =	1.48020322E+08
TCDD Conc (total pg) =	205.75	TCDD Spike Conc =	240.35
		% Recovery =	**85.6**

48514-57-20 Solution 2 (w/o HCX)

	Area 1	Area 2	Sum of Areas
TCDD Native areas =	3.7097000E+06	4.7322610E+06	8.441961E+06
TCDD IS ares =	6.2036040E+07	7.6533944E+07	1.38569984E+08
TCDD IS Conc (total pg) =	2000	TDCC Nat*IS conc =	1.6883922000E+10
TCDD Rf =	0.9259	TDCC IS Area* Rf =	1.283019482E+08
TCDD Conc (total pg) =	131.60	TCDD Spike Conc =	140.25
		% Recovery =	**93.8**

3/15/02 REANALYSIS OF STOCK SOLUTIONS-HCX AND TCDD

Lab Sample ID	49063-25-02			
Sample Data Filename				
Ext. Date				
Analysis Date		3/15/02		
Sample W/Vol		0	units	g wet

Concentration Units: total pg

ANALYTE	CONC. FOUND	Native Area 1	Native Area 2	NATIVE RATIO	Sum of Native Areas	Labeled IS Area 1	Labeled IS Area 2	Sum of Labeled IS Areas	IS CONC (pg)	HCX Curve 1 RRF VALUE	HCX Curve 2 RRF VALUE
HCX	1931.525	8.129.E+06	6.817.E+06	1.19	1.49E+07	1.716.E+07	3.331.E+07	5.048.E+07	1000	0.1533	
HCX	6340.532	8.129.E+06	6.817.E+06	1.19	1.49E+07	1.716.E+07	3.331.E+07	5.048.E+07	1000		0.0467

HCX Curve 1 ranges from 10 ng/mL to 200 ng/mL
HCX Curve 2 ranges from 1000 ng/mL to 4000 ng/mL

49063-25-02 Check Solution 1 (w/ HCX)

	Area 1	Area 2	Sum of Areas
HCX Native areas =	8.129339.E+06	6.817434.E+06	1.4946773E+07
HCX IS ares =	1.7164730.E+07	3.3313586.E+07	5.0478316E+07
HCX IS Conc (total pg) =	1000	HCX* Nat*IS conc =	1.4946773000E+10
HCX Rf =	0.1533	HCX IS Area* Rf =	7.738325843E+06
HCX Conc (total pg) =	1931.53	HCX Spike Conc =	1201.8
		% Recovery =	160.7

49063-25-02 Check Solution 1 (w/ HCX)

	Area 1	Area 2	Sum of Areas
TCDD Native areas =	6.5372685E+06	8.4229030E+06	1.49601715E+07
TCDD IS ares =	2.4604668E+07	3.1261152E+07	5.58658200E+07
TCDD IS Conc (total pg) =	1000	TDCC Nat*IS conc =	1.49601715000E+10
TCDD Rf =	1.0052	TDCC IS Area* Rf =	5.615632226E+07
TCDD Conc (total pg) =	266.40	TCDD Spike Conc =	240.35
		% Recovery =	110.8

49063-25-02 Check Solution 1 (w/o HCX)

	Area 1	Area 2	Sum of Areas
HCX Native areas =	0.000000.E+00	0.000000 E+00	0.0000000E+00
HCX IS ares =	1.7164730 E+07	3.3313586.E+07	5.0478316E+07
HCX IS Conc (total pg) =	1000	HCX* Nat*IS conc =	0.0000000000E+00
HCX Rf =	0.1533	HCX IS Area* Rf =	7.738325843E+06
HCX Conc (total pg) =	0.00	HCX Spike Conc =	0
		% Recovery =	0.0

49063-25-02 Check Solution 1 (w/o HCX)

	Area 1	Area 2	Sum of Areas
TCDD Native areas =	6.4771825E+06	8.3214025E+06	1.47985850E+07
TCDD IS ares =	2.7982428E+07	3.5295312E+07	6.32777400E+07
TCDD IS Conc (total pg) =	1000	TDCC Nat*IS conc =	1.4798585000E+10
TCDD Rf =	1.0052	TDCC IS Area* Rf =	6.360678425E+07
TCDD Conc (total pg) =	232.66	TCDD Spike Conc =	240.35
		% Recovery =	96.8

Appendix C - Toxicity Testing Randomization Assignments

Project Name: EPA/USACE Centredale Manor Fish ELS Bioassay **RANDOMIZATIONS**
Project Number: 42828 **Chemistry Only**
Test type: Static Exposure
Duration: 24-hour *Position No. 200 - 316*
Species: ***Ictalurus punctatus***

Sorted by Position Number				Chemistry Composite	*Sorted by Nominal Concentration of 2,3,7,8-TCDD in Exposure Water*				Chemistry Composite
Pos	Treat	Conc (ng/mL)	Rep	Code	Pos	Treat	Conc (ng/mL)	Rep	Code
200	Conc 7	0.002	6	A	225	Conc 3	0	4	A
201	**Conc 2**	**0.018**	**6**	A	224	Conc 3	0	5	A
202	Conc 9	0.012	4	A	285	Conc 3	0	6	A
203	Conc 10	0.003	7	B	286	Conc 3	0	7	B
204	Conc 9	0.012	10	C	310	Conc 3	0	8	B
205	**Conc 1**	**0.008**	**5**	A	245	Conc 3	0	9	B
206	**Conc 2**	**0.018**	**4**	A	314	Conc 3	0	10	C
207	**Conc 2**	**0.018**	**9**	B	254	Conc 3	0	11	C
208	Conc 9	0.012	8	B	268	Conc 3	0	12	C
209	**Conc 2**	**0.018**	**7**	B	301	Conc 7	0.002	4	A
210	**Conc 5**	**0.005**	**9**	B	223	Conc 7	0.002	5	A
211	**Conc 5**	**0.005**	**6**	A	200	Conc 7	0.002	6	A
212	Conc 10	0.003	11	C	248	Conc 7	0.002	7	B
213	**Conc 4**	**0.002**	**12**	C	277	Conc 7	0.002	8	B
214	Conc 7	0.002	9	B	214	Conc 7	0.002	9	B
215	Conc 6	0.008	9	B	296	Conc 7	0.002	10	C
216	Conc 14	0.005	9	B	236	Conc 7	0.002	11	C
217	**Conc 1**	**0.008**	**6**	A	265	Conc 7	0.002	12	C
218	**Conc 4**	**0.002**	**11**	C	250	Conc 10	0.003	4	A
219	Conc 6	0.008	4	A	295	Conc 10	0.003	5	A
220	Conc 6	0.008	11	C	255	Conc 10	0.003	6	A
221	**Conc 2**	**0.018**	**10**	C	203	Conc 10	0.003	7	B
222	**Conc 2**	**0.018**	**5**	A	267	Conc 10	0.003	8	B
223	Conc 7	0.002	5	A	238	Conc 10	0.003	9	B
224	Conc 3	0	5	A	232	Conc 10	0.003	10	C
225	Conc 3	0	4	A	212	Conc 10	0.003	11	C
226	**Conc 1**	**0.008**	**12**	C	280	Conc 10	0.003	12	C
227	Conc 14	0.005	10	C	228	Conc 14	0.005	4	A
228	Conc 14	0.005	4	A	260	Conc 14	0.005	5	A
229	**Conc 1**	**0.008**	**9**	B	309	Conc 14	0.005	6	A
230	**Conc 11**	**0.012**	**5**	A	294	Conc 14	0.005	7	B
231	Conc 12	0.018	11	C	253	Conc 14	0.005	8	B
232	Conc 10	0.003	10	C	216	Conc 14	0.005	9	B
233	**Conc 11**	**0.012**	**10**	C	227	Conc 14	0.005	10	C
234	**Conc 11**	**0.012**	**12**	C	308	Conc 14	0.005	11	C
235	**Conc 5**	**0.005**	**7**	B	297	Conc 14	0.005	12	C
236	Conc 7	0.002	11	C	219	Conc 6	0.008	4	A
237	**Conc 1**	**0.008**	**7**	B	315	Conc 6	0.008	5	A
238	Conc 10	0.003	9	B	246	Conc 6	0.008	6	A

Project Name: EPA/USACE Centredale Manor Fish ELS Bioassay **RANDOMIZATIONS**
Project Number: 42828 **Chemistry Only**
Test type: Static Exposure
Duration: 24-hour *Position No. 200 - 316*
Species: ***Ictalurus punctatus***

Sorted by Position Number				Chemistry Composite	*Sorted by Nominal Concentration of 2,3,7,8-TCDD in Exposure Water*				Chemistry Composite
Pos	Treat	Conc (ng/mL)	Rep	Code	Pos	Treat	Conc (ng/mL)	Rep	Code
239	**Conc 5**	**0.005**	**10**	C	247	Conc 6	0.008	7	B
240	**Conc 5**	**0.005**	**12**	C	243	Conc 6	0.008	8	B
241	**Conc 1**	**0.008**	**10**	C	215	Conc 6	0.008	9	B
242	Conc 9	0.012	6	A	283	Conc 6	0.008	10	C
243	Conc 6	0.008	8	B	220	Conc 6	0.008	11	C
244	**Conc 1**	**0.008**	**4**	A	251	Conc 6	0.008	12	C
245	Conc 3	0	9	B	202	Conc 9	0.012	4	A
246	Conc 6	0.008	6	A	270	Conc 9	0.012	5	A
247	Conc 6	0.008	7	B	242	Conc 9	0.012	6	A
248	Conc 7	0.002	7	B	292	Conc 9	0.012	7	B
249	**Conc 4**	**0.002**	**4**	A	208	Conc 9	0.012	8	B
250	Conc 10	0.003	4	A	264	Conc 9	0.012	9	B
251	Conc 6	0.008	12	C	204	Conc 9	0.012	10	C
252	Conc 12	0.018	8	B	282	Conc 9	0.012	11	C
253	Conc 14	0.005	8	B	303	Conc 9	0.012	12	C
254	Conc 3	0	11	C	305	Conc 12	0.018	4	A
255	Conc 10	0.003	6	A	289	Conc 12	0.018	5	A
256	**Conc 4**	**0.002**	**6**	A	287	Conc 12	0.018	6	A
257	Conc 12	0.018	9	B	313	Conc 12	0.018	7	B
258	**Conc 8**	**0.003**	**5**	A	252	Conc 12	0.018	8	B
259	**Conc 4**	**0.002**	**7**	B	257	Conc 12	0.018	9	B
260	Conc 14	0.005	5	A	298	Conc 12	0.018	10	C
261	**Conc 8**	**0.003**	**11**	C	231	Conc 12	0.018	11	C
262	**Conc 1**	**0.008**	**11**	C	274	Conc 12	0.018	12	C
263	**Conc 4**	**0.002**	**5**	A	249	**Conc 4**	**0.002**	**4**	A
264	Conc 9	0.012	9	B	263	**Conc 4**	**0.002**	**5**	A
265	Conc 7	0.002	12	C	256	**Conc 4**	**0.002**	**6**	A
266	**Conc 4**	**0.002**	**10**	C	259	**Conc 4**	**0.002**	**7**	B
267	Conc 10	0.003	8	B	271	**Conc 4**	**0.002**	**8**	B
268	Conc 3	0	12	C	275	**Conc 4**	**0.002**	**9**	B
269	**Conc 8**	**0.003**	**10**	C	266	**Conc 4**	**0.002**	**10**	C
270	Conc 9	0.012	5	A	218	**Conc 4**	**0.002**	**11**	C
271	**Conc 4**	**0.002**	**8**	B	213	**Conc 4**	**0.002**	**12**	C
272	**Conc 8**	**0.003**	**8**	B	306	**Conc 8**	**0.003**	**4**	A
273	**Conc 11**	**0.012**	**9**	B	258	**Conc 8**	**0.003**	**5**	A
274	Conc 12	0.018	12	C	291	**Conc 8**	**0.003**	**6**	A
275	**Conc 4**	**0.002**	**9**	B	299	**Conc 8**	**0.003**	**7**	B
276	**Conc 11**	**0.012**	**8**	B	272	**Conc 8**	**0.003**	**8**	B
277	Conc 7	0.002	8	B	311	**Conc 8**	**0.003**	**9**	B

Project Name: EPA/USACE Centredale Manor Fish ELS Bioassay **RANDOMIZATIONS**
Project Number: 42828 **Chemistry Only**
Test type: Static Exposure
Duration: 24-hour *Position No. 200 - 316*
Species: ***Ictalurus punctatus***

Sorted by Position Number

Pos	Treat	Conc (ng/mL)	Rep	Chemistry Composite Code
278	**Conc 8**	**0.003**	**12**	C
279	**Conc 11**	**0.012**	**4**	A
280	Conc 10	0.003	12	C
281	**Conc 5**	**0.005**	**11**	C
282	Conc 9	0.012	11	C
283	Conc 6	0.008	10	C
284	**Conc 11**	**0.012**	**6**	A
285	Conc 3	0	6	A
286	Conc 3	0	7	B
287	Conc 12	0.018	6	A
288	**Conc 5**	**0.005**	**8**	B
289	Conc 12	0.018	5	A
290	**Conc 5**	**0.005**	**5**	A
291	**Conc 8**	**0.003**	**6**	A
292	Conc 9	0.012	7	B
293	**Conc 2**	**0.018**	**8**	B
294	Conc 14	0.005	7	B
295	Conc 10	0.003	5	A
296	Conc 7	0.002	10	C
297	Conc 14	0.005	12	C
298	Conc 12	0.018	10	C
299	**Conc 8**	**0.003**	**7**	B
300	**Conc 11**	**0.012**	**7**	B
301	Conc 7	0.002	4	A
302	**Conc 11**	**0.012**	**11**	C
303	Conc 9	0.012	12	C
304	**Conc 1**	**0.008**	**8**	B
305	Conc 12	0.018	4	A
306	**Conc 8**	**0.003**	**4**	A
307	**Conc 2**	**0.018**	**11**	C
308	Conc 14	0.005	11	C
309	Conc 14	0.005	6	A
310	Conc 3	0	8	B
311	**Conc 8**	**0.003**	**9**	B
312	**Conc 2**	**0.018**	**12**	C
313	Conc 12	0.018	7	B
314	Conc 3	0	10	C
315	Conc 6	0.008	5	A
316	**Conc 5**	**0.005**	**4**	A

Sorted by Nominal Concentration of 2,3,7,8-TCDD in Exposure Water

Pos	Treat	Conc (ng/mL)	Rep	Chemistry Composite Code
269	**Conc 8**	**0.003**	**10**	C
261	**Conc 8**	**0.003**	**11**	C
278	**Conc 8**	**0.003**	**12**	C
316	**Conc 5**	**0.005**	**4**	A
290	**Conc 5**	**0.005**	**5**	A
211	**Conc 5**	**0.005**	**6**	A
235	**Conc 5**	**0.005**	**7**	B
288	**Conc 5**	**0.005**	**8**	B
210	**Conc 5**	**0.005**	**9**	B
239	**Conc 5**	**0.005**	**10**	C
281	**Conc 5**	**0.005**	**11**	C
240	**Conc 5**	**0.005**	**12**	C
244	**Conc 1**	**0.008**	**4**	A
205	**Conc 1**	**0.008**	**5**	A
217	**Conc 1**	**0.008**	**6**	A
237	**Conc 1**	**0.008**	**7**	B
304	**Conc 1**	**0.008**	**8**	B
229	**Conc 1**	**0.008**	**9**	B
241	**Conc 1**	**0.008**	**10**	C
262	**Conc 1**	**0.008**	**11**	C
226	**Conc 1**	**0.008**	**12**	C
279	**Conc 11**	**0.012**	**4**	A
230	**Conc 11**	**0.012**	**5**	A
284	**Conc 11**	**0.012**	**6**	A
300	**Conc 11**	**0.012**	**7**	B
276	**Conc 11**	**0.012**	**8**	B
273	**Conc 11**	**0.012**	**9**	B
233	**Conc 11**	**0.012**	**10**	C
302	**Conc 11**	**0.012**	**11**	C
234	**Conc 11**	**0.012**	**12**	C
206	**Conc 2**	**0.018**	**4**	A
222	**Conc 2**	**0.018**	**5**	A
201	**Conc 2**	**0.018**	**6**	A
209	**Conc 2**	**0.018**	**7**	B
293	**Conc 2**	**0.018**	**8**	B
207	**Conc 2**	**0.018**	**9**	B
221	**Conc 2**	**0.018**	**10**	C
307	**Conc 2**	**0.018**	**11**	C
312	**Conc 2**	**0.018**	**12**	C

Project Name: EPA/USACE Centredale Manor Fish ELS Bioassay **RANDOMIZATIONS**
Project Number: 42828 **Chemistry Only**
Test type: Static Exposure
Duration: 24-hour *Position No. 200 - 316*
Species: ***Ictalurus punctatus***

Sorted by Position Number				Chemistry Composite	*Sorted by Nominal Concentration of 2,3,7,8-TCDD in Exposure Water*				Chemistry Composite
Pos	Treat	Conc (ng/mL)	Rep	Code	Pos	Treat	Conc (ng/mL)	Rep	Code

BOLD INDICATES WITH HCX

Project Name: EPA/USACE Centredale Manor Fish ELS Bioassay
Test type: Continuous flow-through
Duration: 32-days
Species: ***Ictalurus punctatus***

RANDOMIZATIONS
32-Day Test
Position No. 100 - 159

Sorted by Position Number

Pos	Treat	Conc (ng/mL)	Rep
100	Conc 13	Solvent	2
101	Conc 12	0.018	1
102	Conc 10	0.003	3
103	WQ Dummy	0	3
104	**Conc 1**	**0.008**	**2**
105	Conc 3	0	5
106	WQ Dummy	0	5
107	Conc 7	0.002	2
108	**Conc 4**	**0.002**	**1**
109	Conc 14	0.005	3
110	Growth	0	8
111	Conc 7	0.002	1
112	WQ Dummy	0	2
113	Growth	0	6
114	Conc 13	Solvent	5
115	Conc 6	0.008	3
116	Conc 6	0.008	2
117	**Conc 2**	**0.018**	**1**
118	**Conc 11**	**0.012**	**3**
119	**Conc 1**	**0.008**	**3**
120	Conc 9	0.012	2
121	Conc 14	0.005	1
122	Conc 13	Solvent	1
123	**Conc 4**	**0.002**	**2**
124	Conc 3	0	2
125	**Conc 8**	**0.003**	**3**
126	Growth	0	3
127	Conc 9	0.012	3
128	**Conc 2**	**0.018**	**2**
129	**Conc 5**	**0.005**	**2**
130	**Conc 11**	**0.012**	**2**
131	Conc 6	0.008	1
132	Conc 9	0.012	1
133	Conc 3	0	1
134	**Conc 8**	**0.003**	**2**
135	Conc 10	0.003	2
136	Conc 3	0	4
137	Conc 12	0.018	3
138	Conc 12	0.018	2
139	**Conc 1**	**0.008**	**1**
140	**Conc 2**	**0.018**	**3**
141	WQ Dummy	0	1
142	Growth	0	1
143	Growth	0	9
144	**Conc 8**	**0.003**	**1**
145	Conc 10	0.003	1
146	WQ Dummy	0	4
147	**Conc 5**	**0.005**	**1**
148	Conc 3	0	3
149	**Conc 5**	**0.005**	**3**
150	Conc 7	0.002	3
151	Growth	0	7
152	**Conc 4**	**0.002**	**3**
153	**Conc 11**	**0.012**	**1**
154	Conc 14	0.005	2
155	Conc 13	Solvent	3
156	Conc 13	Solvent	4
157	Growth	0	2
158	Growth	0	5
159	Growth	0	4

NOTE: **BOLD INDICATES WITH HCX**

Sorted by Nominal Concentration of 2,3,7,8-TCDD in Exposure Water

Pos	Treat	Conc (ng/mL)	Rep
142	Growth	0	1
157	Growth	0	2
126	Growth	0	3
159	Growth	0	4
158	Growth	0	5
113	Growth	0	6
151	Growth	0	7
110	Growth	0	8
143	Growth	0	9
141	WQ Dummy	0	1
112	WQ Dummy	0	2
103	WQ Dummy	0	3
146	WQ Dummy	0	4
106	WQ Dummy	0	5
133	Conc 3	0	1
124	Conc 3	0	2
148	Conc 3	0	3
136	Conc 3	0	4
105	Conc 3	0	5
122	Conc 13	Solvent	1
100	Conc 13	Solvent	2
155	Conc 13	Solvent	3
156	Conc 13	Solvent	4
114	Conc 13	Solvent	5
111	Conc 7	0.002	1
107	Conc 7	0.002	2
150	Conc 7	0.002	3
145	Conc 10	0.003	1
135	Conc 10	0.003	2
102	Conc 10	0.003	3
121	Conc 14	0.005	1
154	Conc 14	0.005	2
109	Conc 14	0.005	3
131	Conc 6	0.008	1
116	Conc 6	0.008	2
115	Conc 6	0.008	3
132	Conc 9	0.012	1
120	Conc 9	0.012	2
127	Conc 9	0.012	3
101	Conc 12	0.018	1
138	Conc 12	0.018	2
137	Conc 12	0.018	3
108	**Conc 4**	**0.002**	**1**
123	**Conc 4**	**0.002**	**2**
152	**Conc 4**	**0.002**	**3**
144	**Conc 8**	**0.003**	**1**
134	**Conc 8**	**0.003**	**2**
125	**Conc 8**	**0.003**	**3**
147	**Conc 5**	**0.005**	**1**
129	**Conc 5**	**0.005**	**2**
149	**Conc 5**	**0.005**	**3**
139	**Conc 1**	**0.008**	**1**
104	**Conc 1**	**0.008**	**2**
119	**Conc 1**	**0.008**	**3**
153	**Conc 11**	**0.012**	**1**
130	**Conc 11**	**0.012**	**2**
118	**Conc 11**	**0.012**	**3**
117	**Conc 2**	**0.018**	**1**
128	**Conc 2**	**0.018**	**2**
140	**Conc 2**	**0.018**	**3**

Appendix D - Chain of Custodies

Battelle
Columbus Division
505 King Avenue
Columbus, Ohio 43201-2693
(614) 424-4247

PCDD/PCDF/PCB CHAIN OF CUSTODY RECORD

№ 000529

Client: BATTELLE MARINE Sci Lab.

Project Description: ESL STANDARDS

Storage: in Freezer -10°C

Client ID Number	Date Sampled	Time Sampled	Location	No. Containers	Remarks/Condition Upon Receipt
N/A	N/A	N/A	Solution 1 (TCDD 24ng/ml, PCB 77 PCB 126)	3 vials	total ~ 90 ml
			Solution 2 (TCDD 14ng/ml, PCB 77 PCB 126)	4 vials	total Volume ~ 150 ml
			Solution 1 (TCDD 24ng/ml, PCB 77 PCB 126(1), HCX 120ng/ml)	3 vials	Total ~ 90 ml
			Solution 2 (TCDD 14ng/ml, PCB 77 PCB 126, HCX 70ng/ml)	4 vials	Total Volume ~ 150 ml
					Received at -1.2°C 6.22.01 1520

Relinquished by (Signature)	Date	Time	Received by (Signature)	Date	Time	Relinquished by (Signature)	Date	Time
Henry Pham	06-21-01	1PM	[illegible]	6-22-01	1515			
(Printed) HENRY H. PHAM			(Printed) H.L. DIEFENDERFER			(Printed)		

Received for Laboratory by (Signature)	Date	Time	Samples Disposed of by:	Date	Analyses Requested:
(Printed)			Method of Disposal:		

White-With Samples, Yellow-Laboratory, Pink-Field

(1) WN HP 06-21-01

D-1

CHAIN OF CUSTODY RECORD

(1) Date 6/25/01 (2) Page 1 of 1

Pacific Northwest Division
Marine Sciences Laboratory
1529 West Sequim Bay Road
Sequim, Washington 98382

(3) Contact: H. DIEFENDERFER (42328
Project Name: Centralia Mann
Project Manager: H. DIEFENDERFER Phone 6813619

(10) Lab: OCI
Address: 1170 NICHOLS RD
Attention: OCEAN BEACH, MO 65065

Lab No.	(5) Sample No.	(6) Collection Date	(7) Matrix	(8) Testing Parameters						No. of Containers	Observations, Instructions
	catfish eggs	6/25/01	EGGS							(9) 1	(11) Temper eggs
	- shipping container in acceptable condition HR 6/26/01										

Relinquished by: Steve Kahrs 6/25/01 2:00pm
Signature / Date / Time
STEVE KAHRS
Printed Name
OCI
Company

Received by: Heather Robinson 6/26/01 959
Signature / Date / Time
Heather Robinson
Printed Name
Battelle
Company

(12) 1 Total No. of Containers
(14) FED-EX
Shipment Method:
Special Requirements or Comments:
(15)

Relinquished by:
Signature / Date / Time
Printed Name
Company

Received by:
Signature / Date / Time
Printed Name
Company

DISTRIBUTION:
1. Provide white and yellow copies to the Laboratory
2. Return pink copy to Project file or to project manager.
3. Laboratory to return signed white copy to Battelle for project files

BC-1800-192 (07/94)

06/22/01 FRI 13:45 FAX

Appendix E - Fixed Fish Inventory

CENTERDALE MANOR CATFISH EARLY LIFE-STAGE STUDY (7/13/01 to 8/14/01)

FIXED FISH* INVENTORY FOR HISTOPATHOLOGY

Position	Date	Test Day	Mortality (Y/N)	Treatment (ng/mL TCDD) **
157	07/21/01	8	?	0
159	07/21/01	8	?	0
Stock Fry	07/21/01	8	?	0
Holding	07/21/01	8	?	?
103	07/22/01	9	Y	0
151	07/22/01	9	Y	0
157	07/22/01	9	Y	0
Holding	07/22/01	9	?	0
112	07/23/01	10	N	0
151	07/23/01	10	Y	0
112	07/24/01	11	N	0
136	07/24/01	11	Y	0
157	07/24/01	11	Y	0
146	07/26/01	13	N	0
148	07/26/01	13	Y	0
106	07/27/01	14	Y	0
133	07/28/01	15	Y	0
136	07/28/01	15	Y	0
143	07/28/01	15	Y	0
158	07/28/01	15	Y	0
105	07/29/01	16	Y	0
113	07/29/01	16	N	0
124	07/29/01	16	Y	0
136	07/29/01	16	Y	0
146	07/29/01	16	Y	0
155	07/29/01	16	Y	0
105	07/30/01	17	Y	0
105	07/30/01	17	?	0
113	07/30/01	17	Y	0
157	07/30/01	17	Y	0
106	08/01/01	19	Y	0
103	08/02/01	20	Y	0
159	08/02/01	20	Y	0
Growth	08/02/01	20	?	0
124	08/04/01	22	Y	0
114	08/06/01	24	Y	0
143	08/07/01	25	N	0
133	08/08/01	26	Y	0
155	08/11/01	29	Y	0
122	08/12/01	30	Y	0
122	08/13/01	31	Y	0
105	08/14/01	32	N	0

CENTERDALE MANOR CATFISH EARLY LIFE-STAGE STUDY (7/13/01 to 8/14/01)

FIXED FISH* INVENTORY FOR HISTOPATHOLOGY

Position	Date	Test Day	Mortality (Y/N)	Treatment (ng/mL TCDD) **
114	08/14/01	32	N	0
124	08/14/01	32	N	0
155	08/14/01	32	N	0
158	08/14/01	32	N	0
152	07/24/01	11	Y	0.002
152	07/27/01	14	Y	0.002
108	07/28/01	15	Y	0.002
152	07/28/01	15	Y	0.002
108	07/29/01	16	?	0.002
111	07/29/01	16	Y	0.002
123	08/08/01	26	Y	0.002
107	08/14/01	32	N	0.002
111	08/14/01	32	N	0.002
123	08/14/01	32	N	0.002
123	08/14/01	32	N	0.002
150	08/14/01	32	N	0.002
145	07/24/01	11	?	0.003
134	07/28/01	15	Y	0.003
135	07/28/01	15	Y	0.003
144	07/28/01	15	Y	0.003
135	07/31/01	18	?	0.003
145	08/03/01	21	Y	0.003
134	08/05/01	23	Y	0.003
102	08/06/01	24	Y	0.003
102	08/07/01	25	Y	0.003
102	08/11/01	29	Y	0.003
125	08/14/01	32	N	0.003
134	08/14/01	32	N	0.003
135	08/14/01	32	Y	0.003
135	08/14/01	32	N	0.003
144	08/14/01	32	N	0.003
145	08/14/01	32	N	0.003
109	07/23/01	10	Y	0.005
129	07/29/01	16	Y	0.005
147	08/09/01	27	Y	0.005
109	08/14/01	32	N	0.005
121	08/14/01	32	N	0.005
147	08/14/01	32	N	0.005
149	08/14/01	32	N	0.005
154	08/14/01	32	N	0.005
139	07/23/01	10	Y	0.008
119	07/27/01	14	Y	0.008

CENTERDALE MANOR CATFISH EARLY LIFE-STAGE STUDY (7/13/01 to 8/14/01)

FIXED FISH* INVENTORY FOR HISTOPATHOLOGY

Position	Date	Test Day	Mortality (Y/N)	Treatment (ng/mL TCDD) **
119	07/28/01	15	Y	0.008
104	07/29/01	16	Y	0.008
131	08/02/01	20	Y	0.008
131	08/04/01	22	Y	0.008
104	08/05/01	23	Y	0.008
131	08/05/01	23	Y	0.008
139	08/05/01	23	Y	0.008
104	08/06/01	24	Y	0.008
104	08/06/01	24	Y	0.008
116	08/06/01	24	Y	0.008
131	08/06/01	24	Y	0.008
104	08/07/01	25	Y	0.008
131	08/07/01	25	Y	0.008
139	08/07/01	25	Y	0.008
104	08/08/01	26	Y	0.008
139	08/08/01	26	Y	0.008
104	08/09/01	27	Y	0.008
131	08/09/01	27	Y	0.008
139	08/09/01	27	Y	0.008
104	08/12/01	30	Y	0.008
139	08/13/01	31	Y	0.008
104	08/14/01	32	N	0.008
116	08/14/01	32	N	0.008
131	08/14/01	32	N	0.008
153	07/21/01	8	?	0.012
120	07/22/01	9	Y	0.012
120	07/22/01	9	Y	0.012
127	07/22/01	9	Y	0.012
130	07/22/01	9	Y	0.012
118	07/23/01	10	Y	0.012
120	07/23/01	10	Y	0.012
120	07/23/01	10	Y	0.012
130	07/23/01	10	Y	0.012
132	07/23/01	10	Y	0.012
153	07/23/01	10	Y	0.012
132	07/24/01	11	Y	0.012
127	07/30/01	17	Y	0.012
132	07/31/01	18	?	0.012
118	08/03/01	21	Y	0.012
130	08/03/01	21	Y	0.012
127	08/04/01	22	Y	0.012
132	08/04/01	22	Y	0.012

CENTERDALE MANOR CATFISH EARLY LIFE-STAGE STUDY (7/13/01 to 8/14/01)

FIXED FISH* INVENTORY FOR HISTOPATHOLOGY

Position	Date	Test Day	Mortality (Y/N)	Treatment (ng/mL TCDD) **
130	08/05/01	23	Y	0.012
132	08/05/01	23	Y	0.012
120	08/06/01	24	Y	0.012
127	08/11/01	29	Y	0.012
120	08/14/01	32	N	0.012
130	08/14/01	32	N	0.012
101	07/21/01	8	?	0.018
137	07/21/01	8	Y	0.018
138	07/21/01	8	Y	0.018
138	07/21/01	8	?	0.018
140	07/21/01	8	?	0.018
128	07/22/01	9	Y	0.018
137	07/22/01	9	Y	0.018
137	07/22/01	9	Y	0.018
101	07/23/01	10	Y	0.018
137	07/23/01	10	Y	0.018
140	07/23/01	10	Y	0.018
140	07/24/01	11	Y	0.018
101	07/25/01	12	?	0.018
128	07/30/01	17	Y	0.018
101	08/03/01	21	Y	0.018
101	08/14/01	32	N	0.018
128	08/14/01	32	N	0.018
128	08/14/01	32	N	0.018

* Fixed in Davidson's Fish Fix.

** Treatments with a concentration of "0" include controls, solvent controls, water quality measurement containers, and growth measurement containers. Not all are identified in the "Position" column. Where a position number is used, the type of jar can be identified on the randomization sheets.

