Date: February 2003
Calculator: Elisabeth Harrahy, Ph.D.

SECONDARY VALUES FOR TOLUENE (CAS # 108-88-3)

A search was conducted for information on the toxicity of toluene to fish and other aquatic life using the ECOTOX database. It was determined that data are available to meet seven out of the eight requirements. Because there are data for a Daphnid species, it is possible to calculate a secondary acute value for toluene.

The Fox River and the East River are each designated as a warm water sportfish community, non-public water supply. However, it is necessary to calculate secondary values for both cold water and warm water first, for comparative purposes. If the secondary values are lower for warm water than for cold water, then the secondary values for cold water (complete database) will apply for the warm water. If the secondary values for warm water are higher than for cold water, then the secondary values for warm water will apply. Secondary values for cold water should also be calculated because the site is located just upstream of where the Fox River enters Green Bay, and Green Bay is designated cold water, public water supply.

Cold Water

To calculate a secondary acute value (SAV), the lowest genus mean acute value (GMAV) in the database is divided by the secondary acute factor (SAF; an adjustment factor corresponding to the number of satisfied requirements).

SAF for seven out of eight requirements met = 4.3

Lowest GMAV = 9,062.65 μg/L (*Daphnia magna*)

SAV = GMAV/SAF
= 9,062.65/4.3
= 2,107.59 μg/L

There are currently no acceptable chronic data for toluene. Therefore, a secondary chronic value may be calculated only by using default acute-chronic ratios.

SACR = Geometric mean of 18, 18, and 18 = 18

SCV = SAV/SACR
= 2,107.59/18
= **117.08 μg/L**

So, for cold water, the secondary acute value for toluene is 2,108 μg/L (rounded from 2,107.59) and the secondary chronic value is 117 μg/L (rounded from 117.08).

Warm Water Sportfish

The Coho salmon and the rainbow trout drop out of the database when calculating secondary values for warm water. However, because the lowest GMAV for cold water was the GMAV for *Daphnia magna*, which is also in the warm water sportfish database, the secondary values for warm water sportfish will be the same as those for cold water.

Table 1. Requirements for calculation of an acute toxicity criterion for protection of aquatic life for toluene, and corresponding acute toxicity data.

Species Name	Common Name	Duration/ Endpoint	Value µg/L	Reference #[a]	Source
1. At least one salmonid fish in the family Salmonidae, in the class Osteichthyes.					
Oncorhynchus kisutch	**Coho salmon**	**96-h/LC50**	**8,110**	**16**	**AQUIRE**
Oncorhynchus kisutch	**Coho salmon**	**96-h/LC50**	**5,500**	**17**	**AQUIRE**
Oncorhynchus kisutch	**Coho salmon**	**96-h/LC50**	**9,360**	**18**	**AQUIRE**
Species Mean Acute Value (SMAV; geometric mean of LC50 values for this species) = 7,474.00					
Oncorhynchus mykiss	**rainbow trout**	**96-h/LC50**	**24,000**	**13**	**AQUIRE**
Oncorhynchus mykiss	**rainbow trout**	**96-h/LC50**	**5,800**	**19**	**AQUIRE**
Oncorhynchus mykiss	**rainbow trout**	**96-h/LC50**	**6,780**	**12**	**AQUIRE**
Oncorhynchus mykiss	**rainbow trout**	**96-h/LC50**	**15,530**	**4**	**AQUIRE**
Oncorhynchus mykiss	**rainbow trout**	**96-h/LC50**	**24,000**	**14**	**AQUIRE**
SMAV = 12,860.28					
Genus Mean Acute Value (GMAV; geometric mean of SMAVs for this genus) = 9,803.97					
2. At least one non-salmonid fish from another family in the class Osteichthyes, preferably a commercially or recreationally important warmwater species.					
Ictalurus punctatus	**channel catfish**	**96-h/LC50**	**240,000**	**13**	**AQUIRE**
Ictalurus punctatus	**channel catfish**	**96-h/LC50**	**240,000**	**14**	**AQUIRE**
SMAV = 240,000					
Lepomis macrochirus	**bluegill**	**96-h/LC50**	**24,000**	**1**	**AQUIRE**
Lepomis macrochirus	**bluegill**	**96-h/LC50**	**13,000**	**15**	**AQUIRE**
Lepomis macrochirus	**bluegill**	**96-h/LC50**	**170,000**	**13**	**AQUIRE**

