Background Information in Support of June 16 Conference Call With the Scientific Steering Committee

Refinement of the Multiple Line of Evidence (MLOE) Framework for Assessing Direct Effects

June 12, 2006

At the February 28-March 2 meeting of the Scientific Steering Committee (SSC), the Sediment Quality Objectives (SQO) science team presented an alternative framework for the integration of data from the three direct effects indicators. The SSC expressed support for the alternative approach but requested modifications to several specific boxes within the framework. This document describes the revisions to the framework made in response to the SSC's comments.

Additionally, the integration framework the science team presented was predicated on data being available for all three LOE. There will be circumstances where one or two LOE are unavailable, which the framework needs to address. This document also describes the recommended approach for applying the framework when data are missing.

The remainder of this document is predicated on an understanding of the framework that was presented to the SSC in February. To assist, Appendix A to this document provides a summary of the recommended approach. Additionally, the boxes in the framework have been numbered to facilitate discussion during the conference call.

Modifications to the framework

The SSC made three types of suggestions regarding the proposed framework:

1) Boxes 20 and 23 in the potential for chemical effect should be altered to place more weight on the toxicity indicator because the toxicity indicator can respond to unmeasured chemicals. The science team agrees with this suggestion and the suggested modification has been incorporated into the framework that appears in Appendix A.

2) An inconclusive category should be incorporated into the framework to describe circumstances where one line of evidence is in sharp disagreement with the other LOEs. The inconclusive category has been incorporated in the framework when toxicity is high and the other LOEs are in reference condition (see box 42), as the most plausible explanation for this pattern is data error. In contrast, highly modified benthos in combination with reference toxicity and reference chemistry is reasonably explained by physical disturbance; high chemistry in the presence of reference toxicity and reference benthos can be explained as chemicals that are biologically unavailable. Because these latter two circumstances have reasonable

explanations, the science team recommends against classifying these combinations as inconclusive. Instead, we suggest that these combinations be flagged and potentially treated differently when stations are combined in an integrated watershed analysis.

3) The SSC did not develop a consensus recommendation, but engaged the science team in discussion about boxes 4, 8, 9, 12 and 44 and asked that they be considered more closely. Based on these discussions, the science team has modified boxes 9 and 44, but not boxes 4, 8 and 12. The decision to modify Box 9 from low to moderate effect, and to not modify boxes 4, 8, and 12, was based on the State's goal of placing greater emphasis on the benthos than on toxicity as the endpoint of concern. Box 44 was modified because this box could result from a combination of low toxicity, moderate chemistry, and high benthic disturbance, a level of variability among LOEs that is inconsistent with the category of clearly impacted that was previously assigned to this box.

At the February meeting, the science team presented a validation of the framework based on comparison to the manner in which six experts classified 25 sites. The effect of the SSC-initiated changes to the framework on the validation was small, but positive. The classification of only two sites changed and both changes led to a slight improvement in the validation (Table 1).

Application of the MLOE framework when one or more LOEs are unavailable

The recommended approach when two LOEs are missing is that no assessment be conducted. There are severe limitations associated with interpretation of any individual LOE, which is why the State is pursuing a multiple line of evidence approach. The uncertainty with any individual LOE cautions against assessments using only one LOE.

There are two circumstances when a single LOE would be missing and the recommended approach to assigning a station classification differs between them. The first circumstance is when an LOE was not collected, could not be processed or did not meet data quality objectives. In this case, the recommended approach is intended to be protective of the environment and encouraging of collection for all three LOEs. The approach involves assigning the "moderate" condition designation to the missing LOE and applying the existing framework for three LOEs. This provides consistency with the typical application and creates an environmentally protective outcome, where errors in assessment resulting from the missing LOE more often leads to an assessment of greater impact. This reduces the possibility that the use of two LOE will result in an impacted station being incorrectly classified as unimpacted and creates an incentive for affected parties to collect a complete data set.

The effect of applying the missing LOE framework was evaluated using data from the 511 California stations for which all LOEs were available. The classification for an LOE was changed to "moderate" and the change in station classification was assessed. This

process was repeated for each LOE at each station. The results of this missing LOE analysis are shown in Tables 2-4.

Overall, 45% of the samples were classified in a different category when one line of evidence was simulated to be missing. Most of these shifts were by a single classification category, with only 10% shifting two categories and only three samples shifting three categories. Ninety-five percent of the category shifts led to a greater degree of environmental protection than when all three LOEs were available. Fourteen percent of the samples shifted between the "impacted" and "unimpacted" groupings, with 93% of these shifting to the "impacted" grouping.

