Results of acceptable acute toxicity tests on sulfate. (2-8-06 DRAFT for review and comment) (SULFATE1.XLS)

Common Name	Scientific Name	Use Code	Acute Value (mg/L)	Chloride (mg/L)	Ca-Mg ratio (weight)	Hardness (mg/L)	Norm. A. V. (mg/L)	SMAV (mg/L)	GMAV (mg/L)	Reference	Comment
Water flea	*Ceriodaphnia dubia*	b	2,083	1.9	1.15	84				Mount et al. 1997 (See note 11)	Na2SO4; fed
Water flea	*Ceriodaphnia dubia*	b	1,038	931	1.15	84				Mount et al. 1997 (See note 11)	Na2SO4 and NaCl; fed
Water flea	*Ceriodaphnia dubia*	c	2,130	NA	NA	NA				Warne and Schifko 1999	
Water flea	*Ceriodaphnia dubia*	c	1,827	NA	NA	NA				Warne and Schifko 1999	
Water flea	*Ceriodaphnia dubia*	c	2,526	10	2.33	100				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	2,357	10	2.33	100				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	2,526	10	2.33	102				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	2,223	15	2.33	92				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	2,243	15	2.33	94				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	2,402	15	2.33	94				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	2,470	20	2.33	94				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	2,295	20	2.33	94				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	2,494	20	2.33	94				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	a	2,198	25.3	2.33	100	3227.2			Soucek 2004	
Water flea	*Ceriodaphnia dubia*	a	2,724	25.3	2.33	96	3775.2			Soucek 2004	
Water flea	*Ceriodaphnia dubia*	a	1,925	25.1	2.33	96	2975.9			Soucek 2004	
Water flea	*Ceriodaphnia dubia*	a	2,472	24.6	2.33	96	3522.2			Soucek 2004	
Water flea	*Ceriodaphnia dubia*	a	2,481	24.9	2.33	96	3531.6			Soucek 2004	
Water flea	*Ceriodaphnia dubia*	a	2,404	100.4	2.33	96	3564.6			Soucek 2004	
Water flea	*Ceriodaphnia dubia*	a	2,757	101.5	2.33	96	3919.2			Soucek 2004	
Water flea	*Ceriodaphnia dubia*	a	2,184	102.8	2.33	104	3304.1			Soucek 2004	
Water flea	*Ceriodaphnia dubia*	a	1,830	273.7	2.33	98	3232.1			Soucek 2004	
Water flea	*Ceriodaphnia dubia*	a	1,793	281.3	2.33	102	3184.2			Soucek 2004	
Water flea	*Ceriodaphnia dubia*	a	2,095	288.3	2.33	102	3496.4			Soucek 2004	
Water flea	*Ceriodaphnia dubia*	a	1,328	491	2.33	96	3057.7			Soucek 2004	
Water flea	*Ceriodaphnia dubia*	a	1,828	491.7	2.33	98	3547.7			Soucek 2004	
Water flea	*Ceriodaphnia dubia*	a	1,116	497.7	2.33	94	2866.5			Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	2,030	1.9	1.46	94				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	1,868	1.9	1.46	94				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	2,269	1.9	1.46	94				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	2,538	34	5.4	107				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	2,607	34	5.4	107				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	2,436	34	5.4	107				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	3,059	1.9	1.46	194				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	2,706	1.9	1.46	194				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	3,265	1.9	1.46	194				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	2,383	1.9	1.46	288				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	3,361	1.9	1.46	288				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	2,853	1.9	1.46	288				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	3,297	1.9	1.46	288				Soucek 2004	