Lepomis macrochirus	**bluegill**	**96-h/LC50**	**84,000**	**14**	**AQUIRE**
Lepomis macrochirus	**bluegill**	**96-h/LC50**	**340,000**	**14**	**AQUIRE**
Lepomis macrochirus	**bluegill**	**96-h/LC50**	**320,000**	**14**	**AQUIRE**
Lepomis macrochirus	**bluegill**	**96-h/LC50**	**300,000**	**14**	**AQUIRE**
Lepomis macrochirus	**bluegill**	**96-h/LC50**	**240,000**	**14**	**AQUIRE**
Lepomis macrochirus	**bluegill**	**96-h/LC50**	**135,000**	**14**	**AQUIRE**
Lepomis macrochirus	**bluegill**	**96-h/LC50**	**74,000**	**14**	**AQUIRE**
Lepomis macrochirus	**bluegill**	**96-h/LC50**	**135,000**	**14**	**AQUIRE**

SMAV = 115,122.04

3. At least one planktonic crustacean (e.g., cladoceran, copepod).

Cyclops viridis	**cyclopoid copepod**	**96-h/LC50**	**215,000**	**5**	**AQUIRE**

SMAV = 215,000

Daphnia magna	**water flea**	**48-h/EC50**	**19,600**	**6**	**AQUIRE**
Daphnia magna	**water flea**	**48-h/EC50**	**11,518**	**7**	**AQUIRE**
Daphnia magna	**water flea**	**48-h/EC50**	**6,000**	**8**	**AQUIRE**
Daphnia magna	**water flea**	**48-h/EC50**	**6,880**	**9**	**AQUIRE**
Daphnia magna	**water flea**	**48-h/EC50**	**6,560**	**9**	**AQUIRE**

SMAV = 9,062.65

Diaptomus forbesi	**calanoid copepod**	**96-h/LC50**	**447,000**	**10**	**AQUIRE**

SMAV = 447,000

4. At least one benthic crustacean (e.g., ostracod, isopod, amphipod, crayfish).

Gammarus minus	**scud**	**96-h/LC50**	**58,000**	**4**	**AQUIRE**

SMAV = 58,000

5. At least one insect (e.g., mayfly, dragonfly, damselfly, stonefly, caddisfly, mosquito, midge).

Chironomus thummi	**midge**	**48-h/LC50**	**47,000**	**3**	**AQUIRE**
Chironomus thummi	**midge**	**48-h/LC50**	**108,660**	**4**	**AQUIRE**

SMAV = 71,463.42

6. At least one fish or amphibian from a family in the phylum Chordata not already represented in one of the other subdivisions.