Appendix F - Water Quality Summary Tables

Centerdale Manor Catfish ELS 32-Day Test Water Quality Summary

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Salinity ppt	DO Conc mg/L	pH	Sample position
	Target Range:	24 to 28	none	-0.5 to 0.5	> 5.0	6.0 to 9.0	na
Minimum Measurement:		24.53	0.329	0.13	4.65	7.87	100
aximum Measurement:		27.25	424.5	0.2	7.42	8.57	159
7/13/01	9:07:56	24.53	348	0.17	7.35	8.45	100
7/13/01	9:09:01	24.58	348.2	0.17	7.29	8.47	101
7/13/01	9:10:15	24.63	349.5	0.17	7.28	8.52	102
7/13/01	9:10:58	24.62	347.6	0.17	7.42	8.57	103
7/13/01	9:12:11	24.64	349	0.17	7.34	8.53	104
7/13/01	9:13:07	24.68	348.8	0.17	7.41	8.49	105
7/13/01	9:14:58	24.7	348.7	0.17	7.28	8.51	106
7/13/01	9:16:13	24.74	352.1	0.17	7.35	8.51	107
7/13/01	9:17:23	24.77	348.6	0.17	7.36	8.55	108
7/13/01	9:18:22	24.78	380.5	0.18	7.39	8.56	109
7/13/01	9:19:56	24.77	349.6	0.17	7.32	8.49	110
7/13/01	9:20:46	24.78	348	0.17	7.31	8.55	111
7/13/01	9:22:23	24.8	347.8	0.17	7.38	8.54	112
7/13/01	9:23:20	24.79	355.2	0.17	7.36	8.54	113
7/13/01	9:24:24	24.82	348	0.17	7.35	8.52	114
7/13/01	9:25:09	24.77	353.2	0.17	7.26	8.44	115
7/13/01	9:26:06	24.79	349.2	0.17	7.25	8.47	116
7/13/01	9:27:00	24.78	348.3	0.17	7.31	8.48	117
7/13/01	9:27:52	24.8	348.3	0.17	7.34	8.48	118
7/13/01	9:28:29	24.72	348.9	0.17	7.35	8.48	119
7/13/01	9:29:13	24.81	346.8	0.16	7.34	8.48	120
7/13/01	9:30:42	24.69	345.1	0.16	7.18	8.5	121
7/13/01	9:32:47	24.78	347.7	0.17	7.38	8.51	122
7/13/01	9:35:26	24.66	424.5	0.2	7.42	8.48	123
7/13/01	9:37:29	24.83	346.4	0.16	7.34	8.52	124
7/13/01	9:37:57	24.7	346.4	0.16	7.41	8.52	125
7/13/01	9:39:11	24.88	347.3	0.17	7.38	8.52	126
7/13/01	9:39:53	24.72	346	0.16	7.4	8.53	127
7/13/01	9:42:11	24.91	345.7	0.16	7.37	8.52	128
7/13/01	9:43:13	24.75	346.7	0.16	7.27	8.52	129
7/13/01	9:44:11	24.95	347.9	0.17	7.26	8.44	130
7/13/01	9:45:06	24.84	343.8	0.16	7.41	8.5	131
7/13/01	9:46:01	25.06	341.3	0.16	7.36	8.53	132
7/13/01	9:46:38	24.93	345.8	0.16	7.37	8.51	133
7/13/01	9:48:32	25.02	345	0.16	7.3	8.41	134
7/13/01	9:50:14	24.97	346.3	0.16	7.35	8.5	135
7/13/01	9:52:25	25.1	346.8	0.16	7.41	8.45	136
7/13/01	9:52:51	25.03	346.3	0.16	7.36	8.52	137
7/13/01	9:53:50	25.22	346	0.16	7.32	8.51	138
7/13/01	9:54:23	25.06	346.9	0.16	7.29	8.5	139
7/13/01	9:55:35	25.2	345.1	0.16	7.17	8.54	140
7/13/01	9:56:17	25.09	345.2	0.16	7.31	8.51	141
7/13/01	9:58:23	25.17	346.2	0.16	7.36	8.51	142

Centerdale Manor Catfish ELS 32-Day Test Water Quality Summary

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Salinity ppt	DO Conc mg/L	pH	Sample position
	Target Range:	24 to 28	none	-0.5 to 0.5	> 5.0	6.0 to 9.0	na
Minimum Measurement:		24.53	0.329	0.13	4.65	7.87	100
aximum Measurement:		27.25	424.5	0.2	7.42	8.57	159
7/13/01	10:00:13	25.1	345.3	0.16	7.29	8.52	143
7/13/01	10:01:51	24.76	345.8	0.16	7.42	8.48	144
7/13/01	10:02:26	24.9	346.1	0.16	7.42	8.46	145
7/13/01	10:03:26	24.83	348.5	0.17	7.3	8.42	146
7/13/01	10:03:51	24.97	344.5	0.16	7.29	8.48	147
7/13/01	10:04:38	24.92	345.9	0.16	7.3	8.49	148
7/13/01	10:06:06	25	347.8	0.17	7.3	8.41	149
7/13/01	10:07:19	24.96	346.1	0.16	7.23	8.44	150
7/13/01	10:07:49	25.08	345.7	0.16	7.28	8.51	151
7/13/01	10:08:42	25	348.2	0.17	7.3	8.37	152
7/13/01	10:09:44	25.09	347.9	0.17	7.33	8.44	153
7/13/01	10:10:39	25.07	346.5	0.16	7.35	8.46	154
7/13/01	10:11:21	25.1	351	0.17	7.22	8.42	155
7/13/01	10:12:07	25.06	348.7	0.17	7.27	8.35	156
7/13/01	10:12:52	25.14	347	0.16	7.24	8.43	157
7/13/01	10:13:51	25.14	345	0.16	7.38	8.49	158
7/13/01	10:14:21	25.19	345.6	0.16	7.27	8.5	159
7/14/01	10:05:23	26.69	350.9	0.17	6.36	8.08	100
7/14/01	10:07:37	26.96	350.8	0.17	6.13	8.1	101
7/14/01	10:09:01	27.03	350.8	0.17	6.24	8.1	102
7/14/01	10:10:20	26.96	350.7	0.17	6.36	8.1	103
7/14/01	10:11:33	27.06	350.8	0.17	6.26	8.09	104
7/14/01	10:12:40	26.98	351.1	0.17	6.25	8.09	105
7/14/01	10:13:50	26.87	349.4	0.17	6.73	8.18	106
7/14/01	10:15:00	26.88	350.5	0.17	6.39	8.11	107
7/14/01	10:15:50	27.04	351	0.17	6.16	8.08	108
7/14/01	10:16:41	27.05	350.6	0.17	6.22	8.08	109
7/14/01	10:17:39	27.07	350.9	0.17	6.31	8.08	110
7/14/01	10:18:45	26.61	350	0.17	6.6	8.16	111
7/14/01	10:19:28	27.07	350.9	0.17	6.39	8.08	112
7/14/01	10:20:20	27.13	350.7	0.17	6.19	8.08	113
7/14/01	10:21:28	27.07	350.7	0.17	6.29	8.08	114
7/14/01	10:22:11	26.93	350	0.17	6.56	8.12	115
7/14/01	10:22:57	27.09	350.5	0.17	6.5	8.09	116
7/14/01	10:23:42	27.09	351	0.17	6.3	8.09	117
7/14/01	10:25:11	26.97	350.3	0.17	6.27	8.07	118
7/14/01	10:26:22	26.94	350.6	0.17	6.21	8.07	119
7/14/01	10:27:11	26.92	350.4	0.17	6.43	8.08	120
7/14/01	10:28:03	26.85	350.7	0.17	6.44	8.09	121
7/14/01	10:28:52	26.94	350.7	0.17	6.27	8.05	122
7/14/01	10:29:59	26.93	350.7	0.17	6.29	8.06	123
7/14/01	10:30:47	26.87	350	0.17	6.51	8.06	124
7/14/01	10:31:29	26.89	350.1	0.17	6.5	8.08	125

Centerdale Manor Catfish ELS 32-Day Test Water Quality Summary

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Salinity ppt	DO Conc mg/L	pH	Sample position
	Target Range:	24 to 28	none	-0.5 to 0.5	> 5.0	6.0 to 9.0	na
Minimum Measurement:		24.53	0.329	0.13	4.65	7.87	100
aximum Measurement:		27.25	424.5	0.2	7.42	8.57	159
7/14/01	10:32:32	26.9	350.4	0.17	6.21	8.05	126
7/14/01	10:33:17	26.97	350.7	0.17	6.22	8.05	127
7/14/01	10:34:08	26.79	350	0.17	6.29	8.06	128
7/14/01	10:35:30	26.66	350.4	0.17	6.15	8.04	129
7/14/01	10:36:20	26.87	350.8	0.17	6.29	8.04	130
7/14/01	10:37:08	26.8	351.3	0.17	6.21	8.03	131
7/14/01	10:37:57	26.94	350.6	0.17	6.25	8.04	132
7/14/01	10:38:42	26.96	350.7	0.17	6.77	8.06	133
7/14/01	10:39:33	26.98	350.8	0.17	6.21	8.04	134
7/14/01	10:40:24	26.91	350.6	0.17	6.36	8.06	135
7/14/01	10:41:17	26.83	349.7	0.17	6.51	8.09	136
7/14/01	10:42:05	26.89	349.8	0.17	6.35	8.07	137
7/14/01	10:42:50	26.91	350.4	0.17	6.32	8.06	138
7/14/01	10:43:38	26.98	350.5	0.17	6.3	8.05	139
7/14/01	10:44:19	27.06	350.7	0.17	6.26	8.03	140
7/14/01	10:45:14	26.98	350.2	0.17	6.51	8.08	141
7/14/01	10:46:07	27.12	350.9	0.17	6.33	8.04	142
7/14/01	10:46:45	27.09	350.9	0.17	6.26	8.04	143
7/14/01	10:47:35	26.95	350.4	0.17	6.36	8.05	144
7/14/01	10:48:20	26.87	350.5	0.17	6.56	8.07	145
7/14/01	10:49:08	27.11	350.7	0.17	6.34	8.06	146
7/14/01	10:49:44	27.1	350.7	0.17	6.49	8.1	147
7/14/01	10:50:26	27.25	350.7	0.17	6.38	8.05	148
7/14/01	10:51:03	27.13	351	0.17	6.52	8.05	149
7/14/01	10:51:44	27.13	350.5	0.17	6.35	8.05	150
7/14/01	10:52:24	26.97	349.6	0.17	6.7	8.13	151
7/14/01	10:53:19	27.05	350.4	0.17	6.34	8.06	152
7/14/01	10:54:02	27.02	350.8	0.17	6.39	8.05	153
7/14/01	10:54:48	27	350.5	0.17	6.32	8.05	154
7/14/01	10:55:31	26.86	350.2	0.17	6.48	8.07	155
7/14/01	10:56:11	26.84	350.1	0.17	6.63	8.08	156
7/14/01	10:56:55	27.08	350.8	0.17	6.35	8.03	157
7/14/01	10:57:37	27.06	350.3	0.17	6.59	8.08	158
7/14/01	10:58:20	27.16	350.8	0.17	6.28	8.03	159
7/15/01	12:28:21	26.17	341.5	0.16	6.16	8.01	103
7/15/01	12:29:02	26.34	339.8	0.16	6.41	8.05	106
7/15/01	12:29:44	26.36	339.3	0.16	6.27	8.03	112
7/15/01	12:30:59	26.29	339.3	0.16	6.24	8.07	141
7/15/01	12:32:12	26.2	339.3	0.16	6.29	8.06	146
7/16/01	11:05:25	26.66	347.4	0.16	6.19	8	103
7/16/01	11:06:26	26.64	346.9	0.16	6.38	8.06	106
7/16/01	11:07:18	26.66	347.2	0.16	6.12	8.04	112
7/16/01	11:08:21	26.63	346.9	0.16	6.47	8.08	141

Centerdale Manor Catfish ELS 32-Day Test Water Quality Summary

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Salinity ppt	DO Conc mg/L	pH	Sample position
	Target Range:	24 to 28	none	-0.5 to 0.5	> 5.0	6.0 to 9.0	na
Minimum Measurement:		24.53	0.329	0.13	4.65	7.87	100
aximum Measurement:		27.25	424.5	0.2	7.42	8.57	159
7/16/01	11:09:20	26.66	347.1	0.16	6.38	8.06	146
7/17/01	11:01:04	26.7	350.9	0.17	6.81	8.01	103
7/17/01	11:03:54	26.63	350.3	0.17	6.82	8.03	112
7/17/01	11:06:18	26.61	350.1	0.17	7.11	8.06	106
7/17/01	11:08:40	26.66	350.1	0.17	7.14	8.07	141
7/17/01	11:10:45	26.71	350.2	0.17	7.09	8.05	146
7/18/01	10:09:04	26.53	356.1	0.17	5.84	7.99	103
7/18/01	10:10:57	26.57	355.6	0.17	6.1	8.03	106
7/18/01	10:12:35	26.65	356.1	0.17	5.82	8.02	112
7/18/01	10:14:09	26.71	355.6	0.17	6.11	8.04	141
7/18/01	10:15:13	26.49	355.7	0.17	6.16	8.04	146
7/19/01	14:09:03	26.72	361	0.17	6.01	8.01	103
7/19/01	14:10:30	26.63	359.7	0.17	6.21	8.04	106
7/19/01	14:11:46	26.75	360	0.17	5.98	8.01	112
7/19/01	14:13:10	26.72	359.8	0.17	6.18	8.05	141
7/19/01	14:14:30	26.85	359.9	0.17	6.2	8.04	146
7/20/01	9:46:42	26.55	362.1	0.17	6.17	8.05	103
7/20/01	9:48:08	26.52	362.1	0.17	5.99	8.04	106
7/20/01	9:50:51	26.44	362	0.17	5.94	8.05	112
7/20/01	9:54:30	26.5	361.8	0.17	6.1	8.05	141
7/20/01	9:56:51	26.68	362.1	0.17	6.05	8.04	146
7/21/01	12:07:18	26.65	354.9	0.17	5.9	8.08	103
7/21/01	12:09:46	26.68	354.6	0.17	5.94	8.09	112
7/21/01	12:11:02	26.56	354.2	0.17	6.08	8.11	106
7/21/01	12:12:31	26.67	354.1	0.17	5.81	8.11	141
7/21/01	12:13:51	26.67	354	0.17	6.02	8.11	146
7/22/01	15:08:23	26.9	355.2	0.17	5.37	8.09	103
7/22/01	15:09:58	26.67	355.2	0.17	6.01	8.09	106
7/22/01	15:11:10	26.78	355.2	0.17	5.96	8.08	112
7/22/01	15:12:37	26.74	355.1	0.17	6	8.11	141
7/22/01	15:14:10	26.8	355	0.17	5.82	8.07	146
7/24/01	11:01:13	26.54	308	0.15	6.03	8.07	103
7/24/01	11:02:05	26.65	307.7	0.15	5.96	8.08	106
7/24/01	11:03:00	26.57	307.3	0.15	6.27	8.14	112
7/24/01	11:04:22	26.66	307.8	0.15	6	8.09	141
7/24/01	11:05:19	26.64	307.6	0.15	6.23	8.13	146
7/25/01	11:15:08	26.59	300.4	0.14	6.39	8.08	103
7/25/01	11:15:59	26.72	300.3	0.14	6.27	8.09	106
7/25/01	11:16:37	26.66	299.8	0.14	6.57	8.16	112
7/25/01	11:17:59	26.68	300.5	0.14	6.35	8.09	141
7/25/01	11:19:03	26.57	300	0.14	6.5	8.13	146
7/26/01	12:25:58	26.44	335.6	0.16	5.76	8.02	103
7/26/01	12:26:42	26.61	335.4	0.16	5.76	8.01	106

Centerdale Manor Catfish ELS 32-Day Test Water Quality Summary

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Salinity ppt	DO Conc mg/L	pH	Sample position
	Target Range:	24 to 28	none	-0.5 to 0.5	> 5.0	6.0 to 9.0	na
Minimum Measurement:		24.53	0.329	0.13	4.65	7.87	100
aximum Measurement:		27.25	424.5	0.2	7.42	8.57	159
7/26/01	12:28:24	26.49	334.9	0.16	5.98	8.08	112
7/26/01	12:29:50	26.55	335.4	0.16	5.65	8.06	141
7/26/01	12:30:38	26.59	335.2	0.16	5.99	8.08	146
7/27/01	10:55:20	26.3	389.9	0.19	5.57	7.97	103
7/27/01	10:56:17	26.48	388.7	0.18	5.75	7.98	106
7/27/01	10:57:05	26.38	389.2	0.19	5.8	8.02	106
7/27/01	10:58:41	26.44	387.7	0.18	5.54	8.02	141
7/27/01	10:59:48	26.35	387.5	0.18	5.86	8.05	146
7/28/01	12:21:52	26.44	347.4	0.16	5.71	7.94	106
7/28/01	12:23:03	26.6	347.1	0.16	5.93	7.98	112
7/28/01	12:24:23	26.64	347	0.16	5.5	7.98	103
7/28/01	12:25:39	26.56	346.9	0.16	5.51	7.99	141
7/28/01	12:26:46	26.54	346.8	0.16	5.78	8.01	146
7/29/01	15:36:30	26.66	344.8	0.16	5.45	7.97	103
7/29/01	15:38:21	26.86	344.6	0.16	5.69	8.01	106
7/29/01	15:39:44	26.72	344.8	0.16	5.42	8.01	112
7/29/01	15:40:57	26.8	344.7	0.16	5.5	8.01	141
7/29/01	15:42:25	26.85	344.3	0.16	5.74	8.04	146
7/30/01	11:59:11	26.48	345	0.16	5.32	8.01	103
7/30/01	12:00:57	26.58	344.7	0.16	5.38	8.03	106
7/30/01	12:02:14	26.48	344.8	0.16	5.37	8.04	112
7/30/01	12:04:14	26.59	344.8	0.16	5.36	8.04	141
7/30/01	12:05:04	26.61	344.2	0.16	5.57	8.06	146
7/31/01	12:58:11	26.99	356.4	0.17	5.73	7.99	103
7/31/01	12:59:07	27.14	356.1	0.17	5.88	7.99	106
7/31/01	12:59:49	27.06	356	0.17	5.76	8	112
7/31/01	13:00:48	27.05	356	0.17	5.95	8.01	141
7/31/01	13:01:46	27.11	356	0.17	5.98	8.04	146
8/1/01	13:00:10	26.73	365.3	0.17	4.65	8.04	103
8/1/01	13:01:07	26.66	364.8	0.17	4.83	8.09	106
8/1/01	13:02:05	26.81	364.4	0.17	4.98	8.1	112
8/1/01	13:03:46	27.09	365.1	0.17	4.89	8.04	141
8/1/01	13:04:37	27.17	365	0.17	5.03	8.04	146
8/1/01	15:03:53	27.04	365.4	0.17	5.76	8.04	103
8/1/01	15:05:13	26.86	365.2	0.17	6	8.07	106
8/1/01	15:06:12	27.13	365	0.17	5.62	8.03	112
8/1/01	15:07:35	27.13	365.3	0.17	5.47	8.01	141
8/1/01	15:08:54	27.2	365	0.17	5.84	8.04	146
8/2/01	11:57:01	26.77	363.2	0.17	5.85	7.99	146
8/2/01	11:58:21	26.85	363.2	0.17	5.54	7.95	141
8/2/01	11:59:44	26.96	363.2	0.17	5.76	7.99	112
8/2/01	12:00:35	26.83	362.7	0.17	6.01	8.03	106
8/2/01	12:01:24	27.03	362.8	0.17	6	8.03	102

Centerdale Manor Catfish ELS 32-Day Test Water Quality Summary

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Salinity ppt	DO Conc mg/L	pH	Sample position
	Target Range:	24 to 28	none	-0.5 to 0.5	> 5.0	6.0 to 9.0	na
Minimum Measurement:		24.53	0.329	0.13	4.65	7.87	100
aximum Measurement:		27.25	424.5	0.2	7.42	8.57	159
8/3/01	12:20:48	26.99	348.6	0.17	5.8	7.94	103
8/3/01	12:22:37	27	347.8	0.16	5.87	7.97	106
8/3/01	12:23:43	26.97	347.9	0.16	5.71	7.95	112
8/3/01	12:24:58	26.96	348.4	0.16	5.36	7.93	141
8/3/01	12:26:02	27.12	347.8	0.16	5.9	7.97	146
8/4/01	14:24:51	27.08	314.8	0.15	5.88	7.99	103
8/4/01	14:26:09	27.2	313.5	0.15	5.93	8.05	106
8/4/01	14:27:13	27.1	313.3	0.15	5.63	8.04	112
8/4/01	14:28:47	27.06	313.6	0.15	5.37	8.03	141
8/4/01	14:30:02	27.05	313.3	0.15	5.76	8.07	146
8/5/01	8:58:26	26.57	353.9	0.17	5.56	7.96	103
8/5/01	8:59:58	26.57	354.6	0.17	5.5	7.93	106
8/5/01	9:01:14	26.54	355.9	0.17	5.32	7.92	112
8/5/01	9:04:18	26.68	355.2	0.17	5.29	7.94	141
8/5/01	9:06:16	26.78	355	0.17	5.64	7.97	146
8/6/01	12:32:17	26.5	356.1	0.17	5.32	7.94	103
8/6/01	12:33:27	26.58	355.7	0.17	5.45	7.93	103
8/6/01	12:35:02	26.48	355.9	0.17	5.29	7.94	106
8/6/01	12:36:39	26.42	356.4	0.17	5.04	7.9	112
8/6/01	12:39:39	26.57	356.3	0.17	5.13	7.92	141
8/6/01	12:40:24	26.64	355.8	0.17	5.3	7.93	146
8/7/01	12:02:21	26.64	0.329	0.16	5.37	7.92	103
8/7/01	12:03:26	26.66	0.33	0.16	5.39	7.93	106
8/7/01	12:04:16	26.58	0.33	0.16	5.24	7.92	112
8/7/01	12:06:07	26.76	0.329	0.16	5.34	7.96	141
8/7/01	12:07:11	26.82	0.33	0.16	5.33	7.96	146
8/8/01	12:32:14	26.79	352.3	0.17	5.74	7.99	106
8/8/01	12:33:14	26.81	352.9	0.17	5.51	7.99	103
8/8/01	12:34:34	26.74	351.9	0.17	5.55	8	112
8/8/01	12:35:52	26.75	352.2	0.17	5.47	7.99	141
8/8/01	12:37:10	26.81	351.9	0.17	5.67	8.03	146
8/9/01	9:20:08	26.74	353.9	0.17	5.02	7.87	103
8/9/01	9:21:25	26.81	353.3	0.17	5.43	7.91	106
8/9/01	9:22:29	26.78	353.2	0.17	5.33	7.91	112
8/9/01	9:23:44	26.71	353.5	0.17	5.12	7.88	141
8/9/01	9:24:55	26.79	353	0.17	5.53	7.93	146
8/10/01	15:16:06	26.86	353.2	0.17	5.83	8.09	103
8/10/01	15:17:29	27.05	353.8	0.17	5.45	7.97	106
8/10/01	15:18:48	26.87	353.7	0.17	5.57	8.01	112
8/10/01	15:20:32	26.92	354.2	0.17	4.79	7.93	141
8/10/01	15:22:07	26.89	353.4	0.17	5.16	7.98	146
8/11/01	9:30:35	25.68	280.9	0.13	6.01	8.08	103
8/11/01	9:31:22	26.62	280.6	0.13	5.54	8.1	106

Centerdale Manor Catfish ELS 32-Day Test Water Quality Summary

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Salinity ppt	DO Conc mg/L	pH	Sample position
	Target Range:	24 to 28	none	-0.5 to 0.5	> 5.0	6.0 to 9.0	na
Minimum Measurement:		24.53	0.329	0.13	4.65	7.87	100
aximum Measurement:		27.25	424.5	0.2	7.42	8.57	159
8/11/01	9:32:15	26.81	281.4	0.13	5.03	7.97	112
8/11/01	9:33:07	26.67	280.8	0.13	5.36	8.04	141
8/11/01	9:34:06	26.69	280.7	0.13	5.6	8.05	146
8/12/01	11:53:20	26.63	355.1	0.17	5.89	8.03	103
8/12/01	11:54:51	26.8	355.7	0.17	4.98	7.94	106
8/12/01	11:55:25	26.63	355.8	0.17	5.08	7.94	112
8/12/01	11:56:36	26.64	355.1	0.17	5.41	7.98	141
8/12/01	11:57:19	26.67	354.5	0.17	5.8	8.02	146
8/13/01	11:34:44	26.64	353.4	0.17	5.82	7.97	103
8/13/01	11:35:32	26.8	353.1	0.17	5.13	7.93	106
8/13/01	11:36:19	26.56	353.3	0.17	4.95	7.91	112
8/13/01	11:40:52	26.68	353.7	0.17	4.99	7.89	141
8/13/01	11:41:51	26.76	353.2	0.17	5.51	7.95	146
8/14/01	6:18:06	26.62	291.9	0.14	5.26	7.9	100
8/14/01	6:19:39	26.75	289.5	0.14	6.16	8.04	101
8/14/01	6:20:49	26.71	290.3	0.14	5.76	7.98	102
8/14/01	6:21:54	26.76	290.2	0.14	5.9	8.02	103
8/14/01	6:22:52	26.51	289.6	0.14	5.97	8.01	104
8/14/01	6:23:50	26.8	290.5	0.14	5.47	7.96	105
8/14/01	6:24:47	26.93	290.7	0.14	5.18	7.92	106
8/14/01	6:25:52	26.75	291.2	0.14	5.04	7.88	107
8/14/01	6:26:54	26.84	290.7	0.14	5.64	7.94	108
8/14/01	6:27:51	26.89	290.9	0.14	5.2	7.91	109
8/14/01	6:29:25	26.81	290.8	0.14	5.62	7.93	111
8/14/01	6:30:26	26.78	290.7	0.14	5.5	7.94	112
8/14/01	6:31:20	26.84	290.5	0.14	5.73	7.96	114
8/14/01	6:32:27	26.8	290.3	0.14	5.84	7.98	115
8/14/01	6:33:37	26.78	290.4	0.14	5.21	7.93	116
8/14/01	6:34:24	26.72	290.2	0.14	5.41	7.97	118
8/14/01	6:35:53	26.71	290.9	0.14	4.67	7.88	119
8/14/01	6:36:56	26.64	289.7	0.14	6.02	8.01	120
8/14/01	6:37:47	26.7	290.7	0.14	5.33	7.91	121
8/14/01	6:38:35	26.67	290	0.14	5.97	8	122
8/14/01	6:39:29	26.74	290.6	0.14	5.13	7.91	123
8/14/01	6:40:45	26.68	289.8	0.14	5.73	8.01	124
8/14/01	6:41:43	26.74	290.5	0.14	5.43	7.93	125
8/14/01	6:42:47	26.71	289.9	0.14	5.77	8	126
8/14/01	6:43:39	26.72	289.5	0.14	6.27	8.04	127
8/14/01	6:44:31	26.71	290.8	0.14	5.04	7.9	128
8/14/01	6:45:22	26.53	290.4	0.14	5.4	7.92	129
8/14/01	6:46:13	26.68	290	0.14	5.83	7.96	130
8/14/01	6:47:15	26.49	290.2	0.14	5.7	7.95	131
8/14/01	6:48:04	26.69	289.8	0.14	5.89	7.98	132

Centerdale Manor Catfish ELS 32-Day Test Water Quality Summary

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Salinity ppt	DO Conc mg/L	pH	Sample position
	Target Range:	24 to 28	none	-0.5 to 0.5	> 5.0	6.0 to 9.0	na
Minimum Measurement:		24.53	0.329	0.13	4.65	7.87	100
aximum Measurement:		27.25	424.5	0.2	7.42	8.57	159
8/14/01	6:48:52	26.69	291.1	0.14	5.07	7.87	133
8/14/01	6:49:36	26.67	290.4	0.14	5.59	7.96	134
8/14/01	6:50:50	26.65	290.4	0.14	5.33	7.95	135
8/14/01	6:51:48	26.66	290.4	0.14	5.37	7.95	136
8/14/01	6:52:35	26.69	290.1	0.14	5.61	7.95	139
8/14/01	6:53:31	26.7	290.7	0.14	5.37	7.9	141
8/14/01	6:54:51	26.66	290.2	0.14	5.68	7.96	144
8/14/01	6:55:44	26.69	290.8	0.14	5.41	7.91	145
8/14/01	6:56:24	26.77	290.5	0.14	5.56	7.94	146
8/14/01	6:57:33	26.73	289.9	0.14	5.82	8	147
8/14/01	6:58:25	26.75	290.5	0.14	5.57	7.93	148
8/14/01	6:59:06	27.2	290.5	0.14	5.82	7.96	149
8/14/01	7:00:08	26.81	290	0.14	5.78	8.01	150
8/14/01	7:00:59	26.86	289.8	0.14	6.17	8.04	151
8/14/01	7:02:35	26.79	290.4	0.14	5.64	7.94	152
8/14/01	7:03:31	26.85	290.1	0.14	6	7.99	153
8/14/01	7:04:46	26.73	290.8	0.14	5.27	7.89	154
8/14/01	7:05:39	26.78	290.6	0.14	5.3	7.89	155
8/14/01	7:06:39	26.74	290.8	0.14	5.26	7.87	156
8/14/01	7:07:36	26.75	290.2	0.14	5.82	7.96	157
8/14/01	7:08:53	26.75	290.4	0.14	5.52	7.92	158
8/14/01	7:09:38	26.72	290.7	0.14	5.47	7.91	159

Centerdale Manor Catfish ELS Rangefinding Water Quality Summary

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Salinity ppt	DO Conc mg/L	pH	Sample position
	Target Range:	24 to 28	none	-0.5 to 0.5	> 5.0	6.0 to 9.0	na
Minimum Measurement:		20.82	-1.8	0	2.83	7.01	1
aximum Measurement:		27.91	999.6	0.49	10.14	8.66	65
6/26/01	9:18:23	26.25	344	0.16	7.28	8.44	1
6/26/01	9:19:21	26.53	341.6	0.16	7.16	8.48	2
6/26/01	9:20:06	26.6	343.2	0.16	7.22	8.46	3
6/26/01	9:21:07	26.59	344.4	0.16	7.22	8.43	4
6/26/01	9:22:12	26.69	343.3	0.16	7.21	8.53	5
6/26/01	9:23:29	26.66	342.5	0.16	7.16	8.6	6
6/26/01	9:24:35	26.76	343.5	0.16	7.17	8.59	7
6/26/01	9:26:00	26.69	342.9	0.16	6.93	8.61	8
6/26/01	9:26:55	26.69	343.2	0.16	7.18	8.65	9
6/26/01	9:27:30	26.62	342.7	0.16	7.17	8.64	10
6/26/01	9:28:20	26.64	342.3	0.16	7.16	8.63	11
6/26/01	9:29:09	26.67	342.2	0.16	7.2	8.65	12
6/26/01	9:29:52	26.62	342.2	0.16	7.07	8.66	13
6/26/01	9:30:35	26.62	342.2	0.16	7.19	8.66	14
6/26/01	9:32:19	26.49	342.1	0.16	7.18	8.66	15
6/26/01	9:33:08	26.48	345.7	0.16	7.22	8.63	16
6/26/01	9:33:51	26.44	342.6	0.16	7.19	8.63	17
6/26/01	9:34:44	26.53	343	0.16	6.93	8.62	18
6/26/01	9:36:18	26.46	342.7	0.16	7.22	8.64	19
6/26/01	9:37:05	26.52	342.4	0.16	7.23	8.64	20
6/26/01	9:37:54	26.42	343.4	0.16	7.24	8.58	21
6/26/01	9:38:33	26.41	345	0.16	7.24	8.51	22
6/26/01	9:39:19	26.34	343.1	0.16	7.24	8.58	23
6/26/01	9:40:16	26.37	341.9	0.16	7.14	8.5	24
6/26/01	9:41:02	26.29	342.8	0.16	7.12	8.44	25
6/26/01	9:41:52	26.33	341.8	0.16	7.03	8.6	26
6/26/01	9:42:54	26.22	341.9	0.16	7.12	8.62	27
6/26/01	9:43:54	26.15	341.8	0.16	7.33	8.63	28
6/26/01	9:44:48	25.91	342	0.16	6.94	8.62	29
6/26/01	9:45:37	25.97	344.4	0.16	7.16	8.62	30
6/26/01	9:46:26	25.98	344.6	0.16	7.28	8.6	31
6/26/01	9:47:44	26.06	341.1	0.16	7.19	8.49	32
6/26/01	9:48:35	26.11	342.1	0.16	7.25	8.58	33
6/26/01	9:49:37	26.17	341.7	0.16	7.05	8.61	34
6/26/01	9:50:39	26.23	342.3	0.16	7.22	8.62	35
6/26/01	9:51:33	26.25	341.8	0.16	7.21	8.64	36
6/26/01	9:52:35	26.28	343.4	0.16	7.06	8.43	37
6/26/01	9:53:44	26.29	341.7	0.16	7.15	8.54	38
6/26/01	9:54:37	26.37	341.7	0.16	7.22	8.49	39
6/26/01	9:55:21	26.32	341.4	0.16	7.29	8.59	40
6/26/01	9:56:05	26.37	341.8	0.16	7.2	8.62	41
6/26/01	9:57:03	26.46	341.7	0.16	7.18	8.63	42
6/26/01	9:57:47	26.53	341.3	0.16	7.17	8.64	43

