STUDY TITLE

Comments on Draft Water Quality Criteria Report for Permethrin Issued by the California Regional Water Quality Control Board, Central Valley

DATA REQUIREMENTS

None

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Executive Summary

A draft water quality criteria report for the pyrethroid insecticide permethrin has been issued by the University of California, Davis (UCD) and is being circulated for public comment. Compliance Services International (CSI), Lakewood WA, developed the comments presented herein on behalf of FMC Corporation, the registrant for permethrin. These comments address two main areas: data selection for derivation of Acute and Chronic Criteria, and bioavailability.

The data selected by UCD for derivation of the Acute Criterion for permethrin omitted one Relevant and Reliable study. Inclusion of this study resulted in a recalculated Acute Criterion of 11 ng/L. (UCD's proposed Acute Criterion is 10 ng/L.)

Due to limited data available on chronic toxicity, UCD used an Acute-to-Chronic Ratio (ACR) approach to derive the Chronic Criterion for permethrin. The ACR used by UCD was based on two default ACRs. However, using acceptable acute and chronic toxicity data, CSI calculated ACRs for 3 species ranging from 4.69 to 9.77. Based on the geometric mean of all of the ACRs, the recalculated Chronic Criterion is 3 ng/L. (UCD's proposed Chronic Criterion was 2 ng/L.)

Pyrethroids that are bound to particulate matter or associated with dissolved organic matter are not biologically available to aquatic organisms and do not contribute to toxicity; only freely dissolved pyrethroids are bioavailable and toxic. In laboratory toxicity tests using water with minimal particulate or dissolved organic matter, nearly all the pyrethroid is bioavailable. In ambient water, only a small fraction – a few percent or less – of the total pyrethroid may be bioavailable. To be consistent with the underlying data, compliance with permethrin water quality standards should therefore be based on concentrations of freely dissolved permethrin, not total permethrin. Freely dissolved permethrin can be measured directly using solid phase microextraction (SPME) or calculated using an equilibrium partitioning model. Any water quality program should measure or estimate freely dissolved permethrin concentrations to ensure appropriate comparison to concentrations calculated as Acute or Chronic Criteria.

1. Introduction

As part of the Central Valley Pesticide TMDL and Basin Plan Amendment Project, draft water quality criteria for the pyrethroid insecticide permethrin have been derived by the University of California, Davis (Fojut *et al*. 2011) and are being circulated for public comment. Compliance Services International (CSI), Lakewood WA, developed the comments presented below on behalf of FMC Corporation, the registrant for permethrin.

2. Derivation of Acute Criterion

UCD's draft Acute Criterion is based on data for 19 freshwater species, presented in Table 3 of their report. Toxicity values for one of these species require correction, as discussed below. The aquatic toxicity data used by UCD and those proposed by CSI are summarized in Table 1. Evaluation forms for an additional study rated by CSI are presented in Appendix A.

CSI reviewed UCD's acute toxicity study evaluations and data selection, and confirmed all 19 points with the exception of *Daphnia magna*. UCD used the *D. magna* 48-h EC50 of 0.32 µg/L (LeBlanc 1976). Results are also available from one other study (Surprenant 1979) which CSI rated "Relevant and Reliable" (RR), a 48-h LC50 value of 0.92 µg/L. Both LeBlanc (1976) and Surprenant (1979) were 48-h static tests with nominal concentrations. The geomean of the two available endpoints (0.54 µg/L) is the appropriate value to use for this species in deriving an Acute Criterion for permethrin.

The UCD report stated that the BurrliOZ software program (CSIRO 2000) was used to fit the data set to a Burr III distribution. UCD reported a median HC5 of 0.020008 µg/L (20 ng/L). Using the same software and the data shown in UCD's Table 3, CSI obtained a virtually identical median HC5 value. This result corresponds to an Acute Criterion (HC5 divided by 2, reported with one significant digit) of 10 ng/L. With the revised value for *D. magna*, CSI calculated the median HC5 as 0.022213 µg/L (22 ng/L). The revised Acute Criterion is 11 ng/L.

