

APPENDIX C

Toxicity data provided by Elphick et al. (2011).

A) Test information

1) *Pimephales promelas*

Water type	Soft reconstituted	Moderately hard reconstituted	Hard reconstituted	Very Hard reconstituted
Hardness (mg/L CaCO ₃)	53	90	178	360
Alkalinity (mg/L CaCO ₃)	42	60	116	208
Temp (°C)	24 - 26	24 - 26	24 - 26	24 - 26
pH	7.1 - 8.0	7.1 - 8.1	7.7 - 8.2	7.9 - 8.5
Dissolved oxygen (mg/L)	5.0 - 8.2	4.7 - 8.2	5.4 - 8.4	5.2 - 8.4
Duration	7-d	7-d	7-d	7-d
Control Survival	97%	90%	97%	100%
Sulphate added (mg/L)	Measured start	Measured start	Measured start	Measured start
Control	37	74	130	300
78	120	150	170	350
156	170	250	280	420
313	270	420	420	560
625	610	760	720	820
1250	1300	1300	1300	1400
2500	2800	3000	2800	2900
5000	5000	5200	5500	5100

Measured end	Measured end	Measured end	Measured end	Measured end
Control	nt	nt	nt	nt
78	nt	nt	nt	nt
156	nt	nt	nt	nt
313	nt	nt	nt	nt
625	580	nt	nt	nt
1250	1200	1300	1300	nt
2500	2900	2700	2900	2900
5000	nt	5100	5500	5400

nt - not tested. Subsamples at end of exposure were only analyzed at concentrations bracketing the effect level

2) *Ceriodaphnia dubia*

Water type	Soft reconstituted	Moderately hard reconstituted	Hard reconstituted	Very Hard reconstituted
Hardness (mg/L CaCO ₃)	48	85	156	300
Alkalinity (mg/L CaCO ₃)	36	55	132	288
Temp (°C)	24.5 - 26	24.5-26	24.5 - 26	24.5 - 26
pH	7.3 - 8.1	7.7 - 8.1	7.5 - 8.2	7.5 - 8.4
Dissolved oxygen (mg/L)	7.1 - 8.2	6.7 - 8.4	6.7 - 8.2	7.3 - 8.3
Duration	6-d	6-d	6-d	6-d
Control Survival	100%	100%	100%	100%
Control reproduction	14.7	21.1	20.4	18.7

Sulphate added (mg/L)	Measured start	Measured start	Measured start	Measured start
Control	67	74	150	320
78	150	150	270	420
156	230	200	350	480
313	390	350	510	650
625	720	670	820	950
1250	1300	1300	1300	1400
2500	1800	2000	2600	2700
5000	3500	5200	4600	5000

	Measured end	Measured end	Measured end	Measured end
Control	nt	nt	nt	nt
78	nt	nt	nt	nt
156	190	nt	nt	nt
313	350	360	470	670
625	610	620	730	940
1250	nt	1200	1300	1500
2500	nt	nt	nt	nt
5000	nt	nt	nt	nt

nt - not tested. Subsamples at end of exposure were only analyzed at concentrations bracketing the effect level

3) *Pseudacris regilla*

Water type Dechlorinated
 tapwater

Hardness 7.6
Alkalinity 11
Temp 22-24
pH 6.8-7.5
Dissolved oxygen 5.7-8.6
Duration 21 days
Control Survival 100%

Added	Initiation	Midpoint 1	Midpoint 2	Termination
Control	1			
250	240	220	230	270
500	470	520	460	490
1000	1000	930	980	1000
2000	1800	1900	1800	1900

Water type	Reconstituted Moderately hard water
Hardness	96
Alkalinity	68
pH	7.3-8.1
Dissolved oxygen	5.6-8.8
Duration	21 days
Control Survival	95%

Added	Initiation	Midpoint 1	Midpoint 2	Termination
Control	94	89	94	93
250	333	330	340	350
500	590	600	600	610
1000	1100	1000	1100	1100
2000	1900	2000	1900	1900

4) Rainbow Trout

Water type	Dechlorinated tapwater
Hardness	12
Alkalinity	9
Temp	13.5 - 14.5
pH	7.1 - 7.3
Dissolved oxygen	10.1 - 10.5
Duration	31-d
Control Survival	95.7%

Sulphate added	Measured (start)	Measured (end)
Control	0.5	1.6
209	200	210
419	300	380
838	820	800
1675	1600	1500
3350	3500	not tested

5) Coho Salmon

Water type	Dechlorinated tap water
Hardness	11
Alkalinity	11
Temp	10-11
pH	6.9 - 7.4
Dissolved oxygen	10.8 - 11.3
Duration	10-d
Control Survival	97.5%

	Measured (start)	Measured (end)
Control	1	
209	190	200
419	350	450
838	790	860
1675	1400	1500
3350	3400	3600

6) *Hyalella azteca*

Water type	Reconstituted Moderately hard water
Hardness	89
Alkalinity	
Temp	22-24
pH	7.3-8.2
Dissolved oxygen	5.6-8.8
Duration	14 days

Control Survival Nominal	Measured			
	Day 0 (initiation)	Day 7- Old	Day 7- New	Day 14 (termination)
95%	66.5	56	67.3	74
Test Concs	365	447	371	394
Control	307	825	507	502
293	672	520	688	696
439	892	879	908	824
658	1490	1760	1590	1710
988	2220	2580	2340	2510
1481	4870	3770	3500	3870
2222	4240	5160	5070	5290
3333				
5000				

7) For *Brachionus* and *Pseudokirchneriella*, the test solutions were only measured at test initiation - in these tests, the test volume is too small to measure at the end of exposure.

