Review by G. Allen Burton, Jr.
December 23, 2013

Methodology for Derivation of Pesticide Sediment Quality Criteria for the Protection of Aquatic Life. Phase II. Method Development and Derivation of Bifenthrin Sediment Quality Criteria

1. Is the way the method addresses bioavailability in accordance with the current state of research on this topic?

   In part – see response in no. 2

2. Are all of the ways of accounting for bioavailability included in the method (and listed below) scientifically valid? Are there additional technically valid ways to account for bioavailability that could be used?

   a. OC-normalized sediment concentrations
   b. DOC-normalized porewater concentrations
   c. Directly measured freely dissolve porewater concentrations (via SPME or Tenax)

   Other ways that have been used site-specific empirical guidelines based on toxicity to USEPA surrogates (e.g., *Hyalella azteca*), response of indigenous biota (e.g., ERLs/ERMs), response of indigenous biota in colonization studies (e.g., Burton et al. 2005), laboratory or field based SSDs, and assimilative capacity.

3. Will environmental regulators and researchers be able to use existing toxicity and monitoring data included in the method to check compliance or does the method require that new techniques be used to generate new data?

   Perhaps, but those data are limited so there will be a need to generate new data.

4. Is it clear how to evaluate studies by reading section 2.3 and appendix A (rating guides) and looking at tables 7-13?

   Yes, but only with the concerns expressed below regarding subjectivity. Also Table 14 is worrisome – as there is little science behind what is "correct" and decisions on weighting (not provided) are subjective. How will these data be used?

5. Do the categories and point values assigned in tables 8-12 reflect the importance of the parameters to performing valid sediment toxicity testing?

   I find these arbitrary and fear they may be abused by the unknowing regulator

6. Is it clear how to prioritize and organize data by reading sections 2.4 and 2.5? Do the data prioritization and exclusion in the bifenthrin criteria derivation seem

reasonable (section 8.7)? This step plays a large role in determining which data are used to derive the criteria, and thus the magnitude of the criteria.

Yes, but some concerns are expressed below.

7. Is it clear what information should be input in the toxicity data summary Table 14?

   Yes, but how will it be interpreted? See concerns above and below.

8. Are instructions in sections 3.4-3.7, describing how criteria are derived, clear and easy to follow?

   Yes, but see concerns above and below regarding high uncertainty, lack of field validation and need for site-specific derivations using other approaches.

9. Does it make sense to derive two criteria for a given pesticide, one with a 10-d averaging period and one with a 28-d averaging period (section 3.8.2)? Should only one criterion be derived? Please comment on the thoroughness, validity, and completeness of the review and discussion in section 3.8.2. Are there any other considerations that should be included for determining criteria averaging periods?

   Perhaps this makes sense for NPDES permitting, but to my knowledge sediment toxicity has never been used in NPDES permitting. The 10 and 28 d periods are somewhat arbitrary, and are organism and endpoint specific. The 10 day period has precedence but as an indicator of acute toxicity, is still arbitrary and not science based. The authors seem to recognize these issues based on discussions in 3.8.2.

10. Is the assumption of concentration addition reasonable for mixtures of pesticides in the same class (section 4.2)?

    Yes

11. Do you know of QSARs that could be used to estimate toxicity to other species, including threatened/endangered species?

    No

12. Are the bifenthrin criteria generated in section 8 protective of aquatic life, more specifically, are they neither unreasonably overprotective nor underprotective?

    They appear to be over-protective based on the limited data and uncertain application factors being used. The authors focus totally on not being under-protective, but in doing so – are likely being over-protective. As long as there is such a high degree of uncertainty – there should be a site-specific field validation process established. This could mimic the “water effect ratio” approach that USEPA allowed in the NPDES program.