3. Derivation of Chronic Criterion

UCD's draft permethrin criteria document discussed chronic toxicity data for *Brachycentrus americanus* (caddisfly)*, D. magna*, and *Pimephales promelas* (Table 1). CSI agrees with the Maximum Acceptable Toxicant Concentrations (MATCs) presented for *D. magna* and *P. promelas* and does not recommend changes for those species. However, we believe the data for *B. americanus* should be reconsidered. As the chronic toxicity value for *B. americanus,* UCD used a 48-h EC50 based on behavior from a study by Anderson (1982). While the study is rated RR, this EC50 is not an appropriate chronic endpoint for two reasons: first, it was based on an acute exposure (i.e., an insect test with exposures lasting 24-96 h); second, this behavior endpoint was not linked to survival, growth, or reproduction (TenBrook *et al*. 2009). A 21-d LC50 of 0.17 µg/L is available from this study, but NOEC, LOEC, and MATC values were not reported and raw data were not available to calculate these values using appropriate statistical methods.

Derivation of a chronic criterion using the SSD approach would have required, in addition to the species listed above, data on chronic toxicity to the family Salmonidae, a benthic crustacean, and an aquatic

insect. Because chronic toxicity data for these groups were not available, UCD applied an Acute-to-Chronic Ratio (ACR) approach instead (TenBrook *et al*. 2009).

To derive a Chronic Criterion using the ACR approach, ACRs are required for three species, including a fish and an invertebrate. The UCD methodology is unclear about the requirements for ACR calculation. At first, the methodology states that the acute and chronic data used to calculate an ACR must come from the same study in the same dilution water, but then this requirement is relaxed to allow a different study in the same laboratory under identical conditions, or even in a different laboratory – in other words, only the dilution water must be the same. The rationale for this requirement is unclear, since toxicity values are not presumed to be strongly affected by the source of dilution water.

According to UCD's draft criteria report for permethrin, there were no appropriate acute data to pair with any of the available chronic freshwater data. UCD paired one saltwater chronic toxicity value with an appropriate corresponding acute toxicity value to calculate an ACR for *Americamysis bahia*, satisfying one of the three family requirements: an invertebrate. The ACR for *A. bahia* was based on studies by Thompson (1986) and Thompson *et al*. (1989). Both of these studies were rated as "Less Relevant, Reliable" (LR) by UCD, but would have been rated RR had they been freshwater tests. To calculate the ACR, UCD selected a 96-h LC50 for 3- to 5-d shrimp (Thompson 1986) and a 30-d MATC for nauplii survival (Thompson *et al*. 1989). The LC50 selected was the most sensitive acute endpoint available and the MATC selected was the only one that could be calculated from that test. Therefore, the ACR generated by UCD for *A. bahia* is reliable.

However, UCD lacked an ACR value for one fish and one acutely sensitive freshwater species as required to derive a multispecies ACR based on measured data for 3 species. According to the UCD methodology (TenBrook *et al*. 2009), if there are empirical ACRs for fewer than 3 species, a default ACR of 12.4 is used for one or more of three ACR values. The default ACR is the 80th percentile value derived from ACRs for 8 insecticides (chlordane, chlorpyrifos, diazinon, dieldrin, endosulfan, endrin, lindane, and parathion). TenBrook *et al*. (2009) do not explain why these insecticides should be considered representative of pesticides from different chemical groups, or why the 80th percentile should be used as the basis for a default ACR. For permethrin, UCD used the default value for the second and third ACRs along with the calculated ACR for *A. bahia* to derive a multi-species ACR (geomean of the three values) of 8.97.

Although valid acute and chronic data were available for *P. promelas*, the methodology's restrictive requirements for ACR calculation prevented UCD from developing an ACR for this species. However, as shown in Table 1, the Species Mean Acute Value (SMAV) for *P. promelas* of 9.38 µg/L is based upon three relevant and reliable studies (Dwyer *et al*. 1995, 2005; Sappington *et al*. 2001). The MATC available for *P. promelas* (0.96 µg/L) from Spehar *et al*. (1983) is also relevant and reliable. Together, these acute and chronic results support an ACR of 9.77 for *P. promelas.* This empirical value, based on valid acute and chronic endpoints for *P. promelas* and permethrin, is more reliable than the default ACR derived from data for other insecticides.

In the same way, reliable acute and chronic data are also available for *D. magna*. There are two reliable acute values: 0.32 µg/L (LeBlanc 1976) and 0.92 µg/L (Surprenant 1979), with a geometric mean of 0.54 µg/L. There is also a reliable chronic MATC of 0.057 µg/L (Kent *et al*. 1995). These results support an empirical ACR of 9.47 for *D. magna* that is more reliable than the default ACR.