B) Raw Data

1) *Ceriodaphnia dubia* 7-day survival and reproduction.

Test Date: 11/9/09 through 17/9/09

Water Type: Soft Water

Concentration (mg/L SO4)	Replicate	%		SD	Reproduction	Average	SD
		Survival	Survival				
Control	1	1	100	0.0000	20	14.7	4.9453
	2	1	100		13		
	3	1	100		17		
	4	1	100		8		

	5	1	100			20		
	6	1	100			12		
	7	1	100			21		
	8	1	100			7		
	9	1	100			16		
	10	1	100			13		
	1	1	100			10		
	2	1	100			15		
	3	1	100			13		
	4	1	100			12		
150	5	0	0	90	31.6228	3	10	3.8006
	6	1	100			9		
	7	1	100			5		
	8	1	100			8		
	9	1	100			13		
	10	1	100			12		
	1	1	100			6		
	2	1	100			3		
	3	1	100			12		
	4	1	100			7		
210	5	0	0	90	31.6228	3	8.9	5.0431
	6	1	100			15		
	7	1	100			17		
	8	1	100			12		
	9	1	100			10		
	10	1	100			4		
	1	1	100			11		
337	2	1	100	100	0.0000	18	10.3	3.7133
	3	1	100			4		

	4	1	100			13		
	5	1	100			7		
	6	1	100			11		
	7	1	100			8		
	8	1	100			11		
	9	1	100			10		
	10	1	100			10		
	1	1	100			7		
	2	1	100			8		
	3	1	100			2		
	4	1	100			8		
610	5	1	100	100	0.0000	6	5.5	4.0069
	6	1	100			13		
	7	1	100			6		
	8	1	100			5		
	9	1	100			0		
	10	1	100			0		
	1	0	0			0		
	2	0	0			0		
	3	1	100			0		
	4	0	0			0		
1300	5	0	0	10	31.6228	0	0	0.0000
	6	0	0			0		
	7	0	0			0		
	8	0	0			0		
	9	0	0			0		
	10	0	0			0		
1800	1	0	0	0	0.0000	0	0	0.0000
	2	0	0			0		

	3	0	0			0		
	4	0	0			0		
	5	0	0			0		
	6	0	0			0		
	7	0	0			0		
	8	0	0			0		
	9	0	0			0		
	10	0	0			0		
	1	0	0			0		
	2	0	0			0		
	3	0	0			0		
	4	0	0			0		
3500	5	0	0	0	0.0000	0	0	0.0000
	6	0	0			0		
	7	0	0			0		
	8	0	0			0		
	9	0	0			0		
	10	0	0			0		

Test Date: 2/10/09 through 8/10/09
Water Type: Moderately Hard Water

Concentration (mg/L SO4)	Replicate	Survival	% Survival	Average	SD	Reproduction	Average	SD
Control	1	1	100	100	0.0000	26	21.1	3.3813
	2	1	100			17		

	3	1	100			24		
	4	1	100			21		
	5	1	100			16		
	6	1	100			22		
	7	1	100			18		
	8	1	100			22		
	9	1	100			20		
	10	1	100			25		
	1	1	100			26		
	2	1	100			24		
	3	1	100			27		
	4	1	100			23		
150	5	1	100	100	0.0000	21	23.8	2.7406
	6	1	100			24		
	7	1	100			23		
	8	1	100			18		
	9	1	100			26		
	10	1	100			26		
	1	0	0			6		
	2	1	100			22		
	3	1	100			22		
	4	1	100			24		
200	5	1	100	90	31.6228	18	18.3	8.4728
	6	1	100			25		
	7	1	100			0		
	8	1	100			24		
	9	1	100			23		
	10	1	100			19		
355	1	1	100	90	31.6228	23	20.8	7.5689

	2	0	0			0		
	3	1	100			27		
	4	1	100			25		
	5	1	100			21		
	6	1	100			24		
	7	1	100			21		
	8	1	100			21		
	9	1	100			24		
	10	1	100			22		
	1	1	100			21		
	2	1	100			21		
	3	0	0			0		
	4	1	100			23		
645	5	1	100	90	31.6228	19	19.3	6.9450
	6	1	100			24		
	7	1	100			23		
	8	1	100			21		
	9	1	100			21		
	10	1	100			20		
	1	0	0			0		
	2	1	100			6		
	3	1	100			19		
	4	1	100			7		
1250	5	1	100	90	31.6228	2	8.4	5.3996
	6	1	100			7		
	7	1	100			9		
	8	1	100			12		
	9	1	100			12		
	10	1	100			10		