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Common Name	Scientific Name	Use Code	Acute Value (mg/L)	Chloride (mg/L)	Ca-Mg ratio (weight)	Hardness (mg/L)	Norm. A. V. (mg/L)	SMAV (mg/L)	GMAV (mg/L)	Reference	Comment
Water flea	*Ceriodaphnia dubia*	c	3,369	1.9	1.46	390				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	3,073	1.9	1.46	390				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	3,091	1.9	1.46	390				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	3,716	1.9	1.46	484				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	3,506	1.9	1.46	484				Soucek 2004	
Water flea	*Ceriodaphnia dubia*	c	3,338	1.9	1.46	484		3,359	3,359	Soucek 2004	
Water flea	*Daphnia magna*	c	6,173	NA	NA	NA				Arambasic et al. 1995	
Water flea	*Daphnia magna*	b	3,097	1.9	1.15	84				Mount et al. 1997 (See note 11)	Na2SO4; fed
Water flea	*Daphnia magna*	b	1,927	1729	1.15	84				Mount et al. 1997 (See note 11)	Na2SO4 and NaCl; fed
Water flea	*Daphnia magna*	c	5,816	NA	NA	563				Meyer et al. 1985	
Water flea	*Daphnia magna*	c	5,218	NA	NA	105				BC Research 1998; Pickard et al. 1999	
Water flea	*Daphnia magna*	c	1,262	2.4	1.15	25				Davies 2002; Davies et al. 2003	See note 3.
Water flea	*Daphnia magna*	c	1,307	2.4	1.15	25				Davies 2002; Davies et al. 2003	
Water flea	*Daphnia magna*	c	1,513	2.4	6.26	25				Davies 2002; Davies et al. 2003	
Water flea	*Daphnia magna*	c	1,628	2.4	6.26	25				Davies 2002; Davies et al. 2003	
Water flea	*Daphnia magna*	c	1,893	2.4	11.6	25				Davies 2002; Davies et al. 2003	
Water flea	*Daphnia magna*	c	2,111	2.4	11.6	25				Davies 2002; Davies et al. 2003	
Water flea	*Daphnia magna*	c	3,045	2.4	1.15	100				Davies 2002; Davies et al. 2003	
Water flea	*Daphnia magna*	c	3,247	2.4	1.15	100				Davies 2002; Davies et al. 2003	
Water flea	*Daphnia magna*	c	3,835	2.4	6.26	100				Davies 2002; Davies et al. 2003	
Water flea	*Daphnia magna*	c	3,842	2.4	6.26	100				Davies 2002; Davies et al. 2003	
Water flea	*Daphnia magna*	c	4,295	2.4	11.6	100				Davies 2002; Davies et al. 2003	
Water flea	*Daphnia magna*	c	4,541	2.4	11.6	100				Davies 2002; Davies et al. 2003	
Water flea	*Daphnia magna*	c	957	2.4	NA	25				Davies 2002; Davies et al. 2003	
Water flea	*Daphnia magna*	c	1,768	2.4	NA	50				Davies 2002; Davies et al. 2003	
Water flea	*Daphnia magna*	c	3,155	2.4	NA	75				Davies 2002; Davies et al. 2003	
Water flea	*Daphnia magna*	b	537.2	0.7	1.16	27				PESC 1996; Davies 2002	See note 3.
Water flea	*Daphnia magna*	b	6,281	108	11	100				PESC 1996; Davies 2002	
Water flea	*Daphnia magna*	b	7,442	112	6.27	250				PESC 1996; Davies 2002	
Amphipod	*Hyalella azteca*	c	1,226	NA	NA	111				BC Research 1998; Pickard et al. 1999	fed
Amphipod	*Hyalella azteca*	a	1,767	33.6	2.33	96	2830.3			Soucek 2004	
Amphipod	*Hyalella azteca*	a	1,820	33.7	2.33	100	2861.4			Soucek 2004	
Amphipod	*Hyalella azteca*	a	1,779	33.9	2.33	96	2842.7			Soucek 2004	
Amphipod	*Hyalella azteca*	a	1,879	108	2.33	98	3039.7			Soucek 2004	
Amphipod	*Hyalella azteca*	a	1,830	105.5	2.33	100	2976			Soucek 2004	
Amphipod	*Hyalella azteca*	a	2,002	105.7	2.33	100	3148.3			Soucek 2004	
Amphipod	*Hyalella azteca*	a	1,679	308	2.33	98	3131.1			Soucek 2004	
Amphipod	*Hyalella azteca*	a	1,616	310.2	2.33	96	3082.3			Soucek 2004	
Amphipod	*Hyalella azteca*	a	1,684	303.7	2.33	100	3118.8			Soucek 2004	

Results of acceptable acute toxicity tests on sulfate. (2-8-06 DRAFT for review and comment) (SULFATE1.XLS)