The appropriate ACRs for permethrin are summarized in Table 2. Since no major trend is apparent and the ACRs for all species are within a factor of 10, the multi-species ACR can be calculated as the geometric mean of all of the ACRs (TenBrook *et al*. 2009), which is 7.57.

As discussed in Section 2, the acute toxicity value (HC5) derived based on CSI's revised dataset is 0.022213 µg/L. Applying the multi-species ACR of 7.57 to the acute HC5, the calculated Chronic Criterion is 0.0029 µg/L, or 3 ng/L.

4. Bioavailability of Permethrin

The draft criteria report summarizes evidence that pyrethroids bound to particulate matter are not biologically available to aquatic organisms and do not contribute to toxicity; only freely dissolved pyrethroids are bioavailable and toxic. Bound pyrethroids become bioavailable only when they desorb from particles or dissociate from dissolved organic matter.

"As a counterpoint" to the evidence relating permethrin toxicity to the freely dissolved fraction, the draft criteria report notes (p. 9) that "equilibrium partitioning would suggest that as organisms take up permethrin, more permethrin will desorb from particles, so the fraction absorbed to solids is likely not completely unavailable." This is not a logical inference. In the equilibrium partitioning model, the flux of permethrin between phases (freely dissolved, associated with dissolved organic matter, and sorbed to particulate organic matter) is such that concentrations in each phase are constant – fluxes into each phase (e.g., desorption from particles as an input to the freely dissolved phase) are balanced by fluxes in the opposite direction (e.g., sorption of freely dissolved permethrin to particles). The fact that permethrin molecules can move from one phase to the other does not "counter" the evidence that permethrin molecules are bioavailable only when freely dissolved.

The draft criteria report notes the possibility that pyrethroids can be taken up from ingested particles, citing the findings of Mayer *et al*. (2001) as evidence that hydrophobic compounds can be desorbed by digestive juices. The cited study involved uptake of benzo(a)pyrene and zinc by 18 species of benthic marine invertebrates, including 10 species of worms, 5 species of echinoderms, 2 species of mollusks, and a sea anemone. The relevance of these findings to uptake of pyrethroids by sensitive freshwater taxa (such as insects and crustaceans) is unclear. There is no evidence for uptake of pyrethroids by this route, and the UCD report in fact summarizes the evidence to the contrary.

TenBrook *et al*. (2009, Section 3-5.1) state that when a pesticide has only a single bioavailable phase (sorbed to solids, associated with dissolved organic matter, or freely dissolved in water), it is appropriate to evaluate compliance with water quality standards based on concentrations in the bioavailable phase alone. This is the case for permethrin and other pyrethroids, of which only the freely dissolved phase is bioavailable.

Pyrethroid concentrations in the freely dissolved phase can be measured using techniques such as solid-phase microextraction (SPME) or calculated based on partitioning coefficients (Equation 3.6, TenBrook *et al*. 2009, presented as Equation 1 in the draft criteria document for permethrin). UCD notes that Equation 1 should not be used unless site-specific data are available for all the terms in the equation. These terms include SS, the concentration of suspended solids in the water, and f_{oc}, the fraction of organic carbon in the suspended sediment. While f_{oc} of suspended sediment is not usually measured directly, the term $[SS]/f_{oc}$ in Equation 1 is equivalent to the concentration of particulate organic carbon

(POC), which can be readily determined as the difference between total organic carbon (TOC) and dissolved organic carbon (DOC). Thus, the site-specific data needed for Equation 1 are the total concentration of permethrin in water, the concentration of DOC, and the concentration of POC. Values for the other terms in Equation 1, K_{OC} and K_{DOC}, are available in the literature. The suggestion by TenBrook *et al.* (2009) that site-specific K_{OC} and K_{DOC} values must be available is unreasonable: it would prevent all use of the model, because such data are virtually non-existent for any chemical.

5. Conclusions

- The data selected by UCD for derivation of the Acute Criterion for permethrin overlooked one Relevant and Reliable study. Inclusion of this study resulted in a recalculated Acute Criterion of 11 ng/L. (UCD's recommended Acute Criterion was 10 ng/L.)

- Due to limited data available on chronic toxicity, an ACR approach was used to derive the Chronic Criterion for permethrin. The multi-species ACR used by UCD was based on two default ACRs along with an empirical ACR for *Americamysis bahia*. Using acceptable acute and chronic toxicity data, CSI calculated ACRs for two additional species, *D. magna* and *P. promelas*. Based on the geometric mean of the three ACRs, the recalculated Chronic Criterion is 3 ng/L. (UCD's proposed Chronic Criterion was 2 ng/L.)

