

Appendix N. Carbaryl Sensitivity Distribution Data

Tables N.1-N.5 contain the 96-hour LC₅₀ data for fish and associated calculations used to derive the sensitivity distribution shown in the risk assessment. **Tables N.6-N.10** contain the 48- to 96-hour EC₅₀ data for invertebrates and associated calculations used to derive the sensitivity distribution shown in the risk assessment.

Table N.1. Summary of 96 hour LC50 data for effects of carbaryl on freshwater fish. Data are from EFED's database of ecotoxicity data.									
Common Name	Species Name	Mean LC50 (ppb)	Log 10 LC50	Lower Confidence (ppb)	Lower Log 10 LC50	Upper Confidence (ppb)	Upper Log 10 LC50	Test Substance (% a.i.)	MRID /Accession
Carp	<i>Cyprinus carpio</i>	5280	3.723	4600	3.663	6000	3.778	99.5	40098001
Black bullhead	<i>Ictalurus melas</i>	20000	4.301	18000	4.255	24000	4.380	99.5	40098001
Channel catfish	<i>Ictalurus punctatus</i>	7790	3.892	4700	3.672	12800	4.107	99.5	40098001
Green sunfish	<i>Lepomis cyanellus</i>	9460	3.976	7000	3.845	12800	4.107	99.5	40098001
Bluegill sunfish	<i>Lepomis macrochirus</i>	5047	3.703	4400	3.643	5800	3.763	99.5	40098001
Bluegill sunfish	<i>Lepomis macrochirus</i>	14000	4.146	7700	3.886	25200	4.401	99.9	TN 142, 0043115
Largemouth bass	<i>Micropterus salmoides</i>	6400	3.806	4400	3.643	9200	3.964	99.5	40094602
Cutthroat trout	<i>Oncorhynchus clarki</i>	970	2.987	770	2.886	1200	3.079	99.5	40098001
Coho salmon	<i>Oncorhynchus kisutch</i>	2400	3.380	1860	3.270	3000	3.477	99.5	40098001
Rainbow trout	<i>Oncorhynchus mykiss</i>	3300	3.519	2700	3.431	4000	3.602	81.5	42397901
Rainbow trout	<i>Oncorhynchus mykiss</i>	1200	3.079	800	2.903	1800	3.255	99.5	40098001
Chinook salmon	<i>Oncorhynchus tshawytscha</i>	2400	3.380	1600	3.204	3500	3.544	99.5	40098001
Yellow perch	<i>Perca flavescens</i>	350	2.544	280	2.447	430	2.633	99.5	40098001
Fathead minnow	<i>Pimephales promelas</i>	7700	3.886	4800	3.681	12000	4.079	99.5	40098001
Black crappie	<i>Pomoxis nigromaculatus</i>	2600	3.415	1200	3.079	5700	3.756	99.5	40094602
Atlantic salmon	<i>Salmo salar</i>	250	2.398	120	2.079	790	2.898	99.5	40098001
Brown trout	<i>Salmo trutta</i>	6300	3.799	5500	3.740	7200	3.857	99.5	40098001
Brook trout	<i>Salvelinus fontinalis</i>	3000	3.477	2000	3.301	4500	3.653	99.5	40098001
Lake trout	<i>Salvelinus namaycush</i>	690	2.839	500	2.699	900	2.954	99.5	40098001
NR = not reported, NA = not applicable									

Table N.2. Species values for LC50 (mean and upper and lower confidence intervals).				
Common Name	Species Name	Log10 Mean	Log10 Lower	Log10 Upper
Carp	<i>Cyprinus carpio</i>	3.723	3.663	3.778
Black bullhead	<i>Ictalurus melas</i>	4.301	4.255	4.380
Channel catfish	<i>Ictalurus punctatus</i>	3.892	3.672	4.107
Green sunfish	<i>Lepomis cyanellus</i>	3.976	3.845	4.107
Bluegill sunfish	<i>Lepomis macrochirus</i>	3.925	3.765	4.082
Largemouth bass	<i>Micropterus salmoides</i>	3.806	3.643	4.0
Cutthroat trout	<i>Oncorhynchus clarki</i>	2.987	2.886	3.1
Coho salmon	<i>Oncorhynchus kisutch</i>	3.380	3.270	3.5
Rainbow trout	<i>Oncorhynchus mykiss</i>	3.299	3.167	3.4
Chinook salmon	<i>Oncorhynchus tshawytscha</i>	3.380	3.204	3.5
Yellow perch	<i>Perca flavescens</i>	2.544	2.447	2.6
Fathead minnow	<i>Pimephales promelas</i>	3.886	3.681	4.1
Black crappie	<i>Pomoxis nigromaculatus</i>	3.415	3.079	3.8
Atlantic salmon	<i>Salmo salar</i>	2.398	2.079	2.9
Brown trout	<i>Salmo trutta</i>	3.799	3.740	3.9
Brook trout	<i>Salvelinus fontinalis</i>	3.477	3.301	3.7
Lake trout	<i>Salvelinus namaycush</i>	2.839	2.699	3.0

