Food Chain Exposure Evalaution
Insectivorous Waterfowl

Mallard
Exposure = Sediment + Aquatic Inverts
Body Weight = 1.134 Kg (EPA, 1993)
Sediment Ingestion = 2 percent of Food Consumption (EPA, 1993)
Food Ingestion (kg/day) = .0582 BW ^ 0.651 (EPA, 1993)
Aquatic Inverts Ingestion (Food) (kg) = .0582BW^.651 (EPA, 1993)
Fraction of diet comprised of invertebrates (FD) = 75 percent
To Model Aquatic Inverts concet = (Cseds/foc)*BSAF *FL
BSAF (PAHS) = 0.1, all other chemicals are assumed to be 1
FL assumed to be 0.01 (Assumption)

Mallard: Fisherville Pond-North Pool[a]

Chemicals	Sediment Concentration (C_s)	Invertebrates Concentration[b] (C_i)	Sediment Ingestion Rate (IR_s)	Food Ingestion Rate (FI)	Fraction of diet comprised of invertebrates (FD)	Body Weight (BW)	Exposure: Sediments	Exposure: Invertebrates	Total Exposure	Toxicity Reference Values (TRV)[c]	Hazard Quotient
Metals	mg/kg	mg/kg	kg/day	kg/day	Percent	kg	mg/kg/day	mg/kg/day	mg/kg/day	mg/kg/day	Unitless
Arsenic	16	0.94	0.001	0.06	0.75	1.13	0.02	0.04	0.06	5.14	0.011
Cadmium	3	0.19	0.001	0.06	0.75	1.13	0.004	0.01	0.01	1.45	0.008
Chromium	40	2.33	0.001	0.06	0.75	1.13	0.04	0.10	0.14	1	0.14
Copper	44	2.57	0.001	0.06	0.75	1.13	0.05	0.11	0.16	47	0.003
Lead	68	3.98	0.001	0.06	0.75	1.13	0.075	0.17	0.24	1.13	0.21
Mercury	0.1	0.01	0.001	0.06	0.75	1.13	0.0001	0.0002	0.000	0.0064	0.056
Nickel	24	1.41	0.001	0.06	0.75	1.13	0.03	0.06	0.09	77.4	0.001
Selenium	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	0.5	NA
Silver	0.2	0.01	0.001	0.06	0.75	1.13	0.000	0.0005	0.001	NA	NA
Tin	4.5	0.26	0.001	0.06	0.75	1.13	0.005	0.01	0.016	6.8	0.002
Zinc	246	14.44	0.001	0.06	0.75	1.13	0.27	0.60	0.877	14.5	0.060
PAHS											
Total PAH	3.6	0.02	0.001	0.06	0.75	1.13	0.004	0.001	0.005	NA	NA
PCBs/Pesticides											
Total PCB	0.38	0.02	0.001	0.06	0.75	1.13	0.0004	0.001	0.001	0.18	0.008
Total DDE	0.006	0.0004	0.001	0.06	0.75	1.13	0.00001	0.00002	0.00002	0.0028	0.008
Total DDD	0.006	0.0003	0.001	0.06	0.75	1.13	0.00001	0.00001	0.00002	0.0028	0.007
Total DDT	0.003	0.0002	0.001	0.06	0.75	1.13	0.00000	0.00001	0.00001	0.0028	0.004
Chlordane	0.0005	0.00003	0.001	0.06	0.75	1.13	0.000001	0.000001	0.000002	2.14	0.000001
Dieldrin	0.0008	0.00005	0.001	0.06	0.75	1.13	0.000001	0.000002	0.000003	0.077	0.000037
Heptachlor	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	NA	NA
Heptachlor epoxide	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	NA	NA
Hexachlorobenzene	0.0008	0.00005	0.001	0.06	0.75	1.13	0.000001	0.000002	0.000003	NA	NA
Lindane	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	2	NA
Mirex	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	NA	NA

a. Includes sediment sampling stations FP1 and 3A.
b. Based on foc of 0.17
c. Based on data evaluated by Sample et al. 1996

Mallard: Fisherville Pond-Central Pool[a]

