

OHIO EPA SURFACE WATER QUALITY CRITERION FACT SHEET

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Chemical Name: VanadiumDeveloped by: Chris J. SkalskiCAS # 7440-62-2Data Retrieval Date: 7-06-00Internal Code # --Fact Sheet Preparation Date: 3-01-06ACUTE DATA

<u>SPECIES</u>	<u>EC₅₀/LC₅₀</u> <u>(µg/l)</u>	<u>TEST TYPE^a</u>	<u>DURATION</u> <u>(HOURS)</u>	<u>SMAV^b</u> <u>(µg/l)</u>	<u>GMAV^b</u> <u>(µg/l)</u>	<u>REFERENCE</u> <u>NUMBER</u>
Cladoceran	1,370 ^c	S,U	48	2,534	2,534	1
<i>Daphnia magna</i>	1,520 ^c	S,U	48			1
	1,460	S,U	48			1
	1,580	S,U	48			1
	2,900	S,U	48			2
	3,300	S,U	48			2
	3,400 ^d	S,U	48			2
	3,600	S,U	48			2
	3,800	S,U	48			2
	3,900	S,U	48			2
	3,900 ^d	S,U	48			2
	3,900 ^d	S,U	48			2
	4,000	S,U	48			2
	4,200 ^d	S,U	48			2
	4,300 ^d	S,U	48			2
	4,800 ^d	S,U	48			2
	2,300	S,U	48			3
	3,100	S,U	48			4
Fathead Minnow	4,800	S,U	96	1,849	1,849	5
<i>Pimephales promelas</i>	30,000 ^f	S,U	96			5
	1,800 ^c	F,M	96			1
	1,900 ^c	F,M	96			1
	13,000 ^e	S,M	96			5
	55,000 ^e	S,M	96			5
Amphipod	12,300	R,U	96	12,300	12,300	9
<i>Crangonyx pseudogracilis</i>						
Goldfish	15,600	S,U	96	15,600	15,600	3
<i>Carassius auratus</i>						
Brook Trout	7,000	F,M	96	13,608	13,608	6
<i>Salvelinus fontinalis</i>	15,000	F,M	96			6
	24,000	S,M	96			6

^a S = static; F= flow through; R = renewal; U = unmeasured; M = measured.^b SMAV = Species Mean Acute Value; GMAV = Genus Mean Acute Value.^c Data were used in the determination of the SMAV because although the organisms were fed during the toxicity tests, Beusen and Neven (1987) and Kimball (1978) found no difference in acute toxicity in side-by-side daphnid tests that were fed versus unfed.^d Data not used to calculate the SMAV since a corresponding EC50 was available from the same study.^e Data not used to calculate the SMAV since data were reported as "exploratory" by the authors.^f Data not used to calculate the SMAV since it was greater than an order magnitude higher than other data for this species.

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<u>SPECIES</u>	<u>EC₅₀/LC₅₀</u> <u>(µg/l)</u>	<u>TEST TYPE^a</u>	<u>DURATION</u> <u>(HOURS)</u>	<u>SMAV^b</u> <u>(µg/l)</u>	<u>GMAV^b</u> <u>(µg/l)</u>	<u>REFERENCE</u> <u>NUMBER</u>
Rainbow Trout	5,200	F,M	96	7,924	11,435	7
<i>Oncorhynchus mykiss</i>	6,100	F,M	96			7
	6,200	F,M	96			7
	6,400	F,M	96			7
	8,000	F,M	96			7
	10,000	F,M	96			7
	11,700	F,M	96			7
	13,200	F,M	96			7
	118,000 ^d	R,M	96			8
Chinook Salmon	16,500	S,U	96	16,500		11
<i>Oncorhynchus tshawytscha</i>						
Carp	27,800	S,U	96	30,012	30,012	3
<i>Cyprinus carpio</i>	32,400	S,U	96			3
Bluegill	6,000 ^e	S,U	96			5
<i>Lepomis macrochirus</i>	55,000 ^e	S,U	96			5
Flagfish	11,200	R,M	96	11,200	11,200	10
<i>Jordanella floridae</i>						
Colorado Squawfish	3,800	S,U	96	5,032	5,032	12
<i>Ptychocheilus lucius</i>	7,800	S,U	96			12
	4,300	S,U	96			12
Razorback Sucker	3,000	S,U	96	4,727	4,727	12
<i>Xyrauchen texanus</i>	4,000	S,U	96			12
	8,800	S,U	96			12
Bonytail	2,200	S,U	96	3,903	3,903	12
<i>Gila elegans</i>	5,100	S,U	96			12
	5,300	S,U	96			12
Zebrafish ^c	2,900	R,M	96	3,979	3,979	2
<i>Brachydanio rerio</i>	4,100	R,M	96			2
	5,300	R,M	96			2
Giant Gourami ^c	6,410	R,U	96	6,410	6,410	13
<i>Colisa fasciatus</i>						

