Comments on SWRCB Sediment Quality Advisory Committee Kickoff Meeting for the SWRCB Program to Develop Sediment Quality Objectives for Enclosed Bays and Estuaries in California, Held on July 29, 2003

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On July 29, 2003, the State Water Resources Control Board (SWRCB) staff (Chris Beegan) organized a Sediment Quality Advisory Committee "kickoff" meeting to discuss the approach that the State Board staff have adopted for developing sediment quality objectives for the state of California. During the presentations that were made by C. Beegan and S. Bay, a set of PowerPoint slides were used. These slides are available from the SWRCB website in the BPTCP section.

Beegan discussed the background to the current SWRCB efforts to develop sediment quality objectives, mentioning that in 1989 the California Water Code was amended to include the Bay Protection and Toxic Cleanup Program (BPTCP). This program included the requirement for developing sediment quality objectives. While Beegan indicated that this part of the program was not fulfilled due to a shortage of funds, in fact, as discussed by Lee (2003a) in his initial comments on the draft workplan for developing sediment quality objectives, the reason that the sediment quality objectives were not developed under the original BPTCP was due to mismanagement of the program by the State Board staff.

As an individual who actively followed the BPTCP activities, I can unequivocally state (as can others who were involved) that, because of the problems in the way the State Board staff organized the BPTCP, large amounts of funds were inappropriately used on what were obviously technically invalid approaches. Finally, when it became too late to correct these deficiencies, the State Board staff declared that there were not enough funds to proceed with developing sediment quality objectives, as required in the original BPTCP.

Beegan indicated that in 1999 a lawsuit was filed against the SWRCB, which ultimately resulted in a judgment requiring that the State Board comply with the Water Code requirements of developing sediment quality objectives. In accord with the court settlement, a compliance schedule was established, which specified that by June 30, 2003, the SWRCB must adopt a scoping document that covers a workplan for developing sediment quality objectives. By August 5, 2005, the SWRCB must circulate draft objectives, and by February 28, 2007, the SWRCB must adopt objectives and policy to submit to the Office of Administrative Law.

This schedule is not compatible with the sediment quality objective development workplan as it has been finally formulated. As it stands now, the State Board is headed down the same path as with the original BPTCP, where large amounts of funds will be spent unproductively, trying to do something useful with the previously collected data. As I discussed in my comments on the initial and final workplan (Lee 2003a,b), while a large amount of data were collected in the original BPTCP, they were not collected in a coherent, comprehensive, systematic manner, which would allow the use of the data to develop meaningful sediment quality objectives. The State Board staff will burn up a substantial amount of funds, only to find that the existing database is not suitable for developing sediment quality criteria in the timeframe allowed and with the funds available.

The State Board staff was very slow in getting the workplan out for public review. When the stakeholders found significant problems with the workplan, it was then too late to correct the deficiencies, and the State Board adopted a workplan that has significant technical problems and can readily lead to essentially a waste of the funds that are devoted to sediment quality objective development. When the final workplan was issued by the State Board staff a few days before the State Board's meeting to adopt the objectives development plan, I developed a further detailed, comprehensive discussion, with copies of backup documents, which was submitted to A. Baggett, on the significant technical problems associated with the proposed sediment quality objectives development. As far as I can find, my comments on the final workplan have not been included in the materials posted by the State Board staff. They are available from my website, at http://www.gfredlee.com/baggett5-20-03.pdf.

Rather than trying to develop sediment quality objectives based on the existing inadequate BPTCP database, the approach that should be followed, during the time allowed and with the funds available, is to immediately begin to formulate a non-numeric, best professional judgment triad weight-of-evidence approach for evaluating the water quality significance of constituents in aquatic sediments as they may influence the beneficial uses of the waters in which the sediments are located. As I have discussed in my writings on these matters, this approach is recognized by experts in the field as the technically valid, reliable approach to follow. Chemical concentration based approaches such as those present in the workplan and discussed by Steve Bay at the July 29 meeting have been repeatedly shown to be unreliable as regulatory tools. While there may be a coincidence with the results of some of these approaches for some situations, there is no cause and effect that can be used to regulate specific chemicals in the sediments or sources for the chemicals in the sediments.