Chemicals	Sediment Concentration (C_s)	Invertebrates Concentration (C_i)	Sediment Ingestion Rate (IR_s)	Food Ingestion Rate (FI)	Fraction of diet comprised of invertebrates (FD)	Body Weight (BW)	Exposure: Sediments	Exposure: Invertebrates	Total Exposure	Toxicity Reference Values (TRV)[b]	Hazard Quotient
Metals	mg/kg	mg/kg	kg/day	kg/day	Percent	kg	mg/kg/day	mg/kg/day	mg/kg/day	mg/kg/day	Unitless
Arsenic	44	4.08	0.001	0.06	0.75	1.13	0.05	0.17	0.22	5.14	0.04
Cadmium	37	3.45	0.001	0.06	0.75	1.13	0.041	0.14	0.19	1.45	0.13
Chromium	459	43.08	0.001	0.06	0.75	1.13	0.51	1.80	2.31	1	2.31
Copper	903	84.66	0.001	0.06	0.75	1.13	1.01	3.54	4.54	47	0.10
Lead	633	59.36	0.001	0.06	0.75	1.13	0.705	2.48	3.18	1.13	2.82
Mercury	1.9	0.18	0.001	0.06	0.75	1.13	0.002	0.01	0.01	0.006	1.49
Nickel	73	6.85	0.001	0.06	0.75	1.13	0.08	0.29	0.37	77.4	0.005
Selenium	2	0.10	0.001	0.06	0.75	1.13	0.002	0.004	0.01	0.5	0.012
Silver	9	0.86	0.001	0.06	0.75	1.13	0.010	0.04	0.046	NA	NA
Tin	315	29.57	0.001	0.06	0.75	1.13	0.351	1.24	1.586	6.8	0.23
Zinc	856	80.25	0.001	0.06	0.75	1.13	0.95	3.35	4.306	14.5	0.30
PAHS											
Total PAH	48	0.45	0.001	0.06	0.75	1.13	0.054	0.02	0.073	NA	NA
PCBs/Pesticides											
Total PCB	12	1.13	0.001	0.06	0.75	1.13	0.013	0.05	0.060	0.18	0.34
Total DDE	0.24	0.023	0.001	0.06	0.75	1.13	0.0003	0.0009	0.0012	0.0028	0.43
Total DDD	0.14	0.013	0.001	0.06	0.75	1.13	0.0002	0.0005	0.0007	0.0028	0.24
Total DDT	0.017	0.002	0.001	0.06	0.75	1.13	0.00002	0.0001	0.00009	0.0028	0.031
Chlordane	0.021	0.002	0.001	0.06	0.75	1.13	0.00002	0.0001	0.00010	2.14	0.00005
Dieldrin	0.024	0.002	0.001	0.06	0.75	1.13	0.00003	0.0001	0.00012	0.077	0.002
Heptachlor	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	NA	NA
Heptachlor epoxide	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	NA	NA
Hexachlorobenzene	0.003	0.00028	0.001	0.06	0.75	1.13	0.000003	0.00001	0.00002	NA	NA
Lindane	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	2	NA
Mirex	0.01	0.00109	0.001	0.06	0.75	1.13	0.00001	0.00005	0.00006	NA	NA

a. Includes sediment sampling stations FP2, FP5, FP7, FP9, FP6, FP8, FP12, FP1A-01, and FP3A-01.
b. Based on foc of 0.1066
c. Based on data evaluated by Sample et al. 1996

Mallard: Fisherville Pond-South Pool[a]