Common Name	Scientific Name	Use Code	Acute Value (mg/L)	Chloride (mg/L)	Ca-Mg ratio (weight)	Hardness (mg/L)	Norm. A. V. (mg/L)	SMAV (mg/L)	GMAV (mg/L)	Reference	Comment
Amphipod	*Hyalella azteca*	a	1,433	485	2.33	98	3143			Soucek 2004	
Amphipod	*Hyalella azteca*	a	1,480	525.5	2.33	100	3238			Soucek 2004	
Amphipod	*Hyalella azteca*	a	1,438	445	2.33	100	3078.7			Soucek 2004	
Amphipod	*Hyalella azteca*	a	2,000	25.5	2.33	106	2996.4			Soucek 2004	
Amphipod	*Hyalella azteca*	a	1,901	25.6	2.33	100	2930.6			Soucek 2004	
Amphipod	*Hyalella azteca*	a	1,621	25.9	2.33	98	2662.1			Soucek 2004	
Amphipod	*Hyalella azteca*	a	2,002	26.1	2.33	102	3021.3			Soucek 2004	
Amphipod	*Hyalella azteca*	a	2,740	25.1	2.33	194	3251.1			Soucek 2004	
Amphipod	*Hyalella azteca*	a	2,203	26.3	2.33	192	2726.9			Soucek 2004	
Amphipod	*Hyalella azteca*	a	2,955	25.6	2.33	196	3455.9			Soucek 2004	
Amphipod	*Hyalella azteca*	a	2,121	24.9	2.33	296	2070			Soucek 2004	
Amphipod	*Hyalella azteca*	a	3,462	25.3	2.33	292	3433.7			Soucek 2004	
Amphipod	*Hyalella azteca*	a	2,840	26.6	2.33	292	2813.5			Soucek 2004	
Amphipod	*Hyalella azteca*	a	2,724	25.4	2.33	392	2145			Soucek 2004	
Amphipod	*Hyalella azteca*	a	4,046	25.5	2.33	396	3445.1			Soucek 2004	
Amphipod	*Hyalella azteca*	a	4,336	25.5	2.33	396	3735.1			Soucek 2004	
Amphipod	*Hyalella azteca*	a	4,145	24.9	2.33	486	3047.5			Soucek 2004	
Amphipod	*Hyalella azteca*	a	4,345	25	2.33	482	3269.7			Soucek 2004	
Amphipod	*Hyalella azteca*	a	3,796	25.3	2.33	482	2721.1			Soucek 2004	
Amphipod	*Hyalella azteca*	c	491	8.9	5.45	28				Davies 2002; Davies et al. 2003	
Amphipod	*Hyalella azteca*	c	1,518	17.8	5.4	56				Davies 2002; Davies et al. 2003	
Amphipod	*Hyalella azteca*	c	1,700	27	5.4	84				Davies 2002; Davies et al. 2003	
Amphipod	*Hyalella azteca*	c	2,971	36	5.4	112				Davies 2002; Davies et al. 2003	
Amphipod	*Hyalella azteca*	c	4,864	89	5.42	281				Davies 2002; Davies et al. 2003	
Amphipod	*Hyalella azteca*	b	205	0.7	1.16	27				PESC 1996; Davies 2002	
Amphipod	*Hyalella azteca*	b	3,711	108	11	100				PESC 1996; Davies 2002	
Amphipod	*Hyalella azteca*	b	6,787	112	6.27	250		2,986	2,986	PESC 1996; Davies 2002	
Midge	*Chironomus tentans*	b	14,123	1.9	1.46	94				Soucek 2004	
Midge	*Chironomus tentans*	b	14,146	1.9	1.46	94				Soucek 2004	
Midge	*Chironomus tentans*	b	6,667	0.7	1.16	27				PESC 1996; Davies 2002	
Midge	*Chironomus tentans*	b	5,868	108	11	100				PESC 1996; Davies 2002	
Midge	*Chironomus tentans*	b	4,173	112	6.27	250				PESC 1996; Davies 2002	
Fathead minnow	*Pimephales promelas*	b	5,383	1.9	1.15	84				Mount et al. 1997 (See note 11)	Na2SO4; fed
Fathead minnow	*Pimephales promelas*	b	2,059	1,847	1.15	84				Mount et al. 1997 (See note 11)	Na2SO4 and NaCl; fed
Fathead minnow	*Pimephales promelas*	b	10,280	NA	NA	563				Meyer et al. 1985	
Channel catfish	*Ictalurus punctatus*	b	11,000	87	4.9	412				Reed and Evans 1981	
Largemouth bass	*Micropterus salmoides*	b	13,000	87	4.9	412				Reed and Evans 1981	