Beegan, in his presentation at the July 29 meeting, indicated that,

Section 13391.5(d) of CWC defines SQOs:
"'Sediment Quality Objective' means that level of a constituent in sediment which is established with an adequate margin of safety for the reasonable protection of the beneficial uses of water or the prevention of nuisances."

Beegan's presentation also stated,

13393(b) further states "that the SWRCB shall adopt the sediment quality objectives pursuant to the procedures established by this division for adopting or amending water quality control plans. The sediment quality objectives shall be based on scientific information, including, but not limited to, chemical monitoring, bioassays, or established modeling procedures, and shall provide adequate protection for the most sensitive aquatic organisms. The state board shall base the sediment quality objectives on a health risk assessment if there is a potential for exposure of humans to pollutants through the food chain to edible fish, shellfish, or wildlife."

The above discussion allows the State Board considerable latitude in developing sediment quality objectives – i.e., the State Board is not obligated to develop chemical-specific numeric sediment quality objectives. Further, the above clearly establishes that one of the focal points of sediment quality objectives is the control of bioaccumulation of hazardous chemicals in the food web.

A review of the workplan and the discussions presented on July 29, 2003, shows that the State Board staff have made a number of decisions on how to use the funds available, which are contrary to developing technically valid, cost-effective, reliable sediment quality objectives, and, most importantly, are not covering a number of key areas that were originally mandated in the BPTCP as required under sediment quality objectives. Of particular importance is the lack of work on Delta sediment quality objectives, which are clearly defined as part of the BPTCP, and the apparent lack of adequate work on bioaccumulation issues. The bioaccumulation issue is discussed in my initial and subsequent comments.

The most important problem with the State Board staff's approach toward developing the sediment quality objectives is the continued focus on co-occurrence-based numeric objectives patterned after the Long and Morgan/MacDonald approach. As discussed in my detailed comments, this approach is well recognized as technically invalid and highly unreliable. While Long and Morgan, MacDonald, and some others will claim that there is some reliability under certain conditions to the chemically based co-occurrence approach, as discussed by DiToro (2002) in his keynote presentation at the Fifth International Symposium on Sediment Quality Assessment, the relationship between toxicity and co-occurrence-based guidelines is a coincidence, obviously not related to cause and effect, and cannot be used on other sediments to make reliable predictions of sediment toxicity.

Under the "Key Project Elements" of the proposed workplan, Beegan indicated at the July 29 meeting that the development of numeric objectives using regional information is one of the goals of the program. Those who understand aquatic chemistry, aquatic toxicology and water quality know that numeric objectives based on total concentrations are not technically valid. It has been well known since the late 1970s that there is no relationship between the total concentration of a constituent in sediments or group of constituents in sediments and their toxicity. While, superficially, as a coincidence, it may be found that, in a highly polluted area where there are high concentrations of a variety of constituents, there is also toxicity, this does not mean that any of the measured constituents are responsible for the toxicity.

One of the problems with this "coincidence" approach for relating toxicity to total concentrations of constituents, or a summed quotient of constituent concentrations relative to a co-occurrence-based effects level, is that one of the uses for sediment quality objectives is to determine the sources of constituents responsible for the toxicity, and control the discharge of that constituent at the source. As discussed in detailed comments provided on the BPTCP's attempt to develop sediment quality objectives, this approach is obviously technically invalid and should not be used. The approach that should be followed is to identify the constituent(s) responsible for the toxicity that is of significance to impairing water quality, and then determine its source, and control it at the source. The "shotgun" approach of simply using total concentrations of a constituent in sediments, without determining whether the total is in any way related to the impact, and then designating sources of constituents, without regard to whether the sources are discharging toxic available (or what could become available) forms in sediments, is technically invalid and could readily lead to incorrect identification of sources and could result in massive expenditures for constituent control for constituents that accumulate in sediments that have little or no impact on the beneficial uses of the waterbody in which the sediments are located.