Chemicals	Sediment Concentration (C_s)	Invertebrates Concentration (C_i)	Sediment Ingestion Rate (IR_s)	Food Ingestion Rate (FI)	Fraction of diet comprised of invertebrates (FD)	Body Weight (BW)	Exposure: Sediments	Exposure: Invertebrates	Total Exposure	Toxicity Reference Values (TRV)[b]	Hazard Quotient
Metals	mg/kg	mg/kg	kg/day	kg/day	Percent	kg	mg/kg/day	mg/kg/day	mg/kg/day	mg/kg/day	Unitless
Arsenic	55	4.22	0.001	0.06	0.75	1.13	0.06	0.18	0.24	5.14	0.05
Cadmium	30	2.28	0.001	0.06	0.75	1.13	0.033	0.10	0.13	1.45	0.09
Chromium	693	53.33	0.001	0.06	0.75	1.13	0.77	2.23	3.00	1	3.00
Copper	1360	104.58	0.001	0.06	0.75	1.13	1.51	4.37	5.88	47	0.13
Lead	974	74.94	0.001	0.06	0.75	1.13	1.085	3.13	4.22	1.13	3.73
Mercury	2.6	0.20	0.001	0.06	0.75	1.13	0.0029	0.01	0.011	0.0064	1.76
Nickel	81	6.25	0.001	0.06	0.75	1.13	0.09	0.26	0.35	77.4	0.005
Selenium	5	0.26	0.001	0.06	0.75	1.13	0.01	0.01	0.02	0.5	0.032
Silver	14	1.08	0.001	0.06	0.75	1.13	0.016	0.05	0.061	NA	NA
Tin	324	24.93	0.001	0.06	0.75	1.13	0.361	1.04	1.403	6.8	0.21
Zinc	604	46.48	0.001	0.06	0.75	1.13	0.67	1.94	2.615	14.5	0.18
PAHS											
Total PAH	227	1.74	0.001	0.06	0.75	1.13	0.252	0.07	0.325	NA	NA
PCBs/Pesticides											
Total PCB	14	1.09	0.001	0.06	0.75	1.13	0.016	0.05	0.061	0.18	0.34
Total DDE	0.21	0.016	0.001	0.06	0.75	1.13	0.0002	0.0007	0.001	0.003	0.32
Total DDD	0.08	0.006	0.001	0.06	0.75	1.13	0.0001	0.0003	0.00034	0.003	0.12
Total DDT	0.02	0.001	0.001	0.06	0.75	1.13	0.00002	0.0001	0.00008	0.003	0.03
Chlordane	0.03	0.002	0.001	0.06	0.75	1.13	0.00003	0.0001	0.00013	2.140	0.0001
Dieldrin	0.16	0.012	0.001	0.06	0.75	1.13	0.0002	0.0005	0.001	0.077	0.009
Heptachlor	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	NA	NA
Heptachlor epoxide	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	NA	NA
Hexachlorobenzene	0.003	0.00021	0.001	0.06	0.75	1.13	0.000003	0.00001	0.000012	NA	NA
Lindane	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	2	NA
Mirex	0.008	0.00058	0.001	0.06	0.75	1.13	0.00001	0.00002	0.00003	NA	NA

a. Includes sediment sampling stations FP4-99, FP4-01, FP10, FP11, HS1, HS2, HS3, HS4, HS5, and HS6

b. Based on foc of 0.13

c. Based on data evaluated by Sample et al. 1996

Mallard: Singing Pond-Main Channel

Chemicals	Sediment Concentration (C_s)	Invertebrates Concentration (C_i)	Sediment Ingestion Rate (IR_s)	Food Ingestion Rate (FI)	Fraction of diet comprised of invertebrates (FD)	Body Weight (BW)	Exposure: Sediments	Exposure: Invertebrates	Total Exposure	Toxicity Reference Values (TRV)[b]	Hazard Quotient
Metals	mg/kg	mg/kg	kg/day	kg/day	Percent	kg	mg/kg/day	mg/kg/day	mg/kg/day	mg/kg/day	Unitless
Arsenic	18	7.29	0.001	0.06	0.75	1.13	0.02	0.30	0.32	5.14	0.06
Cadmium	5.4	2.25	0.001	0.06	0.75	1.13	0.01	0.09	0.10	1.45	0.07
Chromium	89	37.25	0.001	0.06	0.75	1.13	0.10	1.56	1.66	1	1.66
Copper	366	152.38	0.001	0.06	0.75	1.13	0.41	6.37	6.77	47	0.14
Lead	175	73.04	0.001	0.06	0.75	1.13	0.195	3.05	3.25	1.13	2.87
Mercury	0.6	0.25	0.001	0.06	0.75	1.13	0.0007	0.01	0.011	0.0064	1.74
Nickel	35	14.67	0.001	0.06	0.75	1.13	0.04	0.61	0.65	77.4	0.008
Selenium	NA	NA	0.001	0.06	0.75	1.13	NA	NA	NA	0.5	NA
Silver	1.8	0.75	0.001	0.06	0.75	1.13	0.002	0.03	0.033	NA	NA
Tin	54	22.42	0.001	0.06	0.75	1.13	0.060	0.94	0.996	6.8	0.15
Zinc	274	114.08	0.001	0.06	0.75	1.13	0.31	4.77	5.071	14.5	0.35
PAHS											
Total PAH	25	1.05	0.001	0.06	0.75	1.13	0.028	0.04	0.072	NA	NA
PCBs/Pesticides											
Total PCB	2.0	0.84	0.001	0.06	0.75	1.13	0.002	0.04	0.037	0.18	0.21
Total DDE	0.008	0.0033	0.001	0.06	0.75	1.13	0.00001	0.00014	0.00015	0.0028	0.05
Total DDD	0.008	0.0031	0.001	0.06	0.75	1.13	0.00001	0.00013	0.00014	0.0028	0.05
Total DDT	0.007	0.0029	0.001	0.06	0.75	1.13	0.00001	0.00012	0.00013	0.0028	0.05
Chlordane	0.005	0.00188	0.001	0.06	0.75	1.13	0.000005	0.00008	0.000083	2.14	0.00004
Dieldrin	0.004	0.00179	0.001	0.06	0.75	1.13	0.000005	0.00007	0.000080	0.077	0.001
Heptachlor	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	NA	NA
Heptachlor epoxide	0.0004	0.00017	0.001	0.06	0.75	1.13	0.0000004	0.00001	0.000007	NA	NA
Hexachlorobenzene	0.0006	0.00025	0.001	0.06	0.75	1.13	0.000001	0.00001	0.000011	NA	NA
Lindane	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	2	NA
Mirex	0.002	0.00067	0.001	0.06	0.75	1.13	0.000002	0.00003	0.000030	NA	NA