Centerdale Manor Catfish ELS Rangefinding Water Quality Summary

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Salinity ppt	DO Conc mg/L	pH	Sample position
	Target Range:	24 to 28	none	-0.5 to 0.5	> 5.0	6.0 to 9.0	na
Minimum Measurement:		20.82	-1.8	0	2.83	7.01	1
aximum Measurement:		27.91	999.6	0.49	10.14	8.66	65
6/26/01	9:58:31	26.57	343	0.16	7.19	8.63	44
6/26/01	10:00:11	26.63	340.6	0.16	7.03	8.56	45
6/26/01	10:08:14	26.47	342.8	0.16	6.93	8.47	46
6/26/01	10:09:35	26.66	342.4	0.16	6.94	8.53	47
6/26/01	10:10:38	26.7	343.1	0.16	6.94	8.46	48
6/26/01	10:18:14	26.48	344.6	0.16	6.9	8.45	49
6/26/01	10:19:30	26.6	342.6	0.16	6.92	8.56	50
6/26/01	10:21:28	26.53	342.8	0.16	6.89	8.52	51
6/26/01	10:22:40	26.59	342.3	0.16	6.88	8.49	52
6/26/01	10:24:22	26.51	341.2	0.16	6.87	8.6	53
6/26/01	10:25:40	26.53	341.9	0.16	6.91	8.58	54
6/26/01	10:27:26	26.27	342.6	0.16	7.11	8.45	60
6/26/01	10:28:35	26.66	342.2	0.16	6.81	8.58	61
6/26/01	10:29:46	26.1	340.9	0.16	6.99	8.49	62
6/26/01	10:31:04	25.91	342.5	0.16	7.08	8.46	63
6/26/01	10:32:20	26.39	341.4	0.16	7.08	8.53	64
6/26/01	10:33:28	26.45	342.4	0.16	6.96	8.55	65
6/27/01	11:20:23	27.73	342.2	0.16	6.52	8.12	60
6/27/01	11:25:11	24.86	364.4	0.17	5.68	8.55	1
6/27/01	11:51:09	27.56	350.8	0.17	6.11	8	1
6/27/01	11:52:05	27.63	350.8	0.17	6.31	8.08	2
6/27/01	11:53:01	27.54	350.3	0.17	6.25	8.08	3
6/27/01	11:54:03	27.8	349.8	0.17	6.47	8.13	4
6/27/01	11:55:01	27.64	349.3	0.17	6.45	8.14	5
6/27/01	11:56:03	27.91	350.6	0.17	6.34	8.06	6
6/27/01	11:57:02	27.71	350.6	0.17	6.2	8.03	7
6/27/01	11:58:10	27.7	350.4	0.17	6.38	8.1	8
6/27/01	11:58:59	27.68	351.1	0.17	5.97	8.05	9
6/27/01	12:00:01	27.68	350.8	0.17	6.15	8.03	10
6/27/01	12:00:59	27.63	350.5	0.17	5.95	8.03	11
6/27/01	12:02:02	27.63	350.7	0.17	6.43	8.11	12
6/27/01	12:02:58	27.72	350.6	0.17	6.13	8.03	13
6/27/01	12:04:03	27.19	351.3	0.17	6.56	8.07	14
6/27/01	12:05:07	27.36	350.5	0.17	6.26	8.03	15
6/27/01	12:06:03	27.67	350.4	0.17	6.17	8.04	16
6/27/01	12:07:00	27.37	349.4	0.17	6.29	8.08	17
6/27/01	12:07:52	21.29	-1.8	0	10.14	7.59	18
6/27/01	12:08:51	27.58	350.8	0.17	6.33	8.04	18
6/27/01	12:10:03	27.5	350	0.17	6.2	8.06	19
6/27/01	12:11:02	27.33	350.6	0.17	6.32	8.09	20
6/27/01	12:12:02	27.22	349.9	0.17	6.39	8.1	21
6/27/01	12:13:02	27.53	350.6	0.17	6.17	8.12	21
6/27/01	12:13:41	27.33	350.6	0.17	6.5	8.07	22

Centerdale Manor Catfish ELS Rangefinding Water Quality Summary

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Salinity ppt	DO Conc mg/L	pH	Sample position
	Target Range:	24 to 28	none	-0.5 to 0.5	> 5.0	6.0 to 9.0	na
Minimum Measurement:		20.82	-1.8	0	2.83	7.01	1
aximum Measurement:		27.91	999.6	0.49	10.14	8.66	65
6/27/01	12:14:10	27.35	350.5	0.17	6.09	8.09	23
6/27/01	12:15:01	27.21	349.8	0.17	6.51	8.13	24
6/27/01	12:16:00	27.4	350.1	0.17	6.25	8.06	22
6/27/01	12:16:55	27.16	350	0.17	6.07	8.01	25
6/27/01	12:18:36	26.27	349.1	0.17	6.2	8.02	26
6/27/01	12:19:37	26.77	349.8	0.17	6.2	8	27
6/27/01	12:20:23	26.94	349.4	0.17	6.6	8.11	28
6/27/01	12:21:19	27.02	348.9	0.17	6.6	8.09	29
6/27/01	12:22:12	27.23	350.1	0.17	6.28	8.03	30
6/27/01	12:23:02	27.33	350.3	0.17	6.29	8	31
6/27/01	12:23:58	27.3	349.9	0.17	6.52	8.04	32
6/27/01	12:25:02	27.42	350.2	0.17	6.28	8.03	33
6/27/01	12:25:56	27.51	350.3	0.17	6.5	8.03	34
6/27/01	12:26:50	27.64	350.3	0.17	6.35	8.02	35
6/27/01	12:27:46	27.61	350.6	0.17	6.09	8	36
6/27/01	12:29:02	27.57	350.6	0.17	6.2	8	37
6/27/01	12:29:57	27.56	350.4	0.17	6.3	8.03	38
6/27/01	12:30:54	27.58	350.6	0.17	6.02	7.99	39
6/27/01	12:31:54	27.55	350.2	0.17	6.15	8	40
6/27/01	12:32:56	27.61	350.4	0.17	6.24	8	41
6/27/01	12:33:57	27.34	349.8	0.17	6.32	8.04	42
6/27/01	12:34:45	27.25	350.2	0.17	6.47	8.07	43
6/27/01	12:36:01	27.55	350.5	0.17	5.99	7.99	44
6/27/01	12:36:47	27.66	350.5	0.17	6.1	8	45
6/27/01	12:37:44	27.5	350	0.17	6.26	8.03	46
6/27/01	12:38:50	27.55	350.6	0.17	6.28	8	47
6/27/01	12:40:09	27.84	350.9	0.17	6.04	7.99	48
6/27/01	12:40:57	27.74	350.6	0.17	6.18	8.01	49
6/27/01	12:41:55	27.91	350.6	0.17	5.98	8	50
6/27/01	12:42:50	27.88	350.9	0.17	6.22	8.01	51
6/27/01	12:44:00	27.84	350.6	0.17	6.15	8.01	52
6/27/01	12:44:54	27.84	350.4	0.17	6.32	8.03	53
6/27/01	12:45:56	27.69	349.5	0.17	6.52	8.1	54
6/27/01	12:47:07	27.76	350.9	0.17	6.1	8	60
6/27/01	12:48:02	27.68	349.8	0.17	6.46	8.08	61
6/27/01	12:48:50	27.44	350.2	0.17	6.11	7.99	62
6/27/01	12:49:48	27.27	350	0.17	6.02	8	63
6/27/01	12:50:37	27.3	349.9	0.17	6.36	8.03	64
6/27/01	12:51:36	27.29	349.8	0.17	6.3	8.04	65
6/28/01	8:10:59	27.17	349	0.17	6.07	8.01	60
6/28/01	8:12:50	26.93	348	0.17	6.34	8.09	61
6/28/01	8:14:34	26.92	349	0.17	6.01	7.99	62
6/28/01	8:16:42	26.69	348	0.17	6.1	7.99	63

Centerdale Manor Catfish ELS Rangefinding Water Quality Summary

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Salinity ppt	DO Conc mg/L	pH	Sample position
	Target Range:	24 to 28	none	-0.5 to 0.5	> 5.0	6.0 to 9.0	na
Minimum Measurement:		20.82	-1.8	0	2.83	7.01	1
aximum Measurement:		27.91	999.6	0.49	10.14	8.66	65
6/28/01	8:18:54	26.83	348	0.17	6.17	8.03	64
6/28/01	8:20:09	26.74	348	0.17	6.06	8.04	65
6/29/01	9:38:00	27.27	349	0.17	6.36	8.03	60
6/29/01	9:39:34	27.21	348	0.17	6.49	8.09	61
6/29/01	9:41:23	27.12	349	0.17	5.97	8.01	62
6/29/01	9:42:42	26.92	349	0.17	6.07	8.05	63
6/29/01	9:43:38	26.88	349	0.17	6.37	8.08	64
6/29/01	9:44:34	26.78	349	0.17	6.28	8.07	65
6/30/01	12:21:05	27.48	367	0.17	5.18	8.05	60
6/30/01	12:22:31	27.27	363	0.17	6.37	8.1	61
6/30/01	12:24:05	27.13	364	0.17	5.86	8.01	62
6/30/01	12:25:39	26.91	364	0.17	5.25	8.04	63
6/30/01	12:27:05	27.03	364	0.17	5.93	8.07	64
6/30/01	12:28:26	27.01	364	0.17	6.13	8.05	65
7/1/01	11:08:52	20.82	999.6	0.49	2.83	7.01	60
7/1/01	11:18:59	27.51	350.7	0.17	5.94	8.03	60
7/1/01	11:20:44	27.49	349.4	0.17	6.45	8.14	61
7/1/01	11:22:12	27.4	349.9	0.17	6.01	8.07	62
7/1/01	11:24:27	27.02	349.4	0.17	6.12	8.09	63
7/1/01	11:26:05	27.26	349.6	0.17	6.19	8.11	64
7/1/01	11:28:37	27.06	349.4	0.17	6.3	8.09	65
7/2/01	10:28:55	26.81	354	0.17	5.7	8.03	60
7/2/01	10:30:06	26.83	353	0.17	6.04	8.1	61
7/2/01	10:31:04	26.73	354	0.17	6	8.06	62
7/2/01	10:32:05	26.51	353	0.17	6.14	8.08	63
7/2/01	10:33:30	26.54	353	0.17	6.27	8.11	64
7/2/01	10:34:59	26.48	353	0.17	5.74	8.1	65
7/3/01	8:13:26	25.85	356.7	0.17	5.96	8.26	1
7/3/01	8:14:28	26.93	356.8	0.17	6.11	8.08	2
7/3/01	8:15:30	26.84	356.4	0.17	6.36	8.1	3
7/3/01	8:16:31	26.94	356.6	0.17	6.13	8.09	4
7/3/01	8:17:32	26.82	356.1	0.17	6.15	8.15	5
7/3/01	8:18:34	26.82	356.1	0.17	6.44	8.12	6
7/3/01	8:19:31	26.91	355.9	0.17	6.24	8.16	7
7/3/01	8:20:33	26.93	356.1	0.17	6.22	8.11	8
7/3/01	8:21:31	26.91	356.5	0.17	6.37	8.1	9
7/3/01	8:22:30	26.85	356.7	0.17	5.94	8.08	10
7/3/01	8:23:31	26.92	356.5	0.17	6.12	8.08	11
7/3/01	8:24:31	26.95	356.9	0.17	6.05	8.08	12
7/3/01	8:25:30	26.89	356.5	0.17	6.12	8.08	13
7/3/01	8:26:34	26.91	356.3	0.17	6.4	8.12	14
7/3/01	8:27:31	26.97	356.6	0.17	5.78	8.08	15
7/3/01	8:28:33	27.02	356.5	0.17	6.3	8.09	16

Centerdale Manor Catfish ELS Rangefinding Water Quality Summary

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Salinity ppt	DO Conc mg/L	pH	Sample position
	Target Range:	24 to 28	none	-0.5 to 0.5	> 5.0	6.0 to 9.0	na
Minimum Measurement:		20.82	-1.8	0	2.83	7.01	1
aximum Measurement:		27.91	999.6	0.49	10.14	8.66	65
7/3/01	8:29:30	27.03	356.7	0.17	6.34	8.07	17
7/3/01	8:30:30	27.12	356.8	0.17	6.09	8.08	18
7/3/01	8:31:33	26.92	356.5	0.17	6.18	8.08	19
7/3/01	8:32:30	26.78	356.5	0.17	5.95	8.06	20
7/3/01	8:33:31	26.74	356.5	0.17	6.13	8.07	21
7/3/01	8:34:31	26.91	356.7	0.17	6.03	8.05	22
7/3/01	8:35:30	26.6	356.4	0.17	6.1	8.06	23
7/3/01	8:36:30	26.5	355.8	0.17	6.14	8.07	24
7/3/01	8:37:30	26.43	356.2	0.17	6.09	8.05	25
7/3/01	8:38:30	26.25	356.2	0.17	5.92	8.04	26
7/3/01	8:39:30	26.47	356.1	0.17	6.13	8.05	27
7/3/01	8:40:30	26.42	355.5	0.17	6.44	8.08	28
7/3/01	8:41:31	26.54	355.8	0.17	6.41	8.09	29
7/3/01	8:42:30	26.72	356	0.17	6.25	8.08	30
7/3/01	8:43:31	26.82	355.5	0.17	6.59	8.14	31
7/3/01	8:44:30	26.86	356.5	0.17	6.08	8.05	32
7/3/01	8:45:32	26.78	356.2	0.17	6.32	8.06	33
7/3/01	8:46:31	26.71	355.8	0.17	5.98	8.06	34
7/3/01	8:47:30	26.64	356.3	0.17	6.17	8.04	35
7/3/01	8:48:30	26.8	356.2	0.17	6.29	8.06	36
7/3/01	8:49:30	26.77	356.2	0.17	6.01	8.07	37
7/3/01	8:50:30	26.76	356.5	0.17	6.19	8.05	38
7/3/01	8:51:30	26.88	356.7	0.17	6.04	8.03	39
7/3/01	8:52:30	27.04	356.7	0.17	5.87	8.04	40
7/3/01	8:53:30	27.03	356.8	0.17	6.19	8.04	41
7/3/01	8:54:30	26.88	356.4	0.17	5.77	8.04	42
7/3/01	8:55:29	27.01	356.6	0.17	6.17	8.04	43
7/3/01	8:56:31	27	356.4	0.17	5.88	8.04	44
7/3/01	8:57:32	26.96	356.3	0.17	6.14	8.04	45
7/3/01	8:58:30	26.97	356.8	0.17	6.24	8.05	46
7/3/01	8:59:30	27.02	356.9	0.17	5.99	8.04	47
7/3/01	9:00:30	26.88	356.3	0.17	6.21	8.07	48
7/3/01	9:01:30	26.93	356.5	0.17	6.02	8.03	49
7/3/01	9:02:32	26.66	356.3	0.17	5.98	8.04	50
7/3/01	9:03:30	26.71	356.6	0.17	6.07	8.04	51
7/3/01	9:04:31	26.87	356.4	0.17	6.07	8.03	52
7/3/01	9:05:30	26.73	356.3	0.17	5.86	8.02	53
7/3/01	9:06:30	26.77	356.1	0.17	6.42	8.06	54
7/3/01	9:08:01	26.43	355.8	0.17	6.13	8.05	65
7/3/01	9:09:31	26.61	356	0.17	6.16	8.06	64
7/3/01	9:10:37	26.52	356.3	0.17	6.06	8.03	63
7/3/01	9:12:04	26.7	356.5	0.17	5.68	8.02	62
7/3/01	9:13:21	26.95	356.2	0.17	6.35	8.08	61

Centerdale Manor Catfish ELS Rangefinding Water Quality Summary

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Salinity ppt	DO Conc mg/L	pH	Sample position
	Target Range:	24 to 28	none	-0.5 to 0.5	> 5.0	6.0 to 9.0	na
Minimum Measurement:		20.82	-1.8	0	2.83	7.01	1
aximum Measurement:		27.91	999.6	0.49	10.14	8.66	65
7/3/01	9:14:19	27.03	356.7	0.17	6.07	8.01	60

Centerdale Manor Catfish ELS Reference Toxicant Water Quality Summary

Date M/D/Y	Time hh:mm:ss	Temp °C	SpCond uS/cm	Salinity ppt	DO Conc mg/L	pH	Sample
	Target Range:	24 to 28	none	-0.5 to 0.5	> 5.0	6.0 to 9.0	na
Minimum Measurement:		17.3	-1.2	0	4.29	7.6	460
aximum Measurement:		27.62	390.5	0.19	10.56	8.58	486
8/9/01	10:39:39	26.45	352	0.17	7.24	8.26	484
8/9/01	10:40:36	26.5	353.2	0.17	7.19	8.27	480
8/9/01	10:41:46	26.48	351.4	0.17	7.19	8.33	486
8/9/01	10:42:58	26.49	351.1	0.17	7.17	8.25	482
8/9/01	10:43:57	26.47	354.3	0.17	7.21	8.11	485
8/9/01	10:44:54	26.48	358.7	0.17	7.2	7.89	483
8/9/01	10:50:22	26.32	352	0.17	7.21	8.4	481
8/10/01	11:54:29	26.8	367.5	0.17	5.16	7.96	481
8/10/01	11:55:50	26.93	366.4	0.17	4.29	7.84	484
8/10/01	11:57:58	27	362.5	0.17	5.44	7.98	480
8/10/01	11:59:15	27.62	353.1	0.17	5.79	8.04	486
8/10/01	12:00:12	27.11	355.6	0.17	5.5	7.99	482
8/10/01	12:01:27	27.13	358.5	0.17	5.61	8.01	485
*8/10/01	12:02:39	27.05	358.5	0.17	5.93	8.02	483
8/9/01	10:32:08	26.26	350.6	0.17	7.22	8.39	463
8/9/01	10:33:24	26.44	347.7	0.16	7.21	8.41	466
8/9/01	10:34:21	26.48	349.8	0.17	7.25	8.27	460
8/9/01	10:35:12	26.42	346.9	0.16	7.24	8.45	462
8/9/01	10:36:11	26.47	351.3	0.17	7.19	8.18	461
8/9/01	10:37:01	26.48	350.1	0.17	7.17	8.35	464
8/9/01	10:37:57	26.5	356.2	0.17	7.15	7.89	465
8/10/01	11:42:50	26.14	346.2	0.16	6.74	8.54	463
8/10/01	11:44:26	26.24	346.3	0.16	6.48	8.56	466
8/10/01	11:46:34	26.25	346	0.16	6.85	8.56	460
8/10/01	11:47:39	26.26	345.7	0.16	6.64	8.57	462
8/10/01	11:49:37	26.1	347.2	0.16	6.87	8.58	461
8/10/01	11:50:42	26.23	347.9	0.16	7.2	8.55	464
8/10/01	11:52:14	26.2	349.1	0.17	7.27	8.54	465
8/11/01	9:44:41	17.3	-1.2	0	10.56	7.6	460
8/11/01	9:46:40	26.18	292.7	0.14	4.5	7.98	462
8/11/01	9:47:52	26.38	296.1	0.14	6.25	8.34	463
8/11/01	9:49:05	26.26	303.1	0.14	4.4	7.97	464
8/11/01	9:50:02	26.38	287.5	0.14	7.07	8.5	466
8/12/01	11:32:42	26.13	390.5	0.19	4.78	7.86	463
8/12/01	11:34:12	26.27	364	0.17	6.62	8.4	466
8/12/01	11:34:55	26.25	377.1	0.18	5.22	8.03	460
8/13/01	11:44:53	26.31	363.1	0.17	6.62	8.25	463
8/13/01	11:45:28	26.34	348.1	0.17	7.08	8.54	466
8/13/01	11:46:17	26.25	353.7	0.17	6.9	8.36	460

*For 8/11/2001 through 8/13/2001 data, see *Centredale Manor Catfish ELS 32-Day Test Water Quality Summary* data. The reference-toxicant flow-through jars were on the same flow-through system as the definitive test.

Centerdale Manor Catfish ELS 32-Day and Rangefinding Test Total Ammonia Measures

Position	Treatment	Test	Date	Total Ammonia (mg/L)	Position	Treatment	Test	Date	Total Ammonia (mg/L)
				Target Range: 0-.2					Target Range: 0-.2
60	0 ng/mL	Rangefinding	6/26/01	0.0705	103	0 ng/L, Rep 3	32-Day	7/11/01	0.0005
61	0 ng/mL	Rangefinding	6/26/01	0.0631	106	0 ng/L, Rep 5	32-Day	7/11/01	0.0219
62	0 ng/mL	Rangefinding	6/26/01	0.0599	112	0 ng/L, Rep 2	32-Day	7/11/01	0.0260
63	0 ng/mL	Rangefinding	6/26/01	0.0523	141	0 ng/L, Rep 1	32-Day	7/11/01	0.0267
64	0 ng/mL	Rangefinding	6/26/01	0.0474	146	0 ng/L, Rep 4	32-Day	7/11/01	0.0345
65	0 ng/mL	Rangefinding	6/26/01	0.0394	103	0 ng/L, Rep 3	32-Day	7/11/01	0.0008
2	0 ng/mL, Rep 3	Rangefinding	6/27/01	0.0215	100	Solvent Control, Rep 2	32-Day	7/12/01	0.0256
5	Solvent Control, Rep 1	Rangefinding	6/27/01	0.0199	103	0 ng/L, Rep 3	32-Day	7/12/01	0.0220
6	0 ng/mL, Rep 2	Rangefinding	6/27/01	0.0222	105	0 ng/L, Rep 5	32-Day	7/12/01	0.0237
18	Solvent Control Rep 3	Rangefinding	6/27/01	0.0158	106	0 ng/L, Rep 5	32-Day	7/12/01	0.0177
26	Solvent Control, Rep 2	Rangefinding	6/27/01	0.0167	112	0 ng/L, Rep 2	32-Day	7/12/01	0.0161
27	0 ng/mL, Rep 1	Rangefinding	6/27/01	0.0177	114	Solvent Control, Rep 5	32-Day	7/12/01	0.0152
32	0 ng/mL, Rep 2	Rangefinding	6/27/01	0.0174	122	Solvent Control, Rep 1	32-Day	7/12/01	0.0186
41	Solvent Control, Rep 1	Rangefinding	6/27/01	0.0158	124	0 ng/L, Rep 2	32-Day	7/12/01	0.0271
43	0 ng/mL, Rep 3	Rangefinding	6/27/01	0.0133	133	0 ng/L, Rep 1	32-Day	7/12/01	0.0279
47	Solvent Control, Rep 3	Rangefinding	6/27/01	0.0156	136	0 ng/L, Rep 4	32-Day	7/12/01	0.0163
49	Solvent Control, Rep 2	Rangefinding	6/27/01	0.0133	141	0 ng/L, Rep 1	32-Day	7/12/01	0.0216
50	0 ng/mL, Rep 1	Rangefinding	6/27/01	0.0138	146	0 ng/L, Rep 4	32-Day	7/12/01	0.0259
60	0 ng/mL	Rangefinding	6/27/01	0.0123	148	0 ng/L, Rep 3	32-Day	7/12/01	0.0166
61	0 ng/mL	Rangefinding	6/27/01	0.0142	155	Solvent Control, Rep 3	32-Day	7/12/01	0.0255
62	0 ng/mL	Rangefinding	6/27/01	0.0178	156	Solvent Control, Rep 4	32-Day	7/12/01	0.0167
63	0 ng/mL	Rangefinding	6/27/01	0.0137					
64	0 ng/mL	Rangefinding	6/27/01	0.0194	103	0 ng/L, Rep 3	32-Day	7/13/01	0.0460
65	0 ng/mL	Rangefinding	6/27/01	0.0137	106	0 ng/L, Rep 5	32-Day	7/13/01	0.0690
					112	0 ng/L, Rep 2	32-Day	7/13/01	0.0821
					141	0 ng/L, Rep 1	32-Day	7/13/01	0.0663
					146	0 ng/L, Rep 4	32-Day	7/13/01	0.0659
					106	0 ng/L, Rep 5	32-Day	7/14/01	0.0718
					112	0 ng/L, Rep 2	32-Day	7/14/01	0.0948
					114	Solvent Control, Rep 5	32-Day	7/14/01	0.0948
					122	Solvent Control, Rep 1	32-Day	7/14/01	0.0695
					124	0 ng/L, Rep 2	32-Day	7/14/01	0.0787
					133	0 ng/L, Rep 1	32-Day	7/14/01	0.0704
					136	0 ng/L, Rep 4	32-Day	7/14/01	0.0477
					141	0 ng/L, Rep 1	32-Day	7/14/01	0.0619
					146	0 ng/L, Rep 4	32-Day	7/14/01	0.0409
					148	0 ng/L, Rep 3	32-Day	7/14/01	0.0520
					155	Solvent Control, Rep 3	32-Day	7/14/01	0.0429
					156	Solvent Control, Rep 4	32-Day	7/14/01	0.0313
					100	Solvent Control, Rep 2	32-Day	7/14/01	0.0490
					103	0 ng/L, Rep 3	32-Day	7/14/01	0.3510
					105	0 ng/L, Rep 5	32-Day	7/14/01	0.1310
					103	0 ng/L, Rep 3	32-Day	7/14/01	0.2220
					105	0 ng/L, Rep 5	32-Day	7/14/01	0.0698

Appendix G - Chemistry Sample Number Decoding Information

EPA/USACE Centredale Manor Catfish ELS: Nominal Concentration 2,3,7,8-TCDD (ng/mL in Water) and Sample Number.

This worksheet may be used with the report, "Task 22F Pre-Third Party Validated ELS Egg and Catfish Fry Tissue Chemistry Data Report", to correlate the sample numbers reported with the nominal concentration in the exposure water ***Note: bold indicates "with HCX"***

SORTED BY Battelle Columbus Operations (BCO) SAMPLE NUMBER (or Battelle Marine Sciences Laboratory (MSL) TREATMENT)

2,3,7,8-TCDD and HCX IN EGGS		2,3,7,8-TCDD and HCX IN FRY		PCB Congeners		Lipid Results	
BCO SAMPLE NUMBER	MSL NOMINAL CONCENTRATION (ng/mL)	BCO SAMPLE NUMBER	MSL NOMINAL CONCENTRATION (ng/mL)	BCO SAMPLE NUMBER	MSL NOMINAL CONCENTRATION (ng/mL)	BCO SAMPLE NUMBER	MSL NOMINAL CONCENTRATION (ng/mL)
42828-CONC-1A	**0.008**	**42828-1**	**0.008**	**42828-1A**	**0.008**	**42828-CONC-1A**	**0.008**
42828-CONC-1B	**0.008**	42828-2	0.018	**42828-1B**	**0.008**	**42828-CONC-1B**	**0.008**
42828-CONC-1C	**0.008**	42828-3	0.000	**42828-1C**	**0.008**	**42828-CONC-1C**	**0.008**
42828-CONC-2A	**0.018**	**42828-4**	**0.002**	**42828-2A**	**0.018**	**42828-CONC-2A**	**0.018**
42828-CONC-2B	**0.018**	**42828-5**	**0.005**	**42828-2B**	**0.018**	**42828-CONC-2B**	**0.018**
42828-CONC-2C	**0.018**	42828-6	0.008	**42828-2C**	**0.018**	**42828-CONC-2C**	**0.018**
42828-CONC-3A	0.000	42828-7	0.002	42828-3A	0.000	42828-CONC-3A	0.000
42828-CONC-3B	0.000	**42828-8**	**0.003**	42828-3B	0.000	42828-CONC-3B	0.000
42828-CONC-3C	0.000	42828-9	0.012	42828-3C	0.000	42828-CONC-3C	0.000
42828-CONC-4A	**0.002**	42828-10	0.003	**42828-4A**	**0.002**	**42828-CONC-4A**	**0.002**
42828-CONC-4B	**0.002**	42828-11	0.012	**42828-4B**	**0.002**	**42828-CONC-4B**	**0.002**
42828-CONC-4C	**0.002**	42828-12	0.018	**42828-4C**	**0.002**	**42828-CONC-4C**	**0.002**
42828-CONC-5A	**0.005**	42828-13	SOLVENT	**42828-5A**	**0.005**	**42828-CONC-5A**	**0.005**
42828-CONC-5B	**0.005**	42828-14	0.005	**42828-5B**	**0.005**	**42828-CONC-5B**	**0.005**
42828-CONC-5C	**0.005**			**42828-5C**	**0.005**	**42828-CONC-5C**	**0.005**
42828-CONC-6A	0.008			42828-6A	0.008	42828-CONC-6A	0.008
42828-CONC-6B	0.008			42828-6B	0.008	42828-CONC-6B	0.008
42828-CONC-6C	0.008			42828-6C	0.008	42828-CONC-6C	0.008
42828-CONC-7A	0.002			42828-7A	0.002	42828-CONC-7A	0.002
42828-CONC-7B	0.002			42828-7B	0.002	42828-CONC-7B	0.002
42828-CONC-7C	0.002			42828-7C	0.002	42828-CONC-7C	0.002
42828-CONC-8A	**0.003**			**42828-8A**	**0.003**	**42828-CONC-8A**	**0.003**
42828-CONC-8B	**0.003**			**42828-8B**	**0.003**	**42828-CONC-8B**	**0.003**
42828-CONC-8C	**0.003**			**42828-8C**	**0.003**	**42828-CONC-8C**	**0.003**
42828-CONC-9A	0.012			42828-9A	0.012	42828-CONC-9A	0.012
42828-CONC-9B	0.012			42828-9B	0.012	42828-CONC-9B	0.012
42828-CONC-9C	0.012			42828-9C	0.012	42828-CONC-9C	0.012
42828-CONC-10A	0.003			42828-10A	0.003	42828-CONC-10A	0.003
42828-CONC-10B	0.003			42828-10B	0.003	42828-CONC-10B	0.003
42828-CONC-10C	0.003			42828-10C	0.003	42828-CONC-10C	0.003
42828-CONC-11A	**0.012**			**42828-11A**	**0.012**	**42828-CONC-11A**	**0.012**
42828-CONC-11B	**0.012**			**42828-11B**	**0.012**	**42828-CONC-11B**	**0.012**
42828-CONC-11C	**0.012**			**42828-11C**	**0.012**	**42828-CONC-11C**	**0.012**
42828-CONC-12A	0.018			42828-12A	0.018	42828-CONC-12A	0.018
42828-CONC-12B	0.018			42828-12B	0.018	42828-CONC-12B	0.018
42828-CONC-12C	0.018			42828-12C	0.018	42828-CONC-12C	0.018
42828-CONC-14A	0.005			42828-14A	0.005	42828-CONC-14A	0.005
42828-CONC-14B	0.005			42828-14B	0.005	42828-CONC-14B	0.005
42828-CONC-14C	0.005			42828-14C	0.005	42828-CONC-14C	0.005

SORTED BY MSL NOMINAL CONCENTRATION

2,3,7,8-TCDD and HCX IN EGGS		ELS TISSUE 2,3,7,8-TCDD and HCX IN FRY		PCB Congeners		Lipid Results	
BCO SAMPLE NUMBER	MSL NOMINAL CONCENTRATION (ng/mL)	BCO SAMPLE NUMBER	MSL NOMINAL CONCENTRATION (ng/mL)	BCO SAMPLE NUMBER	MSL NOMINAL CONCENTRATION (ng/mL)	BCO SAMPLE NUMBER	MSL NOMINAL CONCENTRATION (ng/mL)
42828-CONC-3A	0.000	42828-3	0.000	42828-3A	0	42828-CONC-3A	0.000
42828-CONC-3B	0.000	42828-13	SOLVENT	42828-3B	0	42828-CONC-3B	0.000
42828-CONC-3C	0.000	42828-4	0.002	42828-3C	0	42828-CONC-3C	0.000
42828-CONC-4A	0.002	42828-7	0.002	42828-4A	0.002	42828-CONC-4A	0.002
42828-CONC-4B	0.002	42828-8	0.003	42828-4B	0.002	42828-CONC-4B	0.002
42828-CONC-4C	0.002	42828-10	0.003	42828-4C	0.002	42828-CONC-4C	0.002
42828-CONC-7A	0.002	42828-5	0.005	42828-7A	0.002	42828-CONC-7A	0.002
42828-CONC-7B	0.002	42828-14	0.005	42828-7B	0.002	42828-CONC-7B	0.002
42828-CONC-7C	0.002	42828-1	0.008	42828-7C	0.002	42828-CONC-7C	0.002
42828-CONC-8A	0.003	42828-6	0.008	42828-8A	0.003	42828-CONC-8A	0.003
42828-CONC-8B	0.003	42828-9	0.012	42828-8B	0.003	42828-CONC-8B	0.003
42828-CONC-8C	0.003	42828-11	0.012	42828-8C	0.003	42828-CONC-8C	0.003
42828-CONC-10A	0.003	42828-2	0.018	42828-10A	0.003	42828-CONC-10A	0.003
42828-CONC-10B	0.003	42828-12	0.018	42828-10B	0.003	42828-CONC-10B	0.003
42828-CONC-10C	0.003			42828-10C	0.003	42828-CONC-10C	0.003
42828-CONC-5A	0.005			42828-5A	0.005	42828-CONC-5A	0.005
42828-CONC-5B	0.005			42828-5B	0.005	42828-CONC-5B	0.005
42828-CONC-5C	0.005			42828-5C	0.005	42828-CONC-5C	0.005
42828-CONC-14A	0.005			42828-14A	0.005	42828-CONC-14A	0.005
42828-CONC-14B	0.005			42828-14B	0.005	42828-CONC-14B	0.005
42828-CONC-14C	0.005			42828-14C	0.005	42828-CONC-14C	0.005
42828-CONC-1A	0.008			42828-1A	0.008	42828-CONC-1A	0.008
42828-CONC-1B	0.008			42828-1B	0.008	42828-CONC-1B	0.008
42828-CONC-1C	0.008			42828-1C	0.008	42828-CONC-1C	0.008
42828-CONC-6A	0.008			42828-6A	0.008	42828-CONC-6A	0.008
42828-CONC-6B	0.008			42828-6B	0.008	42828-CONC-6B	0.008
42828-CONC-6C	0.008			42828-6C	0.008	42828-CONC-6C	0.008
42828-CONC-9A	0.012			42828-9A	0.012	42828-CONC-9A	0.012
42828-CONC-9B	0.012			42828-9B	0.012	42828-CONC-9B	0.012
42828-CONC-9C	0.012			42828-9C	0.012	42828-CONC-9C	0.012
42828-CONC-11A	0.012			42828-11A	0.012	42828-CONC-11A	0.012
42828-CONC-11B	0.012			42828-11B	0.012	42828-CONC-11B	0.012
42828-CONC-11C	0.012			42828-11C	0.012	42828-CONC-11C	0.012
42828-CONC-2A	0.018			42828-2A	0.018	42828-CONC-2A	0.018
42828-CONC-2B	0.018			42828-2B	0.018	42828-CONC-2B	0.018
42828-CONC-2C	0.018			42828-2C	0.018	42828-CONC-2C	0.018
42828-CONC-12A	0.018			42828-12A	0.018	42828-CONC-12A	0.018
42828-CONC-12B	0.018			42828-12B	0.018	42828-CONC-12B	0.018
42828-CONC-12C	0.018			42828-12C	0.018	42828-CONC-12C	0.018

Appendix H - WHOI Letter Report Establishing a TEF for HCX (Hahn 2002)

Telephone: 1 508 289 3242
Fax: 1 508 457 2134
E-mail: mhahn@whoi.edu

Mark E. Hahn
Associate Scientist
Department of Biology

August, 2001

Cornell,

Here are the preliminary data from the experiment with HCX. As you can see from the table and figures, HCX at 10 μM is able to displace [^{3}H]TCDD (2 nM) from the trout and human AHRs. It is not possible to determine relative affinities from this assay with only two concentrations of HCX, but a very rough estimate of the relative affinity of HCX based on the data we have would be approximately 5000-fold less than that of TCDD. For comparison, this is approximately what we have seen for mono-ortho PCBs in other receptor competition assays. Please note that binding to the AHR does not tell us whether this compound acts as an agonist, a partial agonist, or an antagonist.