Benthic interpretation tool unavailable

The second situation is when data for all LOEs are available, but a benthic assessment tool has not yet been developed for the habitat from which the samples were collected. In contrast to the scenario above where there was a desire to err on the protective side as an incentive for ensuring that all LOEs are collected, the desire when the benthic tool is unavailable is to be more neutral in direction of the error. Table 5 provides the recommended station assessments based on toxicity and chemistry data when the benthic tool has not been developed.

To assess the effect of the benthic tool being unavailable, the framework was applied to the same 511 sites used in the analysis above (Table 6). The site classification changed from that with three LOEs for about 60% of the sites. Most of these shifts were by a single classification category, with only 8 sites shifting two categories and no sites shifting three categories. About three-quarters of the category shifts led to a greater degree of environmental protection than when all three LOEs were available, but most shifts were modifications of the adjectives within the "impacted" or "unimpacted" groupings, rather than shifts across these groups. Only 21 and 14 sites out of 511 shifted from the unimpacted group to the impacted group and vice versa. However, there was an increase of 37 sites in the inconclusive category.

Table 1. Comparison of MLOE frameworks to expert assessment.

	Experts			MLOE	MLOE
	Median	Min	Max	Last SSC meeting	Present revisions
Category Error	13/25	5/22	16/22	8/25	6/25
Percent Error	53	23	73	32	24
Bias	0	-15	+11	-6	-2

Table 2. Changes in station assessment following simulation of missing benthos data.

		Assessment with all 3 LOE					
		Unimpacted	Likely unimpacted	Possibly impacted	Likely impacted	Clearly impacted	Inconclusive
Assessment missing benthos LOE	Unimpacted						
	Likely unimpacted	74% (121)	33% (21)				
	Possibly impacted	26% (43)	8% (5)	12% (14)			
	Likely impacted		55% (35)	88% (106)	81% (81)		100% (1)
	Clearly impacted		5% (3)		19% (19)	100% (62)	

Table 3. Changes in station assessment following simulation of missing toxicity data.

		Assessment with all 3 LOE					
		Unimpacted	Likely unimpacted	Possibly impacted	Likely impacted	Clearly impacted	Inconclusive
Assessment missing toxicity LOE	Unimpacted	20% (32)					100% (1)
	Likely unimpacted	51% (84)	38% (24)	12% (15)			
	Possibly impacted	29% (48)	20% (13)	68% (81)			
	Likely impacted		42% (27)	20% (24)	72% (72)		
	Clearly impacted				28% (28)	100% (62)	

Table 4. Changes in station assessment following simulation of missing chemistry data.

		Assessment with all 3 LOE					
		Unimpacted	Likely unimpacted	Possibly impacted	Likely impacted	Clearly impacted	Inconclusive
Assessment missing chemistry LOE	Unimpacted	96% (157)	27% (17)				
	Likely unimpacted	4% (7)	33% (21)				
	Possibly impacted		41% (26)	98% (117)			100% (1)
	Likely impacted			2% (3)	40% (40)		
	Clearly impacted				60% (60)	100% (62)	

Table 5. Multiple lines of evidence station classifications where benthos LOE is unavailable because interpretative tool has not been developed for that habitat.

		Chemistry			
		Minimal exposure	Low exposure	Moderate exposure	High exposure
Toxicity	Nontoxic	Unimpacted	Likely unimpacted	Likely unimpacted	Inconclusive
	Low toxicity	Likely unimpacted	Likely unimpacted	Possibly impacted	Possibly impacted
	Moderate toxicity	Possibly impacted	Possibly impacted	Likely impacted	Likely impacted
	High toxicity	Likely impacted	Likely impacted	Likely impacted	Clearly impacted

Table 6. Changes in station assessment using the missing benthos framework. The values indicate the percent and number of samples that were in an assessment category (column heading) that would be categorized as the row heading, using the framework for missing benthos.

		Assessment with all 3 LOE					
		Unimpacted	Likely unimpacted	Possibly impacted	Likely impacted	Clearly impacted	Inconclusive
Assessment missing benthos LOE	Unimpacted	25% (41)	12% (8)				
	Likely unimpacted	75% (123)	28% (18)	12% (14)			
	Possibly impacted		20% (13)	38% (45)	18% (18)		
	Likely impacted		12% (8)	51% (61)	53% (53)	52% (32)	100% (1)
	Clearly impacted				8% (8)	48% (30)	
	Inconclusive		27% (17)		21% (21)		