2000	1	0	0	0	0.0000	0	0	0.0000
	2	0	0					
	3	0	0					
	4	0	0					
	5	0	0					
	6	0	0					
	7	0	0					
	8	0	0					
	9	0	0					
	10	0	0					
5200	1	0	0	0	0.0000	0	0	0.0000
	2	0	0					
	3	0	0					
	4	0	0					
	5	0	0					
	6	0	0					
	7	0	0					
	8	0	0					
	9	0	0					
	10	0	0					

Test Date: 28/8/09 through 03/9/09

Water Type: Hard Water

Concentration (mg/L SO4)	Replicate	Survival	% Survival	Average	SD	Reproduction	Average	SD
150	1	1	100	100	0.0000	22	20.4	2.5906

	2	1	100			22		
	3	1	100			23		
	4	1	100			15		
	5	1	100			19		
	6	1	100			21		
	7	1	100			20		
	8	1	100			19		
	9	1	100			24		
	10	1	100			19		
	1	1	100			20		
	2	1	100			17		
	3	1	100			16		
	4	1	100			22		
270	5	1	100	100	0.0000	20	20	2.2111
	6	1	100			22		
	7	1	100			19		
	8	1	100			20		
	9	1	100			23		
	10	1	100			21		
	1	1	100			19		
	2	1	100			21		
	3	1	100			16		
	4	1	100			20		
350	5	1	100	100	0.0000	20	20	2.3094
	6	1	100			20		
	7	1	100			20		
	8	1	100			25		
	9	1	100			18		
	10	1	100			21		

490	1	1	100	100	0.0000	18	17	4.8534
	2	1	100			19		
	3	1	100			20		
	4	1	100			13		
	5	1	100			13		
	6	1	100			17		
	7	1	100			19		
	8	1	100			8		
	9	1	100			26		
	10	1	100			17		
775	1	1	100	90	31.6228	20	20.4	4.3256
	2	1	100			18		
	3	1	100			21		
	4	1	100			12		
	5	1	100			24		
	6	1	100			22		
	7	1	100			20		
	8	0	0			16		
	9	1	100			27		
	10	1	100			24		
1300	1	1	100	80	42.1637	0	5.3	3.4657
	2	1	100			6		
	3	1	100			13		
	4	1	100			8		
	5	1	100			5		
	6	1	100			3		
	7	1	100			4		
	8	1	100			5		
	9	0	0			6		

2600	10	0	0	0	0.0000	3	0	0.0000
	1	0	0			0		
	2	0	0			0		
	3	0	0			0		
	4	0	0			0		
	5	0	0			0		
	6	0	0			0		
	7	0	0			0		
	8	0	0			0		
	9	0	0			0		
4600	10	0	0	0	0.0000	0	0	0.0000
	1	0	0			0		
	2	0	0			0		
	3	0	0			0		
	4	0	0			0		
	5	0	0			0		
	6	0	0			0		
	7	0	0			0		
	8	0	0			0		
	9	0	0			0		

Test Date: 28/8/09 through 03/9/09

Water Type: Very Hard Water

Concentration (mg/L SO4)	Replicate	Survival	% Survival	Average	SD	Reproduction	Average	SD
Control	1	1	100	100	0.0000	19	18.7	2.6687

	2	1	100					18		
	3	1	100					19		
	4	1	100					15		
	5	1	100					21		
	6	1	100					16		
	7	1	100					22		
	8	1	100					22		
	9	1	100					20		
	10	1	100					15		
	1	1	100					16		
	2	1	100					12		
	3	1	100					11		
	4	1	100					7		
420	5	1	100	100	0.0000			18	14	4.7610
	6	1	100					16		
	7	1	100					19		
	8	1	100					19		
	9	1	100					16		
	10	1	100					6		
	1	1	100					12		
	2	1	100					13		
	3	1	100					16		
	4	1	100					9		
480	5	1	100	90	31.6228			14	12.4	5.5618
	6	0	0					0		
	7	1	100					8		
	8	1	100					19		
	9	1	100					16		
	10	1	100					17		

660	1	1	100	90	31.6228	3	12.1	6.8710
	2	1	100			8		
	3	1	100			13		
	4	1	100			15		
	5	1	100			5		
	6	1	100			15		
	7	0	0			4		
	8	1	100			18		
	9	1	100			16		
	10	1	100			24		
945	1	1	100	90	31.6228	2	8.6	5.8538
	2	1	100			5		
	3	0	0			0		
	4	1	100			11		
	5	1	100			8		
	6	1	100			6		
	7	1	100			19		
	8	1	100			16		
	9	1	100			10		
	10	1	100			9		
1450	1	0	0	80	42.1637	0	3	2.7487
	2	1	100			7		
	3	1	100			3		
	4	0	0			0		
	5	1	100			3		
	6	1	100			3		
	7	1	100			8		
	8	1	100			3		
	9	1	100			0		