I look forward to discussing these data with you.

Mark

Competition assay using trout and human AHRs and HCX
AHR = aryl hydrocarbon receptor (dioxin receptor)
HCX = 1,2,4,5,7,8-Hexachloroxanthene(Cambridge Isotopes)
[^{3}H]TCDD = 2,3,7,8-tetrachloro-1,6[^{3}H]-dibenzo-*p*-dioxin

Purpose: To determine the ability of HCX to inhibit [^{3}H]TCDD (2 nM) binding to rainbow trout AHR (rtAHR2a) and human AHR (hAHR)

Method: Velocity sedimentation on sucrose gradients using *in vitro*-expressed AHR proteins as described in Karchner, S.I., Powell, W.H., and Hahn, M.E. (1999) Identification and functional characterization of two highly divergent aryl hydrocarbon receptors (AHR1 and AHR2) in the teleost *Fundulus heteroclitus*. Evidence for a novel subfamily of ligand-binding basic helix-loop-helix Per-ARNT-Sim (bHLH-PAS) factors. *J. Biol. Chem.* 274: 33814-33824.

Results:

Table 1. Data summary

	r. trout AHR2a		human AHR	
	SB (fmol)	% control SB	SB (fmol)	% control SB
Control SB	49.0	100	147.9	100
HCX 10 μM	18.5	37.7	117.6	79.5
HCX 1 μM	39.6	80.8	143.4	96.9

Mark E. Hahn

Figure 1. Rainbow trout AHR

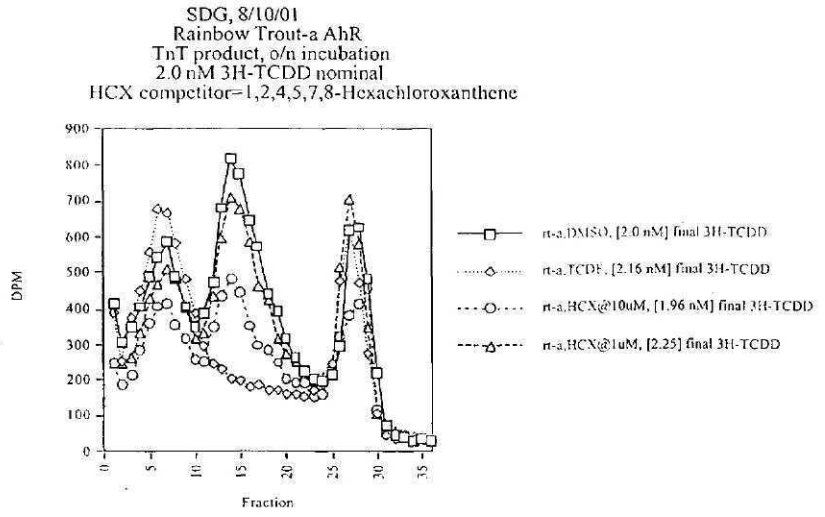
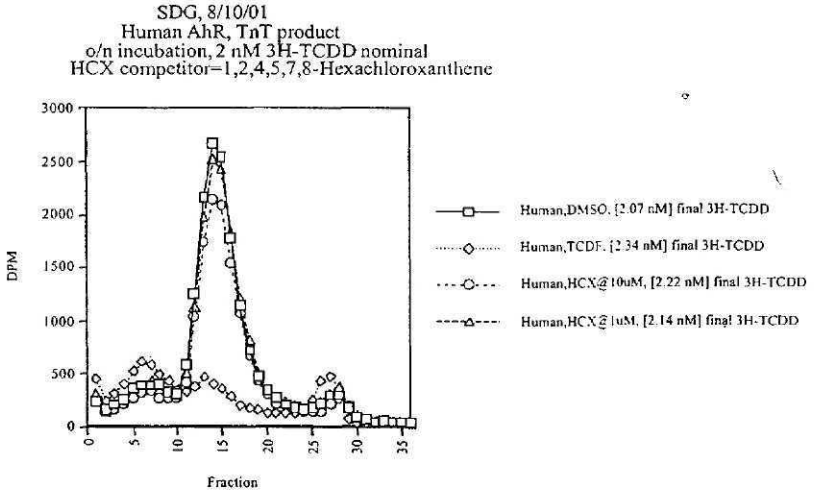


Figure 2. Human AHR



Biology Department, MS # 32, Woods Hole Oceanographic Institution, Woods Hole MA 02543-1049 USA

Appendix I - Fate of HCX and TCDD in Waterborne Exposure Systems

HCX results

Sample ID	Water (pg)	Rinseate (pg)	Sum of Fractions (pg)	Rinsesate/ Water ratio	Water/ Rinseate Ratio
Matrix Spike	95,453.707		95,453.707		
Method Blank	0.000	159.717	159.717		
TCDD/HCX 1 (light/dark)	67,402.936	53,253.24	120,656.174	0.79	1.27
TCDD/HCX 2 (light/dark)	74,619.443	49,434.68	124,054.122	0.66	1.51
TCDD/HCX 3 (light/dark)	77,140.152	58,802.90	135,943.052	0.76	1.31
TCDD/HCX 4 (dark)	79,625.582	34,935.12	114,560.705	0.44	2.28

Sample ID	Water (pg)	Spike Amt*	% Recovery
Matrix Spike	95,453.71	123417.6	77
Method Blank	0.00		
TCDD/HCX 1 (light/dark)	67,402.94	123417.6	55
TCDD/HCX 2 (light/dark)	74,619.44	123417.6	60
TCDD/HCX 3 (light/dark)	77,140.15	123417.6	63
TCDD/HCX 4 (dark)	79,625.58	123417.6	65

Sample ID	Rinseate (pg)	Spike Amt*	% Recovery
Matrix Spike	NA		NA
Method Blank	159.717		
TCDD/HCX 1 (light/dark)	53,253.24	123417.6	43
TCDD/HCX 2 (light/dark)	49,434.68	123417.6	40
TCDD/HCX 3 (light/dark)	58,802.90	123417.6	48
TCDD/HCX 4 (dark)	34,935.12	123417.6	28

Sample ID	Sum of Fractions (pg)	Spike Amt*	% Recovery
Matrix Spike	95,453.71	123417.6	77
Method Blank	159.72		
TCDD/HCX 1 (light/dark)	120,656.17	123417.6	98
TCDD/HCX 2 (light/dark)	124,054.12	123417.6	101
TCDD/HCX 3 (light/dark)	135,943.05	123417.6	110
TCDD/HCX 4 (dark)	114,560.7	123417.6	93

Analyzed by modified method 1631B at Battelle-Columbus, 4/2002. Data have not received third-party review.
* HCX spike amount adjusted by 1.607 (obtained from the recovery on the last analysis of Std sol 1)

TCDD results

Sample ID	Water (pg)	Rinseate (pg)	Sum of Fractions (pg)	Rinsesate/ Water ratio	Water/ Rinseate Ratio
Matrix Spike	18,760.665		18,760.665		
Method Blank	27.685	336.83	364.515		
TCDD/HCX 1 (light/dark)	7,432.239	8,254.12	15,686.359	1.11	0.90
TCDD/HCX 2 (light/dark)	7,155.708	8,581.64	15,737.348	1.20	0.83
TCDD/HCX 3 (light/dark)	10,450.878	6,062.39	16,513.268	0.58	1.72
TCDD/HCX 4 (dark)	10,933.899	5,580.62	16,514.519	0.51	1.96

Sample ID	Water (pg)	Spike Amt	% Recovery
Matrix Spike	18,760.665	15,360	122
Method Blank	27.685		
TCDD/HCX 1 (light/dark)	7,432.239	15,360	48
TCDD/HCX 2 (light/dark)	7,155.708	15,360	47
TCDD/HCX 3 (light/dark)	10,450.878	15,360	68
TCDD/HCX 4 (dark)	10,933.899	15,360	71

Sample ID	Rinseate (pg)	Spike Amt	% Recovery
Matrix Spike	NA		NA
Method Blank	336.83		
TCDD/HCX 1 (light/dark)	8,254.12	15,360	54
TCDD/HCX 2 (light/dark)	8,581.64	15,360	56
TCDD/HCX 3 (light/dark)	6,062.39	15,360	39
TCDD/HCX 4 (dark)	5,580.62	15,360	36

Sample ID	Sum of Fractions (pg)	Spike Amt	% Recovery
Matrix Spike	18,760.665	15,360	122
Method Blank	364.5145		
TCDD/HCX 1 (light/dark)	15686.3585	15,360	102
TCDD/HCX 2 (light/dark)	15737.348	15,360	102
TCDD/HCX 3 (light/dark)	16513.2675	15,360	108
TCDD/HCX 4 (dark)	16514.5185	15,360	108

Analyzed by modified method 1631B at Battelle-Columbus, 4/2002. Data have not received third-party review.

TCDD / HCX ratios

HCX results

Sample ID	HCX Water (pg)	HCX Rinseate (pg)	HCX Sum of Fractions (pg)
Matrix Spike	95,453.707		95,453.707
Method Blank	0.000	159.717	159.717
TCDD/HCX 1 (light/dark)	67,402.936	53,253.24	120,656.174
TCDD/HCX 2 (light/dark)	74,619.443	49,434.68	124,054.122
TCDD/HCX 3 (light/dark)	77,140.152	58,802.90	135,943.052
TCDD/HCX 4 (dark)	79,625.582	34,935.12	114,560.705

TCDD results

Sample ID	TCDD Water (pg)	TCDD Rinseate (pg)	TCDD Sum of Fractions (pg)
Matrix Spike	18,760.665		18,760.665
Method Blank	27.685	336.83	364.515
TCDD/HCX 1 (light/dark)	7,432.239	8,254.12	15,686.359
TCDD/HCX 2 (light/dark)	7,155.708	8,581.64	15,737.348
TCDD/HCX 3 (light/dark)	10,450.878	6,062.39	16,513.268
TCDD/HCX 4 (dark)	10,933.899	5,580.62	16,514.519

Ratios HCX:TCDD

	Water Ratio HCX:TCD	Rinseate Ratio HCX:TCD	Sum of Water and Rinseate Ratio HCX:TCDD
Matrix Spike	5.09		
Method Blank	NA	NA	NA
TCDD/HCX 1 (light/dark)	9.07	6.45	7.69
TCDD/HCX 2 (light/dark)	10.43	5.76	7.88
TCDD/HCX 3 (light/dark)	7.38	9.70	8.23
TCDD/HCX 4 (dark)	7.28	6.26	6.94

Ratios TCDD:HCX

	Water Ratio TCDD:HC	Rinseate Ratio TCDD:HC	Sum of Water and Rinseate Ratio TCDD:HCX
Matrix Spike	0.20		
Method Blank	NA	NA	NA
TCDD/HCX 1 (light/dark)	0.11	0.15	0.13
TCDD/HCX 2 (light/dark)	0.10	0.17	0.13
TCDD/HCX 3 (light/dark)	0.14	0.10	0.12
TCDD/HCX 4 (dark)	0.14	0.16	0.14

Analyzed by modified method 1631B at Battelle-Columbus, 4/2002. Data have not received third-party review.

Appendix J - ToxCalc™ Outputs of Estimated EC and IC values

Non-Lipid Normalized Data

Channel catfish hatchability 10d post-exposure TCDD & PCB (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECv10d	Sample ID:	1dTEC
End Date:	8/14/2001	Lab ID:	1dTEC	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus embryos at 10d
Comments:	Channel catfish hatchability 10d post-exposure TCDD & PCB				

Conc-ppt	1	2	3	4	5
oratory Control	1.0000	0.9000	0.9000	0.9500	0.8000
S-Control	1.0000	1.0000	1.0000	1.0000	0.9000
85.76	1.0000				
92.76	0.8000				
96.14	1.0000				
104.87	0.8500				
125.05	0.9500				
139.14	0.9500				
177.48	1.0000				
191.05	0.9000				
315.73	0.9500				
348.21	0.8500				
458.34	0.8500				
488.34	0.9500				
540.99	0.7500				
618.55	0.0500				
627.07	0.5000				
901.42	0.9500				
972.15	0.1500				
1147.08	0.7000				

			Transform: Arcsin Square Root					Number	Total
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
Pooled	0.9450	1.0000	1.3493	1.1071	1.4588	9.526	10	11	200
85.76	1.0000	1.0582	1.4588	1.4588	1.4588	0.000	1	0	20
92.76	0.8000	0.8466	1.1071	1.1071	1.1071	0.000	1	4	20
96.14	1.0000	1.0582	1.4588	1.4588	1.4588	0.000	1	0	20
104.87	0.8500	0.8995	1.1731	1.1731	1.1731	0.000	1	3	20
125.05	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
139.14	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
177.48	1.0000	1.0582	1.4588	1.4588	1.4588	0.000	1	0	20
191.05	0.9000	0.9524	1.2490	1.2490	1.2490	0.000	1	2	20
315.73	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
348.21	0.8500	0.8995	1.1731	1.1731	1.1731	0.000	1	3	20
458.34	0.8500	0.8995	1.1731	1.1731	1.1731	0.000	1	3	20
488.34	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
540.99	0.7500	0.7937	1.0472	1.0472	1.0472	0.000	1	5	20
618.55	0.0500	0.0529	0.2255	0.2255	0.2255	0.000	1	19	20

Channel catfish hatchability 10d post-exposure TCDD & PCB (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECv10d	Sample ID:	1dTEC
End Date:	8/14/2001	Lab ID:	1dTEC	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus embryos at 10d
Comments:	Channel catfish hatchability 10d post-exposure TCDD & PCB				

627.07	0.5000	0.5291	0.7854	0.7854	0.7854	0.000	1	10	20
901.42	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
972.15	0.1500	0.1587	0.3977	0.3977	0.3977	0.000	1	17	20
1147.08	0.7000	0.7407	0.9912	0.9912	0.9912	0.000	1	6	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.748991	0.896	-1.04222	3.438612
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.10)	1.879006	2.306006		

Reviewed by:_____

Channel catfish hatchability 10d post-exposure TCDD & PCB (non-lipid normalized)

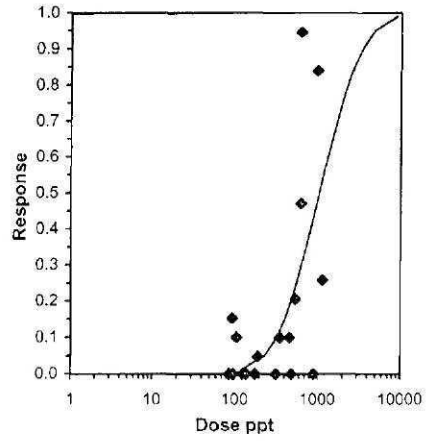
Start Date:	7/13/2001	Test ID:	1dTECv10d	Sample ID:	1dTEC
End Date:	8/14/2001	Lab ID:	1dTEC	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus embryos at 10d
Comments:	Channel catfish hatchability 10d post-exposure TCDD & PCB				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	2.490735	1.362483	-0.3976	5.379069	0.055	88.62354	26.29622	4.5E-12	3.016646	0.401488	6
Intercept	-2.51367	3.822525	-10.6171	5.589723							
TSCR	0.055566	0.032835	-0.01404	0.125174							

Point	Probits	ppt	95% Fiducial Limits	
EC01	2.674	120.9611		
EC05	3.355	227.1212		
EC10	3.718	317.7745		
EC15	3.964	398.5942		
EC20	4.158	477.2498		
EC25	4.326	556.9895		
EC40	4.747	822.1114		
EC50	5.000	1039.074		
EC60	5.253	1313.295		
EC75	5.674	1938.411		
EC80	5.842	2262.285		
EC85	6.036	2708.707		
EC90	6.282	3397.613		
EC95	6.645	4753.739		
EC99	7.326	8925.801		

Significant heterogeneity detected (p = 4.48E-12)



Channel catfish survival 32d post-exposure TCDD & PCB (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECv32d	Sample ID:	1dTEC
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish survival 32d post-exposure TCDD & PCB				

Conc-ppt	1	2	3	4	5
oratory Control	0.9000	0.8000	0.8500	0.8000	0.5500
S-Control	0.8500	1.0000	0.8500	0.9500	0.8500
85.76	0.9000				
92.76	0.7500				
96.14	0.9000				
104.87	0.8000				
125.05	0.9000				
139.14	0.8500				
177.48	0.8500				
191.05	0.8500				
315.73	0.9500				
348.21	0.8500				
458.34	0.6500				
488.34	0.6500				
540.99	0.4500				
618.55	0.0000				
627.07	0.3500				
901.42	0.6000				
972.15	0.0000				
1147.08	0.2000				

			Transform: Arcsin Square Root					Number	Total
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
Pooled	0.8400	1.0000	1.1795	0.8355	1.4588	13.824	10	32	200
85.76	0.9000	1.0714	1.2490	1.2490	1.2490	0.000	1	2	20
92.76	0.7500	0.8929	1.0472	1.0472	1.0472	0.000	1	5	20
96.14	0.9000	1.0714	1.2490	1.2490	1.2490	0.000	1	2	20
104.87	0.8000	0.9524	1.1071	1.1071	1.1071	0.000	1	4	20
125.05	0.9000	1.0714	1.2490	1.2490	1.2490	0.000	1	2	20
139.14	0.8500	1.0119	1.1731	1.1731	1.1731	0.000	1	3	20
177.48	0.8500	1.0119	1.1731	1.1731	1.1731	0.000	1	3	20
191.05	0.8500	1.0119	1.1731	1.1731	1.1731	0.000	1	3	20
315.73	0.9500	1.1310	1.3453	1.3453	1.3453	0.000	1	1	20
348.21	0.8500	1.0119	1.1731	1.1731	1.1731	0.000	1	3	20
458.34	0.6500	0.7738	0.9377	0.9377	0.9377	0.000	1	7	20
488.34	0.6500	0.7738	0.9377	0.9377	0.9377	0.000	1	7	20
540.99	0.4500	0.5357	0.7353	0.7353	0.7353	0.000	1	11	20
618.55	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	1	20	20

Channel catfish survival 32d post-exposure TCDD & PCB (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECv32d	Sample ID:	1dTEC
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish survival 32d post-exposure TCDD & PCB				

627.07	0.3500	0.4167	0.6331	0.6331	0.6331	0.000	1	13	20
901.42	0.6000	0.7143	0.8861	0.8861	0.8861	0.000	1	8	20
972.15	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	1	20	20
1147.08	0.2000	0.2381	0.4636	0.4636	0.4636	0.000	1	16	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.606981	0.896	-0.70849	8.96054
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.10)	1.864613	2.306006		

Reviewed by:_____

Channel catfish survival 32d post-exposure TCDD & PCB (non-lipid normalized)

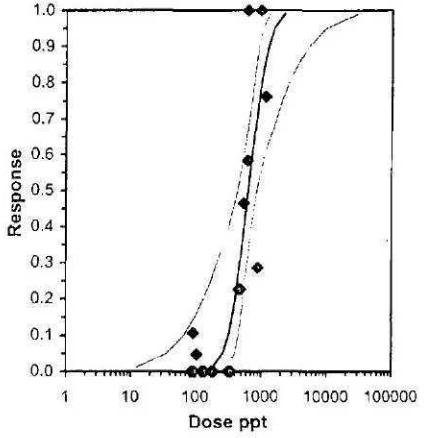
Start Date:	7/13/2001	Test ID:	1dTECv32d	Sample ID:	1dTEC
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish survival 32d post-exposure TCDD & PCB				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	4.265121	1.360619	1.380737	7.149504	0.16	48.12636	26.29622	4.5E-05	2.803643	0.23446	9
Intercept	-6.95787	3.825931	-15.0685	1.152736							
TSCR	0.148658	0.033216	0.078243	0.219072							

Point	Probits	ppt	95% Fiducial Limits	
EC01	2.674	181.2204	11.81065	315.6823
EC05	3.355	261.8124	36.31745	398.3839
EC10	3.718	318.5445	65.76323	453.2844
EC15	3.964	363.6139	97.7731	496.5308
EC20	4.158	403.9393	133.4682	535.9556
EC25	4.326	442.0809	173.5251	574.8654
EC40	4.747	554.9359	323.0224	713.8612
EC50	5.000	636.2717	441.2417	865.1518
EC60	5.253	729.5287	556.1879	1136.239
EC75	5.674	915.7637	712.1366	2051.379
EC80	5.842	1002.234	767.5808	2654.037
EC85	6.036	1113.383	831.4657	3610.173
EC90	6.282	1270.911	913.2265	5353.098
EC95	6.645	1546.304	1041.329	9672.365
EC99	7.326	2233.974	1316.494	29688.98

Significant heterogeneity detected (p = 4.54E-05)



Channel catfish lengths 32d post-exposure TCDD & PCB (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECvLen	Sample ID:	1dTEC
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish lengths 32d post-exposure TCDD & PCB				

Conc-ppt	1	2	3	4	5
oratory Control	3.3030	3.1910	3.2000	3.2770	3.4300
S-Control	3.1350	3.2150	3.2240	3.2180	3.2120
85.76	3.3000				
92.76	3.3730				
96.14	3.2500				
104.87	2.9720				
125.05	3.1830				
139.14	3.0820				
177.48	3.1890				
191.05	3.2030				
315.73	3.1420				
348.21	3.1820				
458.34	3.1150				
488.34	3.0730				
540.99	3.1280				
618.55	0.0000				
627.07	3.1570				
901.42	3.0680				
972.15	0.0000				
1147.08	2.8750				

			Transform: Untransformed					Isotonic	
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Mean	N-Mean
Pooled	3.2405	1.0000	3.2405	3.1350	3.4300	2.490	10	3.3045	1.0000
85.76	3.3000	1.0184	3.3000	3.3000	3.3000	0.000	1	3.3045	1.0000
92.76	3.3730	1.0409	3.3730	3.3730	3.3730	0.000	1	3.3045	1.0000
96.14	3.2500	1.0029	3.2500	3.2500	3.2500	0.000	1	3.2500	0.9835
104.87	2.9720	0.9171	2.9720	2.9720	2.9720	0.000	1	3.1361	0.9491
125.05	3.1830	0.9823	3.1830	3.1830	3.1830	0.000	1	3.1361	0.9491
139.14	3.0820	0.9511	3.0820	3.0820	3.0820	0.000	1	3.1361	0.9491
177.48	3.1890	0.9841	3.1890	3.1890	3.1890	0.000	1	3.1361	0.9491
191.05	3.2030	0.9884	3.2030	3.2030	3.2030	0.000	1	3.1361	0.9491
315.73	3.1420	0.9696	3.1420	3.1420	3.1420	0.000	1	3.1361	0.9491
348.21	3.1820	0.9819	3.1820	3.1820	3.1820	0.000	1	3.1361	0.9491
458.34	3.1150	0.9613	3.1150	3.1150	3.1150	0.000	1	3.1150	0.9427
488.34	3.0730	0.9483	3.0730	3.0730	3.0730	0.000	1	3.1005	0.9383
540.99	3.1280	0.9653	3.1280	3.1280	3.1280	0.000	1	3.1005	0.9383
618.55	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	1	2.0750	0.6279

Channel catfish lengths 32d post-exposure TCDD & PCB (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECvLen	Sample ID:	1dTEC
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish lengths 32d post-exposure TCDD & PCB				

627.07	3.1570	0.9742	3.1570	3.1570	3.1570	0.000	1	2.0750	0.6279
901.42	3.0680	0.9468	3.0680	3.0680	3.0680	0.000	1	2.0750	0.6279
972.15	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	1	1.4375	0.4350
1147.08	2.8750	0.8872	2.8750	2.8750	2.8750	0.000	1	1.4375	0.4350

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.6638	0.896	2.240093	10.77995
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.12)	1.715387	2.306006		

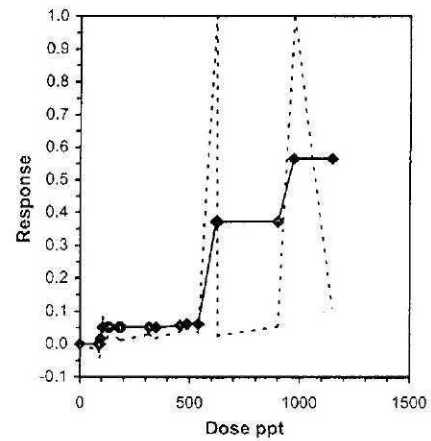
Reviewed by:_____

Channel catfish lengths 32d post-exposure TCDD & PCB (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECvLen	Sample ID:	1dTEC
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish lengths 32d post-exposure TCDD & PCB				

Linear Interpolation (200 Resamples)

Point	ppt	SD	95% CL(Exp)		Skew
IC05	104.63	129.65	99.71	1284.95	0.4748
IC10	550.55	0.52	545.96	554.28	-0.4061
IC15	563.05	0.49	558.71	566.57	-0.4061
IC20	575.55	0.46	571.46	578.86	-0.4061
IC25	588.04	0.43	584.21	591.15	-0.4061
IC40	911.66	0.51	907.17	915.31	-0.4061
IC50	948.32	0.42	944.58	951.36	-0.4061



Channel catfish weights 32d post-expousre TCDD & PCB (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECvWei	Sample ID:	1dTEC
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish weights 32d post-expousre TCDD & PCB				

Conc-ppt	1	2	3	4	5
oratory Control	0.3840	0.3550	0.3520	0.3710	0.4010
S-Control	0.3490	0.3660	0.3750	0.3770	0.3710
85.76	0.4090				
92.76	0.4340				
96.14	0.4120				
104.87	0.3020				
125.05	0.3530				
139.14	0.3580				
177.48	0.3800				
191.05	0.3930				
315.73	0.3900				
348.21	0.3630				
458.34	0.3500				
488.34	0.3380				
540.99	0.3300				
618.55	0.0000				
627.07	0.3730				
901.42	0.3180				
972.15	0.0000				
1147.08	0.2960				

			Transform: Untransformed					Isotonic	
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Mean	N-Mean
Pooled	0.3701	1.0000	0.3701	0.3490	0.4010	4.262	10	0.4063	1.0000
85.76	0.4090	1.1051	0.4090	0.4090	0.4090	0.000	1	0.4063	1.0000
92.76	0.4340	1.1727	0.4340	0.4340	0.4340	0.000	1	0.4063	1.0000
96.14	0.4120	1.1132	0.4120	0.4120	0.4120	0.000	1	0.4063	1.0000
104.87	0.3020	0.8160	0.3020	0.3020	0.3020	0.000	1	0.3627	0.8928
125.05	0.3530	0.9538	0.3530	0.3530	0.3530	0.000	1	0.3627	0.8928
139.14	0.3580	0.9673	0.3580	0.3580	0.3580	0.000	1	0.3627	0.8928
177.48	0.3800	1.0267	0.3800	0.3800	0.3800	0.000	1	0.3627	0.8928
191.05	0.3930	1.0619	0.3930	0.3930	0.3930	0.000	1	0.3627	0.8928
315.73	0.3900	1.0538	0.3900	0.3900	0.3900	0.000	1	0.3627	0.8928
348.21	0.3630	0.9808	0.3630	0.3630	0.3630	0.000	1	0.3627	0.8928
458.34	0.3500	0.9457	0.3500	0.3500	0.3500	0.000	1	0.3500	0.8615
488.34	0.3380	0.9133	0.3380	0.3380	0.3380	0.000	1	0.3380	0.8319
540.99	0.3300	0.8917	0.3300	0.3300	0.3300	0.000	1	0.3300	0.8123
618.55	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	1	0.2303	0.5669

Channel catfish weights 32d post-expousre TCDD & PCB (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECvWei	Sample ID:	1dTEC
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish weights 32d post-expousre TCDD & PCB				

627.07	0.3730	1.0078	0.3730	0.3730	0.3730	0.000	1	0.2303	0.5669
901.42	0.3180	0.8592	0.3180	0.3180	0.3180	0.000	1	0.2303	0.5669
972.15	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	1	0.1480	0.3643
1147.08	0.2960	0.7998	0.2960	0.2960	0.2960	0.000	1	0.1480	0.3643

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.709256	0.896	0.729013	5.447733
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.64)	0.479309	2.306006		

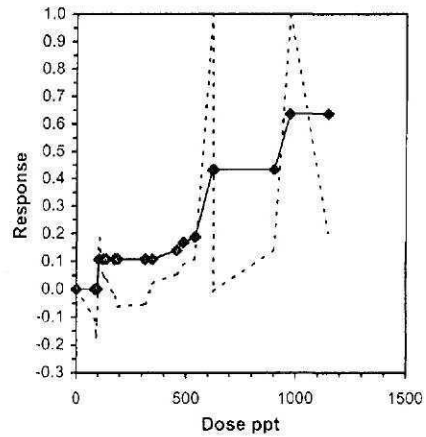
Reviewed by:_____

Channel catfish weights 32d post-expousre TCDD & PCB (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECvWei	Sample ID:	1dTEC
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish weights 32d post-expousre TCDD & PCB				

Linear Interpolation (200 Resamples)

Point	ppt	SD	95% CL(Exp)		Skew
IC05	100.21	0.10	99.53	101.01	0.1063
IC10	104.28	0.19	102.93	105.88	0.1063
IC15	470.01	2.42	451.90	489.35	-0.0573
IC20	544.87	0.71	539.56	550.53	-0.0573
IC25	560.67	0.67	555.70	565.99	-0.0573
IC40	608.10	0.53	604.12	612.35	-0.0573
IC50	924.78	0.49	921.12	928.69	-0.0573



Channel catfish hatchability 10d post-exposure TCDD, PCB & HCX (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHv10d	Sample ID:	1dTEC-HCX
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus embryos at 10d
Comments:	Channel catfish hatchability 10d post-exposure TCDD, PCB & HCX				

Conc-ppt	1	2	3	4	5
oratory Control	1.0000	0.9000	0.9000	0.9500	0.8000
S-Control	1.0000	1.0000	1.0000	1.0000	0.9000
67.46	0.9000				
88.97	0.9500				
96.41	0.9500				
97.78	1.0000				
171.23	0.9000				
176.86	0.9500				
192.45	0.9000				
253.41	0.9500				
331.75	0.7500				
351.42	0.9000				
374.54	0.9500				
503.65	0.8500				
584.49	0.8500				
607.67	0.8000				
745.09	0.6500				
748.38	0.2000				
816.64	0.7000				
1271.17	0.2000				

			Transform: Arcsin Square Root					Number	Total
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
Pooled	0.9450	1.0000	1.3493	1.1071	1.4588	9.526	10	11	200
67.46	0.9000	0.9524	1.2490	1.2490	1.2490	0.000	1	2	20
88.97	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
96.41	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
97.78	1.0000	1.0582	1.4588	1.4588	1.4588	0.000	1	0	20
171.23	0.9000	0.9524	1.2490	1.2490	1.2490	0.000	1	2	20
176.86	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
192.45	0.9000	0.9524	1.2490	1.2490	1.2490	0.000	1	2	20
253.41	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
331.75	0.7500	0.7937	1.0472	1.0472	1.0472	0.000	1	5	20
351.42	0.9000	0.9524	1.2490	1.2490	1.2490	0.000	1	2	20
374.54	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
503.65	0.8500	0.8995	1.1731	1.1731	1.1731	0.000	1	3	20
584.49	0.8500	0.8995	1.1731	1.1731	1.1731	0.000	1	3	20
607.67	0.8000	0.8466	1.1071	1.1071	1.1071	0.000	1	4	20

Channel catfish hatchability 10d post-exposure TCDD, PCB & HCX (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHv10d	Sample ID:	1dTEC-HCX
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus embryos at 10d
Comments:	Channel catfish hatchability 10d post-exposure TCDD, PCB & HCX				

745.09	0.6500	0.6878	0.9377	0.9377	0.9377	0.000	1	7	20
748.38	0.2000	0.2116	0.4636	0.4636	0.4636	0.000	1	16	20
816.64	0.7000	0.7407	0.9912	0.9912	0.9912	0.000	1	6	20
1271.17	0.2000	0.2116	0.4636	0.4636	0.4636	0.000	1	16	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.748991	0.896	-1.04222	3.438612
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.10)	1.879006	2.306006		

Reviewed by:_____

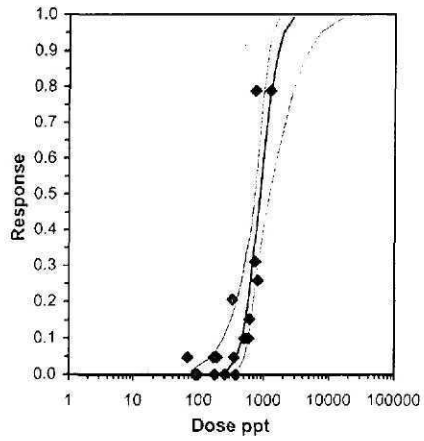
Channel catfish hatchability 10d post-exposure TCDD, PCB & HCX (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHv10d	Sample ID:	1dTEC-HCX
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus embryos at 10d
Comments:	Channel catfish hatchability 10d post-exposure TCDD, PCB & HCX				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	4.670699	1.248385	2.024242	7.317156	0.055	27.76385	26.29622	0.03	2.942209	0.214101	9
Intercept	-8.74217	3.572848	-16.3163	-1.16808							
TSCR	0.061662	0.016667	0.026329	0.096995							

Point	Probits	ppt	95% Fiducial Limits	
EC01	2.674	278.0588	75.49531	406.8473
EC05	3.355	389.0855	161.6913	511.0551
EC10	3.718	465.402	240.9883	581.1453
EC15	3.964	525.1801	313.4079	637.9129
EC20	4.158	578.1196	383.3861	691.9879
EC25	4.326	627.7701	451.6514	748.7512
EC40	4.747	772.6229	635.4972	980.9172
EC50	5.000	875.4057	734.0798	1226.826
EC60	5.253	991.8618	823.0496	1580.813
EC75	5.674	1220.726	966.7863	2480.74
EC80	5.842	1325.565	1025.704	2980.546
EC85	6.036	1459.186	1096.963	3698.192
EC90	6.282	1646.609	1191.513	4860.411
EC95	6.645	1969.58	1343.663	7304.789
EC99	7.326	2756.019	1676.474	15750.87