Table N.3. Genus values for LC50 (mean and upper and lower confidence intervals).								
Common Name	Genus Name	Log10 Mean	Mean LC50 (ppb)	Log10 lower	lower LC50 (ppb)	Log 10 Upper	Upper LC50 (ppb)	Rank on curve
carp	<i>Cyprinus</i>	3.7226	5280.0	3.6628	4600.0	3.7782	6000.0	0.56
catfish	<i>Ictalurus</i>	4.0963	12482.0	3.9637	9197.8	4.2437	17527.1	1.00
sunfish	<i>Lepomis</i>	3.9502	8917.4	3.8050	6383.1	4.0948	12439.8	0.89
bass	<i>Micropterus</i>	3.8062	6400.0	3.6435	4400.0	3.9638	9200.0	0.67
trout/salmon	<i>Oncorhynchus</i>	3.2615	1826.0	3.1318	1354.7	3.3823	2411.3	0.33
perch	<i>Perca</i>	2.5441	350.0	2.4472	280.0	2.6335	430.0	0.00
fathead minnow	<i>Pimephales</i>	3.8865	7700.0	3.6812	4800.0	4.0792	12000.0	0.78
crappie	<i>Pomoxis</i>	3.4150	2600.0	3.0792	1200.0	3.7559	5700.0	0.44
salmon/trout	<i>Salmo</i>	3.0986	1255.0	2.9098	812.4	3.3775	2385.0	0.11
trout	<i>Salvelinus</i>	3.1580	1438.7	3.0000	1000.0	3.3037	2012.5	0.22
Genus Mean for All:		3.4939	4825	3.3324	3403	3.6612	7011	
Genus Standard Deviation for all:		0.4838	4007	0.4861	2946	0.4897	5611	

Table N.4. Calculation of sensitivity distribution curve for fish exposed to carbaryl.							
Proportion	Z _p	Mean LC50		Lower LC50		Upper LC50	
		Log10 point	Point Estimate (ppb)	Log10 point	Point Estimate (ppb)	Log10 point	Point Estimate (ppb)
0.05	-1.645	2.698	498.9	2.533	341.0	2.856	717.2
0.10	-1.282	2.874	747.6	2.709	512.0	3.033	1080.0
0.20	-0.842	3.087	1220.5	2.923	837.8	3.249	1773.7
0.25	-0.675	3.168	1470.9	3.005	1010.5	3.331	2142.4
0.30	-0.524	3.240	1739.4	3.078	1195.9	3.405	2538.8
0.40	-0.253	3.371	2352.3	3.209	1619.7	3.537	3446.2
0.50	0	3.494	3118.2	3.332	2149.9	3.661	4584.0
0.60	0.253	3.616	4133.3	3.455	2853.6	3.785	6097.5
0.70	0.524	3.747	5590.0	3.587	3864.8	3.918	8276.9
0.75	0.675	3.820	6614.0	3.661	4576.4	3.992	9813.3
0.80	0.842	3.901	7966.4	3.742	5517.0	4.074	11846.8
0.90	1.282	4.114	13005.6	3.956	9027.9	4.289	19457.5
0.95	1.645	4.290	19487.2	4.132	13553.0	4.467	29299.5
Z _p = (Log10 LC50 - fish mean GMAV)/(fish std GMAV)							

Table N.5. Sensitivity distribution for fish exposed to carbaryl based on mean and confidence intervals of 96-h LC50 data. Benchmark concentrations for EECs which would result in LOC exceedances for LC50 data are also provided.