Xenopus laevis	**clawed toad**	**96-h/LC50**	**179,000**	**25**	**AQUIRE**
Xenopus laevis	**clawed toad**	**96-h/LC50**	**181,000**	**25**	**AQUIRE**
Xenopus laevis	**clawed toad**	**96-h/LC50**	**193,000**	**25**	**AQUIRE**
Xenopus laevis	**clawed toad**	**96-h/LC50**	**186,000**	**25**	**AQUIRE**
Xenopus laevis	**clawed toad**	**96-h/LC50**	**191,000**	**25**	**AQUIRE**
SMAV = 185,920.40					
Carassius auratus	**goldfish**	**96-h/LC50**	**57,680**	**1**	**AQUIRE**
Carassius auratus	**goldfish**	**96-h/LC50**	**22,800**	**2**	**AQUIRE**
SMAV = 36,264.36					
Gambusia affinis	**western mosquitofish**	**96-h/LC50**	**1,180,000**	**11**	**AQUIRE**
SMAV = 1,180,0000					
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**31,700**	**20**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**34,270**	**1**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**42,330**	**1**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**12,600**	**6**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**30,000**	**21**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**31,000**	**21**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**26,000**	**21**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**18,000**	**21**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**36,000**	**21**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**25,000**	**21**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**27,000**	**21**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**28,000**	**21**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**72,000**	**21**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**66,000**	**21**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**59,000**	**21**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**55,000**	**21**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**56,400**	**22**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**77,400**	**22**	**AQUIRE**

Pimephales promelas	**fathead minnow**	**96-h/LC50**	**54,000**	**22**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**36,200**	**23**	**AQUIRE**
Pimephales promelas	**fathead minnow**	**96-h/LC50**	**17,030**	**24**	**AQUIRE**

SMAV = 35,617.43

7. At least one organism from a family in a phylum other than Arthropoda or Chordata (e.g., Rotifera, Annelida, Mollusca).

Melanoides tuberculata	**snail**	**96-h/LC50**	**1,100,000**	**5**	**AQUIRE**

SMAV = 1,100,000

Physa heterostropha	**pond snail**	**96-h/LC50**	**55,600**	**4**	**AQUIRE**

SMAV = 55,600

8. At least one organism from a family in any order of insect or any other phylum not already represented in subdivisions 1 through 7.

---

[1]Pickering, Q.H. and C. Henderson. 1966. Acute toxicity of some important petrochemicals to fish. Journal of the Water Pollution Control Federation 38(9):1419-1429.

[2]Brenniman, G., R. Hartung and W.J. Weber, Jr. 1976. A continuous flow bioassay method to evaluate the effects of outboard motor exhausts and selected aromatic toxicants on fish. Water Research 10(2):165-169.

[3]Roghair, C.J., A. Buijze, E.S.E. Yedema, and J.L.M. Hermens. 1994. A QSAR for base-line toxicity to the midge *Chironomus riparius*. Chemosphere 28(5):989-997.

[4]Horne, J.D. and B.R. Oblad. 1983. Aquatic toxicity studies of six priority pollutants. Rep. No. 4380. NUS Corporation, Houston Environment Center, Houston, TX. 99 pp.

[5]Panigrahi, A.K. and S.K. Konar. 1989. Acute toxicity of some petroleum pollutants to plankton, fish and benthic organisms. Environ. Ecol. 7(1):44-49.

[6]Pearson, J.G., J.P. Glennon, J.J. Barkley, and J.W. Highfill. 1979. An approach to the toxicological evaluation of a complex industrial wastewater. In: L.L. Marking and R.A. Kimble (eds.), Aquatic Toxicology and Hazard Assessment, 2nd Symposium, ASTM STP 667, Philadelphia, PA. p.284-301.

[7]Bobra, A.M., W.Y. Shiu, and D. Mackay. 1983. A predictive correlation for the acute toxicity of hydrocarbons and chlorinated hydrocarbons to the water flea (*Daphnia magna*). Chemosphere 12(9-10):1121-1129.

[8]Janssen, C.R. and G. Persoone. 1993. Rapid toxicity screening tests for aquatic biota. 1. Methodology and experiments with *Daphnia magna*. Environmental Toxicology and Chemistry 12:711-717.

[9]MacLean, M.M. and K.G. Doe. 1989. The comparative toxicity of crude and refined oils to *Daphnia magna* and *Artemia*.