Channel catfish survival 32d post-exposure TCDD, PCB & HCX (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHv32d	Sample ID:	1dTEC-HCX
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish survival 32d post-exposure TCDD, PCB & HCX				

Conc-ppt	1	2	3	4	5
oratory Control	0.9000	0.8000	0.8500	0.8000	0.5500
S-Control	0.8500	1.0000	0.8500	0.9500	0.8500
67.46	0.8000				
88.97	0.7500				
96.41	0.8000				
97.78	0.9000				
171.23	0.8000				
176.86	0.9500				
192.45	0.7000				
253.41	0.9500				
331.75	0.7000				
351.42	0.6500				
374.54	0.3500				
503.65	0.8000				
584.49	0.6000				
607.67	0.8000				
745.09	0.6000				
748.38	0.0000				
816.64	0.5500				
1271.17	0.0000				

			Transform: Arcsin Square Root					Number	Total
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
Pooled	0.8400	1.0000	1.1795	0.8355	1.4588	13.824	10	32	200
67.46	0.8000	0.9524	1.1071	1.1071	1.1071	0.000	1	4	20
88.97	0.7500	0.8929	1.0472	1.0472	1.0472	0.000	1	5	20
96.41	0.8000	0.9524	1.1071	1.1071	1.1071	0.000	1	4	20
97.78	0.9000	1.0714	1.2490	1.2490	1.2490	0.000	1	2	20
171.23	0.8000	0.9524	1.1071	1.1071	1.1071	0.000	1	4	20
176.86	0.9500	1.1310	1.3453	1.3453	1.3453	0.000	1	1	20
192.45	0.7000	0.8333	0.9912	0.9912	0.9912	0.000	1	6	20
253.41	0.9500	1.1310	1.3453	1.3453	1.3453	0.000	1	1	20
331.75	0.7000	0.8333	0.9912	0.9912	0.9912	0.000	1	6	20
351.42	0.6500	0.7738	0.9377	0.9377	0.9377	0.000	1	7	20
374.54	0.3500	0.4167	0.6331	0.6331	0.6331	0.000	1	13	20
503.65	0.8000	0.9524	1.1071	1.1071	1.1071	0.000	1	4	20
584.49	0.6000	0.7143	0.8861	0.8861	0.8861	0.000	1	8	20
607.67	0.8000	0.9524	1.1071	1.1071	1.1071	0.000	1	4	20

Channel catfish survival 32d post-exposure TCDD, PCB & HCX (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHv32d	Sample ID:	1dTEC-HCX
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish survival 32d post-exposure TCDD, PCB & HCX				

745.09	0.6000	0.7143	0.8861	0.8861	0.8861	0.000	1	8	20
748.38	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	1	20	20
816.64	0.5500	0.6548	0.8355	0.8355	0.8355	0.000	1	9	20
1271.17	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	1	20	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.606981	0.896	-0.70849	8.96054
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.10)	1.864613	2.306006		

Reviewed by:_____

Channel catfish survival 32d post-exposure TCDD, PCB & HCX (non-lipid normalized)

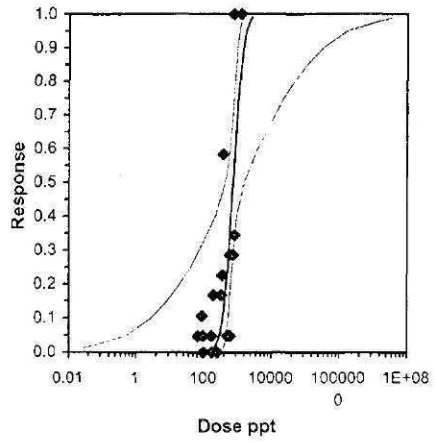
Start Date:	7/13/2001	Test ID:	1dTECHv32d	Sample ID:	1dTEC-HCX
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish survival 32d post-exposure TCDD, PCB & HCX				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	4.268778	1.772551	0.51114	8.026417	0.16	57.87166	26.29622	1.2E-06	2.865633	0.234259	11
Intercept	-7.23275	5.028191	-17.892	3.426534							
TSCR	0.174566	0.039118	0.091641	0.257492							

Point	Probits	ppt	95% Fiducial Limits	
EC01	2.674	209.2498	0.026701	384.8409
EC05	3.355	302.2117	0.565212	476.1959
EC10	3.718	367.6361	2.85455	537.6398
EC15	3.964	419.6036	8.453945	587.5717
EC20	4.158	466.0964	19.88131	635.4471
EC25	4.326	510.0677	40.98634	686.572
EC40	4.747	640.1538	222.0708	953.3053
EC50	5.000	733.8937	443.2134	1608.149
EC60	5.253	841.3603	609.2767	3938.585
EC75	5.674	1055.938	775.8815	23267.92
EC80	5.842	1155.555	830.8477	48398.55
EC85	6.036	1283.592	893.2981	114488.5
EC90	6.282	1465.036	972.2614	340459.8
EC95	6.645	1782.194	1094.26	1724886
EC99	7.326	2573.957	1350.646	36604161

Significant heterogeneity detected (p = 1.19E-06)



Channel catfish lengths 32d post-exposure TCDD, PCB & HCX (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHvLen	Sample ID:	1dTEC-HCX
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish lengths 32d post-exposure TCDD, PCB & HCX				

Conc-ppt	1	2	3	4	5
oratory Control	3.3030	3.1910	3.2000	3.2770	3.4300
S-Control	3.1350	3.2150	3.2240	3.2180	3.2120
67.46	3.2500				
88.97	3.0930				
96.41	3.1840				
97.78	3.1140				
171.23	3.1660				
176.86	3.1920				
192.45	3.0570				
253.41	3.0710				
331.75	3.2310				
351.42	3.1080				
374.54	2.8640				
503.65	3.2250				
584.49	2.9170				
607.67	3.2690				
745.09	3.1960				
748.38	0.0000				
816.64	3.2230				
1271.17	0.0000				

			Transform: Untransformed					Isotonic	
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Mean	N-Mean
Pooled	3.2405	1.0000	3.2405	3.1350	3.4300	2.490	10	3.2453	1.0000
67.46	3.2500	1.0029	3.2500	3.2500	3.2500	0.000	1	3.2453	1.0000
88.97	3.0930	0.9545	3.0930	3.0930	3.0930	0.000	1	3.1498	0.9706
96.41	3.1840	0.9826	3.1840	3.1840	3.1840	0.000	1	3.1498	0.9706
97.78	3.1140	0.9610	3.1140	3.1140	3.1140	0.000	1	3.1498	0.9706
171.23	3.1660	0.9770	3.1660	3.1660	3.1660	0.000	1	3.1498	0.9706
176.86	3.1920	0.9850	3.1920	3.1920	3.1920	0.000	1	3.1498	0.9706
192.45	3.0570	0.9434	3.0570	3.0570	3.0570	0.000	1	3.1197	0.9613
253.41	3.0710	0.9477	3.0710	3.0710	3.0710	0.000	1	3.1197	0.9613
331.75	3.2310	0.9971	3.2310	3.2310	3.2310	0.000	1	3.1197	0.9613
351.42	3.1080	0.9591	3.1080	3.1080	3.1080	0.000	1	3.1080	0.9577
374.54	2.8640	0.8838	2.8640	2.8640	2.8640	0.000	1	3.0942	0.9535
503.65	3.2250	0.9952	3.2250	3.2250	3.2250	0.000	1	3.0942	0.9535
584.49	2.9170	0.9002	2.9170	2.9170	2.9170	0.000	1	3.0942	0.9535
607.67	3.2690	1.0088	3.2690	3.2690	3.2690	0.000	1	3.0942	0.9535

Channel catfish lengths 32d post-exposure TCDD, PCB & HCX (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHvLen	Sample ID:	1dTEC-HCX
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish lengths 32d post-exposure TCDD, PCB & HCX				

745.09	3.1960	0.9863	3.1960	3.1960	3.1960	0.000	1	3.0942	0.9535
748.38	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	1	1.6115	0.4966
816.64	3.2230	0.9946	3.2230	3.2230	3.2230	0.000	1	1.6115	0.4966
1271.17	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	1	0.0000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.6638	0.896	2.240093	10.77995
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.12)	1.715387	2.306006		

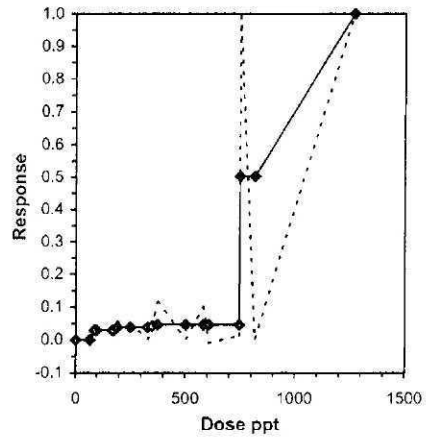
Reviewed by:_____

Channel catfish lengths 32d post-exposure TCDD, PCB & HCX (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHvLen	Sample ID:	1dTEC-HCX
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish lengths 32d post-exposure TCDD, PCB & HCX				

Linear Interpolation (200 Resamples)

Point	ppt	SD	95% CL(Exp)		Skew
IC05	745.11	182.14	0.00	745.30	-1.4671
IC10	745.47	0.04	745.09	745.65	-1.2859
IC15	745.83	0.03	745.47	746.00	-1.2859
IC20	746.20	0.03	745.85	746.35	-1.2859
IC25	746.56	0.03	746.24	746.70	-1.2859
IC40	747.64	0.02	747.38	747.75	-1.2859
IC50	748.36	11.74	748.14	1021.61	5.5523



Channel catfish weights 32d post-exposure TCDD, PCB & HCX (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHvWei	Sample ID:	1dTEC-HCX
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish weights 32d post-exposure TCDD, PCB & HCX				

Conc-ppt	1	2	3	4	5
oratory Control	0.3840	0.3550	0.3520	0.3710	0.4010
S-Control	0.3490	0.3660	0.3750	0.3770	0.3710
67.46	0.4280				
88.97	0.3550				
96.41	0.3840				
97.78	0.3670				
171.23	0.3810				
176.86	0.3720				
192.45	0.3440				
253.41	0.3690				
331.75	0.4040				
351.42	0.3800				
374.54	0.2340				
503.65	0.3850				
584.49	0.2750				
607.67	0.3810				
745.09	0.3700				
748.38	0.0000				
816.64	0.3680				
1271.17	0.0000				

			Transform: Untransformed					Isotonic	
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Mean	N-Mean
Pooled	0.3701	1.0000	0.3701	0.3490	0.4010	4.262	10	0.3991	1.0000
67.46	0.4280	1.1564	0.4280	0.4280	0.4280	0.000	1	0.3991	1.0000
88.97	0.3550	0.9592	0.3550	0.3550	0.3550	0.000	1	0.3729	0.9344
96.41	0.3840	1.0376	0.3840	0.3840	0.3840	0.000	1	0.3729	0.9344
97.78	0.3670	0.9916	0.3670	0.3670	0.3670	0.000	1	0.3729	0.9344
171.23	0.3810	1.0295	0.3810	0.3810	0.3810	0.000	1	0.3729	0.9344
176.86	0.3720	1.0051	0.3720	0.3720	0.3720	0.000	1	0.3729	0.9344
192.45	0.3440	0.9295	0.3440	0.3440	0.3440	0.000	1	0.3729	0.9344
253.41	0.3690	0.9970	0.3690	0.3690	0.3690	0.000	1	0.3729	0.9344
331.75	0.4040	1.0916	0.4040	0.4040	0.4040	0.000	1	0.3729	0.9344
351.42	0.3800	1.0267	0.3800	0.3800	0.3800	0.000	1	0.3729	0.9344
374.54	0.2340	0.6323	0.2340	0.2340	0.2340	0.000	1	0.3290	0.8245
503.65	0.3850	1.0403	0.3850	0.3850	0.3850	0.000	1	0.3290	0.8245
584.49	0.2750	0.7430	0.2750	0.2750	0.2750	0.000	1	0.3290	0.8245
607.67	0.3810	1.0295	0.3810	0.3810	0.3810	0.000	1	0.3290	0.8245

Channel catfish weights 32d post-exposure TCDD, PCB & HCX (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHvWei	Sample ID:	1dTEC-HCX
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish weights 32d post-exposure TCDD, PCB & HCX				

745.09	0.3700	0.9997	0.3700	0.3700	0.3700	0.000	1	0.3290	0.8245
748.38	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	1	0.1840	0.4611
816.64	0.3680	0.9943	0.3680	0.3680	0.3680	0.000	1	0.1840	0.4611
1271.17	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	1	0.0000	0.0000

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.709256	0.896	0.729013	5.447733
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.64)	0.479309	2.306006		

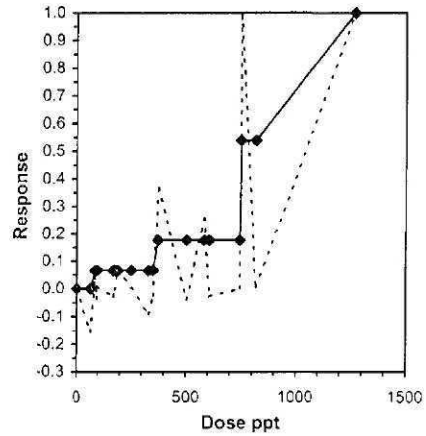
Reviewed by:_____

Channel catfish weights 32d post-exposure TCDD, PCB & HCX (non-lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHvWei	Sample ID:	1dTEC-HCX
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish weights 32d post-exposure TCDD, PCB & HCX				

Linear Interpolation (200 Resamples)

Point	ppt	SD	95% CL(Exp)		Skew
IC05	83.87	1.38	75.28	96.78	0.5019
IC10	358.66	1.08	350.58	367.29	-0.0573
IC15	369.17	1.02	361.54	377.32	-0.0573
IC20	745.31	0.04	745.00	745.64	-0.0573
IC25	745.76	0.04	745.47	746.07	-0.0573
IC40	747.12	0.03	746.89	747.37	-0.0573
IC50	748.03	0.03	747.83	748.23	-0.0573



Lipid Normalized Data

Channel catfish hatchability 10d post-exposure TCDD & PCB (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECLv10d	Sample ID:	1dTEC(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus embryos at 10d
Comments:	Channel catfish hatchability 10d post-exposure TCDD & PCB				

Conc-ppt	1	2	3	4	5
oratory Control	1.0000	0.9000	0.9000	0.9500	0.8000
S-Control	1.0000	1.0000	1.0000	1.0000	0.9000
4255.07	0.8000				
4309.36	1.0000				
4403.08	0.9500				
5313.77	1.0000				
6773.62	1.0000				
7862.27	0.9000				
8596.15	0.8500				
10051.28	0.8500				
10284.34	0.9500				
10870.6	0.9500				
14447.98	0.9500				
20261.74	0.7500				
24350.66	0.8500				
26434.56	0.9500				
29718.86	0.5000				
29820.69	0.1500				
36415.39	0.7000				
42954.87	0.0500				

			Transform: Arcsin Square Root					Number	Total
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
Pooled	0.9450	1.0000	1.3493	1.1071	1.4588	9.526	10	11	200
4255.07	0.8000	0.8466	1.1071	1.1071	1.1071	0.000	1	4	20
4309.36	1.0000	1.0582	1.4588	1.4588	1.4588	0.000	1	0	20
4403.08	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
5313.77	1.0000	1.0582	1.4588	1.4588	1.4588	0.000	1	0	20
6773.62	1.0000	1.0582	1.4588	1.4588	1.4588	0.000	1	0	20
7862.27	0.9000	0.9524	1.2490	1.2490	1.2490	0.000	1	2	20
8596.15	0.8500	0.8995	1.1731	1.1731	1.1731	0.000	1	3	20
10051.28	0.8500	0.8995	1.1731	1.1731	1.1731	0.000	1	3	20
10284.34	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
10870.6	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
14447.98	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
20261.74	0.7500	0.7937	1.0472	1.0472	1.0472	0.000	1	5	20
24350.66	0.8500	0.8995	1.1731	1.1731	1.1731	0.000	1	3	20
26434.56	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20

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Reviewed by:_____

Channel catfish hatchability 10d post-exposure TCDD & PCB (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECLv10d	Sample ID:	1dTEC(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus embryos at 10d
Comments:	Channel catfish hatchability 10d post-exposure TCDD & PCB				

29718.86	0.5000	0.5291	0.7854	0.7854	0.7854	0.000	1		10	20
29820.69	0.1500	0.1587	0.3977	0.3977	0.3977	0.000	1		17	20
36415.39	0.7000	0.7407	0.9912	0.9912	0.9912	0.000	1		6	20
42954.87	0.0500	0.0529	0.2255	0.2255	0.2255	0.000	1		19	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.748991	0.896	-1.04222	3.438612
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.10)	1.879006	2.306006		

Channel catfish hatchability 10d post-exposure TCDD & PCB (lipid normalized)

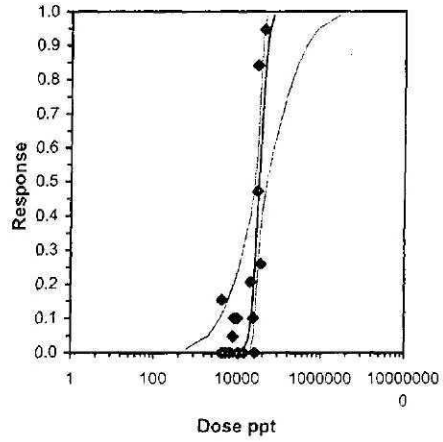
Start Date:	7/13/2001	Test ID:	1dTECLv10d	Sample ID:	1dTEC(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus embryos at 10d
Comments:	Channel catfish hatchability 10d post-exposure TCDD & PCB				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	6.943786	2.67386	1.275459	12.61211	0.055	53.38388	26.29622	6.5E-06	4.512064	0.144014	7
Intercept	-26.3308	11.99948	-51.7686	-0.89306							
TSCR	0.065028	0.022139	0.018096	0.11196							

Point	Probits	ppt	95% Fiducial Limits	
EC01	2.674	15032.75	601.0116	21273.03
EC05	3.355	18844.43	2034.785	24352.39
EC10	3.718	21257.07	3878.581	26304.71
EC15	3.964	23057.06	5966.176	27837.22
EC20	4.158	24595.72	8357.224	29271.51
EC25	4.326	25997.33	11081.85	30773.92
EC40	4.747	29893.65	20749.61	37963.51
EC50	5.000	32513.55	26244.19	49666.41
EC60	5.253	35363.06	29804.63	72365.56
EC75	5.674	40663.07	33812.34	147340.3
EC80	5.842	42980.29	35190.94	197357.6
EC85	6.036	45848.48	36755.26	278324
EC90	6.282	49730.78	38710.82	430182.8
EC95	6.645	56097.79	41659.64	823030.7
EC99	7.326	70321.85	47549.53	2794690

Significant heterogeneity detected (p = 6.54E-06)



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Reviewed by:_____

Channel catfish survival 32d post-exposure TCDD & PCB (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECLv32d	Sample ID:	1dTEC(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish survival 32d post-exposure TCDD & PCB				

Conc-ppt	1	2	3	4	5
oratory Control	0.9000	0.8000	0.8500	0.8000	0.5500
S-Control	0.8500	1.0000	0.8500	0.9500	0.8500
4255.07	0.7500				
4309.36	0.9000				
4403.08	0.9000				
5313.77	0.8500				
6773.62	0.9000				
7862.27	0.8500				
8596.15	0.8000				
10051.28	0.6500				
10284.34	0.9500				
10870.6	0.8500				
14447.98	0.6500				
20261.74	0.4500				
24350.66	0.8500				
26434.56	0.6000				
29718.86	0.3500				
29820.69	0.0000				
36415.39	0.2000				
42954.87	0.0000				

			Transform: Arcsin Square Root					Number	Total
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
Pooled	0.8400	1.0000	1.1795	0.8355	1.4588	13.824	10	32	200
4255.07	0.7500	0.8929	1.0472	1.0472	1.0472	0.000	1	5	20
4309.36	0.9000	1.0714	1.2490	1.2490	1.2490	0.000	1	2	20
4403.08	0.9000	1.0714	1.2490	1.2490	1.2490	0.000	1	2	20
5313.77	0.8500	1.0119	1.1731	1.1731	1.1731	0.000	1	3	20
6773.62	0.9000	1.0714	1.2490	1.2490	1.2490	0.000	1	2	20
7862.27	0.8500	1.0119	1.1731	1.1731	1.1731	0.000	1	3	20
8596.15	0.8000	0.9524	1.1071	1.1071	1.1071	0.000	1	4	20
10051.28	0.6500	0.7738	0.9377	0.9377	0.9377	0.000	1	7	20
10284.34	0.9500	1.1310	1.3453	1.3453	1.3453	0.000	1	1	20
10870.6	0.8500	1.0119	1.1731	1.1731	1.1731	0.000	1	3	20
14447.98	0.6500	0.7738	0.9377	0.9377	0.9377	0.000	1	7	20
20261.74	0.4500	0.5357	0.7353	0.7353	0.7353	0.000	1	11	20
24350.66	0.8500	1.0119	1.1731	1.1731	1.1731	0.000	1	3	20
26434.56	0.6000	0.7143	0.8861	0.8861	0.8861	0.000	1	8	20

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Reviewed by:_____

Channel catfish survival 32d post-exposure TCDD & PCB (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECLv32d	Sample ID:	1dTEC(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish survival 32d post-exposure TCDD & PCB				

29718.86	0.3500	0.4167	0.6331	0.6331	0.6331	0.000	1	13	20
29820.69	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	1	20	20
36415.39	0.2000	0.2381	0.4636	0.4636	0.4636	0.000	1	16	20
42954.87	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	1	20	20

Auxiliary Tests	**Statistic**	**Critical**	**Skew**	**Kurt**
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.606981	0.896	-0.70849	8.96054
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.10)	1.864613	2.306006		

Channel catfish survival 32d post-exposure TCDD & PCB (lipid normalized)

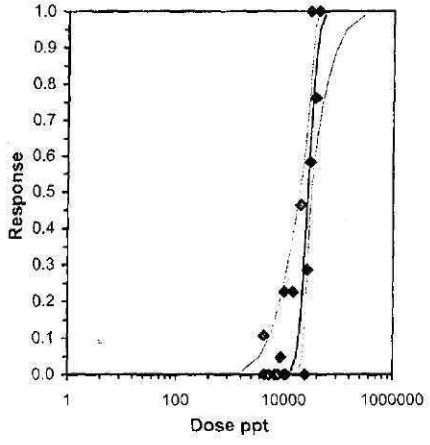
Start Date:	7/13/2001	Test ID:	1dTECLv32d	Sample ID:	1dTEC(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish survival 32d post-exposure TCDD & PCB				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	7.758765	2.662894	2.113683	13.40385	0.16	40.51279	26.29622	6.6E-04	4.429612	0.128886	18
Intercept	-29.3683	11.88117	-54.5553	-4.18137							
TSCR	0.168666	0.029386	0.106371	0.230961							

Point	Probits	ppt	95% Fiducial Limits	
EC01	2.674	13482.72	1699.768	18980.77
EC05	3.355	16504.9	3548.406	21475.03
EC10	3.718	18383.9	5241.825	22986.34
EC15	3.964	19771.07	6809.195	24105.22
EC20	4.158	20947.82	8369.879	25071.99
EC25	4.326	22013.02	9974.116	25976.08
EC40	4.747	24943.61	15298.28	28805.19
EC50	5.000	26891.33	19336.57	31368.64
EC60	5.253	28991.14	23430.34	35633.46
EC75	5.674	32850.72	28424.54	49958.4
EC80	5.842	34521.2	29859.59	58716.24
EC85	6.036	36575.87	31358.07	71481.56
EC90	6.282	39335.71	33115.83	92206.6
EC95	6.645	43813.88	35642.15	135462.5
EC99	7.326	53634.86	40504.96	281539

Significant heterogeneity detected (p = 6.55E-04)



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Reviewed by:_____

Channel catfish lengths 32d post-exposure TCDD & PCB (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECLvLen	Sample ID:	1dTEC(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish lengths 32d post-exposure TCDD & PCB				

Conc-ppt	1	2	3	4	5
oratory Control	3.3030	3.1910	3.2000	3.2770	3.4300
S-Control	3.1350	3.2150	3.2240	3.2180	3.2120
4255.07	3.3730				
4309.36	3.3000				
4403.08	3.1830				
5313.77	3.1890				
6773.62	3.2500				
7862.27	3.2030				
8596.15	2.9720				
10051.28	3.1150				
10284.34	3.1420				
10870.6	3.0820				
14447.98	3.0730				
20261.74	3.1280				
24350.66	3.1820				
26434.56	3.0680				
29718.86	3.1570				
29820.69	0.0000				
36415.39	2.8750				
42954.87	0.0000				

			Transform: Untransformed					Isotonic	
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Mean	N-Mean
Pooled	3.2405	1.0000	3.2405	3.1350	3.4300	2.490	10	3.3068	1.0000
4255.07	3.3730	1.0409	3.3730	3.3730	3.3730	0.000	1	3.3068	1.0000
4309.36	3.3000	1.0184	3.3000	3.3000	3.3000	0.000	1	3.3000	0.9980
4403.08	3.1830	0.9823	3.1830	3.1830	3.1830	0.000	1	3.2073	0.9699
5313.77	3.1890	0.9841	3.1890	3.1890	3.1890	0.000	1	3.2073	0.9699
6773.62	3.2500	1.0029	3.2500	3.2500	3.2500	0.000	1	3.2073	0.9699
7862.27	3.2030	0.9884	3.2030	3.2030	3.2030	0.000	1	3.2030	0.9686
8596.15	2.9720	0.9171	2.9720	2.9720	2.9720	0.000	1	3.1021	0.9381
10051.28	3.1150	0.9613	3.1150	3.1150	3.1150	0.000	1	3.1021	0.9381
10284.34	3.1420	0.9696	3.1420	3.1420	3.1420	0.000	1	3.1021	0.9381
10870.6	3.0820	0.9511	3.0820	3.0820	3.0820	0.000	1	3.1021	0.9381
14447.98	3.0730	0.9483	3.0730	3.0730	3.0730	0.000	1	3.1021	0.9381
20261.74	3.1280	0.9653	3.1280	3.1280	3.1280	0.000	1	3.1021	0.9381
24350.66	3.1820	0.9819	3.1820	3.1820	3.1820	0.000	1	3.1021	0.9381
26434.56	3.0680	0.9468	3.0680	3.0680	3.0680	0.000	1	3.1021	0.9381

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Reviewed by:_____

Channel catfish lengths 32d post-exposure TCDD & PCB (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECLvLen	Sample ID:	1dTEC(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish lengths 32d post-exposure TCDD & PCB				

29718.86	3.1570	0.9742	3.1570	3.1570	3.1570	0.000	1		3.1021	0.9381
29820.69	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	1		1.4375	0.4347
36415.39	2.8750	0.8872	2.8750	2.8750	2.8750	0.000	1		1.4375	0.4347
42954.87	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	1		0.0000	0.0000

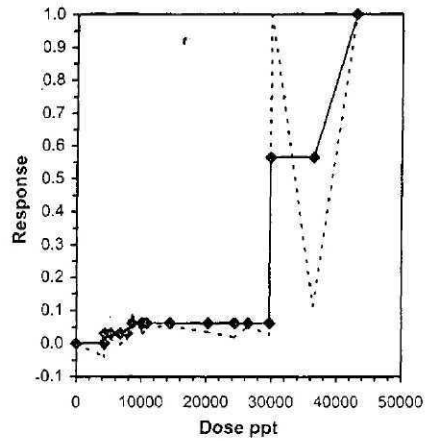
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.6638	0.896	2.240093	10.77995
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.12)	1.715387	2.306006		

Channel catfish lengths 32d post-exposure TCDD & PCB (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECLvLen	Sample ID:	1dTEC(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish lengths 32d post-exposure TCDD & PCB				

Linear Interpolation (200 Resamples)

Point	ppt	SD	95% CL(Exp)		Skew
IC05	8310.266	73.90789	7610.481	8751.267	-0.6730
IC10	29726.57	0.588831	29720.99	29730.08	-0.6730
IC15	29736.68	0.556118	29731.42	29740	-0.6730
IC20	29746.8	0.523405	29741.84	29749.92	-0.6730
IC25	29756.91	0.490694	29752.27	29759.84	-0.6730
IC40	29787.26	0.392553	29783.54	29789.6	-0.6730
IC50	29807.48	0.32713	29804.39	29809.44	-0.6730



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Reviewed by:_____

Channel catfish weights 32d post-exposure TCDD & PCB (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECLvWei	Sample ID:	1dTEC(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish weights 32d post-exposure TCDD & PCB				

Conc-ppt	1	2	3	4	5
oratory Control	0.3840	0.3550	0.3520	0.3710	0.4010
S-Control	0.3490	0.3660	0.3750	0.3770	0.3710
4255.07	0.4340				
4309.36	0.4090				
4403.08	0.3530				
5313.77	0.3800				
6773.62	0.4120				
7862.27	0.3930				
8596.15	0.3020				
10051.28	0.3500				
10284.34	0.3900				
10870.6	0.3580				
14447.98	0.3380				
20261.74	0.3300				
24350.66	0.3630				
26434.56	0.3180				
29718.86	0.3730				
29820.69	0.0000				
36415.39	0.2960				
42954.87	0.0000				

			Transform: Untransformed					Isotonic	
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Mean	N-Mean
Pooled	0.3701	1.0000	0.3701	0.3490	0.4010	4.262	10	0.4044	1.0000
4255.07	0.4340	1.1727	0.4340	0.4340	0.4340	0.000	1	0.4044	1.0000
4309.36	0.4090	1.1051	0.4090	0.4090	0.4090	0.000	1	0.4044	1.0000
4403.08	0.3530	0.9538	0.3530	0.3530	0.3530	0.000	1	0.3845	0.9509
5313.77	0.3800	1.0267	0.3800	0.3800	0.3800	0.000	1	0.3845	0.9509
6773.62	0.4120	1.1132	0.4120	0.4120	0.4120	0.000	1	0.3845	0.9509
7862.27	0.3930	1.0619	0.3930	0.3930	0.3930	0.000	1	0.3845	0.9509
8596.15	0.3020	0.8160	0.3020	0.3020	0.3020	0.000	1	0.3500	0.8656
10051.28	0.3500	0.9457	0.3500	0.3500	0.3500	0.000	1	0.3500	0.8656
10284.34	0.3900	1.0538	0.3900	0.3900	0.3900	0.000	1	0.3500	0.8656
10870.6	0.3580	0.9673	0.3580	0.3580	0.3580	0.000	1	0.3500	0.8656
14447.98	0.3380	0.9133	0.3380	0.3380	0.3380	0.000	1	0.3444	0.8517
20261.74	0.3300	0.8917	0.3300	0.3300	0.3300	0.000	1	0.3444	0.8517
24350.66	0.3630	0.9808	0.3630	0.3630	0.3630	0.000	1	0.3444	0.8517
26434.56	0.3180	0.8592	0.3180	0.3180	0.3180	0.000	1	0.3444	0.8517

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Channel catfish weights 32d post-exposure TCDD & PCB (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECLvWei	Sample ID:	1dTEC(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish weights 32d post-exposure TCDD & PCB				

29718.86	0.3730	1.0078	0.3730	0.3730	0.3730	0.000	1	0.3444	0.8517
29820.69	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	1	0.1480	0.3660
36415.39	0.2960	0.7998	0.2960	0.2960	0.2960	0.000	1	0.1480	0.3660
42954.87	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	1	0.0000	0.0000

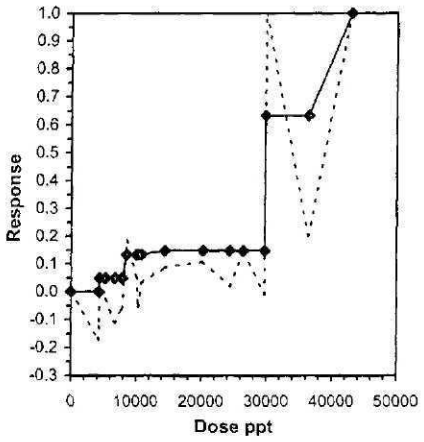
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.709256	0.896	0.729013	5.447733
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.64)	0.479309	2.306006		

Channel catfish weights 32d post-exposure TCDD & PCB (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECLvWei	Sample ID:	1dTEC(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish weights 32d post-exposure TCDD & PCB				

Linear Interpolation (200 Resamples)

Point	ppt	SD	95% CL(Exp)		Skew
IC05	7869.751	1657.295	0	8115.012	-0.6803
IC10	8299.833	29.08721	8082.349	8532.185	-0.0573
IC15	29719.22	6967.258	0	29724.57	-1.1062
IC20	29729.7	0.630199	29724.99	29734.73	-0.0573
IC25	29740.18	0.590811	29735.77	29744.9	-0.0573
IC40	29771.63	0.472649	29768.1	29775.41	-0.0573
IC50	29792.6	0.393874	29789.65	29795.74	-0.0573



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Reviewed by:_____

Channel catfish hatchability 10d post-exposure TCDD, PCB & HCX (lipid-normalized)

Start Date:	7/13/2001	Test ID:	1dTECHLv1	Sample ID:	1dTEC-HCX(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus embryos at 10d
Comments:	Channel catfish hatchability 10d post-exposure TCDD, PCB & HCX				