^a S = static; F = flow through; R = renewal; U = unmeasured; M = measured.^b SMAV = Species Mean Acute Value; GMAV = Genus Mean Acute Value.^c Species non-native to North America. The SMAV was not used in determining the Tier II values.^d Test was conducted using embryos and was therefore not used to calculate the SMAV.^e Data not used to calculate the SMAV since data were reported as "exploratory" by the authors.

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<u>SPECIES</u>	<u>EC₅₀/LC₅₀</u> <u>(µg/l)</u>	<u>TEST TYPE^a</u>	<u>DURATION</u> <u>(HOURS)</u>	<u>SMAV^b</u> <u>(µg/l)</u>	<u>GMAV^b</u> <u>(µg/l)</u>	<u>REFERENCE</u> <u>NUMBER</u>
Guppy	6,100	R,M	96	7,888	7,888	2
<i>Poecilia reticulata</i>	10,200	R,M	96			2
Flannelmouth Sucker <i>Catostomus latipinnis</i>	11,500	S,U	96	11,500	11,500	14

^a S = static; F = flow through; R = renewal; U = unmeasured; M = measured.

^b SMAV = Species Mean Acute Value; GMAV = Genus Mean Acute Value.

CHRONIC DATA

<u>SPECIES</u>	<u>CHRONIC VALUE</u> <u>(µg/l)</u>	<u>METHOD</u>	<u>SMCV^a</u> <u>(µg/l)</u>	<u>GMCV^a</u> <u>(µg/l)</u>	<u>REFERENCE</u> <u>NUMBER</u>
Fathead Minnow <i>Pimephales promelas</i>	170 (120-240)	Embryo-Larval	170	170	1
Cladoceran <i>Daphnia magna</i>	2,071 (1,890-2,270)	Life Cycle	2,071	2,071	2
Cladoceran <i>Daphnia magna</i>	>482 ^b	Life Cycle			1
Cladoceran <i>Daphnia magna</i>	>940 ^b	Life Cycle			1
Flagfish <i>Jordanella floridae</i>	83 (41-170)	Partial Life Cycle	83	83	10

^a SMCV = Species Mean Chronic Value; GMCV = Genus Mean Chronic Value.

^b Data not used to calculate the SMCV since definitive data for the same species was available.

