DERIVATION OF ACUTE AND CHRONIC TOXICITY CRITERIA
FOR ENDRIN
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EPA SPECIES MEAN ACUTE VALUES

(values from 10/80 EPA AWQC document, EPA 440/5-80-047 and 3/95 GLI Criteria Update, EPA-820-B-95-004)

Cladoceran *(Daphnia magna)*

VALUE (ug/L)	REFERENCE
41	Mayer and Ellersieck, 1985
74	Mayer and Ellersieck, 1985
4.2	Mayer and Ellersieck, 1985
59	Elnabarawy, et al. 1986
160	Thurston, et al. 1985
SMAV = 59	(5 results)

Cladoceran *(Simocephalus serrulatus)*

VALUE (ug/L)	REFERENCE
26	Sanders & Cope, 1966
45	Sanders & Cope, 1966
SMAV = 34	(2 results)

Cladoceran *(Daphnia pulex)*

VALUE (ug/L)	REFERENCE
20	Mayer and Ellersieck, 1985
30	Elnabarawy, et al. 1986
SMAV = 24.5	(2 results)

Cladoceran *(Ceriodaphnia reticulata)*

VALUE (ug/L)	REFERENCE
24	Elnabarawy, et al. 1986
SMAV = 24	(1 result)

Isopod *(Asellus brevicadus)*

VALUE (ug/L)	REFERENCE
1.5	Sanders, 1972
SMAV = 1.5	(1 results)

Amphipod *(Gammarus fasciatus)*

VALUE (ug/L)	REFERENCE
5.5 [FT,U]	Sanders, 1972
4.3	Sanders, 1972
1.3	Sanders, 1972
SMAV = 3.1	(3 results)

Amphipod *(Gammarus lacustris)*

VALUE (ug/L)	REFERENCE
3	Sanders, 1969
SMAV = 3	(1 results)

Glass shrimp *(Palaemonetes kadiakensis)*

VALUE (ug/L)	REFERENCE
3.2	Sanders, 1972
0.5 [FT,U]	Sanders, 1972
SMAV = 1.3	(2 results)

Crayfish *(Orconectes immunis)*

VALUE (ug/L)	REFERENCE
89	Thurston, et al. 1985
SMAV = 89	(1 result)

Crayfish *(Orconectes nais)*

VALUE (ug/L)	REFERENCE
320	Sanders, 1972
3.2	Sanders, 1972
SMAV = 32	(2 results)

Normally, one or both of these results would be rejected under EPA's 1985 Guidelines because the results vary by more than a factor of 10. However, EPA used the geometric mean in its criteria calculation.

Mayfly *(Hexagenia bilineata)*

VALUE (ug/L)	REFERENCE
64	Sanders, 1972
SMAV = 64	(1 result)

Snipefly *(Atherix variegatus)*

VALUE (ug/L)	REFERENCE
4.6	Mayer and Ellersieck, 1985
SMAV = 4.6	(1 result)

Midge *(Tanytarsus dissimilis)*

VALUE (ug/L)	REFERENCE
0.84	Thurston, et al. 1985
SMAV = 0.84	(1 result)

Stonefly (*Pteronacella badia)*

VALUE (ug/L)	REFERENCE
0.54	Sanders & Cope, 1968
SMAV = 0.54	(1 result)

Stonefly (*Pteronarcys californica)*

VALUE (ug/L)	REFERENCE
0.25	Sanders & Cope, 1968
SMAV = 0.25	(1 result)

Stonefly (*Claasenia sabulosa*)

VALUE (ug/L)	REFERENCE
0.76	Sanders & Cope, 1968
SMAV = 0.76	(1 result)

Damselfly (*Ischnura verticalis*)

VALUE (ug/L)	REFERENCE
2.4	Mayer and Ellersieck, 1986
2.1	Mayer and Ellersieck, 1986
1.8	Sanders, 1972
SMAV = 2.1	(3 results)

Annelid *(Lumbriculus variegatus)*

VALUE (ug/L)	REFERENCE
42.6	USEPA, 1991
SMAV = 42.6	(1 result)