Beegan, in his "Key Project Elements" discussion, indicated as one of the elements, *"Provide implementation policy for different applications."* As was discussed by members of the public at the State Board workshop and the July 29, 2003, meeting, it is essential that the policy be established early on how the objectives will be used, and the objectives then developed to properly mate with the policy. Failure to adopt this approach can readily result in objectives that are not implementable because the policy for which the objective will be used does not properly consider the characteristics of the objective.

Beegan's last point on "Key Project Elements" is, "*Focus on protecting benthic communities/aquatic life using weight of evidence approach."* Beegan, at the end of the July 29, 2003, meeting, made an off-the-cuff comment about how possibly S. Bay's approach for developing numeric sediment quality objectives may fail, and a weight-of-evidence approach would have to be adopted. It is well understood by those who have worked for years on sediment quality objectives (such as Chapman, 2002; DiToro, 2002; Burton, 2002; Engler, 2003; Wenning, 2003; Bridges, 2003; and others) that a non-numeric best professional judgment triad weight-of-evidence approach is the approach that should be used to evaluate whether constituents in sediments are causing significant adverse impacts on the beneficial uses of the waters overlying the sediments.

As discussed above, what should be immediately done is for the State Board staff to abandon all of its numeric, chemical-specific, regional sediment quality objectives development approaches, and focus the funds available on developing and then evaluating a non-numeric weight-of-evidence approach. Failure to adopt this approach will mean that this second effort by the State Board staff to develop sediment quality objectives will also fail, because, again, large amounts of funds will be wasted on co-occurrence-based approaches that have been known since the 1970s to be unreliable as a regulatory tool for managing contaminated sediments.

As I have discussed in my previous comments, a key issue that must be included in the weight-of-evidence approach is the proper incorporation of chemical information with the

aquatic life toxicity and bioaccumulation information and organism assemblage information relative to habitat characteristics for an area of concern. At the Fifth International Symposium on Sediment Quality Assessment, I presented a paper, "Appropriate Use of Chemical Information in a Best Professional Judgment Triad Weight of Evidence Evaluation of Sediment Quality" (Lee and Jones-Lee, 2002a), on how to properly incorporate chemical information into a water quality weight of evidence. The proper approach does not involve total concentrations of constituents, but requires assessing the toxic available forms of chemical constituents through the use of TIEs and sediment biouptake studies. This paper was stimulated by the experience I encountered with the BPTCP, where the State Board staff attempted to use total concentrations and co-occurrence as the "chemistry" component. This approach is obviously technically invalid and should not be adopted.

During the questioning of Beegan, I asked if the sediment quality objective development included tidal fresh waters of the Delta. Beegan indicated that it did not. However, a review of the BPTCP shows that BPTCP included developing objectives for the Delta. Failure of the current State Board efforts to address the Delta sediment quality objectives is a serious error on the part of the State Board staff that needs to be corrected.

The presentation on July 29 included a discussion of "Scientific Approach" by Steve Bay of the Southern California Coastal Water Research project. Presented below are comments on the presentation made by S. Bay.

S. Bay presented a list of the "Science Team." A review of the team member institutions shows that this team does not include any of the private laboratory experts who are as qualified as, if not more qualified than, several of those who were selected by the State Board staff as members of the Science Team. Bay indicated that the Scientific Steering Committee (SSC) would consist of key federal and state agencies and Ed Long and Don MacDonald, two individuals representing private consulting firms who have a significant bias in favor of using the chemical concentration co-occurrence-based approach they developed for establishing sediment quality objectives. By including these two individuals, as well as several others who are known to be pro-chemical-concentration-based approach, on the team, the State Board staff has strongly biased the results of the scientific team to continue to support chemical concentration co-occurrence-based approaches, rather than a technically valid approach based on a properly developed weight of evidence.

If anything, the dominant view of the advisors to the State Board should reflect the opinion of the experts in the field that co-occurrence-based sediment quality objectives are not reliable for regulating contaminated sediments. While a few years ago there were only a few of us who understood the fundamentally flawed nature of co-occurrence-based criteria/objectives, today there are a large number of recognized leaders in the field who understand these problems and who strongly recommend against using co-occurrence-based values for regulating contaminated sediments.

