

August 25, 2004

Craig J. Wilson
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Division of Water Quality
State Water Resources Control Board
P.O. Box 100
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Subject: Comments on statistical issues in the draft Water Quality Control Policy

Dear Mr. Wilson:

I am writing to follow up on my participation in the September 8th workshop and to add my comments on the September draft of Appendix A. As I stated to the board, my overall view is that the direction in which these draft policies are moving is a very sensible one from my perspective as a statistician. There are critical features of the July draft that I regard as excellent steps to improve the process of making Section 303(d) listing decisions:

- The exact binomial method is a good choice of a statistical framework, offering a clear, easily understood basis for routine use in making decisions.
- The use of an arbitrary "rule-of-thumb", such as "list if at least 10% of the samples exceed the standard" is ill-advised. Such rules amount to "head-in-the-sand statistics", since their performance characteristics—i.e. Type I and Type II error probabilities, are highly variable and uncontrolled.
- By contrast, the method you and your staff have employed to achieve "balanced error probabilities" at specified "pegs" (true percentages of exceedance) is clear and effective as a means of controlling the effects of random variability in testing in an even-handed way. In my teaching of statistics to science and engineering students at Caltech over the last thirty-six years, I have regularly recommended this kind of specification of error probabilities as more useful and transparent than the usual approach of arguing that one or the other hypothesis should have the *a priori* "benefit of the doubt".
- There is a wonderful balance between listing and delisting decisions, always using currently relevant test data in the same, consistent way. I will say more about this below.

Some of the participants in the September 8th workshop criticized the use of the same critical thresholds for listing and delisting—e.g. 3 exceedances out of 25 puts a toxicant on the list and 2 exceedances out of 25 takes a toxicant off the list, suggesting that this

I have an even greater concern about the September version of Table 4.1. Not only have the pegs been moved downward to match the 3% and 5% used in Table 3.1, but also the wonderfully consistent treatment of listing vs. delisting (remarked upon previously) has been destroyed by the sentence immediately below Table 4.1. The critical change in that sentence is the one replacing "alpha and beta at most 0.2" by "alpha and beta at most .10". If the consistency of inferences for listing and delisting were maintained, Table 3.1 shows that Table 4.1 would require a minimal sample size of 16 for delisting and, for example, sample sizes of 16-24 with at most one exceedance would call for delisting. I recommend deleting this change and restoring the original balance and statistical logic.

I hope the strenuous efforts you and your staff have made at the direction of the board—to develop a solid and consistent system for routine decision-making regarding listing, will bear fruit and will lead to the adoption of such a system, making intelligent use of the science of statistics to guide (but not replace) the careful evaluation of scientific evidence about the possible impairment of water bodies.

Sincerely,

Gary Lorden

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