- Pyrethroids bound to particulate matter or associated with dissolved organic matter are not biologically available to aquatic organisms and do not contribute to toxicity; only freely dissolved pyrethroids are bioavailable and toxic. In laboratory toxicity tests using water with minimal particulate or dissolved organic matter, nearly all the pyrethroid is bioavailable. In ambient water, only a small fraction – a few percent or less – of the total pyrethroid may be bioavailable. For consistency with the underlying data, compliance with permethrin water quality standards should therefore be based on concentrations of freely dissolved permethrin, not total permethrin. Freely dissolved permethrin can be measured directly using SPME or estimated using an equilibrium partitioning model such as the one presented by TenBrook *et al*. (2009).

6. References

Anderson RL. 1982. Toxicity of fenvalerate and permethrin to several nontarget aquatic invertebrates. *Environ Entomol* 11:1251-1257.

Anderson BS, Phillips BM, Hunt JW, Connor V, Richard N, Tjeerdema RS. 2006. Identifying primary stressors impacting macroinvertebrates in the Salinas River (CA, USA): Relative effects of pesticides and suspended particles. *Environ Poll* 141:402-408.

Buccafusco RJ. 1976a. Acute toxicity of PP-557 technical to channel catfish (*Ictalurus punctatus*). EG&G Bionomics: Wareham, MA. CDPR ID: study number 15147.

Buccafusco RJ. 1976b. Acute toxicity of PP-557 technical to Atlantic salmon (*Salmo salar*). EG&G Bionomics: Wareham, MA. CDPR ID: 00083085, study number 15150.

Buccafusco RJ. 1977. Acute toxicity of permethrin technical (PP 557) to crayfish (*Procambarus blandingi*). EG&G Bionomics: Wareham, MA. CDPR ID: study number 15140.

CSIRO. 2000. BurrliOZ v. 1.0.13: Commonwealth Scientific and Industrial Research Organization, Australia.

Dwyer FJ, Sappington LC, Buckler DR, Jones SB. 1995. Use of a surrogate species in assessing contaminant risk to endangered and threatened fishes. Final report – September, 1995. EPA/600/R-96/029.

Dwyer FJ, Hardesty DK, Henke CE, Ingersoll CG, Whites DW, Mount DR, Bridges CM. 1999. Assessing contaminant sensitivity of endangered and threatened species: toxicant classes. EPA/600/R-99/098.

Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: Part I. Acute toxicity of five chemicals. *Arch Environ Contam Toxicol* 48:143-154.

Fojut TL, Rering C, Tjeerdema RS. 2011. Draft water quality criteria report for permethrin. Phase III: Application of the pesticide water quality criteria methodology. U. California, Davis.

Harwood AD, You J, Lydy MJ. 2009. Temperature as a toxicity identification evaluation tool for pyrethroid insecticides: Toxicokinetic confirmation. *Environ Toxicol Contam* 28:1051-1058.

Holcombe GW, Phipps GL, Tanner DK. 1982. The acute toxicity of Kelthane, Dursban, disulfoton, Pydrin, and permethrin to fathead minnows *Pimephales promelas* and rainbow trout *Salmo gairdneri. Environ Poll A* 29:167-178.

Kent SJ, Williams NJ, Gillings E, Morris DS. 1995. Permethrin: chronic toxicity to *Daphnia magna*. Zeneca Brixham Environmental Laboratory: Brixham, UK. Laboratory project ID BL5443/B. EPA MRID 43745701.

LeBlanc GA. 1976. Acute toxicity of FMC-33297 technical to *Daphnia magna*. EG&G, Bionomics: Wareham, MA. CDPR ID: study number 15100.

Mayer LM, Weston DP, Bock MJ. 2001. Benzo[a]pyrene and zinc solubilization by digestive fluids of benthic invertebrates - A cross-phyletic study. *Environ Toxicol Chem* 20:1890-1900.

Paul EA, Simonin HA. 2006. Toxicity of three mosquito insecticides to crayfish. *Bull Environ Contam Toxicol* 76:614-621.

Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. *Environ Toxicol Chem* 20:2869-2876.

Spehar RL, Tanner DK, Nordling Br. 1983. Toxicity of the synthetic pyrethroids, permethrin and AC 222, 705 and their accumulation in early life stages of fathead minnows and snails. *Aquat Toxicol* 3:171-182.

