Reviewer: John P. Knezovich, PhD
Date: 12/14/07

Review of the Draft Staff Report
Water Quality Control Plan for Enclosed Bays and Estuaries
Part 1: Sediment Quality

The State mandate for external scientific peer review requires that the reviewer determine whether the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices. The Water Quality Control Plan for Enclosed Bays and Estuaries (Part 1: Sediment Quality) presents a comprehensive and well-defined approach for the assessing the potential hazard posed by contaminated sediments in California's bays and estuaries. The staff has clearly put considerable effort into rigorously evaluating the state of the art and has provided recommendations that are tailored for application in California. Appropriate and rigorous evaluations of existing national and regional methods were conducted. Recommendations for creation of sediment quality objectives were based on a critical evaluation of existing data as well as sound expert judgment.

Responses to five specific topic areas were requested and have been provided below. Overall, the staff has used sound scientific knowledge, methods, and practices to derive the proposed recommendations for sediment quality objectives. No significant flaws or deviations from accepted scientific practice were found. Accordingly, the suggestions for corrections or modification are intended to clarify the proposed guidelines for assessment of sediment quality.

1. The exposure-receptor relationship selected for protection.
The use of benthic invertebrates as ecological indicators of sediment contamination is well accepted by the scientific community and is not a controversial issue. Because benthic invertebrates are in intimate contact with sediments and pore water, they represent biota with the greatest potential for exposure to sediment-sorbed contaminants.

Section 5.3 of the draft report outlines a sound rationale for selection of indicator organisms that are at greatest risk of exposure to sediment-sorbed contaminants. The staff recommendation to focus on beneficial uses linked to specific receptors is appropriate and provides proper focus for implementation. Furthermore, the recommendation to focus on the use of understood receptors (i.e., benthic invertebrates) is practical and does not exclude the use of fish and wildlife in broader ecological risk assessments.

2. Approach to assess the exposure-receptor relationship.
The draft report recommends that multiple lines of evidence (MLOE) be used to assess the potential risk posed to benthic invertebrates by sediment-sorbed contaminants. This approach, which is already routinely used by state and federal agencies, is necessary due to the variability in sediment type, contaminant distribution, and ecosystem

characteristics between and within sites. Due to these multiple sources of variability, no single line of evidence has been demonstrated that can reliably account for these variables and their influence on contaminant bioavailability. Accordingly, use of multiple test organisms, in-situ responses and assessment of laboratory exposures to field sediments remains the most accurate way to account for contaminant availability and deleterious effects.

Section 2 of the draft report presents a conceptual model for the behavior of contaminants in sediments. Figure 2.2 presents processes by which contaminants may interact with sediment, biota and water. It would be appropriate to indicate that bioturbation can contribute to entrainment of contaminants in sediment as well as resuspension. This could be accomplished by adding a rotating arrow within the sediment on the right side of the figure.

Section 5 of the draft report provides an evaluation of alternatives to the adoption of sediment quality objectives (SQOs). Staff recommendations advocate the adoption of SQOs for bays and estuaries, with a reference envelope approach being proposed for estuaries. Because estuaries tend to have more dynamic water chemistry than bays, a less robust approach is appropriate.

The statement that the bioavailability of hydrophobic organic and inorganic pollutants is strongly influenced by salinity (bottom of page 53) should be modified to state that bioavailability can be influenced by salinity. While the bioavailability of hydrophobic contaminants may be influenced in the transition from marine to estuarine systems, the magnitude of the effect is not always large.

3. Individual lines of evidence.

a. Are the proposed sediment toxicity indicators appropriate for assessing both the potential risk of exposure from toxic pollutants and the biological effects in benthic invertebrates within bays and estuaries of California?

The proposed acute and sublethal toxicity tests are appropriate for assessing the risk of exposure and biological effects in sediments in California. The use of both acute and sublethal endpoints is necessary to assess contaminant availability and toxicity. The proposed tests were derived by evaluating a variety of candidate tests for feasibility, performance, and cost. Pore water and sediment elutriate tests were not evaluated as they were deemed to be impractical for routine use. This is a reasonable conclusion.

Thresholds were derived by assessing test variability and distribution of the toxicity response data. The use of toxicity threshold values is appropriate and should prove to be a useful tool for discriminating between sites. Although such an approach is unprecedented, the basis for establishing these thresholds is sound.

b. Are the proposed sediment chemistry indicators appropriate for assessing the potential risk of exposure from toxic pollutants to benthic invertebrates within bays and estuaries of California?

The proposed chemistry indicators presented in Section 5.5.3 of the draft report were derived from existing state and national guidelines as well as from new indicators. The use of sediment quality guidelines (SQGs) in the absence of other information is not recommended as they are not always accurate predictors of sediment toxicity. The situation in which effects are observed in the absence high pollutant concentrations (pg. 75) illustrates this point. The report states two possible reasons for such an occurrence: 1) the presence of a non-pollutant related stressor such as physical disturbance, or 2) the presence of an undetected pollutant. The second reason should be modified to include possible toxicants that may not be pollutants (e.g., algal toxins, sulfides). Conversely, the lack of effects when pollutants levels are high may be due to low bioavailability. The statement is made that simple, effective approaches to quantify bioavailability are not currently available. While this statement is generally true, the presence of acid volatile sulfides (AVS) has been shown to inhibit the bioavailability (and toxicity) of metals in a quantifiable manner (i.e., toxicity is not observed when AVS concentrations exceed the sum of the concentration of metals).