Specific Comments

13. 2.2.2 The acute-to-chronic ratio estimation has high levels of uncertainty associated with it.
14. 2.3.2 The data quality scoring systems presented in Tables 9 - 12, are useful, but should be taken with a "grain of salt" as they are subjective at multiple levels based on the scorer, the points assigned to each criteria and the guidance from which they are derived. I helped generate the ASTM and USEPA guidance on sediment collection and manipulation and also their freshwater toxicity test methods – and am well aware of the inherent subjectivity used in much of the "guidance". This applies to spiking method and equilibration time. I strongly caution this guidance from being overly prescriptive and discarding potentially useful and valid data.
15. 2.3.2 There has been a lot of freshwater sediment toxicity testing in recent years using snails and molluscs – both of which have been shown to be quite sensitive, particularly with chronic endpoints. These should be added as possible test species. See some of the attached pdfs.
16. 2.3.2.1 pp. 31 and 32 are confusing with the untitled tables on both pages. This appears to be a formatting problem. Table 14 needs to be explained and it is a concern on how these criteria will be used to rate the relevance and reliability of data – again this is very subjective and there is little science to justify decision weightings.
17. 2.4 Point estimates such as EC10s should be promoted rather than the much ridiculed and problematic NOEC/LOEC approach - whenever possible.
18. 2.4 g. DOC data will be quite rare, but obviously important so there should be detailed guidance on how to obtain it properly to ensure there are reduced collection and manipulation artifacts.
19. 3, 3.4, 3.5.2, and 3.5.3 I disagree with the SSD requirement for 5 taxa, which automatically defaults to a highly uncertain assessment factor. This approach should build on the extensive sediment quality guidelines research and policy setting that has (*and ongoing*) taken place in the EU under the Water Framework Directive and REACH programs. These programs have been generating useful sediment guideline approaches on a wide range of chemicals for several years – with extensive involvement of private and public sector expertise from all the Member States. They have successfully used sediment SSDs to develop PNECs that have been validated with field studies. This massive European effort should not be discounted. The European Chemicals Agency (ECHA) held a sediment experts workshop last year as a first step to develop guidance on sediment guideline development. The proceedings from this workshop are due out in early 2014 and the guidance in 2015.
20. 3.4.1 *Diporeia* is only found in the Great Lakes and is epibenthic. Why are fish being used? Oligochaetes must mean *Lumbriculus variegatus*, which is very tolerant (as is Tubifex) and only useful to measure tissue residues and predict food web transport. Please include *Lymnea stagnalis* and allow for testing of other snails and mussels. Algae testing for sediments? How does one do this and why? Vascular plant testing? Where are the methods for plants?
21. 3.6.3. What is the justification for use the 80th percentile as the default ACR?

22. 3.7 The guidance for herbicides is a concern, as there are so few data. Since we know herbicides can be highly toxic to non-target species, they should be handled as the insecticides are.
23. 3.8.1 Perhaps I am confused but is seems your calculation on p. 55 is lower for acute than chronic toxicity.
24. 3.8.3. Should not USEPA also be cited in addition to TenBrook et al 2010?
25. 4.3.3. Suggest a "water effects ratio" type of approach be developed for sediments using the NPDES program as a precedent.
26. 5. Why is guidance only provided to "downward" adjust criteria? Isn't there a possibility given the lack of data and many assumptions being used that criteria may be over-protective, and certainly this is possible in some environments. Based on Clements et al. 2012 and others – one should consider the "ecological context" where criteria are being applied. Certainly areas where tolerant species prevail naturally (mouths of large rivers) do not have the sensitivity to chemicals that high gradient mountain stream systems do.
27. Are there plans to develop metals criteria? If so, please see the attachments provided and build on the EU efforts.
28. *It is wonderful to see this progressive effort! I hope you are successful and your approach can serve as a model for others.*

References cited *(or see attachments)*

Burton GA Jr, Nguyen LTH, Janssen C, Baudo R, McWilliam R, Bossuyt B, Beltrami M, Green A. 2005. Field validation of sediment zinc toxicity. *Environ Toxicol Chem* 24:541-553.

Clements WH, CW Hickey, KA Kidd. 2012. How do aquatic communities respond to contaminants? It depends on the ecological context. *Environ Toxicol Chem* 31:1932-1940.

Attachments recommended authors review (as pdfs):

1. MERAG (Metals Environmental Risk Assessment Guidance) *While specific for metals, this overview document has been very useful for European regulators*
2. MERAG 3 (Fact sheet 3. Effects assessment: Data compilation, selection and derivation of pnec values for the risk assessment of different environmental compartiments (water, STP, soil, sediment. 2007) *Useful Fact Sheet showing how PNECs for sediment are derived and weight-of-evidence*
3. MERAG 7 (Fact sheet 7. Uncertainty analysis. 2007) *Useful Fact Sheet showing uncertainty analyses*
4. Ni SQG ETC 2013 (Vangheluwe et al. 2013. Improving sediment-quality guidelines for nickel: Development and application of predictive bioavailability models to assess chronic toxicity of nickel in freshwater sediments. *Environ Toxicol Chem* 32:2507-2519.) *PNEC derivation using 7 species*
5. SETAC NA Advance research on Ni toxicity 14-11-2013 (Nguyen et al. Advance research on nickel toxicity in sediments: species, bioavailability and toxicity.

SETAC North America Annual Meeting, Nashville TN) *Recent Ni testing to develop a site-specific PNEC including a unionid mussel*