Coho salmon *(Onchorhynchus kisutch)*

VALUE (ug/L)	REFERENCE
0.51	Katz, 1961
SMAV = 0.51	(1 result)

Chinook salmon *(Onchorhynchus tshawytscha)*

VALUE (ug/L)	REFERENCE
1.2	Katz, 1961
SMAV = 1.2	(1 result)

Rainbow trout *(Onchorhynchus mykiss)*

VALUE (ug/L)	REFERENCE
0.75 S,U	Mayer & Ellersieck, 1986
0.3 FT,M	Thurston, et al. 1985
1.1 S,U	Macek, et al. 1969
0.58 S,U	Katz, 1961
SMAV = 0.3	(1 FT,M result)

Goldfish *(Carassius auratus)*

VALUE (ug/L)	REFERENCE
2.1 S,U	Henderson, et al. 1959
0.46 FT,U	Mayer & Ellersieck, 1986
0.95 FT,M	Thurston, et al. 1985
SMAV = 0.95	(1 FT,M result)

Fathead minnow *(Pimephales promelas)*

VALUE (ug/L)	METHOD	REFERENCE
0.50	FT,M	Brungs & Bailey, 1966
0.49	FT,M	Brungs & Bailey, 1966
0.40	FT,M	Brungs & Bailey, 1966
0.45	FT,M	Brungs & Bailey, 1966
1.1	S,U	Henderson, et al. 1959
1.4	S,U	Henderson, et al. 1959
1.8	S,U	Mayer & Ellersieck, 1986
0.65	FT,M	Thurston, et al. 1985
SMAV = 0.49		(5 FT,M results)

Flagfish *(Jordanella floridae)*
Guppy *(Poecilia reticulata)*
Not used because the species are non-resident to Wisconsin, Iowa, and the Great Lakes states.

Threespine stickleback (*Gasterosteus aculeatus*)

VALUE (ug/L)	REFERENCE
0.44	Katz, 1961
SMAV = 0.44	(1 result)

Bluegill (*Lepomis macrochirus*)

VALUE (ug/L)	METHOD	REFERENCE
0.61	S,U	Macek, et al. 1969
0.41	S,U	Macek, et al. 1969
0.37	S,U	Macek, et al. 1969
0.66	S,U	Henderson, et al. 1969
0.61	S,U	Sanders, 1972
0.21	FT,M	Thurston, et al. 1985
SMAV = 0.21		(1 FT,M result)

Yellow perch *(Perca flavescens)*

VALUE (ug/L)	REFERENCE
0.15	Mayer and Ellersieck, 1985
SMAV = 4.15	(1 result)

Largemouth bass *(Micropterus salmoides)*

VALUE (ug/L)	REFERENCE
0.31	Thurston, et al. 1985
SMAV = 0.31	(1 result)

Carp (*Cyprinus carpio*)

VALUE (ug/L)	REFERENCE
0.32	Mayer and Ellersieck, 1986
SMAV = 0.54	(1 result)

Bullfrog tadpole (*Rana catesbeiana*)

VALUE (ug/L)	REFERENCE
2.5	Thurston, et al. 1985
SMAV = 2.5	(1 result)

Channel catfish (*Ictalurus punctatus)*

VALUE (ug/L)	METHOD	REFERENCE
0.32	S,U	Mayer & Ellersieck, 1986
1.1	S,U	Mayer & Ellersieck, 1986
0.42	FT,M	Thurston, et al. 1985
SMAV = 0.42		(1 FT,M result)

Black bullhead (*Ictalurus melas*)

VALUE (ug/L)	REFERENCE
1.1	Mayer and Ellersieck, 1986
SMAV = 1.1	(1 result)

Mosquitofish (*Gambusia affinis*)

VALUE (ug/L)	METHOD	REFERENCE
1.1	S,U	Mayer & Ellersieck, 1986
0.69	FT,M	Thurston, et al. 1985
SMAV = 0.69		(1 FT,M result)

This species is not resident to Wisconsin, but is among at least one other Great Lakes state, so the GMAV is used in the criteria calculation.