Surprenant DC. 1979. Acute toxicity of FMC 33297 to the water flea (*Daphnia magna*). EG&G Bionomics Report BW-79-12-547.

TenBrook PL, Palumbo AJ, Fojut TL, Tjeerdema RS, Hann P, Karkoski J. 2009. Methodology for derivation of pesticide water quality criteria for the protection of aquatic life in the Sacramento and San Joaquin River Basins. Phase II: methodology development and derivation of chlorpyrifos criteria. Report prepared for the Central Valley Regional Water Quality Control Board, Rancho Cordova, CA.

Thompson RS. 1986. Supplemental data in support of MRID 42584001. Permethrin: Determination of acute toxicity to mysid shrimps (*Mysidopsis bahia*). Laboratory project ID BL/B/2921. Brixham study no P131/B. Study performed by Brixham Environmental Laboratory: Devon, UK. EPA MRID 43492902.

Thompson RS, Williams TD, Tapp JF. 1989. Permethrin: Determination of chronic toxicity to mysid shrimps (*Mysidopsis bahia*) (Run 2). Laboratory project ID: BL/B/3574. Study performed by Imperial Chemical Industries PLC Brixham Laboratory Freshwater Quarry: Brixham, Devon, UK. EPA MRID 41315701.

Wheelock CE, Miller JL, Miller MJ, Gee SJ, Shan G, Hammock BD. 2004. Development of toxicity identification evaluation procedures for pyrethroid detection using esterase activity. *Environ Toxicol Chem* 23:2699-2708.

Yang WC, Hunter W, Spurlock F, Gan J. 2007. Bioavailability of permethrin and cyfluthrin in surface waters with low levels of dissolved organic matter. *J Environ Qual* 36:1678-1685.

Zhang Z-Y, Yu X-Y, Wang D-L, Yan H-J, Liu X-J. 2010. Acute toxicity to zebrafish of two organophosphates and four pyrethroids and their binary mixtures. *Pest Manag Sci* 66:84-89.

Table 1. Summary of permethrin aquatic toxicity data endpoints used to derive criteria.

Species	Endpoint	UCD Conc (µg/L)	Reference	CSI Proposed	Reference
ACUTE TOXICITY					
Ceriodaphnia dubia	48/96h LC50	0.664	Geomean: Wheelock *et al*. 2004, Yang *et al*. 2007	0.664	Geomean: Wheelock *et al*. 2004, Yang *et al*. 2007
Chironomus dilutus	96h LC50	0.189	Harwood *et al*. 2009	0.189	Harwood *et al*. 2009
Danio rerio	*96h LC50*	2.5	Zhang *et al*. 2010	2.5	Zhang *et al*. 2010
Daphnia magna	48h EC50	0.32	LeBlanc 1976	0.54	Geomean: LeBlanc 1976, Surprenant 1979
Erimonax monachus	96h LC50	1.7	Dwyer *et al*. 2005	1.7	Dwyer *et al*. 2005
Etheostoma fonticola	96h LC50	3.34	Dwyer *et al*. 1999, 2005	3.34	Dwyer *et al*. 1999, 2005
Etheostoma lepidum	96h LC50	2.71	Dwyer *et al*. 1999, 2005	2.71	Dwyer *et al*. 1999, 2005
Hyalella azteca	96h LC50	0.0211	Anderson *et al*. 2006	0.0211	Anderson *et al*. 2006
Ictalurus punctatus	*96h LC50*	5.4	Buccafusco 1976a	5.4	Buccafusco 1976a
Notropis mekistocholas	96h LC50	4.16	Dwyer *et al*. 2005	4.16	Dwyer *et al*. 2005
Oncorhynchus apache	96h LC50	1.71	Dwyer *et al*. 1995, 2005, Sappington *et al*. 2001	1.71	Dwyer *et al*. 1995, 2005, Sappington *et al*. 2001
Oncorhynchus clarki henshawi	96h LC50	1.58	Dwyer *et al*. 1995, 2005, Sappington *et al*. 2001	1.58	Dwyer *et al*. 1995, 2005, Sappington *et al*. 2001
Oncorhynchus mykiss	96h LC50	7.0	Holcombe *et al*. 1982	7.0	Holcombe *et al*. 1982
Orconectes immunis	96h LC50	0.21	Paul and Simonin 2006	0.21	Paul and Simonin 2006
PImephales promelas	96h LC50	9.38	Dwyer *et al*. 1995, 2005, Sappington *et al*. 2001	9.38	Dwyer *et al*. 1995, 2005, Sappington *et al*. 2001
Procambarus blandingi	96h LC50	0.21	Buccafusco 1977	0.21	Buccafusco 1977
Procloeon sp.	48h LC50	0.0896	Anderson *et al*. 2006	0.0896	Anderson *et al*. 2006
Salmo salar	96h LC50	1.5	Buccafusco 1976b	1.5	Buccafusco 1976b
Xyrauchen texanus	96h LC50	5.95	Dwyer *et al*. 1995, 2005, Sappington *et al*. 2001	5.95	Dwyer *et al*. 1995, 2005, Sappington *et al*. 2001