Environment Canada, EE-111, Dartmouth, Nova Scotia. p.64.
[10]Saha, M.K. and S.K. Konar. 1983. Acute toxicity of some petroleum pollutants to plankton and fish. Environ. Ecol. 1(1):117-119.
[11]Wallen, I.E., W.C. Greer and R. Lasater. 1957. Toxicity to *Gambusia affinis* of certain pure chemicals in waters. Sewage Ind. Wastes 29(6):695-711.
[12]Brooke, L.T., D.J. Call, S.H. Poirier, and S.L. Harting. 1986. Toxicity of toluene to several freshwater species. Center for Lake Superior Environmental Stud., Univ.of Wisconsin-Superior, Superior, WI (Report to Battelle Memorial Research Institute, Columbus, OH) :10
[13]Johnson, W.W. and M.T. Finley. 1980. Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates. Resource Publication No. 137, U.S. Fish and Wildlife Service, U.S.D.I., Washington, D.C. 98 pp.
[14]Mayer, F.L.J. and M.R. Ellersieck. 1986. Manual of Acute Toxicity: Interpretation and Data Base for 410 Chemicals and 66 Species of Freshwater Animals. Resource Publication No. 160, U.S. Fish and Wildlife Service, U.S.D.I., Washington, D.C. 505 pp.
[15]Buccafusco, R.J., S.J. Ells and G.A. LeBlanc. 1981. Acute toxicity of priority pollutants to bluegill (*Lepomis macrochirus*). Bull. Environ. Contam. Toxicol. 26(4):446-452.
[16]Moles, A. 1980. Sensitivity of parasitized Coho salmon fry to crude oil, toluene, and naphthalene. Trans. Am. Fish. Soc. 109(3):293-297.
[17]Moles, A., S. Bates, S.D. Rice, and S. Korn. 1981. Reduced growth of Coho salmon fry exposed to two petroleum components, toluene and naphthalene, in fresh water. Trans. Am. Fish. Soc. 110(3):430-436.
[18]Korn, S. and S. Rice. 1981. Sensitivity to, and accumulation and depuration of, aromatic petroleum components by early life stages of Coho salmon (*Oncorhynchus kisutch*). Rapp. P.-V. Reun. Cons. Int. Explor. Mer. 178:87-92.
[19]Galassi, S., M. Mingazzini, L. Vigano, D. Cesareo, and M.L. Tosato. 1988. Approaches to modeling toxic responses of aquatic organisms to aromatic hydrocarbons. Ecotoxicology and Environmental Safety 16(2):158-169.
[20]Geiger, D.L., L.T. Brooke, and D.J. Call. 1990. Acute toxicities of organic chemicals to fathead minnows (*Pimephales promelas*), Vol. 5. Center for Lake Superior Environmental Studies, University of Wisconsin- Superior, Superior, WI. I:332.
[21]Devlin, E.W., J.D. Brammer, and R.L. Puyear. 1982. Acute toxicity of toluene to three age groups of fathead minnows (*Pimephales promelas*). Bull. Environ. Contam. Toxicol. 29(1):12-17.
[22]Mayes, M.A., H.C. Alexander, and D.C. Dill. 1983. A study to assess the influence of age on the response of fathead minnows in static acute toxicity tests. Bull. Environ. Contam. Toxicol. 31(2):139-147.
[23]Geiger, D.L., S.H. Poirier, L.T. Brooke and D.J. Call. 1986. Acute toxicities of organic chemicals to fathead minnows (*Pimephales promelas*), Vol. 3. Center for Lake Superior Environmental Studies, University of Wisconsin- Superior, Superior, WI. I:328.
[24]Marchini, S., M.L. Tosato, T.J. Norberg-King, D.E. Hammermeister, and M.D. Hoglund. 1992. Lethal and sublethal toxicity of benzene derivatives to the fathead minnow using a short-term test. Environ. Toxicol. Chem. 11(2):187-195.
[25]Kononen, D.W. and R.A. Gorski. 1997. A method for evaluating the toxicity of industrial solvent mixtures. Environ. Toxicol. Chem. 16(5):968-976.

.