	10	1	100			3		
	1	0	0			0		
	2	0	0			0		
	3	0	0			0		
	4	0	0			0		
2700	5	0	0	0	0.0000	0	0	0.0000
	6	0	0			0		
	7	0	0			0		
	8	0	0			0		
	9	0	0			0		
	10	0	0			0		
	1	0	0			0		
	2	0	0			0		
	3	0	0			0		
	4	0	0			0		
5000	5	0	0	0	0.0000	0	0	0.0000
	6	0	0			0		
	7	0	0			0		
	8	0	0			0		
	9	0	0			0		
	10	0	0			0		

2) Fathead Minnow 7-day survival and biomass

Test Date: 28/8/09 through 04/9/09

Water Type: Soft Water

Concentration (mg/L SO4)	Replicate	Survival	% Survival	Average	SD	Total Weight (mg)	Tare Weight (mg)	Biomass-mg	Average	SD
Control	1	9	90	96.66667	5.7735	1335.76	1329.8	0.596	0.619667	0.0218
	2	10	100			1346.16	1339.92	0.624		
	3	10	100			1346.13	1339.74	0.639		
120	1	10	100	96.66667	5.7735	1346.22	1339.47	0.675	0.634	0.0437
	2	9	90			1346.56	1340.68	0.588		
	3	10	100			1345.55	1339.16	0.639		
170	1	10	100	100	0.0000	1335.86	1329.45	0.641	0.655	0.0296
	2	10	100			1341.26	1334.91	0.635		
	3	10	100			1345.12	1338.23	0.689		
270	1	9	90	93.33333	5.7735	1342.36	1336.58	0.578	0.6	0.0322
	2	9	90			1340.12	1334.27	0.585		
	3	10	100			1347.77	1341.4	0.637		
595	1	8	80	83.33333	15.2753	1348.36	1342.1	0.626	0.566337	0.1042
	2	7	70			1348.54	1344.08	0.44601		
	3	10	100			1341.86	1335.59	0.627		
1250	1	6	60	63.33333	5.7735	1339.31	1337.18	0.213	0.294667	0.1221
	2	6	60			1335.14	1332.78	0.236		
	3	7	70			1341.38	1337.03	0.435		
2850	1	6	60	33.33333	25.1661	1338.17	1337.06	0.111	0.070329	0.0410
	2	1	10			1336.22	1335.93	0.028992		
	3	3	30			1335.85	1335.14	0.070996		
5000	1	0	0	3.333333	5.7735	0	0	0	0.013	0.0225
	2	0	0			0	0	0		
	3	1	10			1335.59	1335.2	0.039001		

Test Date: 28/8/09 through 04/9/09
Water Type: Moderately Hard Water

Concentration (mg/L SO4)	Replicate	Survival	% Survival	Average	SD	Total Weight (mg)	Tare Weight (mg)	Biomass- mg	Average	SD
Control	1	10	100	90	10.0000	1347.53	1340.83	0.67001	0.626663	0.0394
	2	9	90			1338.83	1332.66	0.61699		
	3	8	80			1340.61	1334.68	0.59299		
150	1	10	100	93.33333	5.7735	1349.71	1342.62	0.709	0.633997	0.0787
	2	9	90			1333.21	1327.69	0.552		
	3	9	90			1341.46	1335.05	0.64099		
250	1	6	60	86.66667	23.0940	1336.94	1332.83	0.411	0.565	0.1343
	2	10	100			1340.6	1334.02	0.658		
	3	10	100			1343.78	1337.52	0.626		
420	1	10	100	93.33333	5.7735	1343.41	1336.43	0.698	0.60533	0.0930
	2	9	90			1332.72	1326.66	0.60599		
	3	9	90			1346.35	1341.23	0.512		
760	1	10	100	100	0.0000	1346.64	1339.74	0.69	0.668663	0.0295
	2	10	100			1347.57	1341.22	0.635		
	3	10	100			1340.48	1333.67	0.68099		
1300	1	10	100	90	17.3205	1346.92	1341.5	0.542	0.538333	0.0736
	2	10	100			1346.6	1340.5	0.61		
	3	7	70			1345.24	1340.61	0.463		
2850	1	4	40	46.66667	5.7735	1344.03	1342.85	0.11801	0.245667	0.1110
	2	5	50			1345	1341.81	0.31899		
	3	5	50			1338.65	1335.65	0.3		
5150	1	0	0	3.333333	5.7735	0	0	0	0.007666	0.0133
	2	1	10			1335.34	1335.11	0.022998		
	3	0	0			0	0	0		