	Mean		Lower		Upper	
Proportion	Point Estimate of LC50 (ppb)	Benchmark Concentration* (ppb)	Point Estimate of LC50 (ppb)	Benchmark Concentration* (ppb)	Point Estimate of LC50 (ppb)	Benchmark Concentration* (ppb)
0.05	499	25	341	17	717	36
0.10	748	37	512	26	1,080	54
0.20	1,221	61	838	42	1,774	89
0.25	1,471	74	1,010	51	2,142	107
0.30	1,739	87	1,196	60	2,539	127
0.40	2,352	118	1,620	81	3,446	172
0.50	3,118	156	2,150	107	4,584	229
0.60	4,133	207	2,854	143	6,097	305
0.70	5,590	279	3,865	193	8,277	414
0.75	6,614	331	4,576	229	9,813	491
0.80	7,966	398	5,517	276	11,847	592
0.90	13,006	650	9,028	451	19,457	973
0.95	19,487	974	13,553	678	29,300	1,465

*LC50 x acute listed LOC. Units in ug/L. Represents EEC required to exceed LOC.

Table N.6. Summary of 48-hour and 96 hour EC50 data for effects of carbaryl on freshwater invertebrates. Data are from EFED's database of ecotoxicity data.

Common Name	Species Name	Mean EC50 (ppb)	Mean Log 10 EC50	Lower Confidence EC50	Lower Log 10 EC50	Upper Confidence EC50	Upper Log 10 EC50	Test Substance (% a.i.)	Duration of exposure (h)	MRID /Accession
Sowbug	<i>Asellus brevicaudus</i>	280	2.447	214	2.330	367	2.565	99.5	96	40098001
Stonefly	<i>Claassenia sabulosa</i>	5.6	0.748	3.9	0.591	8.7	0.940	99.5	96	40098001
Water flea	<i>Daphnia magna</i>	7.2	0.857	6.33	0.801	8.37	0.923	81.5	48	42397903
Water flea	<i>Daphnia magna</i>	5.6	0.748	2.7	0.431	12	1.079	99.5	48	40098001
Water flea	<i>Daphnia pulex</i>	6.4	0.806	NR	NA	NR	NA	99.5	48	40098001
Scud	<i>Gammarus fasciatus</i>	26	1.415	16	1.204	39	1.591	99.5	96	40098001
Scud	<i>Gammarus lacustris</i>	16	1.204	12	1.079	19	1.279	Tech	96	05009242
Scud	<i>Gammarus pseudolimnaeus</i>	8	0.903	4.9	0.690	13	1.114	99.5	48	40098001
Stonefly	<i>Isogenus sp.</i>	3.6	0.556	2.4	0.380	5.5	0.740	99.5	96	40098001
Crayfish	<i>Procambarus sp.</i>	1.9	0.279	1.1	0.041	3.1	0.491	99.5	96	40098001
Stonefly	<i>Pteronarcella badia</i>	1.7	0.230	1.4	0.146	2.4	0.380	99.5	96	40098001
Water flea	<i>Simocephalus serrulatus</i>	7.6	0.881	6.2	0.792	9.4	0.973	99.5	48	40098001
NR = not reported, NA = not applicable										

Table N.7. Species values for EC50 (mean and upper and lower confidence intervals).				
Common Name	Species Name	Log10 Mean	Log10 Lower	Log10 Upper
Sowbug	<i>Asellus brevicaudus</i>	2.447	2.330	2.565
Stonefly	<i>Claassenia sabulosa</i>	0.748	0.591	0.940
Water flea	<i>Daphnia magna</i>	0.803	0.616	1.001
Water flea	<i>Daphnia pulex</i>	1.111	NR	NR
Scud	<i>Gammarus lacustris</i>	1.204	1.079	1.3
Scud	<i>Gammarus pseudolimnaeus</i>	0.903	0.690	1.1
Stonefly	<i>Isogenus sp.</i>	0.556	0.380	0.7
Crayfish	<i>Procambarus sp.</i>	0.255	0.094	0.4
Water flea	<i>Simocephalus serrulatus</i>	0.881	0.792	1.0