a. Includes sediment sampling stations SP1, SP2 and SP3

b. Based on foc of 0.024

c. Based on data evaluated by Sample et al. 1996

Mallard: Singing Pond-Marsh Area

Chemicals	Sediment Concentration (C_s)	Invertebrates Concentration (C_i)	Sediment Ingestion Rate (IR_s)	Food Ingestion Rate (FI)	Fraction of diet comprised of invertebrates (FD)	Body Weight (BW)	Exposure: Sediments	Exposure: Invertebrates	Total Exposure	Toxicity Reference Values (TRV)[b]	Hazard Quotient
Metals	mg/kg	mg/kg	kg/day	kg/day	Percent	kg	mg/kg/day	mg/kg/day	mg/kg/day	mg/kg/day	Unitless
Arsenic	92	13.09	0.001	0.06	0.75	1.13	0.10	0.55	0.65	5.14	0.13
Cadmium	25.8	3.69	0.001	0.06	0.75	1.13	0.03	0.15	0.18	1.45	0.13
Chromium	318	45.45	0.001	0.06	0.75	1.13	0.35	1.90	2.25	1	2.25
Copper	2939	419.91	0.001	0.06	0.75	1.13	3.27	17.54	20.82	47	0.44
Lead	1206	172.26	0.001	0.06	0.75	1.13	1.34	7.20	8.54	1.13	7.56
Mercury	4.5	0.65	0.001	0.06	0.75	1.13	0.0051	0.03	0.032	0.0064	5.02
Nickel	99	14.11	0.001	0.06	0.75	1.13	0.11	0.59	0.70	77.4	0.01
Selenium	5	0.28	0.001	0.06	0.75	1.13	0.01	0.01	0.02	0.5	0.034
Silver	4.9	0.70	0.001	0.06	0.75	1.13	0.005	0.03	0.035	NA	NA
Tin	238	34.00	0.001	0.06	0.75	1.13	0.265	1.42	1.69	6.8	0.25
Zinc	1854	264.90	0.001	0.06	0.75	1.13	2.07	11.07	13.132	14.5	0.91
PAHS											
Total PAH	201	2.87	0.001	0.06	0.75	1.13	0.22	0.12	0.344	NA	NA
PCBs/Pesticides											
Total PCB	1.6	0.23	0.001	0.06	0.75	1.13	0.002	0.01	0.011	0.18	0.06
Total DDE	0.135	0.0192	0.001	0.06	0.75	1.13	0.00015	0.0008	0.00095	0.0028	0.34
Total DDD	0.038	0.0054	0.001	0.06	0.75	1.13	0.00004	0.0002	0.00027	0.0028	0.10
Total DDT	0.006	0.0008	0.001	0.06	0.75	1.13	0.00001	0.00003	0.00004	0.0028	0.015
Chlordane	0.016	0.00226	0.001	0.06	0.75	1.13	0.000018	0.0001	0.000112	2.14	0.0001
Dieldrin	0.060	0.00857	0.001	0.06	0.75	1.13	0.000067	0.0004	0.000425	0.077	0.006
Heptachlor	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	NA	NA
Heptachlor epoxide	0.00140	0.00020	0.001	0.06	0.75	1.13	0.000002	0.00001	0.000010	NA	NA
Hexachlorobenzene	0.00073	0.00010	0.001	0.06	0.75	1.13	0.000001	0.000004	0.000005	NA	NA
Lindane	0.00090	0.00013	0.001	0.06	0.75	1.13	0.000001	0.00001	0.000006	2	0.000003
Mirex	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	NA	NA