Test Date: 2/9/09 through 9/9/09

Water Type: Hard Water

Concentration (mg/L SO4)	Replicate	Survival	% Survival	Average	SD	Total Weight (mg)	Tare Weight (mg)	Biomass- mg	Average	SD
Control	1	9	90	96.6667	5.7735	1340.76	1334.56	0.62	0.613	0.0102
	2	10	100			1344.83	1338.82	0.601		
	3	10	100			1351.93	1345.76	0.617		
170	1	10	100	100	0.0000	1349.02	1342.96	0.60601	0.554	0.0609
	2	10	100			1348.28	1343.41	0.487		
	3	10	100			1354.29	1348.6	0.56901		
280	1	10	100	96.6667	5.7735	1351.69	1346.05	0.56399	0.552	0.0120
	2	10	100			1349.89	1344.49	0.54		
	3	9	90			1355.93	1350.41	0.552		
420	1	10	100	100	0.0000	1353	1347.86	0.514	0.517	0.0610
	2	10	100			1347.92	1342.13	0.579		
	3	10	100			1297.63	1293.06	0.45699		
720	1	9	90	93.3333	5.7735	1294.36	1288.93	0.54299	0.567	0.0219
	2	9	90			1293.76	1288.04	0.572		
	3	10	100			1298.05	1292.19	0.58601		
1300	1	10	100	96.6667	5.7735	1295.62	1289.48	0.614	0.527	0.0800
	2	10	100			1298.62	1294.05	0.45699		
	3	9	90			1291.03	1285.94	0.50901		
2850	1	10	100	93.3333	11.5470	1293.72	1288.69	0.503	0.453	0.0707
	2	10	100			1296.43	1292.4	0.403		
	3	8	80			1209.16	1285.51	--		
5500	1	2	20	23.3333	5.7735	1289.21	1288.46	0.075	0.089	0.0140
	2	3	30			1292.56	1291.68	0.088		
	3	2	20			1290.65	1289.62	0.103		

Test Date: 28/8/09 through 04/9/09

Water Type: Very Hard Water

Concentration (mg/L SO4)	Replicate	Survival	% Survival	Average	SD	Total Weight (mg)	Tare Weight (mg)	Biomass- mg	Average	SD
Control	1	10	100	100	0.0000	1296.24	1289.91	0.633	0.636	0.0187
	2	10	100			1296.83	1290.27	0.65599		
	3	10	100			1296.38	1290.19	0.61901		
350	1	9	90	93.3333	5.7735	1294.67	1290.04	0.463	0.5	0.0397
	2	10	100			1298.04	1293.09	0.49501		
	3	9	90			1288.58	1283.16	0.54199		
420	1	10	100	96.6667	5.7735	1297.61	1291.18	0.64299	0.556997	0.0995
	2	10	100			1292.68	1288.2	0.44801		
	3	9	90			1296.23	1290.43	0.57999		
560	1	10	100	96.6667	5.7735	1297.5	1291.25	0.625	0.536997	0.1234
	2	10	100			1295.83	1289.93	0.58999		
	3	9	90			1297.84	1293.88	0.396		
820	1	10	100	100	0.0000	1300.14	1293.86	0.628	0.610337	0.0155
	2	10	100			1301.06	1295.02	0.604		
	3	10	100			1293.93	1287.94	0.59901		
1400	1	10	100	96.6667	5.7735	1298.24	1292.87	0.537	0.494667	0.0608
	2	9	90			1288.47	1284.22	0.425		
	3	10	100			1295.23	1290.01	0.522		
2900	1	10	100	93.3333	11.5470	1294.92	1289.99	0.49301	0.439337	0.0732
	2	10	100			1294.99	1290.3	0.46899		
	3	8	80			1291.18	1287.62	0.35601		
5250	1	8	80	76.6667	5.7735	1297.03	1293.25	0.378	0.386	0.0139
	2	7	70			1291.93	1288.15	0.378		
	3	8	80			1293.03	1289.01	0.402		

3) *P. subcapitata* 72-h growth inhibition test

Test Date: 11/8/09 through 14/8/09

Water Type: Soft Water

Concentration (mg/L SO4)	Replicate	Cell Density	Average	SD
Control	1	26	25.625	4.6579
	2	28		
	3	22		
	4	30		
	5	16		
	6	26		
	7	27		
	8	30		
84	1	37	44.5	5.8023
	2	43		
	3	50		
	4	48		
150	1	42	42	6.3770
	2	38		
	3	51		
	4	37		
250	1	28	27.25	2.8723
	2	25		
	3	31		
	4	25		
530	1	26	25.25	6.7020
	2	34		
	3	23		
	4	18		
1100	1	19	19.5	3.1091
	2	18		

	3	24		
	4	17		
	1	3		
2000	2	5	4.25	2.9861
	3	8		
	4	1		
	1	0		
4600	2	0	0	0.0000
	3	0		
	4	0		

Test Date: 11/8 through 14/8/09
Water Type: Moderately Hard Water

Concentration (mg/L SO4)	Replicate	Cell Density	Average	SD
	1	26		
	2	26		
	3	28		
Control	4	29	27.25	4.2003
	5	26		
	6	19		
	7	33		
	8	31		
	1	27		
150	2	32	25.75	4.7871
	3	22		
	4	22		
	1	24		
200	2	19	19.25	3.3040
	3	17		
	4	17		
330	1	17	19.75	3.0957
	2	18		