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Common Name	Scientific Name	Use Code	Acute Value (mg/L)	Chloride (mg/L)	Ca-Mg ratio (weight)	Hardness (mg/L)	Norm. A. V. (mg/L)	SMAV (mg/L)	GMAV (mg/L)	Reference	Comment
Bluegill	*Lepomis macrochirus*	b	12,000	87	4.9	412				Reed and Evans 1981	
Bluegill	*Lepomis macrochirus*	b	9,130	9.5	2.9	44				Trama 1954	See note 5.
Bluegill	*Lepomis macrochirus*	b	8,792	9.5	2.9	44				Cairns and Scheier 1959	
Bluegill	*Lepomis macrochirus*	b	8,623	9.5	2.9	44				Cairns and Scheier 1959	
Bluegill	*Lepomis macrochirus*	b	8,454	9.5	2.9	44				Cairns and Scheier 1959	
Fingernail clam	*Spherium simile*	c	1,857	1.9	1.46	89				Soucek 2004	
Fingernail clam	*Spherium simile*	c	2,069	1.9	1.46	81				Soucek 2004	
Fingernail clam	*Spherium simile*	c	2,633	1.9	1.46	83				Soucek 2004	
Fingernail clam	*Spherium simile*	c	2,278	33	5.4	89				Soucek 2004	
Fingernail clam	*Spherium simile*	c	2,122	33	5.4	96				Soucek 2004	
Fingernail clam	*Spherium simile*	c	2,671	1.9	2.33	274				Soucek 2004	
Fingernail clam	*Spherium simile*	c	2,509	1.9	2.33	285				Soucek 2004	
Fingernail clam	*Spherium simile*	d	3,025	33	1.46	90	4120.5			Soucek 2004	
Fingernail clam	*Spherium simile*	d	2,582	33	1.46	87	3694			Soucek 2004	
Fingernail clam	*Spherium simile*	d	2,343	33	1.46	94	3416.5			Soucek 2004	
Fingernail clam	*Spherium simile*	c	3,139	1.9	1.46	274				Soucek 2004	
Fingernail clam	*Spherium simile*	c	2,712	1.9	1.46	264				Soucek 2004	
Fingernail clam	*Spherium simile*	c	2,297	1.9	1.46	195				Soucek 2004	
Fingernail clam	*Spherium simile*	c	2,082	1.9	1.46	191		3,733	3,733	Soucek 2004	
Fatmucket	*Lampsilis siliquoidea*	a	3,377	25	2.33	100	4405.8			Soucek 2005	
Fatmucket	*Lampsilis siliquoidea*	a	3,525	25	2.33	300	3452.2			Soucek 2005	
Fatmucket	*Lampsilis siliquoidea*	a	3,729	25	2.33	500	2554.6			Soucek 2005	
Fatmucket	*Lampsilis siliquoidea*	c	1,727	5	1.46	100				Soucek 2005	
Fatmucket	*Lampsilis siliquoidea*	d	1,822	33	1.46	100	2862.4	3,247	3,247	Soucek 2005	
Mosquitofish	*Gambusia affinis*	b	11,159	NA	NA	NA				Wallin et al. 1957	See note 6.

Notes:
1. Acute Values, Normalized Acute Values, SMAVs, and GMAVs are in "mg SO4/L".
2. NA = not available.
3. Although some important information concerning test conditions is not available regarding tests reported by Davies (2002), Davies et al. (2003), and PESC (1996), these tests are considered acceptable because ASTM, U.S. EPA, and/or Canadian standard procedures were followed.
4. This table does not contain any acute values for salmonids because values for salmonids will not be used in Illinois criteria calculations.
5. See also: Academy of Natural Sciences (1960) and Patrick et al. (1968).
6. The test organisms were probably stressed, but the test demonstrates that this species is insensitive to sulfate.

Results of acceptable acute toxicity tests on sulfate. (2-8-06 DRAFT for review and comment) (SULFATE1.XLS)

Common Name	Scientific Name	Use Code	Acute Value (mg/L)	Chloride (mg/L)	Ca-Mg ratio (weight)	Hardness (mg/L)	Norm. A. V. (mg/L)	SMAV (mg/L)	GMAV (mg/L)	Reference	Comment

7. C. Stephan created this table by revising a table that was prepared by ADVENT.
8. Use Codes:
   a. Used quantitatively, i.e., used in the calculation of a SMAV. Hardness is known to be in the range of 87 to 500 mg/L, the concentration of chloride is known to be in the range of 25 to 526 mg/L, and the Ca-Mg ratio is known to be in the range of 1.7 to 2.9.
   b. Used qualitatively, i.e., used to demonstrate that the test organisms are not as sensitive to sulfate as the four most sensitive tested species.
   c. Not used.
   d. Used in the calculation of a SMAV even though the Ca-Mg ratio is 1.46.
9. Normalized Acute Values = Acute Values normalized to hardness = 300 mg/L and chloride = 75 mg/L. Only Acute Values with Use Codes a and d are normalized.
10. A SMAV is the geometric mean of the Normalized Acute Values that are given for the species.
11. The acute values from Mount et al. (1997) for C. dubia, D. magna, and the fathead minnow indicate the relative sensitivities of the three species to sulfate.