Species	**Endpoint**	**UCD Conc (µg/L)**	**Reference**	**CSI Proposed**	**Reference**
CHRONIC TOXICITY					
Americamysis bahia	30d MATC	0.016	Thompson *et al*. 1989	0.016	Thompson *et al*. 1989
Brachycentrus americanus	48h EC50	0.064	Anderson 1982	No valid MATC	—
Daphnia magna	21d MATC	0.057	Geomean: Two endpoints from same test, Kent *et al*. 1995	0.057	Kent *et al*. 1995
Pimephales promelas	32d MATC	0.96	Spehar *et al*. 1983	0.96	Spehar *et al*. 1983

Table 2. Revised Acute-to-Chronic Ratios (ACRs) for derivation of the permethrin chronic criterion.

Species	MATC (µg/L)	Ref	SMAV (µg/L)	Ref	ACR
Americamysis bahia	0.016	Thompson *et al*. 1989	0.075	Thompson 1986	4.69
Daphnia magna	0.057	Kent *et al*. 1995	0.54	Geomean: LeBlanc 1976, Suprenant 1979	9.47
Pimephales promelas	0.96	Spehar *et al*. 1983	9.38	Dwyer *et al*. 1995, 2005, Sappington *et al*. 2001	9.77

Appendix A. Study Evaluation Forms

Surprenant 1979

Toxicity Data Summary **Relevance: 90** **Reliability: 85.5**

	Surprenant 1979	***Daphnia magna***
Parameter	**Value**	**Comment**
Test method cited	NR	
Phylum	Arthropoda	
Class	Branchiopoda	
Order	Cladocera	
Family	Daphniidae	
Genus	*Daphnia*	
Species	*magna*	
Family in North America?	Yes	
Age/size at start of test/growth phase	≤24-h	
Source of organisms	Cultured in-house	
Have organisms been exposed to contaminants?	No	
Animals acclimated and disease-free?	Yes	
Animals randomized?	Yes	
Test vessels randomized?	NR	
Test duration	48 h	
Data for multiple times?	Yes	
Effect 1	Mortality	
Control response 1	0% mortality	
Temperature	21°C	
Test type	Static	
Photoperiod/light intensity	50-70 fc	
Dilution water	Reconstituted deionized water (USEPA, 1975)	
pH	8.3	
Hardness	160-190 mg/L CaCO3	
Alkalinity	110-130 mg/L CaCO3	
Conductivity	400-600 µmhos/cm	
Dissolved Oxygen	8.3-9.8 mg/L	
Feeding	None	
Purity of test substance	94%	
Concentrations measured?	No	
Measured is what % of nominal?	Not applicable	
Toxicity values calculated based on nominal or measured concentrations?	Nominal	
Chemical method documented?	Not applicable	
Concentration of carrier (if any) in test solutions	Acetone (500 µl/L)	
Concentration 1 Nom/Meas (µg/L)	0.15 µg/L	3 reps/5 per rep
Concentration 2 Nom/Meas (µg/L)	0.23 µg/L	3 reps/5 per rep
Concentration 3 Nom/Meas (µg/L)	0.38 µg/L	3 reps/5 per rep
Concentration 4 Nom/Meas (µg/L)	0.61 µg/L	3 reps/5 per rep
Concentration 5 Nom/Meas (µg/L)	0.99 µg/L	3 reps/5 per rep

	Surprenant 1979	***Daphnia magna***
Parameter	**Value**	**Comment**
Concentration 6 Nom/Meas (µg/L)	1.9 µg/L	3 reps/5 per rep
Control (describe type)	Solvent and Dilution water	3 reps/5 per rep
LC50 (µg/L; indicate calculation method)	48 h: 0.92 (0.78-1.1)	Method: Moving average angle

Reliability points taken off for:

Documentation:
Analytical method (4), measured concentrations (3), hypothesis tests (8)
Total 15

Acceptability:
Acceptable standard (5), measured concentrations within 20% of nominal (4), random design (2), hypothesis tests (3)
Total 14

Surprenant 1979

Rating of relevance/usability of single-species data for derivation of criteria.