	3	20		
	4	24		
	1	24		
610	2	20	18.75	4.2720
	3	14		
	4	17		
	1	28		
1200	2	19	26.25	6.8981
	3	23		
	4	35		
	1	15		
2700	2	9	14	4.1633
	3	13		
	4	19		
	1	0		
4800	2	0	0	0.0000
	3	0		
	4	0		

Test Date: 28/8/09 through 03/9/09

Water Type: Very Hard Water

Concentration (mg/L SO4)	Replicate	Cell Density	Average	SD
	1	46		
	2	37		
	3	34		
Control	4	42	37.25	4.6828
	5	35		
	6	34		
	7	32		
	8	38		
310	1	27	24.25	2.6300
	2	22		

	3	22		
	4	26		
	1	28		
390	2	26	25	2.5820
	3	22		
	4	24		
	1	31		
550	2	33	32.75	3.0957
	3	30		
	4	37		
	1	34		
780	2	32	45.25	14.6373
	3	53		
	4	62		
	1	54		
1300	2	43	47.5	9.7468
	3	36		
	4	57		
	1	20		
2800	2	17	16	3.3665
	3	12		
	4	15		
	1	0		
5000	2	0	0	0.0000
	3	0		
	4	0		

4) *B. calyciflorus* 48-h rotifer life cycle test.

Test Date: 30/9/09 through 03/10/09

Water Type: 40 mg/L Hardness (soft)

Concentration (mg/L SO4)	Replicate	Initial Density	Final Density	Average	SD	Growth Rate - R	Average	SD
-----------------------------	-----------	--------------------	------------------	---------	----	--------------------	---------	----

Control	1	1	1	6	4.7208	0	0.784823	0.5444
	2	1	0			1.2425		
	3	1	12			1.0397		
	4	1	8			1.1989		
	5	1	11			1.0397		
	6	1	8			0.97296		
	7	1	7			0		
	8	1	1			0.69315		
250	1	1	4	6.875	2.0310	0.97296	0.941468	0.1669
	2	1	7			1.0397		
	3	1	8			0.69315		
	4	1	4			1.0986		
	5	1	9			0.89588		
	6	1	6			1.0986		
	7	1	9			1.0397		
	8	1	8			0.97296		
500	1	1	7	8.125	2.4749	1.0397	1.023811	0.1717
	2	1	8			1.1989		
	3	1	11			1.1989		
	4	1	11			1.1513		
	5	1	10			0.89588		
	6	1	6			0.69315		
	7	1	4			1.0397		
	8	1	8			0.89588		
950	1	1	6	3.5	2.5635	0.54931	0.744222	0.1775
	2	1	3			0.54931		
	3	1	3			0.69315		
	4	1	4			0.80472		
	5	1	5			0.97296		
	6	1	7					
	7	1	0					
	8	1	0					
1800	1	1	1	0.125	0.3536	0	0	#DIV/0!
	2	1	0					

	3	1	0					
	4	1	0					
	5	1	0					
	6	1	0					
	7	1	0					
	8	1	0					
	1	1	1			0		
	2	1	0					
	3	1	0					
4000	4	1	0	0.125	0.3536			
	5	1	0			0	#DIV/0!	
	6	1	0					
	7	1	0					
	8	1	0					

Test Date: 30/9/09 through 3/10/09
Water Type: 80 mg/L Hardness (moderate)

Concentration (mg/L SO4)	Replicate	Initial Density	Final Density	Average	SD	Growth Rate - R	Average	SD
Control	1	1	8	7.875	3.3568	1.0397	1.095214	0.0621
	2	1	8			1.0397		
	3	1	11			1.1989		
	4	1	8			1.0397		
	5	1	0					
	6	1	9			1.0986		
	7	1	9			1.0986		
	8	1	10			1.1513		
280	1	1	2	7.125	2.9001	0.34657	0.92768	0.2781
	2	1	9			1.0986		
	3	1	4			0.69315		
	4	1	7			0.97296		
	5	1	11			1.1989		

	6	1	7			0.97296		
	7	1	9			1.0986		
	8	1	8			1.0397		
	1	1	11			1.1989		
	2	1	0					
	3	1	11			1.1989		
510	4	1	9	7	3.6645	1.0986	1.016929	0.1660
	5	1	7			0.97296		
	6	1	8			1.0397		
	7	1	5			0.80472		
	8	1	5			0.80472		
	1	1	7			0.97296		
	2	1	5			0.80472		
	3	1	2			0.34657		
960	4	1	10	5.625	2.8253	1.1513	0.798354	0.2859
	5	1	3			0.54931		
	6	1	3			0.54931		
	7	1	8			1.0397		
	8	1	7			0.97296		
	1	1	9			1.0986		
	2	1	6			0.89588		
	3	1	5			0.80472		
1800	4	1	6	5.25	2.5495	0.89588	0.882856	0.1220
	5	1	6			0.89588		
	6	1	6			0.89588		
	7	1	0					
	8	1	4			0.69315		
	1	1	1			0		
	2	1	0					
	3	1	0					
3200	4	1	0	0.125	0.0000		0	0.0000
	5	1	0					
	6	1	0					
	7	1	0					