The authors have recognized the shortcomings of SQGs and recommend that sediment chemistry only be used as a surrogate measure of exposure and that it be used with other lines of evidence. Given the lack of reliability of SQGs, this is a prudent approach. In addition, the recommendation that the State use existing, regional, or new SQGs derived from California data is appropriate. This rationale was derived from an assessment presented in Attachment 6, which demonstrated that a logistic regression model approach is preferred due to its ability to incorporate new data.

c. Are the proposed benthic community indicators appropriate for assessing the biological effects through benthic community condition within bays and estuaries of California?

Because bays and estuaries in California have diverse habitats and benthic assemblages, there has not been consensus on the application of a standard benthic index. In this report, 5 benthic indices were evaluated by calibrating with a common data set. Threshold values were subsequently selected and performance was evaluated by expert judgment. This assessment revealed that using multiple indices generally resulted in greater accuracy. The recommendation to select a combination of benthic indices for applicable water bodies is appropriate; however, the specific indices to be used are not identified in the recommendation.

4. Integration framework: Is the integration framework appropriate for determining if a station meets the narrative objective?

Although the triad approach for assessing sediment quality is frequently used, multiple approaches have been used for integrating the individual lines of evidence. In Section 5.5 of the draft report, a logic-based framework is proposed that assigns each line of evidence into one of four response categories. The proposed classifications for severity of effects are rational as are the categories defining the potential that effects are chemically mediated. The six impact categories that define potential outcomes (5 levels of impact, 1 inconclusive) provide a reasonable range of effect classification and have been logically incorporated into a classification scheme.

The proposed non-equal weighting framework is attractive because it considers the potential for exposure and the magnitude of biological effects. In comparing the performance of this framework with expert judgment, the framework performed well and could accurately distinguish degraded and reference sites in California. Because subjective judgment tends to be a factor in any assessment approach, the proposed framework is acceptable as its underlying methods are suitably transparent.

5. Is the implementation of the narrative SQO appropriate, given the limitations of the individual tools and potential uncertainty associated with sediment quality assessment?

Implementation of the proposed narrative SQO is appropriate and has been defined in a rigorous manner. Single lines of evidence such as toxicity or chemistry are not appropriate for regulation of sediments, which present more complexity than the water column. Because the sediment quality triad (i.e., chemistry, toxicity, benthic community) presents the most robust approach for assessment of sediments, it is the most appropriate approach for implementing the narrative SQO. This approach is more complex and costly than traditional assessments of water quality, but is necessary to provide data sufficient to make sound judgments. Although this approach would still rely heavily on expert judgment, it is sufficiently robust to be applied. The staff recommendation appropriately recognizes that additional development and evaluation will be required before a detailed approach is considered.

For the sake of completeness and accuracy, the following typographical errors should be corrected in the final version of the report:

Global: Spell out first use of acronyms (e.g., ERM, TIE, etc.)
Global: Align table headings and columns.
Pages 8, 9: Figures 1 & 2 should be Figures 2.1 and 2.2, respectively.
Pages 13, 14: Figures 1 & 2 are not present. These would appear to be regional maps.
Page 17, last sentence: Delete "A summary of.." as this is redundant. The sentence should read: "Sediment quality related impairments…are summarized…" This same correction needs to be applied elsewhere in the document (i.e., pages 18, 21).
Page 18: Figure 4 is not present.
Page 19: Use consistent capitalization in Table 3.6.
Page 21: Figures 5, 6 & 7 are not present.
Page 23: Figure 11 is not present. Also, this would appear to be Figure 8 as nos. 8-10 are not called out in the text.
Page 24: Figure 12 is not present.
Page 25, last sentence: "A summary of… impairments are…" should be "A summary of… impairments is…"
Page 31, first sentence: Replace "pollutant" with "toxicant" (a TIE process is just as valuable if it identifies a naturally occurring toxicant).
Page 32, first paragraph: Period is missing at the end of the last sentence.
Page 32, last sentence of 2nd paragraph: "This results is.." should be "This result is.."
Page 34, middle of last paragraph: Space missing between "human health."

Page 40, last sentence of 1st paragraph: "Bite" should be "Bight."
Page 40: A return is missing between the 2nd and 3rd paragraphs.
Page 40, last paragraph: tributyltin should be lower case.
Page 42, Section 4.6: The last sentence should be part of the paragraph above it.
Page 55: Table 1 should be Table 5.1
Page 67, column heading: "lababoratoriess" should be "laboratories."
Pages 70, 72: "Plate 5.1" should be "Figure 5.1"
Page 71: "Plate XX" should be "Figure 5.1."
Page 88, Table 5.13: "Disagreement values represent is the …" should be "Disagreement values represent the…"
Appendix C: Figure 1 is blank.