Conc-ppt	1	2	3	4	5
oratory Control	1.0000	0.9000	0.9000	0.9500	0.8000
S-Control	1.0000	1.0000	1.0000	1.0000	0.9000
3371.77	1.0000				
3989.8	0.9500				
4285.04	0.9500				
4818.43	0.9000				
4837.09	0.9000				
6436.36	0.9000				
6502.3	0.9500				
9164.32	0.7500				
10056.08	0.9500				
10205.4	0.9500				
10428.03	0.9000				
14472.62	0.8500				
15669.87	0.8500				
16335.23	0.8000				
23068.93	0.7000				
26996.06	0.6500				
38978.34	0.2000				
63877.96	0.2000				

			Transform: Arcsin Square Root					Number	Total
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
Pooled	0.9450	1.0000	1.3493	1.1071	1.4588	9.526	10	11	200
3371.77	1.0000	1.0582	1.4588	1.4588	1.4588	0.000	1	0	20
3989.8	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
4285.04	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
4818.43	0.9000	0.9524	1.2490	1.2490	1.2490	0.000	1	2	20
4837.09	0.9000	0.9524	1.2490	1.2490	1.2490	0.000	1	2	20
6436.36	0.9000	0.9524	1.2490	1.2490	1.2490	0.000	1	2	20
6502.3	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
9164.32	0.7500	0.7937	1.0472	1.0472	1.0472	0.000	1	5	20
10056.08	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
10205.4	0.9500	1.0053	1.3453	1.3453	1.3453	0.000	1	1	20
10428.03	0.9000	0.9524	1.2490	1.2490	1.2490	0.000	1	2	20
14472.62	0.8500	0.8995	1.1731	1.1731	1.1731	0.000	1	3	20
15669.87	0.8500	0.8995	1.1731	1.1731	1.1731	0.000	1	3	20
16335.23	0.8000	0.8466	1.1071	1.1071	1.1071	0.000	1	4	20

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Reviewed by:_____

Channel catfish hatchability 10d post-exposure TCDD, PCB & HCX (lipid-normalized)

Start Date:	7/13/2001	Test ID:	1dTECHLv1	Sample ID:	1dTEC-HCX(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus embryos at 10d
Comments:	Channel catfish hatchability 10d post-exposure TCDD, PCB & HCX				

23068.93	0.7000	0.7407	0.9912	0.9912	0.9912	0.000	1	6	20
26996.06	0.6500	0.6878	0.9377	0.9377	0.9377	0.000	1	7	20
38978.34	0.2000	0.2116	0.4636	0.4636	0.4636	0.000	1	16	20
63877.96	0.2000	0.2116	0.4636	0.4636	0.4636	0.000	1	16	20

Auxillary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.748991	0.896	-1.04222	3.438612
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.10)	1.879006	2.306006		

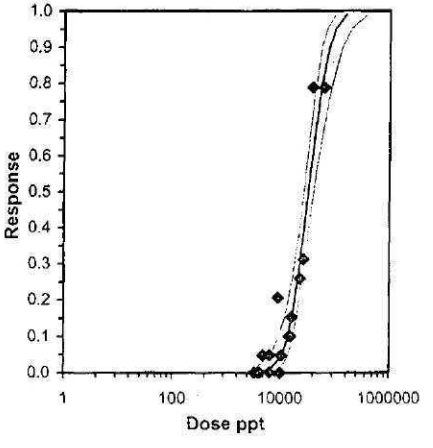
Channel catfish hatchability 10d post-exposure TCDD, PCB & HCX (lipid-normalized)

Start Date:	7/13/2001	Test ID:	1dTECHLv1	Sample ID:	1dTEC-HCX(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus embryos at 10d
Comments:	Channel catfish hatchability 10d post-exposure TCDD, PCB & HCX				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	3.437686	0.567806	2.324787	4.550585	0.055	14.4165	26.29622	0.57	4.515791	0.290893	7
Intercept	-10.5239	2.499134	-15.4222	-5.62557							
TSCR	0.05942	0.013164	0.033619	0.085221							

Point	Probits	ppt	95% Fiducial Limits	
EC01	2.674	6903.534	3508.608	9922.377
EC05	3.355	10897.17	6782.814	14231.25
EC10	3.718	13899.39	9572.505	17367.49
EC15	3.964	16379.44	12010.71	19975.43
EC20	4.158	18662.45	14309.12	22441.92
EC25	4.326	20873.06	16539.32	24932.96
EC40	4.747	27675.38	23068.47	33571.67
EC50	5.000	32793.72	27467.49	41192.93
EC60	5.253	38858.64	32195.94	51344.1
EC75	5.674	51522.3	41046.7	75633.37
EC80	5.842	57625.23	45007.07	88578.76
EC85	6.036	65657.18	50015.58	106687.4
EC90	6.282	77372.29	57002.39	135091.3
EC95	6.645	98688.74	69005.27	192197.6
EC99	7.326	155779.4	98265.69	374223.4



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Reviewed by:_____

Channel catfish survival 32d post-exposure TCDD, PCB & HCX (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHLv3	Sample ID:	1dTEC-HCX(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	EPAF 91-EPA Freshwater	Test Species:	PP-Pimephales promelas
Comments:	Channel catfish survival 32d post-exposure TCDD, PCB & HCX				

Conc-ppt	1	2	3	4	5
oratory Control	0.9000	0.8000	0.8500	0.8000	0.5500
S-Control	0.8500	1.0000	0.8500	0.9500	0.8500
3371.77	0.9000				
3989.8	0.7500				
4285.04	0.8000				
4818.43	0.8000				
4837.09	0.8000				
6436.36	0.7000				
6502.3	0.9500				
9164.32	0.7000				
10056.08	0.9500				
10205.4	0.3500				
10428.03	0.6500				
14472.62	0.8000				
15669.87	0.6000				
16335.23	0.8000				
23068.93	0.5500				
26996.06	0.6000				
38978.34	0.0000				
63877.96	0.0000				

			Transform: Arcsin Square Root					Number	Total
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Resp	Number
Pooled	0.8400	1.0000	1.1795	0.8355	1.4588	13.824	10	32	200
3371.77	0.9000	1.0714	1.2490	1.2490	1.2490	0.000	1	2	20
3989.8	0.7500	0.8929	1.0472	1.0472	1.0472	0.000	1	5	20
4285.04	0.8000	0.9524	1.1071	1.1071	1.1071	0.000	1	4	20
4818.43	0.8000	0.9524	1.1071	1.1071	1.1071	0.000	1	4	20
4837.09	0.8000	0.9524	1.1071	1.1071	1.1071	0.000	1	4	20
6436.36	0.7000	0.8333	0.9912	0.9912	0.9912	0.000	1	6	20
6502.3	0.9500	1.1310	1.3453	1.3453	1.3453	0.000	1	1	20
9164.32	0.7000	0.8333	0.9912	0.9912	0.9912	0.000	1	6	20
10056.08	0.9500	1.1310	1.3453	1.3453	1.3453	0.000	1	1	20
10205.4	0.3500	0.4167	0.6331	0.6331	0.6331	0.000	1	13	20
10428.03	0.6500	0.7738	0.9377	0.9377	0.9377	0.000	1	7	20
14472.62	0.8000	0.9524	1.1071	1.1071	1.1071	0.000	1	4	20
15669.87	0.6000	0.7143	0.8861	0.8861	0.8861	0.000	1	8	20
16335.23	0.8000	0.9524	1.1071	1.1071	1.1071	0.000	1	4	20

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Channel catfish survival 32d post-exposure TCDD, PCB & HCX (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHLv3	Sample ID:	1dTEC-HCX(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	EPAF 91-EPA Freshwater	Test Species:	PP-Pimephales promelas
Comments:	Channel catfish survival 32d post-exposure TCDD, PCB & HCX				

23068.93	0.5500	0.6548	0.8355	0.8355	0.8355	0.000	1	9	20
26996.06	0.6000	0.7143	0.8861	0.8861	0.8861	0.000	1	8	20
38978.34	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	1	20	20
63877.96	0.0000	0.0000	0.1120	0.1120	0.1120	0.000	1	20	20

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.606981	0.896	-0.70849	8.96054
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.10)	1.864613	2.306006		

Channel catfish survival 32d post-exposure TCDD, PCB & HCX (lipid normalized)

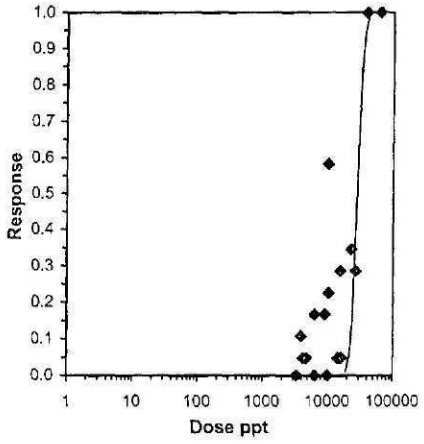
Start Date:	7/13/2001	Test ID:	1dTECHLv3	Sample ID:	1dTEC-HCX(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	EPAF 91-EPA Freshwater	Test Species:	PP-Pimephales promelas
Comments:	Channel catfish survival 32d post-exposure TCDD, PCB & HCX				

Maximum Likelihood-Probit

Parameter	Value	SE	95% Fiducial Limits		Control	Chi-Sq	Critical	P-value	Mu	Sigma	Iter
Slope	13.96173	6.609858	-0.05054	27.974	0.16	42.92721	26.29622	2.9E-04	4.449926	0.071624	19
Intercept	-57.1287	29.40668	-119.468	5.210684							
TSCR	0.212816	0.03055	0.148054	0.277579							

Point	Probits	ppt	95% Fiducial Limits
EC01	2.674	19200.06	
EC05	3.355	21483.95	
EC10	3.718	22810.53	
EC15	3.964	23751.55	
EC20	4.158	24527.04	
EC25	4.326	25212.5	
EC40	4.747	27025.88	
EC50	5.000	28179.01	
EC60	5.253	29381.34	
EC75	5.674	31494.57	
EC80	5.842	32374.74	
EC85	6.036	33431.79	
EC90	6.282	34810.96	
EC95	6.645	36960.45	
EC99	7.326	41356.99	

Significant heterogeneity detected (p = 2.87E-04)



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Reviewed by:_____

Channel catfish lengths 32d post-exposure TCDD, PCB & HCX (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHLvL	Sample ID:	1dTEC-HCX(Lipid)
End Date:	7/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	8/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish lengths 32d post-exposure TCDD, PCB & HCX				

Conc-ppt	1	2	3	4	5
oratory Control	3.3030	3.1910	3.2000	3.2770	3.4300
S-Control	3.1350	3.2150	3.2240	3.2180	3.2120
3371.77	3.1140				
3989.8	3.0930				
4285.04	3.1840				
4818.43	3.2500				
4837.09	3.1660				
6436.36	3.0570				
6502.3	3.1920				
9164.32	3.2310				
10056.08	3.0710				
10205.4	2.8640				
10428.03	3.1080				
14472.62	3.2250				
15669.87	2.9170				
16335.23	3.2690				
23068.93	3.2230				
26996.06	3.1960				
38978.34	0.0000				
63877.96	0.0000				

			Transform: Untransformed					Isotonic	
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Mean	N-Mean
Pooled	3.2405	1.0000	3.2405	3.1350	3.4300	2.490	10	3.2405	1.0000
3371.77	3.1140	0.9610	3.1140	3.1140	3.1140	0.000	1	3.1614	0.9756
3989.8	3.0930	0.9545	3.0930	3.0930	3.0930	0.000	1	3.1614	0.9756
4285.04	3.1840	0.9826	3.1840	3.1840	3.1840	0.000	1	3.1614	0.9756
4818.43	3.2500	1.0029	3.2500	3.2500	3.2500	0.000	1	3.1614	0.9756
4837.09	3.1660	0.9770	3.1660	3.1660	3.1660	0.000	1	3.1614	0.9756
6436.36	3.0570	0.9434	3.0570	3.0570	3.0570	0.000	1	3.1600	0.9752
6502.3	3.1920	0.9850	3.1920	3.1920	3.1920	0.000	1	3.1600	0.9752
9164.32	3.2310	0.9971	3.2310	3.2310	3.2310	0.000	1	3.1600	0.9752
10056.08	3.0710	0.9477	3.0710	3.0710	3.0710	0.000	1	3.1091	0.9595
10205.4	2.8640	0.8838	2.8640	2.8640	2.8640	0.000	1	3.1091	0.9595
10428.03	3.1080	0.9591	3.1080	3.1080	3.1080	0.000	1	3.1091	0.9595
14472.62	3.2250	0.9952	3.2250	3.2250	3.2250	0.000	1	3.1091	0.9595
15669.87	2.9170	0.9002	2.9170	2.9170	2.9170	0.000	1	3.1091	0.9595
16335.23	3.2690	1.0088	3.2690	3.2690	3.2690	0.000	1	3.1091	0.9595

ToxCalc v5.0.23

Reviewed by:_____

Channel catfish lengths 32d post-exposure TCDD, PCB & HCX (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHLvL	Sample ID:	1dTEC-HCX(Lipid)
End Date:	7/14/2001	Lab ID:	Battelle	Sample Type:	*I. punctatus* eggs at 1d
Sample Date:	8/14/2001	Protocol:	Elonen et al., 1998	Test Species:	*I. punctatus* fry at 32d
Comments:	Channel catfish lengths 32d post-exposure TCDD, PCB & HCX				

23068.93	3.2230	0.9946	3.2230	3.2230	3.2230	0.000	1		3.1091	0.9595
26996.06	3.1960	0.9863	3.1960	3.1960	3.1960	0.000	1		3.1091	0.9595
38978.34	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	1		0.0000	0.0000
63877.96	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	1		0.0000	0.0000

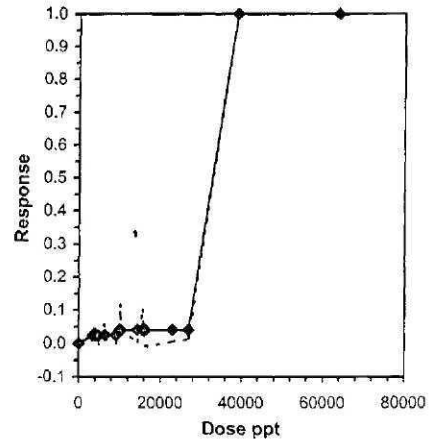
Auxiliary Tests	**Statistic**	**Critical**	**Skew**	**Kurt**
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.6638	0.896	2.240093	10.77995
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.12)	1.715387	2.306006		

Channel catfish lengths 32d post-exposure TCDD, PCB & HCX (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHLvL	Sample ID:	1dTEC-HCX(Lipid)
End Date:	7/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	8/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish lengths 32d post-exposure TCDD, PCB & HCX				

Linear Interpolation (200 Resamples)

Point	ppt	SD	95% CL(Exp)		Skew
IC05	27114.18	5194.879	0	27716.27	-2.6865
IC10	27738.61	79.70128	27036.13	28309.01	-0.4061
IC15	28363.04	75.27343	27699.59	28901.75	-0.4061
IC20	28987.47	70.84558	28363.04	29494.49	-0.4061
IC25	29611.9	66.41773	29026.5	30087.23	-0.4061
IC40	31485.19	53.13419	31016.87	31865.45	-0.4061
IC50	32734.05	44.27849	32343.78	33050.93	-0.4061



ToxCalc v5.0.23

Reviewed by:_____

Channel catfish weights 32d post-exposure TCDD, PCB & HCX (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHLvW	Sample ID:	1dTEC-HCX(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish weights 32d post-exposure TCDD, PCB & HCX				

Conc-ppt	1	2	3	4	5
oratory Control	0.3840	0.3550	0.3520	0.3710	0.4010
S-Control	0.3490	0.3660	0.3750	0.3770	0.3710
3371.77	0.3670				
3989.8	0.3550				
4285.04	0.3840				
4818.43	0.4280				
4837.09	0.3810				
6436.36	0.3440				
6502.3	0.3720				
9164.32	0.4040				
10056.08	0.3690				
10205.4	0.2340				
10428.03	0.3800				
14472.62	0.3850				
15669.87	0.2750				
16335.23	0.3810				
23068.93	0.3680				
26996.06	0.3700				
38978.34	0.0000				
63877.96	0.0000				

			Transform: Untransformed					Isotonic	
Conc-ppt	Mean	N-Mean	Mean	Min	Max	CV%	N	Mean	N-Mean
Pooled	0.3701	1.0000	0.3701	0.3490	0.4010	4.262	10	0.3809	1.0000
3371.77	0.3670	0.9916	0.3670	0.3670	0.3670	0.000	1	0.3809	1.0000
3989.8	0.3550	0.9592	0.3550	0.3550	0.3550	0.000	1	0.3809	1.0000
4285.04	0.3840	1.0376	0.3840	0.3840	0.3840	0.000	1	0.3809	1.0000
4818.43	0.4280	1.1564	0.4280	0.4280	0.4280	0.000	1	0.3809	1.0000
4837.09	0.3810	1.0295	0.3810	0.3810	0.3810	0.000	1	0.3809	1.0000
6436.36	0.3440	0.9295	0.3440	0.3440	0.3440	0.000	1	0.3733	0.9803
6502.3	0.3720	1.0051	0.3720	0.3720	0.3720	0.000	1	0.3733	0.9803
9164.32	0.4040	1.0916	0.4040	0.4040	0.4040	0.000	1	0.3733	0.9803
10056.08	0.3690	0.9970	0.3690	0.3690	0.3690	0.000	1	0.3690	0.9689
10205.4	0.2340	0.6323	0.2340	0.2340	0.2340	0.000	1	0.3419	0.8976
10428.03	0.3800	1.0267	0.3800	0.3800	0.3800	0.000	1	0.3419	0.8976
14472.62	0.3850	1.0403	0.3850	0.3850	0.3850	0.000	1	0.3419	0.8976
15669.87	0.2750	0.7430	0.2750	0.2750	0.2750	0.000	1	0.3419	0.8976
16335.23	0.3810	1.0295	0.3810	0.3810	0.3810	0.000	1	0.3419	0.8976

ToxCalc v5.0.23

Reviewed by:_____

Channel catfish weights 32d post-exposure TCDD, PCB & HCX (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHLvW	Sample ID:	1dTEC-HCX(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish weights 32d post-exposure TCDD, PCB & HCX				

23068.93	0.3680	0.9943	0.3680	0.3680	0.3680	0.000	1		0.3419	0.8976
26996.06	0.3700	0.9997	0.3700	0.3700	0.3700	0.000	1		0.3419	0.8976
38978.34	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	1		0.0000	0.0000
63877.96	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	1		0.0000	0.0000

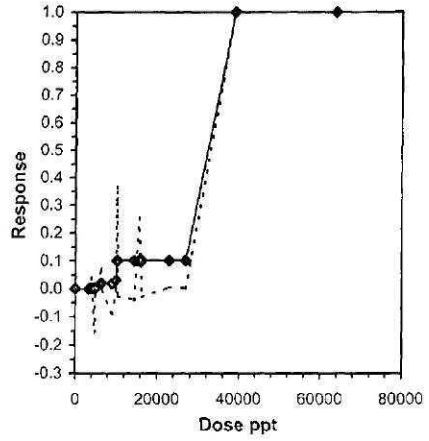
Auxiliary Tests	Statistic	Critical	Skew	Kurt
Shapiro-Wilk's Test indicates non-normal distribution (p <= 0.01)	0.709256	0.896	0.729013	5.447733
Equality of variance cannot be confirmed				
The control means are not significantly different (p = 0.64)	0.479309	2.306006		

Channel catfish weights 32d post-exposure TCDD, PCB & HCX (lipid normalized)

Start Date:	7/13/2001	Test ID:	1dTECHLvW	Sample ID:	1dTEC-HCX(Lipid)
End Date:	8/14/2001	Lab ID:	Battelle	Sample Type:	I. punctatus eggs at 1d
Sample Date:	7/14/2001	Protocol:	Elonen et al., 1998	Test Species:	I. punctatus fry at 32d
Comments:	Channel catfish weights 32d post-exposure TCDD, PCB & HCX				

Linear Interpolation (200 Resamples)

Point	ppt	SD	95% CL(Exp)		Skew
IC05	10095.65	4.308604	10060.65	10127.36	-0.2928
IC10	10200.41	5055.063	10167.25	77447.17	2.6869
IC15	27631.69	24.56203	27432.2	27812.48	-0.2928
IC20	28299.14	23.11721	28111.38	28469.3	-0.2928
IC25	28966.59	21.67238	28790.57	29126.11	-0.2928
IC40	30968.94	17.3379	30828.12	31096.56	-0.2928
IC50	32303.84	14.44825	32186.49	32410.19	-0.2928



ToxCalc v5.0.23

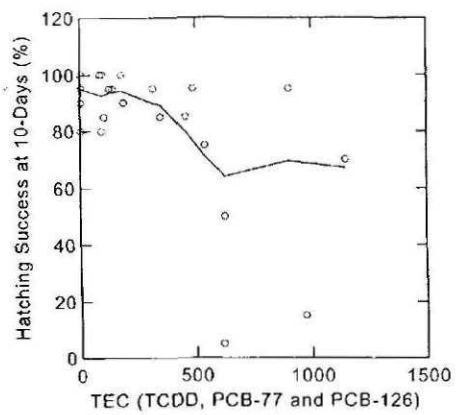
Reviewed by:_____

Appendix K - SYSTAT™ Statistical Analysis Outputs

STATISTICAL ANALYSES OF CATFISH HATCHING SUCCESS, SURVIVAL AND GROWTH DATA AS A FUNCTION OF NON-LIPID NORMALIZED TOTAL TEC (TCDD, PCB-77 AND PCB-126 ONLY)

1dTECoutput.doc, 3/29/03
IMPORT successfully completed.

Analysis of Catfish Hatching Success at 10 Days



42 case(s) deleted due to missing data.

Dep Var: TEC N: 28 Multiple R: 0.613091153 Squared multiple R: 0.375880762

Adjusted squared multiple R: 0.351876176 Standard error of estimate: 2.66705E+02

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	9.83562E+02	1.88107E+02	0.000000000	.	5.22874	0.00002
VHATCH	-8.508460074	2.150171133	-0.613091153	1.00E+00	-3.95711	0.00052

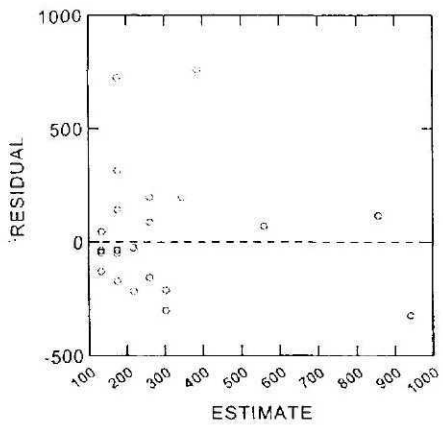
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	1.11383E+06	1	1.11383E+06	1.56587E+01	0.000522784
Residual	1.84943E+06	26	7.11318E+04		

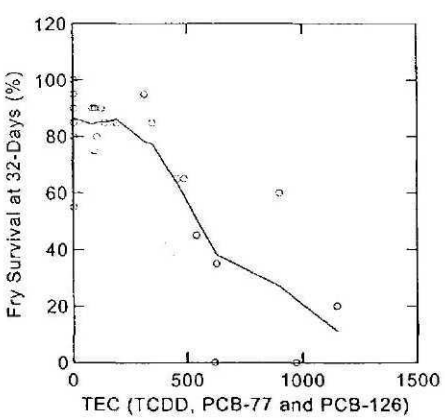
*** WARNING ***
Case 24 has large leverage (Leverage = 0.444289694)
Case 26 is an outlier (Studentized Residual = 3.257585298)
Case 27 has large leverage (Leverage = 0.347725162)
Case 28 is an outlier (Studentized Residual = 3.490248752)

```
Durbin-Watson D Statistic      1.023
First Order Autocorrelation    0.328
```

Plot of Residuals against Predicted Values



Analysis of Catfish Fry Survival at 32 days



42 case(s) deleted due to missing data.

Dep Var: TEC N: 28 Multiple R: 0.802355475 Squared multiple R: 0.643774308

Adjusted squared multiple R: 0.630073320 Standard error of estimate: 2.01493E+02

ffect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
ONSTANT	9.54239E+02	1.07324E+02	0.000000000	.	8.89117	0.00000
VALIVE	-9.677850254	1.411848260	-0.802355475	1.00E+00	-6.85474	0.00000

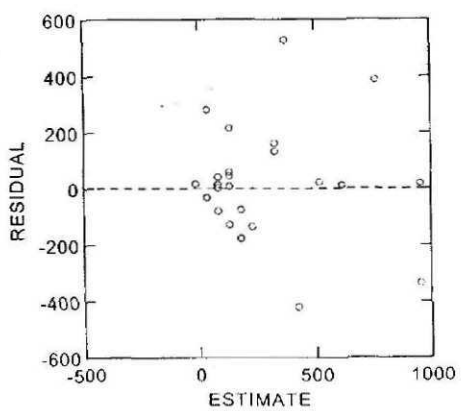
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	1.90767E+06	1	1.90767E+06	4.69874E+01	0.000000282
Residual	1.05559E+06	26	4.05996E+04		

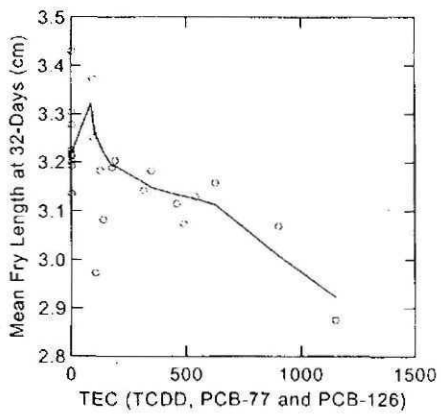
*** WARNING ***
Case 26 is an outlier (Studentized Residual = 3.082881627)

Durbin-Watson D Statistic 1.224
First Order Autocorrelation 0.314

Plot of Residuals against Predicted Values



Analysis of Catfish Fry Length at 32 Days



44 case(s) deleted due to missing data.

Dep Var: TEC N: 26 Multiple R: 0.668186619 Squared multiple R: 0.446473358

Adjusted squared multiple R: 0.423409748 Standard error of estimate: 2.30226E+02

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	5.82440E+03	1.27328E+03	0.000000000	.	4.57433	0.00012
MEANLENGTH	-1.76023E+03	4.00069E+02	-0.668186619	1.00E+00	-4.39981	0.00019

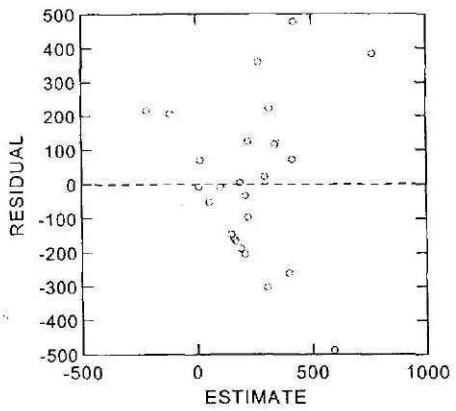
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	1.02607E+06	1	1.02607E+06	1.93583E+01	0.000191102
Residual	1.27210E+06	24	5.30041E+04		

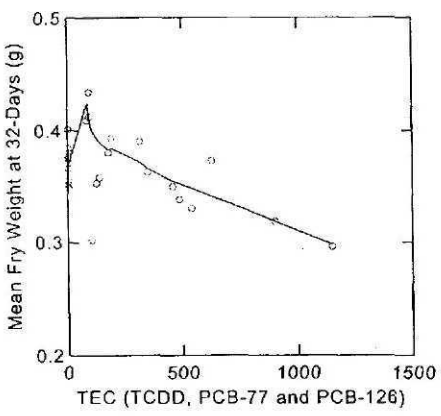
*** WARNING ***
Case 28 has large leverage (Leverage = 0.320572125)

Durbin-Watson D Statistic 0.850
First Order Autocorrelation 0.517

Plot of Residuals against Predicted Values



Analysis of Catfish Fry Weight at 32 days



44 case(s) deleted due to missing data.

Dep Var: TEC N: 26 Multiple R: 0.555146335 Squared multiple R: 0.308187453

Adjusted squared multiple R: 0.279361930 Standard error of estimate: 2.57383E+02

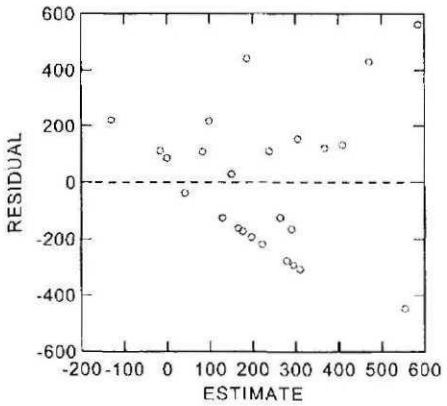
Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	2.11777E+03	5.80841E+02	0.000000000	.	3.64604	0.00128
MEANWEIGHT	-5.17821E+03	1.58366E+03	-0.555146335	1.00E+00	-3.26978	0.00324

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	7.08267E+05	1	7.08267E+05	1.06915E+01	0.003242120
Residual	1.58990E+06	24	6.62459E+04		

Durbin-Watson D Statistic 0.513
First Order Autocorrelation 0.639

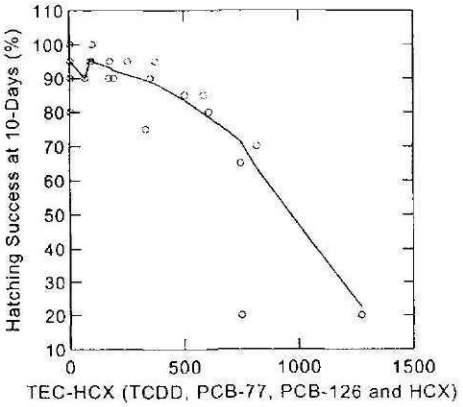
Plot of Residuals against Predicted Values



STATISTICAL ANALYSES OF CATFISH HATCHING SUCCESS, SURVIVAL AND GROWTH DATA AS A FUNCTION OF NON-LIPID NORMALIZED TOTAL TEC (TCDD, PCB-77, PCB-126 AND HCX)

1dTECHoutput.doc, 3/29/03
IMPORT successfully completed.

Analysis of Catfish Hatching Success at 10 Days



42 case(s) deleted due to missing data.

Dep Var: TECH N: 28 Multiple R: 0.820215287 Squared multiple R: 0.672753117

Adjusted squared multiple R: 0.660166699 Standard error of estimate: 1.91575E+02

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	1.38565E+03	1.57077E+02	0.000000000	.	8.82145	0.00000
VHATCH	-1.31467E+01	1.798212498	-0.820215287	1.00E+00	-7.31100	0.00000

Analysis of Variance

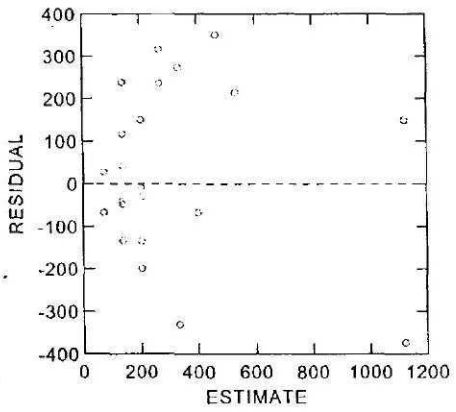
Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	1.96169E+06	1	1.96169E+06	5.34507E+01	0.000000092
Residual	9.54226E+05	26	3.67010E+04		

***** WARNING *****
Case 26 has large leverage (Leverage = 0.407960982)
Case 26 is an outlier (Studentized Residual = -2.871652873)
Case 28 has large leverage (Leverage = 0.407960982)

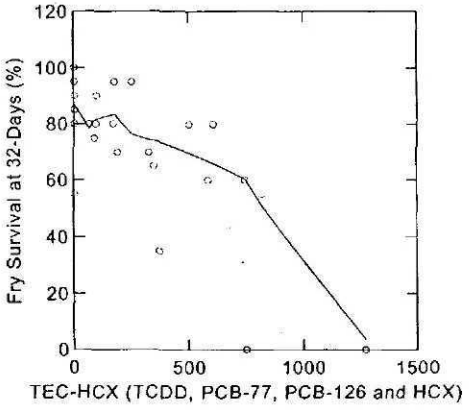
Durbin-Watson D Statistic 1.263

First Order Autocorrelation 0.355

Plot of Residuals against Predicted Values



Analysis of Catfish Fry Survival at 32 days



42 case(s) deleted due to missing data.

Dep Var: TECH N: 28 Multiple R: 0.754976041 Squared multiple R: 0.569988823

Adjusted squared multiple R: 0.553449931 Standard error of estimate: 2.19604E+02

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	9.81960E+02	1.28474E+02	0.000000000	.	7.64323	0.00000
VALIVE	-9.943240493	1.693744789	-0.754976041	1.00E+00	-5.87057	0.00000

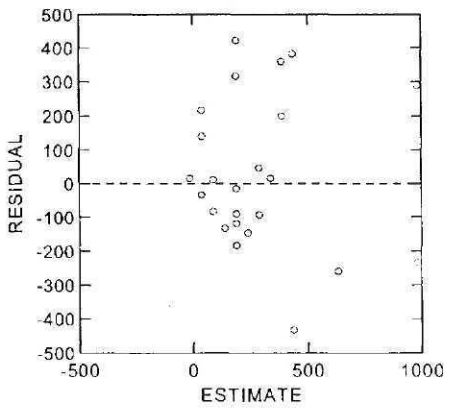
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	1.66204E+06	1	1.66204E+06	3.44635E+01	0.000003440
Residual	1.25388E+06	26	4.82261E+04		

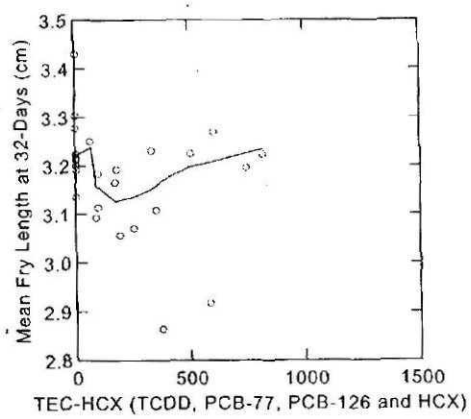
*** WARNING ***
Case 26 has large leverage (Leverage = 0.342256214)
Case 28 has large leverage (Leverage = 0.342256214)

Durbin-Watson D Statistic 1.326
First Order Autocorrelation 0.301

Plot of Residuals against Predicted Values



Analysis of Catfish Fry Length at 32 Days



44 case(s) deleted due to missing data.