8

1	0
---	---

Test Date: 17/11/09 through 20/11/09
Water Type: 160 mg/L Hardness (hard)

Concentration (mg/L SO4)	Replicate	Initial Density	Final Density	Average	SD	Growth Rate - R	Average	SD
Control	1	1	13	11	2.6726	1.2825	1.183773	0.1378
	2	1	6			0.89588		
	3	1	11			1.1989		
	4	1	15			1.354		
	5	1	9			1.0986		
	6	1	11			1.1989		
	7	1	12			1.2425		
	8	1	11			1.1989		
330	1	1	5	7.875	3.9438	0.80471	1.07817	0.1620
	2	1	11			1.1989		
	3	1	11			1.1989		
	4	1	0			0.89588		
	5	1	6			1.1989		
	6	1	11			1.1513		
	7	1	10			1.1513		
	8	1	9			1.0986		
560	1	1	10	9.625	0.7440	1.1513	1.1309	0.0379
	2	1	10			1.1513		
	3	1	9			1.0986		
	4	1	10			1.1513		
	5	1	9			1.0986		
	6	1	11			1.1989		
	7	1	9			1.0986		
	8	1	9			1.0986		
1100	1	1	7	7	1.1952	0.97296	0.966343	0.0879
	2	1	7			0.97296		

	3	1	9			1.0986		
	4	1	5			0.80472		
	5	1	8			1.0397		
	6	1	7			0.97296		
	7	1	6			0.89588		
	8	1	7			0.97296		
	1	1	4			0.69315		
	2	1	6			0.89588		
	3	1	4			0.69315		
1800	4	1	2	4.625	1.9226	0.34657	0.725849	0.2186
	5	1	4			0.69315		
	6	1	3			0.54931		
	7	1	6			0.89588		
	8	1	8			1.0397		
	1	1	0					
	2	1	0					
	3	1	0					
4000	4	1	0	0	0.0000		#DIV/0!	#DIV/0!
	5	1	0					
	6	1	0					
	7	1	0					
	8	1	0					

Test Date: 17/11/09 through 20/11/09

Water Type: 320 mg/L Hardness (very hard)

Concentration (mg/L SO4)	Replicate	Initial Density	Final Density	Average	SD	Growth Rate - R	Average	SD
Control	1	1	6	5	2.3299	0.89588	0.857381	0.1389
	2	1	6			0.89588		
	3	1	6			0.89588		
	4	1	0					
	5	1	7			0.97296		

500	6	1	6	7.75	1.5811	0.89588	1.014443	0.1044
	7	1	3			0.54931		
	8	1	6			0.89588		
	1	1	9			1.0986		
	2	1	10			1.1513		
	3	1	8			1.0397		
	4	1	9			1.0986		
	5	1	6			0.89588		
740	6	1	8	6.625	3.2923	1.0397	0.996197	0.1367
	7	1	6			0.89588		
	8	1	6			0.89588		
	1	1	9			1.0986		
	2	1	8			1.0397		
	3	1	11			1.1989		
	4	1	6			0.89588		
	5	1	8			1.0397		
1200	6	1	0	3	2.6186	0.89588	0.603687	0.3621
	7	1	6			0.80472		
	8	1	5			0.80472		
	1	1	5			0.80472		
	2	1	4			0.69315		
	3	1	7			0.97296		
	4	1	0			0.80472		
	5	1	5			0		
1800	6	1	1	2	2.8785	0.34657	0.553853	0.4627
	7	1	0			0.34657		
	8	1	2			0		
	1	1	2			0		
	2	1	0			0.97296		
	3	1	1			0.89588		
	4	1	0					
5	1	7						
6	1	6						
7	1	0						

4600	8	1	0	0	0.0000	#DIV/0!	#DIV/0!
	1	1	0				
	2	1	0				
	3	1	0				
	4	1	0				
	5	1	0				
	6	1	0				
	7	1	0				
8	1	0					

5) *P. regilla* 28-day survival and growth

	Conc- mg/L	Total Weight- mg	28d Survival
Moderately Hard water	93	486.82	4
	93	558	4
	93	619.94	5
	338	791.22	5
	338	473.59	4
	338	569.19	4
	600	584.21	4
	600	749.25	4
	600	739.95	5
	1075	524.28	3
	1075	769.67	5
	1075	563.6	3
	1925	0	0
	1925	202.81	2
	1925	0	1

	Conc- mg/L	28d Survival	Total Weight- mg
Very soft water Vancouver municipal tapwater (dechlorinated)	1	5	709.95
	1	5	764.03
	1	5	755.58
	240	5	805.88
	240	5	877.99
	240	5	811.44
	485	4	600.56
	485	5	814.14
	485	5	894.9
	978	3	750.55
	978	5	883.73
	978	5	741.02
	1850	3	558.87
	1850	2	353.18
	1850	3	238.19

C) Summary table taken from Elphick et al. (2011).