MINIMUM DATABASE REQUIREMENT EVALUATION

According to s. NR 105.05(1)(a), acute toxicity criteria can be calculated if data are available on one or more species of freshwater animal in at least 8 different families, provided that of the 8 species:

1. At least one is a salmonid fish in the family Salmonidae in the class Osteichthyes,
2. At least one is a non-salmonid fish from another family in the class Osteichthyes, preferably a commercially or recreationally important species,
3. At least one is a planktonic crustacean (e.g., cladoceran, copepod),
4. At least one is a benthic crustacean (e.g., ostracod, isopod, amphipod, crayfish),
5. At least one is an insect (e.g., mayfly, dragonfly, damselfly, stonefly, caddisfly, mosquito, midge),
6. At least one is a fish or amphibian from a family in the phylum Chordata not already represented in one of the other subdivisions,
7. At least one is an organism from a family in a phylum other than Arthropoda or Chordata (e.g., Rotifera, Annelida, Mollusca), and
8. At least one is an organism from a family in any order of insect or any other phylum not already represented in subds. 1. to 7.

Using the above numbering scheme, the following species are represented in the minimum database requirements for criteria calculation. If any of the 8 categories are not represented in the database, a criterion cannot be calculated under ch. NR 105. Instead, a secondary value must be calculated.

1. Rainbow trout
2. Bluegill
3. Cladoceran *(D. magna)*
4. Amphipod (*G. fasciatus*)
5. Stonefly *(P. californica)*
6. Fathead minnow, family Cyprinidae
7. Annelid (*L. variegatus*)
8. Channel catfish, family Ictaluridae

CONCLUSION: An acute toxicity criterion can be calculated for endrin according to ch. NR 105.

GENUS NAME (w/ component species)		GMAV (ug/L)	CLASSIFICATIONS * CW	WW	LFF	LAL
Hexagenia		64	x	x	x	x
Orconectes		53.4	x	x	x	x
O. nais	32					
O. immunis	89					
Lumbriculus		43	x	x	x	x
Daphnia		38.0	x	x	x	x
D. magna	59					
D. pulex	24					
Simocephalus		34	x	x	x	x
Ceriodaphnia		24	x	x	x	x
Atherix		4.6	x	x	x	x
Gammarus		3.07	x	x	x	x
G. fasciatus	3.1					
G. lacustris	3					
Rana		2.5	x	x	x	x
Ischnura		2.1	x	x	x	x
Asellus		1.5	x	x	x	x
Palaemontes		1.3	x	x	x	x
Carassius		0.95	x	x	x	
Tanytarsus		0.84	x	x	x	x
Claassenia		0.76	x	x	x	x
Gambusia		0.69	x	x		
Ictalurus		0.68	x	x		
I. melas	1.1					
I. punctatus	0.42					
Onchorhynchus		0.57	x			
O. kisutch	0.51					
O. tshawytscha	1.2					
O. mykiss	0.3					
Pteronarcella		0.54	x	x	x	x
Pimephales		0.49	x	x	x	
Cyprinus		0.32	x	x	x	
Micropterus		0.31	x	x		
Pteronarcys		0.25	x	x	x	x
Lepomis		0.21	x	x		
Perca		0.15	x	x		
TOTAL NUMBER OF GENERA REPRESENTED:			25	24	19	16

* - KEY TO CLASSIFICATIONS (an X is listed for species considered in each):

CW = Coldwater community, all genera are considered here.

WW = Warmwater sportfish community, only the coldwater fish are excluded from this database (also includes warmwater forage).

LFF = Limited forage fish community, all sport fish are excluded from this database.

LAL = Limited aquatic life, all fish are excluded from this database.

The four most sensitive genera in each classification are used to calculate the criteria under each classification, pursuant to s. NR 105.05 (2). From this point, the results of the calculation are shown using the variables listed in sub. (2).