Dep Var: TECH N: 26 Multiple R: 0.264545806 Squared multiple R: 0.069984483

Adjusted squared multiple R: 0.031233837 Standard error of estimate: 2.48589E+02

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	2.06420E+03	1.37975E+03	0.000000000	.	1.49607	0.14767
MEANLENGTH	-5.83536E+02	4.34217E+02	-0.264545806	1.00E+00	-1.34388	0.19155

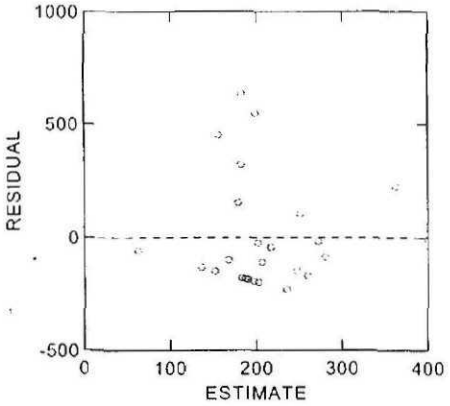
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	1.11606E+05	1	1.11606E+05	1.806021050	0.191554120
Residual	1.48312E+06	24	6.17969E+04		

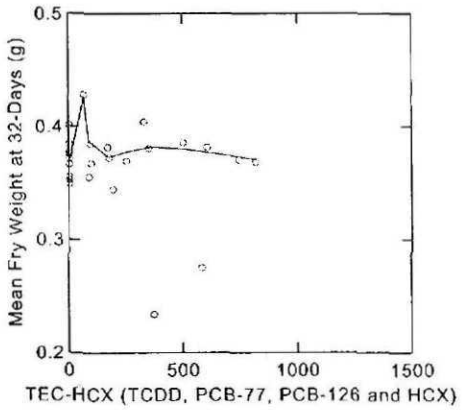
*** WARNING ***
Case 21 has large leverage (Leverage = 0.334657722)
Case 27 is an outlier (Studentized Residual = 3.014143237)

Durbin-Watson D Statistic 0.219
First Order Autocorrelation 0.749

Plot of Residuals against Predicted Values



Analysis of Catfish Fry Weight at 32 Days



44 case(s) deleted due to missing data.

Dep Var: TECH N: 26 Multiple R: 0.221788043 Squared multiple R: 0.049189936

Adjusted squared multiple R: 0.009572850 Standard error of estimate: 2.51353E+02

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	7.55010E+02	4.90579E+02	0.000000000	.	1.53902	0.13688
MEANWEIGHT	-1.48882E+03	1.33612E+03	-0.221788043	1.00E+00	-1.11429	0.27619

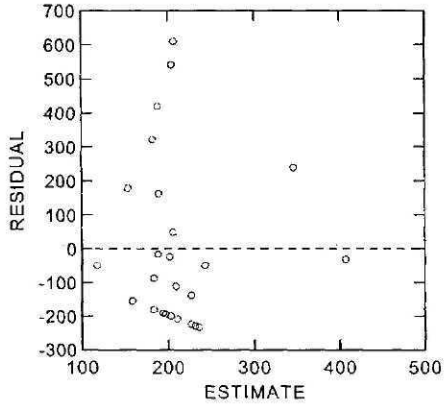
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	7.84443E+04	1	7.84443E+04	1.241634382	0.276191207
Residual	1.51628E+06	24	6.31782E+04		

*** WARNING ***
Case 21 has large leverage (Leverage = 0.525659473)

Durbin-Watson D Statistic 0.200
First Order Autocorrelation 0.767

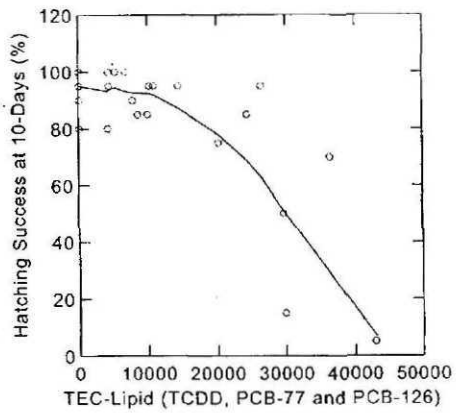
Plot of Residuals against Predicted Values



STATISTICAL ANALYSES OF CATFISH HATCHING SUCCESS, SURVIVAL AND GROWTH DATA AS A FUNCTION OF LIPID NORMALIZED TOTAL TEC (TCDD, PCB-77, AND PCB-126 ONLY)

1dTECLoutput.doc, 3/29/03
IMPORT successfully completed.

Analysis of Catfish Hatching Success at 10 Days



42 case(s) deleted due to missing data.

Dep Var: TECLIPID N: 28 Multiple R: 0.760168070 Squared multiple R: 0.577855494

Adjusted squared multiple R: 0.561619167 Standard error of estimate: 8.32585E+03

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	4.44019E+04	5.87221E+03	0.000000000	.	7.56136	0.00000
VHATCH	-4.00438E+02	6.71228E+01	-0.760168070	1.00E+00	-5.96576	0.00000

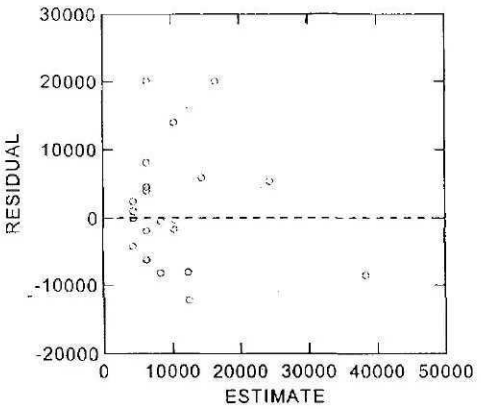
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	2.46711E+09	1	2.46711E+09	3.55903E+01	0.000002689
Residual	1.80232E+09	26	6.93198E+07		

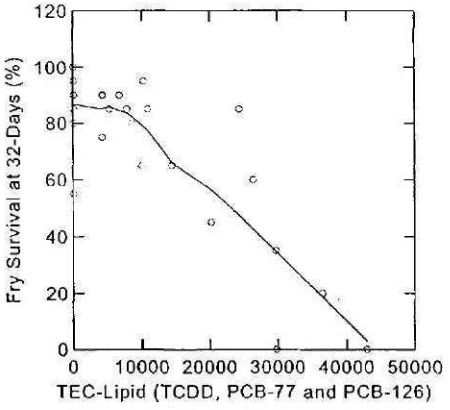
*** WARNING ***
Case 26 has large leverage (Leverage = 0.347725162)
Case 28 has large leverage (Leverage = 0.444289694)

Durbin-Watson D Statistic 1.096
First Order Autocorrelation 0.447

Plot of Residuals against Predicted Values



Analysis of Catfish Fry Survival at 32 days



42 case(s) deleted due to missing data.

Dep Var: TECLIPID N: 28 Multiple R: 0.831378501 Squared multiple R: 0.691190212

Adjusted squared multiple R: 0.679312913 Standard error of estimate: 7.12104E+03

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	3.77031E+04	3.79299E+03	0.000000000	.	9.94022	0.00000
VALIVE	-3.80637E+02	4.98966E+01	-0.831378501	1.00E+00	-7.62851	0.00000

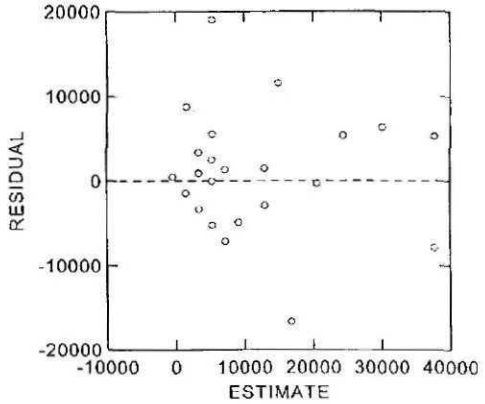
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	2.95099E+09	1	2.95099E+09	5.81942E+01	0.000000043
Residual	1.31844E+09	26	5.07093E+07		

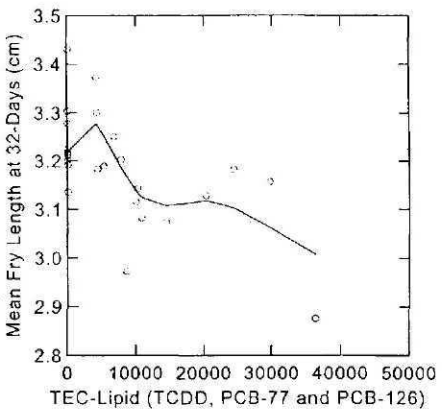
*** WARNING ***
Case 23 is an outlier (Studentized Residual = 3.170943214)

Durbin-Watson D Statistic 1.072
First Order Autocorrelation 0.449

Plot of Residuals against Predicted Values

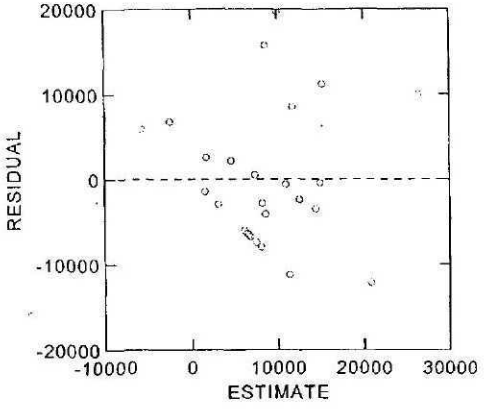


Analysis of Catfish Fry Length at 32 Days

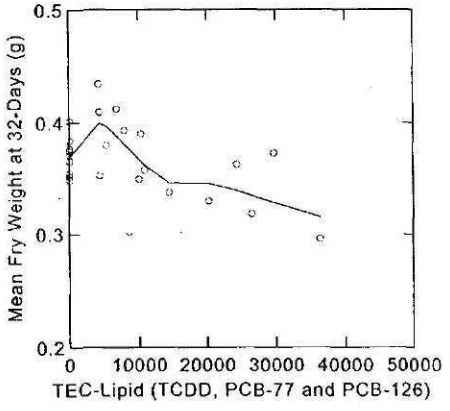



```
44 case(s) deleted due to missing data.

Dep Var: TECLIPID    N: 26    Multiple R: 0.636341752    Squared multiple R: 0.404930826

Adjusted squared multiple R: 0.380136277    Standard error of estimate: 8.26714E+03

Effect          Coefficient     Std Error      Std Coef Tolerance     t    P(2 Tail)

CONSTANT        1.93327E+05  4.57219E+04  0.000000000  .          4.22832  0.00030
MEANLENGTH     -5.80560E+04  1.43660E+04 -0.636341752  1.00E+00 -4.04122  0.00047

                              Analysis of Variance

Source              Sum-of-Squares   df  Mean-Square     F-ratio       P

Regression            1.11618E+09     1  1.11618E+09 1.63314E+01 0.000474765
Residual              1.64029E+09    24  6.83455E+07
-------------------------------------------------------------------------------

*** WARNING ***
Case          27 has large leverage    (Leverage =  0.320572125)

Durbin-Watson D Statistic      0.809
First Order Autocorrelation    0.565
```

Plot of Residuals against Predicted Values



Analysis of Catfish Fry Weight at 32 days



44 case(s) deleted due to missing data.

Dep Var: TECLIPID N: 26 Multiple R: 0.493285356 Squared multiple R: 0.243330443

Adjusted squared multiple R: 0.211802545 Standard error of estimate: 9.32233E+03

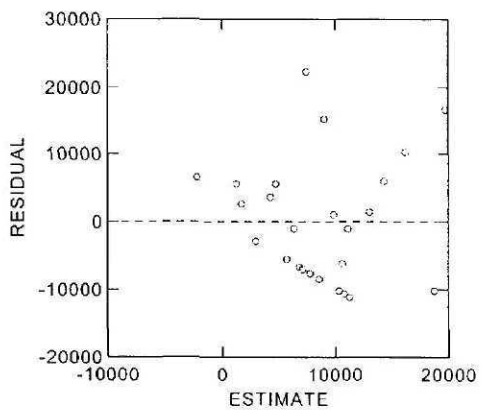
Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	6.68956E+04	2.10379E+04	0.000000000	.	3.17977	0.00403
MEANWEIGHT	-1.59352E+05	5.73596E+04	-0.493285356	1.00E+00	-2.77812	0.01045

Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	6.70734E+08	1	6.70734E+08	7.717940506	0.010446136
Residual	2.08574E+09	24	8.69058E+07		

Durbin-Watson D Statistic 0.550
First Order Autocorrelation 0.651

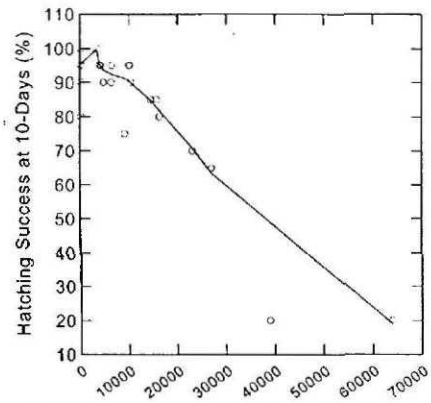
Plot of Residuals against Predicted Values



STATISTICAL ANALYSES OF CATFISH HATCHING SUCCESS, SURVIVAL AND GROWTH DATA AS A FUNCTION OF LIPID NORMALIZED TOTAL TEC (TCDD, PCB-77, PCB-126 AND HCX)

1dTECHLoutput.doc, 3/29/03
IMPORT successfully completed.

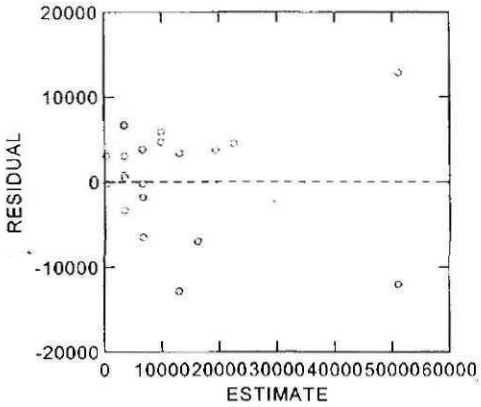
Analysis of Catfish Hatching Success at 10 Days



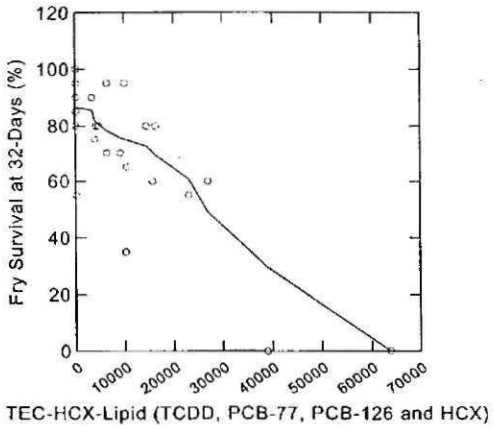

```
42 case(s) deleted due to missing data.

Dep Var: TECHLIPID    N: 28    Multiple R: 0.914421475    Squared multiple R: 0.836166633

Adjusted squared multiple R: 0.829865350    Standard error of estimate: 5.86760E+03

Effect          Coefficient     Std Error      Std Coef Tolerance     t    P(2 Tail)

CONSTANT        6.37347E+04  4.81100E+03  0.000000000  .          13.24770  0.00000
VHATCH         -6.34446E+02  5.50760E+01 -0.914421475  1.00E+00 -1.15E01  0.00000

                              Analysis of Variance

Source              Sum-of-Squares   df  Mean-Square     F-ratio        P

Regression            4.56862E+09     1  4.56862E+09 1.32698E+02 0.000000000
Residual              8.95148E+08    26  3.44288E+07
-------------------------------------------------------------------------------

*** WARNING ***
Case          27 has large leverage    (Leverage =  0.407960982)
Case          27 is an outlier         (Studentized Residual = -3.077701158)
Case          28 has large leverage    (Leverage =  0.407960982)
Case          28 is an outlier         (Studentized Residual =  3.356977809)
```

```
Durbin-Watson D Statistic      1.853
First Order Autocorrelation   -0.018
```

Plot of Residuals against Predicted Values



Analysis of Catfish Fry Survival at 32 Days



42 case(s) deleted due to missing data.

Dep Var: TECHLIPID N: 28 Multiple R: 0.825153421 Squared multiple R: 0.680878168

Adjusted squared multiple R: 0.668604251 Standard error of estimate: 8.18913E+03

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	4.35764E+04	4.79086E+03	0.000000000	.	9.09573	0.00000
VALIVE	-4.70422E+02	6.31604E+01	-0.825153421	1.00E+00	-7.44806	0.00000

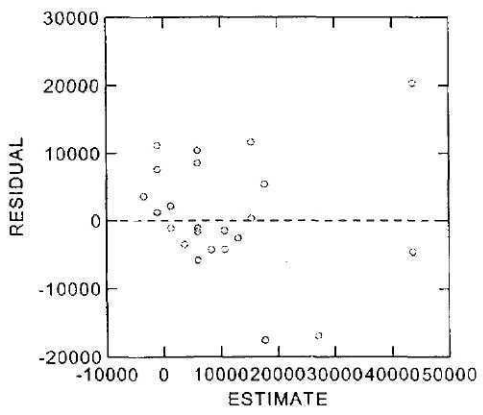
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	3.72016E+09	1	3.72016E+09	5.54736E+01	0.000000066
Residual	1.74361E+09	26	6.70618E+07		

*** WARNING ***
Case 27 has large leverage (Leverage = 0.342256214)
Case 28 has large leverage (Leverage = 0.342256214)
Case 28 is an outlier (Studentized Residual = 3.744964261)

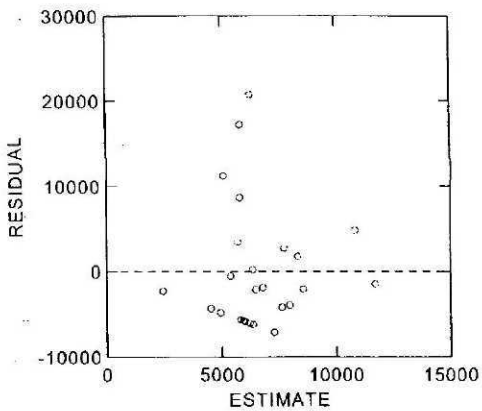
Durbin-Watson D Statistic 1.848
First Order Autocorrelation -0.042

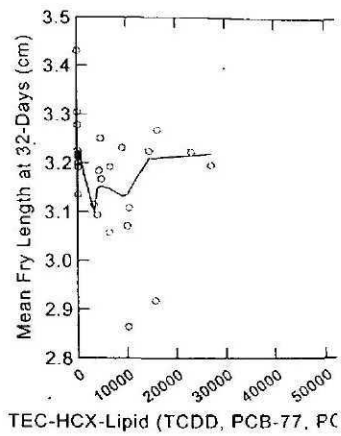
Plot of Residuals against Predicted Values



Analysis of Catfish Fry Length at 32 Days

Plot of Residuals against Predicted Values





44 case(s) deleted due to missing data.

Dep Var: TECHLIPID N: 26 Multiple R: 0.248567388 Squared multiple R: 0.061785746

Adjusted squared multiple R: 0.022693486 Standard error of estimate: 7.45734E+03

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	5.86083E+04	4.13906E+04	0.000000000	.	1.41598	0.16963
MEANLENGTH	-1.63760E+04	1.30259E+04	-0.248567388	1.00E+00	-1.25718	0.22078

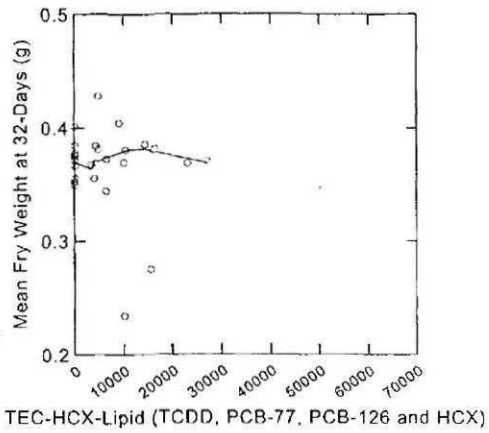
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	8.78952E+07	1	8.78952E+07	1.580510961	0.220784260
Residual	1.33468E+09	24	5.56119E+07		

*** WARNING ***
Case 20 has large leverage (Leverage = 0.334657722)
Case 26 is an outlier (Studentized Residual = 3.405011676)

Durbin-Watson D Statistic 0.175
First Order Autocorrelation 0.744

Analysis of Catfish Fry Weight at 32 Days



44 case(s) deleted due to missing data.

Dep Var: TECHLIPID N: 26 Multiple R: 0.161488597 Squared multiple R: 0.026078567

Adjusted squared multiple R: 0.000000000 Standard error of estimate: 7.59792E+03

Effect	Coefficient	Std Error	Std Coef	Tolerance	t	P(2 Tail)
CONSTANT	1.84329E+04	1.48293E+04	0.000000000	.	1.24301	0.22587
MEANWEIGHT	-3.23775E+04	4.03885E+04	-0.161488597	1.00E+00	-0.80165	0.43062

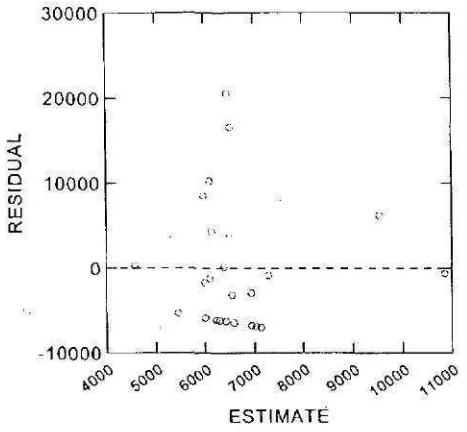
Analysis of Variance

Source	Sum-of-Squares	df	Mean-Square	F-ratio	P
Regression	3.70988E+07	1	3.70988E+07	0.642644863	0.430620783
Residual	1.38548E+09	24	5.77284E+07		

*** WARNING ***
Case 20 has large leverage (Leverage = 0.525659473)
Case 26 is an outlier (Studentized Residual = 3.267127303)

Durbin-Watson D Statistic 0.127
First Order Autocorrelation 0.772

Plot of Residuals against Predicted Values



Appendix L - Battelle Letter Report Evaluating Gross Pathological Lesions in Field Collected Fish (Hillman 2003)

Battelle
. . . Putting Technology To Work

Duxbury Operations
397 Washington Street
Duxbury, Massachusetts 02332
Telephone 781-934-0571
Fax: 781-934-2124

April 28, 2003

Ms. Beverly Lawrence
U.S. Army Corps of Engineers, New England District
696 Virginia Road
Concord, MA 01742-2751

CONTRACT NO. DACW33-01-D-0004
DELIVERY ORDER: 01 Centredale Manor Restoration Superfund Project Site
SUBJECT: Task 19A (Early Life Stage Test Pathology) and Task 21 F (Ichthyoplankton Sample Pathology) Report of Findings

Dear Ms. Lawrence:

I have examined for gross pathology the samples of ichthyoplankton collected by Normandeau Associates (NAI) from sites around the Centredale Manor Superfund Site in May and June 2001. During May, surface tows collected ichthyoplankton from four locations in Lyman Mill Pond (Stations LPX1, LPX2, LPX3, LPX4), three locations in Greystone Mill Pond (Stations GMP1, GMP2, GMP3), and two locations in Assapumpsett Pond (reported as ASP1 and ASP2). During June, samples were collected from the same locations in Lyman Mill Pond and Greystone Mill Pond. During the May and June sampling periods dipnet samples were collected from two locations in the Allendale Reach Tailrace (TRCN and TRCU). The collected material was placed in 10% formalin and returned to NAI's laboratory for processing. It appears that at some point some of the material was stained with a red dye, probably Rose Bengal. The sample vials were labeled either "eggs" or "larvae."

The accompanying table details the results of my observations of these samples. The table shows the sample identification numbers, station identifications, and the dates of collection of each sample. The station identifications listed in the table were taken from the labels in the sample vials. You will note in the table that there are two stations indicated as APM1 and APM2. These would seem to correspond to the stations indicated in NAI's reports (*Bioassessment Report of the Ichthyoplankton Community in Greystone Mill Pond, Lyman Mill Pond, and Assapumpsett Pond, North Providence, Rhode Island*, dated April 2002, and *Bioassessment Report of the Fish Community in the Woonasquatucket River, North Providence, Rhode Island*, dated April 2002) as ASP1 and ASP2.

The purpose of my observations was to compare the gross pathology of the field-collected ichthyoplankton with pathology observed in early-life stage catfish bioassays conducted by Battelle the facility in Sequim, Washington. The bioassays ran through the 32-day post-hatch stage.

Collections at Assapumpsett Pond and Greystone Mill Pond, the two reference sites, in May 2001 yielded primarily eggs/embryos. The embryos collected at Assapumpsett Pond appeared to be developing normally for the most part, whereas those from Greystone Mill Pond, where most of the eggs were collected, showed the most abnormalities. Those eggs that were characterized as normal generally showed a fairly advanced embryo that appeared to be developing normally. The majority of the eggs that were not normal were necrotic, and did not appear to show any signs of embryonic development. Development was either arrested early or the eggs had not been fertilized to begin with.

There were several hundred eggs/embryos in the vial labeled Sample Number 168420, GMP2. An aliquot of the vial was removed and placed in a Petri dish. Thirty eggs/embryos were selected from the Petri dish at random for examination. I also took a 30-specimen aliquot of 165 larvae from Sample 168424, GMP3C, by emptying the sample vial into a Petri dish and selecting 30 individuals for examination at random. Station GMP3C appears from the chart in NAI's reports to be in the uppermost portion of Greystone Mill Pond.

Quite a few individuals classified as larvae were well beyond the post yolk-sac fry stage, and are shown in the table as "juveniles." They will be discussed subsequently.

As shown in the table, most of the egg/embryos were developing normally. The one (of two) egg/embryo from Station GMP3C contained an embryo that appeared to have only one large eyespot.

Most post yolk-sac fry (reported as "larvae") examined also appeared normal, and most were well beyond the 32-day post-hatch stage. Of the 173 total "larvae" examined, only 4 showed any gross pathology. One individual from the aliquot from GMP3C had a small lesion on its back, which I didn't consider a developmental anomaly, but rather, a small spot where the skin had been rubbed off. The single individual in Sample 168405, GMP3, had undeveloped eyes, as did the one individual in the sample of 14 from Sample 168411, LPX2A, and the one in a sample of 10 from Sample 168448, LPX3A.

Forty-three 43 juveniles were collected, 21 coming from one station, Station TRCU in June 2001. One of the juveniles from TRCU appeared to have a slight cranial-facial malformation.

As I indicated earlier, the purpose of my observations was for comparison with observations made on catfish embryo/early yolk-sac fry, yolk-sac fry, and post yolk-sac fry from laboratory exposures at Battelle's facility in Sequim, Washington. Seven kinds of characteristics were quantified for catfish: normal appearance, small or abnormally developed, presence of hemorrhage, bent tail, short tail, cranial-facial malformations, and short snout. Abnormalities in the embryo/early yolk-sac fry included hemorrhages in the tail and cranial region and on the surface of the yolk sac, distension of the yolk sac, and fluid retention in and around the yolk sac. Direct comparison of the samples collected in the field is difficult because no early yolk-sac fry were included in the samples obtained from NAI. Because of the formalin fixation and staining of the relatively few embryos examined, it was not possible to determine whether there were hemorrhages or fluid retention in the embryos. Most of the abnormalities in the stages labeled "eggs" were related to necrosis of either unfertilized eggs or eggs in which embryogenesis did not progress very far.

Abnormalities in the post yolk-sac fry from the early life stage test consisted of hemorrhages at the base of the pelvic and caudal fins and various areas on the body surface; distended air bladders; gas emboli around the air bladder, cranial and facial abnormalities including domed

heads, shortened, flattened, and wider than normal head shape; cavitations in the visceral mass; distended abdomens; abnormally curved barbels; and lateral and vertical curvature of the spine. Again, comparison of the field samples to the early life stage test samples was difficult. Fixation and staining of the field-collected material made identification of most of those types of abnormalities unobservable. Most of the field-collected material was very late post yolk-sac stage or later. Most of the abnormalities observed in the laboratory-exposed animals should they have occurred in embryos and fry from the Woonasquatucket River area, would probably have led to the death of the organisms before they reached the later stages that I examined. Thus, the low frequency of observed abnormalities in the field-collected material would be expected.

It is somewhat more difficult to determine whether the higher frequency of abnormal eggs/embryos in the field samples is related to contaminant effects or the usually higher ratio of undeveloped eggs to developing embryos. If contaminants affect early (up to the 16-cell stage) stage mitosis, the embryos won't develop at all. I did observe a number of necrotic eggs that either weren't fertilized or embryogenesis didn't progress much past the blastula stage. It's possible to assess contaminant effects in those early stages, but eggs would have to be collected very shortly (within a day) after fertilization.

In summary, the ichthyoplankton collected by NAI in the Woonasquatucket River area appeared to be generally normal, with very few gross abnormalities. The life stages examined were considerably older than the 32-day post-hatch fry observed in the laboratory, and represent those fish that survived any toxic effects that would have impacted earlier-stage embryos and fry.

The difference in the abundance of eggs at Assapumpset Pond and Greystone Mill Pond as compared to the Lyman Mill and Allendale Reach sites is worth mentioning as it could perhaps indicate a lack of spawning at the other sites. The reports by NAI show that the largest number of eggs, by far, a mean number of about 292 per 100 m^2, was collected at GMP2 on May 3rd. They were identified only as centrarchid eggs, which included *Lepomis* sp. (sunfish), *Micropterus salmoides* (largemouth bass), and *Pomoxis* sp. (crappie). Collections of eggs at all the other sites were relatively small by comparison. Most of the larvae taken at all of the sites were also centrarchids. Almost all of the larvae at the other sites, as well as those in the collections from Greystone Mill Pond, were well beyond the 32-day post-hatch stage, indicating an earlier spawning than what occurred at GMP2. The difference in spawning time may have only been a week or two, but it could account for the difference in the relative absence of eggs at Lyman Mill Pond and Allendale Reach Tailrace compared to Greystone Mill Pond. Eggs collected at Assapumpsett Pond were primarily those of white perch *Morone americana*. Relatively few white perch larvae were collected, and they were collected only in Greystone Mill Pond. No juvenile or adult white perch were collected by NAI at any site; so the presence of eggs and larvae of white perch appears to be incidental. Therefore, there is no clear indication of a lack of spawning at Lyman Mill Pond or Allendale Reach Tailrace. The absence of eggs at those sites during the collection period probably reflects an earlier spawning time there. A further indication of an earlier spawning is that many of the eggs collected appear to have been in the water, undeveloped, for a considerable time period, and were either unfertilized or embryogenesis did not proceed past the earliest stages, probably blastula.

It should be noted that there is a wastewater treatment plant on Greystone Mill Pond. As indicated earlier, most of the abnormalities seen in the eggs occurred in the eggs from Greystone Mill Pond. It isn't possible to determine whether those abnormalities were induced by nutrients or other constituents of the treatment plant discharge.

Statistically, it would appear that there is no difference in gross pathology between the larvae from the more heavily contaminated sites of Lyman Mill Pond and the Allendale Reach Tailrace and those from the reference sites of Greystone Mill Pond and Assapumpsett Pond. However, most of the larval abnormalities, undeveloped eyes, occurred in the Lyman Mill Pond collections. The one juvenile abnormality, a slight cranial-facial malformation, occurred in the Allendale Reach Tailrace. Although not statistically significant, the abnormalities in the contaminated sites might be an indication of contaminant effects. As indicated earlier, if there are dioxin-related effects, they would be evident very early in development, resulting in the death of the early embryo. They would probably not be statistically evident in later-stage fry or juveniles, but their presence in the samples could be seen as a hint of the possibility of effects.

Thank you for the opportunity to examine the collections. I hope the results of my observations have been helpful. Please contact me at (781) 952-5328 or William Steinhauer at (781) 952-5319 if you have any questions or comments.

Sincerely,

Robert E. Hillman
Research Leader

cc: C. Rosiu, USEPA
A. Krasko, USEPA
N. Richardson, MACTEC

Results of Observations of Gross Pathology of Ichthyoplankton Samples Collected in May and June 2001 from the Woonasquatucket River and Allied Ponds.