Table 3. Responses of various aquatic organisms to waterborne sulfate, at different hardness levels^a

Species	Endpoint	Hardness	EC10 or IC10 ^b	EC25 or IC25	EC50 or IC50	NOEC	LOEC
<i>Ceriodaphnia dubia</i>	Survival	40	NC ^c	NC	914 (809–1,030)	610	1,300
		80	NC	NC	1,267 (1,026–1,566)	1,250	2,000
		160	NC	NC	1,551 (1,297–1,855)	1,300	2,600
		320	NC	NC	1,619 (1,364–1,920)	1,450	2,700
	Reproduction	40	137 (71–204)	246 (172–326)	465 (358–592)	<150	150
		80	622 (NC–813)	855 (601–1,036)	1,129 (990–1,269)	645	1,250
		160	1,174 (1,153–1,188)	1,212 (1,206–1,219)	1,257 (1,248–1,267)	775	1,300
<i>Brachionus calyciflorus</i>	Reproduction	320	402 (331–481)	542 (455–640)	843 (710–1,003)	420	480
		40	703 (158–1,013)	997 (739–1,115)	1,214 (1,083–1,308)	950	1,800
		80	245 (148–744)	1,824 (721–1,921)	2,200 (2,089–2,277)	510	960
		160	678 (258–1,059)	1,292 (1,078–1,766)	>1,800	560	1,100
		320	844 (795–1,174)	1,027 (900–NC)	>1,800	1,800	>1,800
<i>Hyalella azteca</i>	Survival	80	2069 (NC)	2,246 (NC)	2461 (NC)	1,637	2,412
	Reproduction	80	380 (NC–626)	1,056 (NC)	>2,412	1,637	2,412
<i>Oncorhynchus kisutch</i>	Embryo	15	941 (803–1,062)	1,264 (1,128–1,391)	1,755 (1,607–1,921)	825	1,450
<i>Oncorhynchus mykiss</i>	Embryo-alevin	15	356 (256–433)	501 (407–582)	734 (640–823)	205	340
<i>Pimephales promelas</i>	Survival	40	559 (293–805)	933 (601–1,230)	1,649 (1,255–2,097)	595	1,250
		80	1,555 (869–2,032)	2,183 (1,499–2,634)	2,938 (2,359–3,385)	1,300	2,850
		160	3,231 (2,084–3,840)	3,801 (2,817–4,356)	4,553 (3,827–5,157)	2,850	5,500
		320	2,451 (1,129–> 5,250)	>5,250	>5,250	2,900	5,250
	Biomass	40	388 (187–553)	752 (537–943)	1,244 (1,047–1,449)	595	1,250
<i>Pseudacris regilla</i>	Survival	80	1,342 (NC–1,926)	1,950 (915–2,485)	2,591 (2,211–2,975)	760	1,300
		160	2,491 (NC–2,934)	3,077 (2,525–3,541)	3,892 (3,445–4,397)	1,300	2,850
		320	1,323 (297–2,656)	3,463 (1,953–5,473)	>5,250	820	1,400
	Growth	15	719 (234–1,041)	1,190 (750–2,002)	>1,850	978	1,850
		80	985 (146–1,302)	1,205 (363–1,510)	1,507 (907–1,963)	1,075	1,925
<i>Pseudokirchneriella subcapitata</i>	Cell yield	15	1,342 (NC–1,905)	1,560 (NC–2,079)	1,853 (1,646–2,082)	978	1,950
		80	1,252 (NC–1,492)	1,348 (NC–1,649)	1,510 (1,217–2,167)	1,075	1,925
		10	700 (NC–1,256)	1,112 (262–1,325)	1,430 (1,206–1,637)	1,100	2,000
		80	1,345 (NC–1,532)	1,763 (936–2,170)	2,742 (1,871–3,221)	1,200	2,700
<i>Fontinalis antipyretica</i>	Chlorophyll	320	1,377 (NC–1,582)	1,727 (1,371–1,983)	2,518 (2,093–3,007)	1,300	2,800
		15 (test 1)	53 (NC–261)	176 (NC–320)	298 (158–1,014)	145	300
		15 (test 2)	716 (680–750)	820 (777–920)	1,029 (931–1,288)	654	1,240
	Growth	15 (test 1)	531 (243–818)	849 (600–1,034)	>2,575	603	1,250
		15 (test 2)	297 (NC–1,025)	828 (335–1,040)	>2,522	654	1,240

^a Responses are presented on the basis of 10th, 25th and 50th percentile effect concentration (ECx) or inhibition concentration (ICx), as well as no observed effect concentration (NOEC) and lowest observed effect concentration (LOEC).

^b IC10 and EC10 values were not considered sufficiently robust for use in guideline calculation in cases in which they were lower than the NOEC.

^c NC = Not calculable.