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REFERENCES

1. Kimball, G. 1978. The Effects of Lesser Known Metals and One Organic to Fathead Minnows (*Pimephales promelas*) and *Daphnia magna*. Manuscript, Dept. Of Entomology, Fisheries, and Wildlife, Univ. Of Minnesota, Minneapolis, MN: 88 p.
2. Beusen, J.-M. and B. Neven. 1987. Toxicity of Vanadium to Different Freshwater Organisms. Bull. Environ. Contam. Toxicol. 39(2):194-201.
3. Ding, S.R. 1980. Acute Toxicities of Vanadium, Nickel, and Cobalt to Several Species of Aquatic Organisms. Environ. Qual. 1:17-21.
4. Allen, Y., P. Calow and D.J. Baird. 1995. A Mechanistic Model of Contaminant-Induced Feeding Inhibition in *Daphnia magna*. Environ. Toxicol. Chem. 14(9):1625-1630.
5. Tarzwell, C.M. and C. Henderson. 1960. Toxicity of Less Common Metals to Fishes. Ind. Wastes 5:12.
6. Ernst, W.R. and E.T. Garside. 1987. Lethal Effects of Vanadium to Two Life Stages of Brook Trout *Salvelinus fontinalis* (Mitchill). Can. J. Zool. 65(3):628-634.
7. Stendahl, D.H. and J.B. Sprague. 1982. Effects of Water Hardness and pH on Vanadium Lethality to Rainbow Trout. Water Res. 16(10):1479-1488. In: P.T.S. Wong, P.V. Hodson, A.J. Niimi, V. Cairns and U. Borgmann (Eds.), Proc. 5th Annual Aquatic Toxicity Workshop, Hamilton, Ont., Fish. Mar. Serv. Tech. Rep. No. 862:144.
8. Giles, M.A. and J.F. Klaverkamp. 1982. The Acute Toxicity of Vanadium and Copper to Eyed Eggs of Rainbow Trout (*Salmo gairdneri*). Water Res. 16(6):885-889.
9. Martin, T.R. and D.M. Holdich. 1986. The Acute Lethal Toxicity of Heavy Metals to Peracarid Crustaceans (with Particular Reference to Fresh-Water Asellids and Gammarids). Water Res. 20(9):1137-1147.
10. Holdway, D.A. and J.B. Sprague. 1979. Chronic Toxicity of Vanadium to Flagfish. Water Res. 13(9):905-910.
11. Hamilton, S.J. and K.J. Buhl. 1990. Safety Assessment of Selected Inorganic Elements to Fry of Chinook Salmon (*Oncorhynchus tshawytscha*). Ecotoxicol. Environ. Saf. 20(3):307-324.
12. Hamilton, S.J. 1995. Hazard Assessment of Inorganics to Three Endangered Fish in the Green River, Utah. Ecotoxicol. Environ. Saf. 30(2):134-142.
13. Srivasta, D.K. and R.K. Tyagi. 1985. Toxicity of Selenium and Vanadium to the Striped Gourami, *Colisa fasciatus* (Bloch and Schneider). Acta. Hydrobiol. 25/26(3/4):481-486.
14. Hamilton, S.J. and K.J. Buhl. 1997. Hazard Evaluation of Inorganics, Singly and in Mixtures, to Flannelmouth Sucker *Catostomus latipinnis* in the San Juan River, New Mexico. Ecotoxicol. Environ. Saf. 38(3):296-308.

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Data Requirement OAC 3745-1-36(A)(1)	SPECIES	GMAV (µg/l)
(a)	Trout	11,435
(b)	Bonytail	3,903
(c)	Fathead Minnow	1,849
(d)	<i>Daphnia magna</i>	2,534
(e)	Amphipod	12,300

Secondary Acute Factor (SAF) = 6.1

Secondary Acute Value (SAV) = Lowest GMAV ÷ SAF
 = 1,849 ÷ 6.1
 = 303 = 300 µg/l

Tier II Acute Aquatic Value (AAV) = SAV ÷ 2
 = 303 ÷ 2
 = 152 = 150 µg/l

CALCULATION OF CHRONIC AQUATIC VALUE (CAV)^a

Experimentally determined Acute-Chronic Ratios (ACRs):

SPECIES	ACUTE VALUE (µg/l)	CHRONIC VALUE (µg/l)	ACUTE-CHRONIC RATIO	SPECIES MEAN ACR
Fathead Minnow <i>Pimephales promelas</i>	1,849	170	10.9	10.9
Cladoceran <i>Daphnia magna</i>	3,562	2,071	1.72	1.72
Cladoceran <i>Daphnia magna</i>	1,480	>482	<3.07 ^b	
Cladoceran <i>Daphnia magna</i>	1,480	>940	<1.57 ^b	
Flagfish <i>Jordanella floridae</i>	11,200	83	135	135 ^c

Secondary Acute-Chronic Ratio (SACR) = $\sqrt[3]{(10.9)(1.72)(18)} = 6.96$

Chronic Aquatic Value (CAV) = SAV ÷ SACR
 = 303 ÷ 6.96 = 44 µg/l

^aSee Ohio Administrative Code 3745-1-36 effective February 22, 2002.^bNot used to determine the Species Mean ACR since a definitive Species Mean ACR could be calculated.^cNot used to determine the SACR because it was higher than the other ACRs by over an order of magnitude. The SACR was calculated using ACRs of species whose SMAVs were close to the FAV.