CRITERIA CALCULATION:

	CW	WW	LFF	LAL
GMAV RANKS				
4	0.31	0.31	0.54	0.54
3	0.25	0.25	0.49	0.49
2	0.21	0.21	0.32	0.32
1	0.15	0.15	0.25	0.25
n	25	24	19	16
ln GMAV				
4	-1.171183	-1.171183	-0.616186	-0.616186
3	-1.386294	-1.386294	-0.710416	-0.710416
2	-1.560648	-1.560648	-1.139434	-1.139434
1	-1.89712	-1.89712	-1.386294	-1.386294
(ln GMAV)^2				
4	1.3716696	1.3716696	0.3796854	0.3796854
3	1.9218121	1.9218121	0.5046904	0.5046904
2	2.4356214	2.4356214	1.2983105	1.2983105
1	3.5990642	3.5990642	1.9218121	1.9218121
P				
4	0.1538462	0.16	0.2	0.2352941
3	0.1153846	0.12	0.15	0.1764706
2	0.0769231	0.08	0.1	0.1176471
1	0.0384615	0.04	0.05	0.0588235
sq rt P				
4	0.3922323	0.4	0.4472136	0.4850713
3	0.3396831	0.3464102	0.3872983	0.420084
2	0.2773501	0.2828427	0.3162278	0.3429972
1	0.1961161	0.2	0.2236068	0.2425356
EV	-6.015245	-6.015245	-3.85233	-3.85233
EW	9.3281673	9.3281673	4.1044983	4.1044983
EP	0.3846154	0.4	0.5	0.5882353
EPR	1.2053816	1.2292529	1.3743465	1.4906881
J	0.05	0.05	0.05	0.05
S	3.6342669	3.5636919	3.7669816	3.4729854
L	-2.598981	-2.598981	-2.257367	-2.257367
A	-1.786334	-1.802115	-1.415044	-1.480784
FAV	0.1675734	0.1649496	0.2429148	0.2274593
ATC	0.0837867	0.0824748	0.1214574	0.1137297

Since the criterion for warmwater is less than the coldwater criterion, it is set equal to the coldwater criterion. The LFF criterion is greater than coldwater, but the LAL criterion is less than LFF, so LAL is set equal to LFF. Essentially, this means that there is relief available for the LFF and LAL criteria compared

to coldwater, but no additional relief to the LFF criterion is available for LAL. No relief is available for warmwater compared to coldwater either. The “no relief” findings are due to either the amount of data or the results of the acute tests, or both, and since those species in warmwater and LAL are all included in the "larger" databases already (coldwater and LFF respectively), it was deemed appropriate to set the criteria equal to those for the “larger” databases rather than having more restrictive criteria applied to these "subset" classifications.

In addition, due to the exclusion of the genera not resident to Wisconsin and the other Great Lakes states, the calculated criterion is slightly lower than the EPA criterion published in GLI (1995). The difference is very small (0.084 vs. 0.086 ug/L), but because the Wisconsin/Great Lakes species database are included in EPA’s national database, the criteria for coldwater and warmwater are set equal to the GLI acute criterion of 0.086 ug/L. This is a similar concept to the warmwater and LAL discussion above.

Acute toxicity criteria for endrin:
ATC = 0.086 ug/L (coldwater and warmwater)
ATC = 0.12 ug/L (LFF and LAL)

EPA ACUTE-CHRONIC RATIOS:

Not enough data are available to permit the calculation of independent chronic toxicity criteria (see table below). Instead, acute-chronic ratios (ACRs) must be developed such that the chronic criterion equals the final acute value divided by the appropriate ACR. The following table summarizes the calculation procedure for the ACRs using the procedure in s. NR 105.06 (5).

SPECIES	ACUTE VALUE	CHRONIC VALUE	TEST ACR	(rounded) SMACR
Flagfish	0.85	0.26	3.27	3.27
Saltwater species:				
Sheepshead minnow	0.36	0.19	1.89	1.89
Grass shrimp	0.72	0.039	18.46	18.46

The flagfish and saltwater ratios were used because there are no ratios available for either invertebrates or freshwater fish resident to the Great Lakes. The Final ACRs for each classification are as follows:

All classifications = Geo. mean of 18.46, 1.89, and 3.27 = 4.85

Chronic toxicity criteria for endrin:
CW, WW = 0.172 / 4.85 = 0.035 ug/L
LFF, LAL = 0.243 / 4.85 = 0.050 ug/L