			Eggs			Larvae			Juveniles		
Sample	Station	Date Collected	Number Examined	Number Anomalies	Percent Anomalies	Number Examined	Number Anomalies	Percent Anomalies	Number Examined	Number Anomalies	Percent Anomalies
168393	APM1	5-02-01	1	0	0	6	0	0	6	0	0
168394	APM1	5-02-01	14	0	0				1	0	0
168413	APM2	5-03-01	1	0	0				1	0	0
168414	APM2	5-03-01				1	0	0	1	0	0
168416	APM1	5-03-01	12	7	58						
168417	GMP1	5-03-01	4	3	75						
168418	GMP2	5-03-01	3	2	67						
168419	GMP2	5-03-01	2	0	0						
168420	GMP2	5-03-01	30	13	43				1	0	0
168421	GMP3A	5-08-01				1	0	0			
168422	GMPD	5-08-01				5	0	0			
168424	GMP3C	5-08-01	2	1	50	30	1	3	1	0	0
168425	LPX1	5-08-01				3	0	0			
168426	LPX1	5-08-01				4	0	0			
168427	LPX1C	5-08-01				2	0	0			
168429	LPX2	5-08-01				1	0	0			
168431	LPX3	5-09-01				7	0	0			
168433	LPX3	5-09-01				1	0	0			
168435	LPX4	5-09-01				2	0	0			
168437	TRCN	5-09-01							7	0	0
168438	TRCU	5-09-01							3	0	0
168399	GMP1	6-12-01				3	0	0			
168400	GMP1B	6-13-01				2	0	0			
168405	GMP3	6-13-01	1	0	0	1	1	100			
168409	LPX1B	6-13-01				1	0	0			
168410	LPX1C	6-13-01				1	0	0			
168411	LPX2A	6-13-01				14	1	7			
168446	LPX2B	6-13-01				1	0	0			
168448	LPX3A	6-13-01				10	1	10			
168449	LPX3B	6-13-01				1	0	0			
168451	LPX4A	6-13-01				1	0	0			
168452	LPX4B	6-13-01				4	0	0			
168453	LPX4C	6-13-01				3	0	0			
168454	TRCN	6-13-01				10	0	0			
168455	TRCU	6-13-01							21	1	5

APPENDIX I

RECEPTOR-SPECIFIC EXPOSURE PARAMETERS

TABLE I-1
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - GREAT BLUE HERON

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Common Name	*Great blue heron*				
Scientific Name	*Ardea herodias*				
Exposure parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference[a]
Home Range	HR	ha	0.6	Feeding territory size for freshwater rookery in Oregon in fall.	Bayer, 1978
Exposure Duration	ED	days/year	365	Summer resident; most migrating herons leave breeding ground by October and return between February and April.	USEPA, 1993
Dietary Composition				Mostly fish, some amphibians, reptiles, crustaceans, insects, birds, and mammals (lower Michigan/river). Dietary composition based on percent wet weight of aquatic prey in stomach contents, normalized to 100 percent.	USEPA, 1993; Alexander, 1977
fish	P_{fish}	unitless	95%		assumption
insects	P_{insect}	unitless	0%		assumption
crustaceans	P_{crust}	unitless	1%		assumption
amphibians	P_{amphib}	unitless	4%		assumption
mammals[b]	P_{mam}	unitless	0%		assumption
seeds	P_{seed}	unitless	0%		assumption
vegetation	P_{veg}	unitless	0%		assumption
Food Ingestion Rate	IR_{food}	kg/day	0.39	Calculated using regression equation for wading birds: $\log(IR_{food})$ (g/day) = 0.966 * log(BW) - 0.64 (g)	Kushlan, 1978
Water Ingestion Rate	IR_{water}	l/day	0.10	Calculated using regression equation for birds: IR_{water} (l/day) = 0.059 * $BW^{0.67}$ (kg) and selected body weight.	Calder and Braun, 1983
Sediment Ingestion Rate	IR_{sed}	kg/day	0.019	Assume 5 percent of daily food ingestion rate.	assumption
Body Weight	BW	kg	2.2	Average body weight of female herons.	USEPA, 1993

TABLE I-1
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - GREAT BLUE HERON

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Footnotes:

a. Primary literature as cited in USEPA, 1993 unless otherwise noted.

b. Assumed that small mammals not included in diet, however, birds and mammals comprised 1% of reported diet in a lower Michigan river study (Alexander, 1977).

References:

Alexander, .G., 1977. Food of vertebrate predators on trout waters in north central lower Michigan; Michigan Academician 10:181-195

Bayer,R.D., 1978. Aspects of an Oregon estuarine great blue heron population; In: Sprunt, A., J. Ogden, S. Winkler, eds. Wading Birds; Natl. Audubon Soc. Res. Rep. 7:213-217.

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USEPA, 1993. Wildlife Exposure Factors Handbook; United States Environmental Protection Agency, Office of Research and Development; EPA/600/R-93/187a; December 1993; Washington, D.C.

TABLE I-2
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - KINGFISHER

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Common Name	**Belted Kingfisher**				
Scientific Name	***Ceryle alcyon***				
Exposure parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference[a]
Home Range	HR	ha	1.03	Based on estimated 1.03 km shoreline estimate for streams in Ohio by early summer breeding pairs; converted to acres assuming that average stream width is 10 meters.	Brooks and Davis, 1987
Exposure Duration	ED	days/year	365	In Maine, fall depatures in mid October with returns in early April.	Bent, 1940
Dietary Composition				Generally feed primarily on fish but also sometimes include large numbers of crayfish in diet as well as amphibians, mussels, insects, and even young birds and mice. Dietary composition based on analysis of fecal pellets from animals captured from riparian streams in Nova Scotia.	USEPA, 1993; White, 1936
fish	P_{fish}	unitless	100%		assumption
insects	P_{insect}	unitless	0%		assumption
crustaceans	P_{crust}	unitless	0%		assumption
amphibians	P_{amphib}	unitless	0%		assumption
mammals	P_{mam}	unitless	0%		assumption
seeds	P_{seed}	unitless	0%		assumption
vegetation	P_{veg}	unitless	0%		assumption
Food Ingestion Rate	IR_{food}	kg/day	0.05	Calculated using regression equation for non-passerines: IR_{food} (g/day) = 0.301 * $BW^{0.751}$ (g)[b].	USEPA, 1993; Suter, 1993
Water Ingestion Rate	IR_{water}	l/day	0.016	Calculated using regression equation for birds: IR_{water} (l/day) = 0.059 * $BW^{0.67}$ (kg) and selected body weight.	Calder and Braun, 1983
Sediment Ingestion Rate	IR_{sed}	kg/day	0.0	Assume no contact with sediment.	assumption
Body Weight	BW	kg	0.15	Average body weight of kingfishers in Pennsylvania and Ohio.	Brooks and Davis, 1987

TABLE I-2
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - KINGFISHER

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Footnotes:

a. Primary literature as cited in USEPA, 1993 unless otherwise noted.

b. Values derived from the regression equation expressed on a dry weight basis. Converted to a wet weight ingestion rate by calculating the estimated intake (kg/day) of each food item (i.e., multiply dry weight ingestion rate by percent composition), dividing by 1 minus the moisture content of that food item and summing across all food items. Assumed that fish, invertebrates, crustaceans, amphibians, mammals, seeds, and plants contain 73%, 80%, 80%, 73%, 63%, 11.5%, and 85% water content, respectively (Suter, 1993).

References:

Bent, A.C., 1940. Life histories of North American cuckoos, goat suckers, hummingbirds, and their allies; Washington, D.C.; U.S. Government Printing Office; Smithsonian Inst. U.S. Nat. Mus. Bull. 176.

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White, H.C., 1936. The food of kingfishers and mergansers on the Margaree River, Nova Scotia; J. Biol. Board Can. 2:299-309.

TABLE I-3
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - RIVER OTTER

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Common Name	**River Otter**				
Scientific Name	***Lutra canadensis***				
Exposure parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference[a]
Home Range	HR	ha	295	Reported home range for adult females in Montana/riverine habitat containing heavy vegetation.	Foy, 1984
Exposure Duration	ED	days/year	365	Active year-round	USEPA, 1993
Dietary Composition[b]				Opportunistic hunters along shorelines and open water; prey consumption depends on availability. River otters are predominanty piscivorous; depending on availability they are also known to consume birds (e.g., ducks), crayfish, aquatic insects, and amphibians. Dietary composition assumptions based on spring diet in northwestern Illinois riverine system.	Alexander and Woolf, 1987; USEPA, 1993
fish	P_{fish}	unitless	85%		assumption
insects	P_{insect}	unitless	2%		assumption
crustaceans	P_{crust}	unitless	11%		assumption
amphibians	P_{amphib}	unitless	3%		assumption
birds/mammals[c]	P_{mam}	unitless	0%		assumption
seeds	P_{seed}	unitless	0%		assumption
vegetation	P_{veg}	unitless	0%		assumption
Food Ingestion Rate	IR_{food}	kg/day	1.4	Calculated using regression equation for mammals: IR_{food} (g/day) = 0.235 * $BW^{0.822}$ (g)[d].	USEPA, 1993
Water Ingestion Rate	IR_{water}	l/day	0.59	Calculated using regression equation for mammals: IR_{water} (l/day) = 0.099 * $BW^{0.90}$ (kg) and selected body weight.	Calder and Braun, 1983
Sediment Ingestion Rate	IR_{sed}	kg/day	0.027	Assume 2 percent of daily food ingestion rate	assumption
Body Weight	BW	kg	7.3	Average of female summer and fall weights in Montana.	USEPA, 1993

TABLE I-3
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - RIVER OTTER

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Footnotes:

a. Primary literature as cited in USEPA, 1993 unless otherwise noted.

b. Assumed that animals will also forage in floodplain (increasing throughout the year); dietary composition applicable to spring/early summer.

c. Assumed that birds and small mammals not included in diet. However birds and small mammals can make up 1 - 13 % of river otter diet depending on season and availability.

d. Values derived from the regression equation expressed on a dry weight basis. Converted to a wet weight ingestion rate by calculating the estimated intake (kg/day) of each food item (i.e., multiply dry weight ingestion rate by percent composition), dividing by 1 minus the moisture content of that food item and summing across all food items. Assumed that fish, invertebrates, crustaceans, amphibians, mammals, seeds, and plants contain 73%, 80%, 80%, 73%, 63%, 11.5%, and 85% water content, respectively (Suter, 1993).

References:

Alexander, E.A., and A. Woolf, 1987. River otter food habits in northwestern Illinois, Trans. Illinois Acad. Sci. 80:115-118.

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USEPA, 1993. Wildlife Exposure Factors Handbook; United States Environmental Protection Agency, Office of Research and Development; EPA/600/R-93/187a; December 1993; Washington, D.C.

TABLE I-4
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - TREE SWALLOW

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Common Name	**Tree Swallow**				
Scientific Name	***Tachycineta bicolor***				
Exposure parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference[a]
Home Range	HR	ha	0.50	Based on 0.1 km shoreline range estimate; converted to acres assuming that average river width is 50 meters.	McCarty and Winkler, 1999
Exposure Duration	ED	days/year	365	Fall depatures in mid October with returns in early April.	assumption
Dietary Composition				Generally feed on winged insects, catching them in flight. However, also known to feed on bayberries in colder months, prior to anual southern migration. Dietary composition assumed to be 100% insects.	Robertson et al., 1992
fish	P_{fish}	unitless	0%		assumption
insects	P_{insect}	unitless	100%		assumption
crustaceans	P_{crust}	unitless	0%		assumption
amphibians	P_{amphib}	unitless	0%		assumption
mammals	P_{mam}	unitless	0%		assumption
seeds	P_{seed}	unitless	0%		assumption
vegetation	P_{veg}	unitless	0%		assumption
Food Ingestion Rate	IR_{food}	kg/day	0.015	Calculated using regression equation for non-passerines: IR_{food} (g/day) = 0.301 * $BW^{0.751}$ (g)[b].	USEPA, 1993; Suter, 1993
Water Ingestion Rate	IR_{water}	l/day	0.0044	Calculated using regression equation for birds: IR_{water} (l/day) = 0.059 * $BW^{0.67}$ (kg) and selected body weight.	Calder and Braun, 1983
Sediment Ingestion Rate	IR_{sed}	kg/day	0.0	Assume no contact with sediment.	assumption
Body Weight	BW	kg	0.021	Average body weight of females in Pennsylvania and Ohio.	Roberson et al., 1992

TABLE I-4
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - TREE SWALLOW

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Footnotes:

a. Primary literature as cited in USEPA, 1993 unless otherwise noted.

b. Values derived from the regression equation expressed on a dry weight basis. Converted to a wet weight ingestion rate by calculating the estimated intake (kg/day) of each food item (i.e., multiply dry weight ingestion rate by percent composition), dividing by 1 minus the moisture content of that food item and summing across all food items. Assumed that fish, invertebrates, crustaceans, amphibians, mammals, seeds, and plants contain 73%, 80%, 80%, 73%, 63%, 11.5%, and 85% water content, respectively (Suter, 1993).

References:

Calder, W.A., and E.J. Braun, 1983. Scaling of osmotic regulation in mammals and birds, Am. J. Physiol., 244: R601-R606.

McCarty and Winkler, 1999. Foraging ecology and diet selectivity of tree swallows feeding nestlings. The Condor 101.

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TABLE I-5
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - TREE SWALLOW NESTLING

BASELINE ECOLOGICALRISK ASSESSMENT
CENTREDALE MANOR RESTORATION SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Common Name	**Tree Swallow (Nestling)**				
Scientific Name	***Tachycineta bicolor***				
Exposure parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference[a]
Home Range	HR	ha	0.5	Based on 0.1 km shoreline range estimate; converted to acres assuming that average river width is 50 meters.	McCarty and Winkler, 1999
Exposure Duration	ED	days/year	365	Fall depatures in mid October with returns in early April.	assumption
Dietary Composition				Generally feed on winged insects, catching them in flight. However, also known to feed on bayberries in colder months, prior to anual southern migration. Dietary composition assumed to be 100% insects.	Robertson et al., 1992
fish	P_{fish}	unitless	0%		assumption
insects	P_{insect}	unitless	100%		assumption
crustaceans	P_{crust}	unitless	0%		assumption
amphibians	P_{amphib}	unitless	0%		assumption
mammals	P_{mam}	unitless	0%		assumption
seeds	P_{seed}	unitless	0%		assumption
vegetation	P_{veg}	unitless	0%		assumption
Food Ingestion Rate	IR_{food}	kg/day	0.0089	Calculated using regression equation for non-passerines: IR_{food} (g/day) = 0.301 * $BW^{0.751}$ (g)[b].	USEPA, 1993
Water Ingestion Rate	IR_{water}	l/day	0.0048	Calculated using regression equation for birds: IR_{water} (l/day) = 0.059 * $BW^{0.67}$ (kg) and selected body weight.	Calder and Braun, 1983
Soil Ingestion Rate	IR_{soil}	kg/day	0.0	Assume no contact with sediment.	assumption
Body Weight	BW	kg	0.024	Average nestling weights collected in 2001from nest boxes from Greystone, Allendale, and Lyman Mill Ponds for tissue chemistry.	Robertson et al., 1992

TABLE I-5
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - TREE SWALLOW NESTLING

BASELINE ECOLOGICALRISK ASSESSMENT
CENTREDALE MANOR RESTORATION SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Common Name	**Tree Swallow (Nestling)**
Scientific Name	***Tachycineta bicolor***

Footnotes:

a. Primary literature as cited in USEPA, 1993 unless otherwise noted.

b. Values derived from the regression equation expressed on a dry weight basis. Converted to a wet weight ingestion rate by calculating the estimated intake (kg/day) of each food item (i.e., multiply dry weight ingestion rate by percent composition), dividing by 1 minus the moisture content of that food item and summing across all food items. Assumed that birds, mammals, invertebrates, amphibians, seeds, and plants contain 63%, 64%, 80%, 73%, 12%, and 85% water content, respectively (Suter, 1993).

References:

McCarty and Winkler, 1999. Foraging ecology and diet selictivity of tree swallows feeding nestlings. The Condor 101.

Calder, W.A., and E.J. Braun, 1983. Scaling of osmotic regulation in mammals and birds, Am. J. Physiol., 244: R601-R606.

Nagy, K.A., 1987. Field metabolic rate and food requirement scaling in mammals and birds; Ecol. Monogr. 57:111-128.

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Suter, G.W., 1993. Ecological Risk Assessment; Lewis Publishers, Boca Raton.

USEPA, 1993. Wildlife Exposure Factors Handbook; United States Environmental Protection Agency, Office of Research and Development; EPA/600/R-93/187a; December 1993; Washington, D.C.

TABLE I-6
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - LITTLE BROWN BAT

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Common Name	**Little brown bat**				
Scientific Name	***Myotis lucifugus***				
Exposure parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference[a]
Home Range	HR	ha	0.5	Reported home range for adult females in Montana/riverine habitat containing heavy vegetation.	Buchler, 1976
Exposure Duration	ED	days/year	365	Hibernate or migrate south in the late fall.	Burt, 1972
Dietary Composition[b]				Generally feed on winged insects (from dusk to dawn), over water and in trees	Bulcher, 1976; Burt, 1972
fish	P_{fish}	unitless	0%		assumption
insects	P_{insect}	unitless	100%		assumption
crustaceans	P_{crust}	unitless	0%		assumption
amphibians	P_{amphib}	unitless	0%		assumption
mammals[c]	P_{mam}	unitless	0%		assumption
seeds	P_{seed}	unitless	0%		assumption
vegetation	P_{veg}	unitless	0%		assumption
Food Ingestion Rate	IR_{food}	kg/day	0.0025	Adult females (kg/day wet wt.); range 0.0025-0.0037.	Fenton & Barclay, 1980
Water Ingestion Rate	IR_{water}	l/day	0.0012	Calculated using regression equation for mammals: IR_{water} (l/day) = 0.099 * $BW^{0.90}$ (kg) and selected body weight.	Calder and Braun, 1983
Sediment Ingestion Rate	IR_{sed}	kg/day	0.000	Assume no contact with sediment.	assumption
Body Weight	BW	kg	0.0071	Average of female summer and fall weights in Montana.	Bopp, 1999

TABLE I-6
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - LITTLE BROWN BAT

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Footnotes:

a. Primary literature as cited in USEPA, 1993 unless otherwise noted.

b. Values derived from the regression equation expressed on a dry weight basis. Converted to a wet weight ingestion rate by calculating the estimated intake (kg/day) of each food item (i.e., multiply dry weight ingestion rate by percent composition), dividing by 1 minus the moisture content of that food item and summing across all food items. Assumed that fish, invertebrates, crustaceans, amphibians, mammals, seeds, and plants contain 73%, 80%, 80%, 73%, 63%, 11.5%, and 85% water content, respectively (Suter, 1993).

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TABLE I-7
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - AMERICAN WOODCOCK

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Common Name	**Woodcock**				
Scientific Name	***Scolopax minor***				
Exposure parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference[a]
Home Range	HR	ha	4.5	Average home range of females (with broods) in Wisconsin woods	Gregg, 1984
Exposure Duration	ED	days/year	365	Fall migration begins late September with return to northern breeding grounds by late March or early April.	USEPA, 1993
Dietary Composition				Prefer earthworms but will also consume insects (fly, beetle, moth/butterfly larvae) and other soil invertebrates; will also consume seeds and other plant material. Dietary composition based on analysis of esophagus, stomach, and proventriculus contents (% wet weight) from animals captured from fields in Maine.	USEPA, 1993; Krohn, 1970.
birds	P_{bird}	unitless	0%		assumption
mammals	P_{mam}	unitless	0%		assumption
invertebrates	P_{insect}	unitless	100%		assumption
amphibians	P_{amphib}	unitless	0%		assumption
seeds	P_{seed}	unitless	0%		assumption
vegetation/fruit	P_{veg}	unitless	0%		assumption
Food Ingestion Rate	IR_{food}	kg/day	0.08	Calculated using regression equation for non-passerines: IR_{food} (g/day) = 0.301 * $BW^{0.751}$ (g)[b].	USEPA, 1993
Water Ingestion Rate	IR_{water}	l/day	0.020	Calculated using regression equation for birds: IR_{water} (l/day) = 0.059 * $BW^{0.67}$ (kg) and selected body weight.	Calder and Braun, 1983
Soil Ingestion Rate	IR_{soil}	kg/day	0.012	Assume 15 percent of daily food ingestion rate	assumption
Body Weight	BW	kg	0.20	Average adult female weights reported in three studies (throughout range, central Massachusetts, and Minnesota)	USEPA, 1993

TABLE I-7
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - AMERICAN WOODCOCK

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Footnotes:

a. Primary literature as cited in USEPA, 1993 unless otherwise noted.

b. Values derived from the regression equation expressed on a dry weight basis. Converted to a wet weight ingestion rate by calculating the estimated intake (kg/day) of each food item (i.e., multiply dry weight ingestion rate by percent composition), dividing by 1 minus the moisture content of that food item and summing across all food items. Assumed that birds, mammals, invertebrates, amphibians, seeds, and plants contain 63%, 64%, 80%, 73%, 12%, and 85% water content, respectively (Suter, 1993).

References:

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TABLE I-8
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - SHORT-TAILED SHREW

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Common Name	Short-tailed Shrew				
Scientific Name	*Blarina brevicauda*				
Exposure parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference[a]
Home Range	HR	ha	0.39	Average annual home ranges in southern Manitoba/tamarack bog habitat.	Buckner, 1966
Exposure Duration	ED	days/year	365	Active year round.	USEPA, 1993
Dietary Composition				Consumes insects, worms, snails, and other invertebrates as well as mice, voles, frogs and other vertebrates. Dietary composition estimates derived from a New York population based on % volume in stomach contents from samples collected between June and October.	USEPA, 1993; Whitaker and Feraro, 1963
birds	P_{bird}	unitless	0%		assumption
mammals	P_{mam}	unitless	0%		assumption
invertebrates	P_{insect}	unitless	85%	includes earthworms, slugs, snails, beetles, lepidopteran larvae, and chilopoda	assumption
amphibians	P_{amphib}	unitless	0%		assumption
seeds	P_{seed}	unitless	0%		assumption
vegetation/fruit	P_{veg}	unitless	14%	includes fungi and vegetation	assumption
Food Ingestion Rate	IR_{food}	kg/day	0.013	Calculated using regression equation for mammals: IR_{food} (g/day) = 0.235 * BW $^{0.822}$ (g)[b].	USEPA, 1993
Water Ingestion Rate	IR_{water}	l/day	0.0026	Calculated using regression equation for mammals: IR_{water} (l/day) = 0.099 * BW $^{0.90}$ (kg) and selected body weight.	Calder and Braun, 1983
Soil Ingestion Rate	IR_{soil}	kg/day	0.00064	Assume 5 percent of daily food ingestion rate	assumption
Body Weight	BW	kg	0.017	Average female weights in western Pennsylvania population	Guilday, 1957

TABLE I-8
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - SHORT-TAILED SHREW

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Footnotes:

a. Primary literature as cited in USEPA, 1993 unless otherwise noted.

b. Values derived from the regression equation expressed on a dry weight basis. Converted to a wet weight ingestion rate by calculating the estimated intake (kg/day) of each food item (i.e., multiply dry weight ingestion rate by percent composition), dividing by 1 minus the moisture content of that food item and summing across all food items. Assumed that birds, mammals, invertebrates, amphibians, seeds, and plants contain 63%, 64%, 80%, 73%, 12%, and 85% water content, respectively (Suter, 1993).

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TABLE I-9
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - MALLARD

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Common Name	**Mallard**				
Scientific Name	***Anas platyrhynchos***				
Exposure parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference[a]
Home Range	HR	ha	540	Average female mallard home ranges in Minnesota wetlands and rivers.	USEPA, 1993
Exposure Duration	ED	days/year	365	Leave summer foraging areas in early September and return by end of March.	USEPA, 1993
Dietary Composition				Primarily aquatic plants in winter; breeding females shift to a largely invertebrate based diet to obtain protein for egg laying. Dietary composition based on percent wet weight volume in esophagus from animals caught in south central North Dakota/prairie potholes. Values are averages of prey composition in diet for April, May, and June normalized to 100 percent.	USEPA, 1993; Swanson et al., 1985
fish	P_{fish}	unitless	0%		assumption
insects	P_{insect}	unitless	61%		assumption
crustaceans	P_{crust}	unitless	13%		assumption
amphibians	P_{amphib}	unitless	0%		assumption
mammals[b]	P_{mam}	unitless	0%		assumption
seeds	P_{seed}	unitless	23%		assumption
vegetation	P_{veg}	unitless	3%		assumption
Food Ingestion Rate	IR_{food}	kg/day	0.23	Calculated using regression equation for non-passerines: IR_{food} (g/day) = 0.301 * $BW^{0.751}$ (g)[c].	USEPA, 1993.
Water Ingestion Rate	IR_{water}	l/day	0.061	Calculated using regression equation for birds: IR_{water} (l/day) = 0.059 * $BW^{0.67}$ (kg) and selected body weight.	Calder and Braun, 1983
Sediment Ingestion Rate	IR_{sed}	kg/day	0.011	Assume 5 percent of daily food ingestion rate	assumption
Body Weight	BW	kg	1.0	Average body weight of female mallards throughout North America.	USEPA, 1993

TABLE I-9
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - MALLARD

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Footnotes:

a. Primary literature as cited in USEPA, 1993 unless otherwise noted.

b. Assumed that small mammals not included in diet, however, miscellaneous mammals comprised up to 8.5% of reported diet in a study of North Dakota prairie potholes (Swanson et al., 1985).

c. Values derived from the regression equation expressed on a dry weight basis. Converted to a wet weight ingestion rate by calculating the estimated intake (kg/day) of each food item (i.e., multiply dry weight ingestion rate by percent composition), dividing by 1 minus the moisture content of that food item and summing across all food items. Assumed that fish, invertebrates, crustaceans, amphibians, mammals, seeds, and plants contain 73%, 80%, 80%, 73%, 63%, 11.5%, and 85% water content, respectively (Suter, 1993).

References:

Calder, W.A., and E.J. Braun, 1983. Scaling of osmotic regulation in mammals and birds, Am. J. Physiol., 244: R601-R606.

Dwyer T.J., G.L. Krapu, and D.M. Janke, 1979. Use of prairie pothole habitat by breeding mallards; J. Widl. Manage. 43:526-531.

Kirby R.E., J.H. Riechmann, L.M. Cowardin, 1985. Home range and habitat use of forest-dwelling mallards in Minnesota; Wilson Bull. 97:215-219.

Nagy, K.A., 1987. Field metabolic rate and food requirement scaling in mammals and birds; Ecol. Monogr. 57:111-128.

Nelson, A.L. and A.C. Martin, 1953. Gamebird weights; J. Wild. Manage. 17:36-42.

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TABLE I-10
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - RACCOON (Aquatic)

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Common Name	Raccoon				
Scientific Name	*Procyon lotor*				
Exposure parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference[a]
Home Range	HR	ha	108	Average adult female home range size from May through December in riparian habitat in Michigan.	Stuewer, 1943
Exposure Duration	ED	days/year	183	Exposure to aquatic prey assumed to be substantial for spring/summer only (i.e., 6 months).	USEPA, 1993
Dietary Composition[b]				Diet varies throughout year, switching from predominantly animal to plants (especially fruits). In spring/early summer, frogs, crayfish, mussels, insects; by autumn, fleshy fruits, nuts, acorns, corn. Dietary composition derived as normalized percentages of aquatic prey in diet for spring in forested bottom land in Maryland.	USEPA, 1993; Llewllyn and Uhler, 1952
fish	P_{fish}	unitless	3%		assumption
insects	P_{insect}	unitless	47%		assumption
crustaceans	P_{crust}	unitless	43%		assumption
amphibians	P_{amphib}	unitless	7%		assumption
mammals[c]	P_{mam}	unitless	0%		assumption
seeds	P_{seed}	unitless	0%		assumption
vegetation	P_{veg}	unitless	0%		assumption
Food Ingestion Rate	IR_{food}	kg/day	1.5	Calculated using regression equation for mammals: IR_{food} (g/day) = 0.235 * $BW^{0.822}$ (g)[d].	USEPA, 1993
Water Ingestion Rate	IR_{water}	l/day	0.51	Calculated using regression equation for mammals: IR_{water} (l/day) = 0.099 * $BW^{0.90}$ (kg) and selected body weight.	Calder and Braun, 1983
Sediment Ingestion Rate	IR_{sed}	kg/day	0.075	Assume 5 percent of daily food ingestion rate	assumption
Body Weight	BW	kg	6.2	Average Illinois females (parous and nulliparous) weights	Sanderson, 1984

TABLE I-10
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - RACCOON (Aquatic)

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Footnotes:

a. Primary literature as cited in USEPA, 1993 unless otherwise noted.

b. Assumed that animals will also forage in floodplains (increasing throughout the year); dietary composition applicable to spring/early summer.

c. Assumed that small mammals not included in diet, however, rodents comprised up to 7% of reported diet in a study of forested bottomland in Maryland (Llewellyn and Uhler, 1952).

d. Values derived from the regression equation expressed on a dry weight basis. Converted to a wet weight ingestion rate by calculating the estimated intake (kg/day) of each food item (i.e., multiply dry weight ingestion rate by percent composition), dividing by 1 minus the moisture content of that food item and summing across all food items. Assumed that fish, invertebrates, crustaceans, amphibians, mammals, seeds, and plants contain 73%, 80%, 80%, 73%, 63%, 11.5%, and 85% water content, respectively (Suter, 1993).

References:

Calder, W.A., and E.J. Braun, 1983. Scaling of osmotic regulation in mammals and birds. Am. J. Physiol., 244: R601-R606.

Fritzell, E.K., 1978. Habitat use by prairie raccoons during the waterfowl breeding season; J. Wildl. Manage. 42:118-127.

Johnson, A.S., 1970. Biology of the raccoon (*Procyon lotor varius* Nelson and Goldman) in Alabama); Alabama Cooperative Wildlife Research Unit; Auburn Univ. Agric. Ex. Stn. Bull. 402.

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TABLE I-11
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - RACCOON (Terrestrial)

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Common Name	Raccoon				
Scientific Name	*Procyon lotor*				
Exposure parameter	Symbol	Units	Selected Value	Reported Values/Notes	Reference[a]
Home Range	HR	ha	108	Average adult female home range size from May through December in riparian habitat in Michigan.	Stuewer, 1943
Exposure Duration	ED	days/year	183	Exposure to terrestrial prey assumed to be substantial for late summer/fall only (i.e., 6 months).	USEPA, 1993
Dietary Composition[b]				Diet varies throughout year, switching from predominantly animal to plants (especially fruits). In spring/early summer, frogs, crayfish, mussels, insects; by autumn, fleshy fruits, nuts, acorns, corn. Dietary composition derived as normalized percentages of non-aquatic prey in diet for fall in forested bottom land in Maryland. Values are derived from % wet volume samples from the digestive track.	USEPA, 1993; Llewllyn and Uhler, 1952
birds	P_{bird}	unitless	0%		assumption
mammals	P_{mam}	unitless	0%		assumption
invertebrates	P_{insect}	unitless	25%		assumption
amphibians	P_{amphib}	unitless	4%		assumption
seeds	P_{seed}	unitless	8%	corn, acorns	assumption
vegetation/fruit	P_{veg}	unitless	63%	*Smilax*, pokeberry, wild cherry, blackberries, grapes	assumption
Food Ingestion Rate	IR_{food}	kg/day	1.75	Calculated using regression equation for mammals: IR_{food} (g/day) = 0.235 * $BW^{0.822}$ (g)[d].	USEPA, 1993
Water Ingestion Rate	IR_{water}	l/day	0.51	Calculated using regression equation for mammals: IR_{water} (l/day) = 0.099 * $BW^{0.90}$ (kg) and selected body weight.	Calder and Braun, 1983
Soil Ingestion Rate	IR_{soil}	kg/day	0.087	Assume 5 percent of daily food ingestion rate	assumption
Body Weight	BW	kg	6.2	Average Illinois females (parous and nulliparous) weights	Sanderson, 1984

TABLE I-11
RECEPTOR-SPECIFIC EXPOSURE PARAMETERS FOR INDICATOR WILDLIFE SPECIES - RACCOON (Terrestrial)

BASELINE ECOLOGICAL RISK ASSESSMENT
CENTREDALE MANOR RESTORATION PROJECT SUPERFUND SITE
NORTH PROVIDENCE, RHODE ISLAND

Footnotes:

a. Primary literature as cited in USEPA, 1993 unless otherwise noted.

b. Assumed that animals will also forage in floodplains (increasing throughout the year); dietary composition applicable to spring/early summer.

c. Assumed that small mammals not included in diet, however, rodents comprised up to 7% of reported diet in a study of forested bottomland in Maryland (Llewellyn and Uhler, 1952).

d. Values derived from the regression equation expressed on a dry weight basis. Converted to a wet weight ingestion rate by calculating the estimated intake (kg/day) of each food item (i.e., multiply dry weight ingestion rate by percent composition), dividing by 1 minus the moisture content of that food item and summing across all food items. Assumed that birds, mammals, invertebrates, amphibians, seeds, and plants contain 63%, 64%, 80%, 73%, 12%, and 85% water content, respectively (Suter, 1993).

References:

Calder, W.A., and E.J. Braun, 1983. Scaling of osmotic regulation in mammals and birds. Am. J. Physiol., 244: R601-R606.

Fritzell, E.K., 1978. Habitat use by prairie raccoons during the waterfowl breeding season; J. Wildl. Manage. 42:118-127.

Johnson, A.S., 1970. Biology of the raccoon (*Procyon lotor varius* Nelson and Goldman) in Alabama); Alabama Cooperative Wildlife Research Unit; Auburn Univ. Agric. Ex. Stn. Bull. 402.

Llewellyn, L.M., and F.M. Uhler, 1952. The foods of fur animals of the Patuxent Research Refuge, Maryland; Am. Midl. Nat. 48:193-203.

Lotze, J.-H., 1979. The raccoon (*Procyon lotor*) on St. Catherines Island, Georgia. 4. Comparisons of home ranges determined by livetrapping and radiotracking; New York, N.Y.; American Museum of Natural History; Rep. No. 2664.

Nagel, W.O., 1943. How big is a 'coon; Missouri Conservationist 6-7.

Nagy, K.A., 1987. Field metabolic rate and food requirement scaling in mammals and birds; Ecol. Monogr. 57:111-128.

Sanderson, G.C., 1984. Cooperative raccoon collections; Ill. Nat. Hist. Survey Div.; Pittman-Robertson Proj. W-49-31.

Stuewer, R.W., 1943. Raccoons: their habits and management in Michigan; Ecol. Monogr. 13:203-257.

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