Table N.8. Genus values for EC50 (mean and upper and lower confidence intervals).								
Common Name	Genus Name	Log10 Mean	Mean EC50	Log10 lower	lower EC50	Log 10 Upper	Upper EC50	Rank on curve
sowbug	<i>Asellus</i>	2.4472	280.0	2.3304	214.0	2.5647	367.0	1.00
stonefly	<i>Claassenia</i>	0.7482	5.6	0.5911	3.9	0.9395	8.7	0.33
water flea	<i>Daphnia</i>	0.9567	9.1	0.6164	4.1	1.0010	10.0	0.67
scud	<i>Gammarus</i>	1.0536	11.3	0.8847	7.7	1.1963	15.7	0.83
stonefly	<i>Isogenus</i>	0.5563	3.6	0.3802	2.4	0.7404	5.5	0.17
crayfish	<i>Procambarus</i>	0.2546	1.8	0.0938	1.2	0.4358	2.7	0.00
water flea	<i>Simocephalus</i>	0.8808	7.6	0.7924	6.2	0.9731	9.4	0.50
Genus Mean for All:		0.9853	46	0.8127	34	1.1215	60	
Genus Standard Deviation for all:		0.6985	103	0.7189	79	0.6799	135	

Table N.9. Calculation of sensitivity distribution curve for invertebrates exposed to carbaryl.							
		Mean EC50		Lower EC50		Upper EC50	
Proportion	Z _p	Log10 point	Point Estimate (ppb)	Log10 point	Point Estimate (ppb)	Log10 point	Point Estimate (ppb)
0.05	-1.645	-0.164	0.7	-0.370	0.4	0.003	1.0
0.10	-1.282	0.090	1.2	-0.109	0.8	0.250	1.8
0.20	-0.842	0.397	2.5	0.207	1.6	0.549	3.5
0.25	-0.675	0.514	3.3	0.328	2.1	0.663	4.6
0.30	-0.524	0.619	4.2	0.436	2.7	0.765	5.8
0.40	-0.253	0.809	6.4	0.631	4.3	0.950	8.9
0.50	0	0.985	9.7	0.813	6.5	1.122	13.2
0.60	0.253	1.162	14.5	0.995	9.9	1.294	19.7
0.70	0.524	1.351	22.5	1.189	15.5	1.478	30.0
0.75	0.675	1.457	28.6	1.298	19.9	1.580	38.1
0.80	0.842	1.573	37.5	1.418	26.2	1.694	49.4
0.90	1.282	1.881	76.0	1.734	54.2	1.993	98.4
0.95	1.645	2.134	136.3	1.995	98.9	2.240	173.8
Z _p = (Log10 LC50 - invertebrate mean GMAV)/(invertebrate std GMAV)							

Table N.10. Sensitivity distribution for invertebrates exposed to carbaryl based on mean and confidence intervals of EC50 data. Benchmark concentrations for EECs which would result in LOC exceedances for EC50 data are also provided.

	Mean		Lower		Upper	
Proportion	Point Estimate of EC50 (ppb)	Benchmark Concentration* (ppb)	Point Estimate of EC50 (ppb)	Benchmark Concentration* (ppb)	Point Estimate of EC50 (ppb)	Benchmark Concentration* (ppb)
0.05	0.69	0.03	0.43	0.02	1.01	0.05
0.10	1.23	0.06	0.78	0.04	1.78	0.09
0.20	2.50	0.12	1.61	0.08	3.54	0.18
0.25	3.27	0.16	2.13	0.11	4.60	0.23
0.30	4.16	0.21	2.73	0.14	5.82	0.29
0.40	6.44	0.32	4.27	0.21	8.90	0.45
0.50	9.67	0.48	6.50	0.32	13.23	0.66
0.60	14.52	0.73	9.88	0.49	19.66	0.98
0.70	22.46	1.12	15.47	0.77	30.05	1.50
0.75	28.63	1.43	19.86	0.99	38.06	1.90
0.80	37.45	1.87	26.18	1.31	49.43	2.47
0.90	76.00	3.80	54.24	2.71	98.44	4.92
0.95	136.27	6.81	98.91	4.95	173.76	8.69

*EC50 x acute listed LOC. Units in ug/L. Represents EEC required to exceed LOC.