a. Includes sediment sampling stations SP4, SP5, and SP6

b. Based on foc of 0.07

c. Based on data evaluated by Sample et al. 1996

Mallard: Singing Pond-Lake Wildwood

Chemicals	Sediment Concentration (C_s)	Invertebrates Concentration (C_i)	Sediment Ingestion Rate (IR_s)	Food Ingestion Rate (FI)	Fraction of diet comprised of invertebrates (FD)	Body Weight (BW)	Exposure: Sediments	Exposure: Invertebrates	Total Exposure	Toxicity Reference Values (TRV)[b]	Hazard Quotient
Metals	mg/kg	mg/kg	kg/day	kg/day	Percent	kg	mg/kg/day	mg/kg/day	mg/kg/day	mg/kg/day	Unitless
Arsenic	7	0.48	0.001	0.06	0.75	1.13	0.01	0.02	0.03	5.14	0.005
Cadmium	0.98	0.07	0.001	0.06	0.75	1.13	0.001	0.003	0.004	1.45	0.003
Chromium	26	1.74	0.001	0.06	0.75	1.13	0.03	0.07	0.10	1	0.10
Copper	33	2.19	0.001	0.06	0.75	1.13	0.04	0.09	0.13	47	0.003
Lead	108	7.22	0.001	0.06	0.75	1.13	0.121	0.30	0.42	1.13	0.37
Mercury	0.2	0.01	0.001	0.06	0.75	1.13	0.0002	0.00056	0.001	0.0064	0.12
Nickel	8	0.54	0.001	0.06	0.75	1.13	0.01	0.02	0.03	77.4	0.0004
Selenium	3	0.20	0.001	0.06	0.75	1.13	0.004	0.01	0.01	0.5	0.024
Silver	0.12	0.01	0.001	0.06	0.75	1.13	0.0001	0.00033	0.0005	NA	NA
Tin	63	4.20	0.001	0.06	0.75	1.13	0.070	0.18	0.246	6.8	0.036
Zinc	98	6.51	0.001	0.06	0.75	1.13	0.11	0.27	0.381	14.5	0.026
PAHS											
Total PAH	3	0.02	0.001	0.06	0.75	1.13	0.004	0.001	0.004	NA	NA
PCBs/Pesticides											
Total PCB	0.12	0.01	0.001	0.06	0.75	1.13	0.0001	0.00034	0.0005	0.18	0.003
Total DDE	0.020	0.0013	0.001	0.06	0.75	1.13	0.00002	0.00006	0.00008	0.0028	0.028
Total DDD	0.022	0.0014	0.001	0.06	0.75	1.13	0.00002	0.00006	0.00008	0.0028	0.030
Total DDT	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	0.0028	NA
Chlordane	0.011	0.00070	0.001	0.06	0.75	1.13	0.000012	0.000029	0.000041	2.14	0.00002
Dieldrin	0.001	0.00009	0.001	0.06	0.75	1.13	0.000002	0.000004	0.000005	0.077	0.0001
Heptachlor	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	NA	NA
Heptachlor epoxide	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	NA	NA
Hexachlorobenzene	0.00119	0.00008	0.001	0.06	0.75	1.13	0.000001	0.000003	0.000005	NA	NA
Lindane	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	2	NA
Mirex	ND	NA	0.001	0.06	0.75	1.13	NA	NA	NA	NA	NA

a. Includes all WP sediment sampling stations

b. Based on foc of 0.15

c. Based on data evaluated by Sample et al. 1996