	Surprenant 1979	***Daphnia magna***
Parameter	**Value**	**Comment**
Acceptable standard (or equivalent) method used	10	NR (-10)
Endpoint linked to survival/growth/reproduction	15	Yes
Freshwater	15	Yes
Chemical ≧80% pure	15	94%
Species is in a family that resides in North America	15	Yes
Toxicity value calculated or calculable (e.g., LC50)	15	Yes
Controls		
Described (i.e., solvent, dilution water)	7.5	Yes
Response reported and meets acceptability requirements	7.5	Yes
Total	100	(-10)

Surprenant 1979

Documentation rating for single-species aquatic laboratory data.

	Surprenant 1979	***Daphnia magna***
Parameter	**Value**	**Comment**
Results published or in signed, dated format	6	
Exposure duration	12	
Control type	8	
Organism information (i.e., age, life stage)		
Source	5	
Age/life stage/size/growth phase	5	
Chemical		
Grade or purity	5	
Analytical method (if measured)	4	NR (-4)
Nominal concentrations	3	
Measured concentrations	3	NR (-3)
Exposure type	5	
Dilution water source	3	
Hardness	2	
Alkalinity	2	
Dissolved oxygen	4	
Temperature	4	
Conductivity	2	
pH	3	
Photoperiod and/or light intensity (plant studies must include intensity)	3	
Statistics		
Methods identified	5	
Hypothesis tests		
Statistical significance	2	NR (-2)
Significance level	2	NR (-2)
Minimum significant difference	2	NR (-2)
% of control at NOEC and/or LOEC	2	NR (-2)
Point estimates (i.e., LC50, EC25)	8	
Total	100	(-15)

Surprenant 1979

Acceptability rating for single-species aquatic laboratory data.

	Surprenant 1979	***Daphnia magna***
Parameter	**Value**	**Comment**
Acceptable standard (or equivalent) method used (e.g., ASTM, USEPA, OECD, APHA)	5	NR (-5)
Test was of appropriate duration	2	
Control		
Appropriate (e.g., solvent control included, if carrier was used)	6	
Response within test guidance	9	
Chemical		
Purity >80% pure	10	
Measured concentrations within 20% of nominal	4	NR (-4)
Concentrations do not exceed 2× water solubility	4	
Carrier solvent ≤0.5 mL/L (acute); ≤0.1 mL/L (chronic); score 4 if not used	4	
Organisms		
Appropriate size/age/growth phase	3	
No prior contaminant exposure	4	
Organisms randomly assigned to test containers	1	
Adequate number per replicate/appropriate cell density	2	
Organisms fed 2 h before solution renewal or not fed in acute tests; fed appropriately in chronic tests	3	
Organisms properly acclimated and disease-free prior to testing	1	
Exposure type and renewal frequency appropriate to chemical	2	
Dilution water source acceptable	2	
Hardness within organism tolerance and/or dilution water specifications	2	
Alkalinity within organism tolerance and/or dilution water specifications	2	
Dissolved oxygen ≥60%	6	
Temperature within organism tolerance (3 pts) and/or test guidance and held to ± 1ºC (3 pts)	6	
Conductivity within organism tolerance and/or dilution water specifications	1	
pH within organism tolerance and/or dilution water specifications	2	
Photoperiod and light intensity within organism tolerance and/or test guidance	2	
Statistics		

	Surprenant 1979	***Daphnia magna***
Parameter	**Value**	**Comment**
Adequate number of concentrations	3	
Random or random block design employed	2	NR (-2)
Adequate replication	2	
Appropriate spacing between concentrations (dilution factor ≥0.3)	2	
Appropriate statistical method used	2	
Hypothesis tests		
Minimum significant difference (MSD) below recommended upper bound	1	NA (-1)
NOEC response reasonable compared to control	1	NA (-1)
LOEC response reasonable compared to control	1	NA (-1)
Point estimates		
LC/EC values calculable (i.e., no < or > results)	3	
Total	100	(-14)