An example of the bias built into the sediment quality objectives development approach is demonstrated by the individuals selected to be Scientific Steering Committee advisors to the State Board on this effort. As Beegan pointed out at the July 29 meeting, two of the nine

individuals selected are opposed to the use of chemical concentrations in developing sediment quality guidelines. These individuals understand the problems with co-occurrence-based sediment quality guidelines as a regulatory tool. The Scientific Steering Committee should be expanded to include experts in the field who are in private practice, besides Ed Long and Don MacDonald. It is inappropriate to include Ed Long and Don MacDonald as part of the SSC team and not include individuals such as Dr. Scott Ogle, Dr. Peter Chapman or Richard Wenning, who have been active for many years in sediment quality criteria development and evaluating the use of these criteria in regulatory programs, and who are recognized in the field as experts in the topic area.

Bay indicated, in response to a question that I asked about whether sediment TIEs would be included in sediment quality objectives development, that they would not. This means that the sediment quality objectives that will be developed will be seriously flawed, since they will not properly incorporate chemical information as to the cause of toxicity. This was one of the most significant deficiencies in the previous BPTCP studies, where those responsible for developing the studies did not incorporate TIEs to determine whether the chemicals measured in the sediments were responsible for the toxicity observed. If there is no incorporation of toxicity investigation evaluation in the chemical characterization (which is misnamed "chemistry") of the sediments and toxicity, then the chemical aspects of toxicity will not be adequately and reliably addressed. As discussed by Lee and Jones-Lee (2002a), TIEs are an important component of chemical characteristic evaluation that must be incorporated into a credible sediment quality evaluation. Without them, the sediment quality objectives can readily be nothing more than, at some location, a coincidence that there is some relationship between some "guideline" value of the concentration of a total constituent or the sum of total constituents in sediments and toxicity or altered organism assemblages. This, in turn, could lead to massive expenditures by the public and private interests in control of constituents that tend to accumulate in sediments, without regard to whether these control programs are directed toward controlling real, significant water quality problems caused by the chemical constituents being controlled.

Bay stated, on the PowerPoint slide "Effects Assessment and Analysis," that one of the objectives is to *"Evaluate performance of existing sediment quality guidelines,"* and then lists *"Empirical approaches (e.g., ERM, AET)"* and *"Causal approaches (e.g., equilibrium partitioning)."* First, he has mislabeled equilibrium partitioning as a causal approach. Equilibrium partitioning is based on a theoretical approach that does not necessarily lead to understanding cause and effect. It should be noted, however, that the US EPA, after spending ten years investigating it, has had to abandon equilibrium partitioning as a basis for developing sediment quality objectives. The State Board staff and S. Bay will be no more successful in this regard than the US EPA. It should also be noted that the original BPTCP studies, in some areas (such as Upper Newport Bay), did not include gathering information (such as AVS) that is essential to properly apply equilibrium partitioning to evaluate whether metals in sediments were present at sufficient concentrations to be potentially toxic. This is another example of the serious deficiencies that exist in the current BPTCP database that will make its use, as proposed by Bay, unreliable.

Bay, in the slide "SQO Development," indicated that numeric SQOs would incorporate mixture effects. If this means that they are going to try to use the summed quotient Long and

Morgan co-occurrence-based approach, this should not be done, since it is well known to be unreliable, where the results depend on the number of components incorporated into the summed quotient value. As DiToro (2002) and Chapman, et al. (2002) have pointed out, and as is obvious based on aquatic chemistry and toxicology, coincidence between exceedance of a single or summed quotient co-occurrence-based sediment quality guideline and a toxic response is only an indication that the area is contaminated – i.e., contains elevated concentrations of a number of constituents. It provides no reliable information on the cause of toxicity. The toxic constituent(s) could readily be constituents that are not part of the summed quotient guideline value. Without TIEs to determine the cause of the toxicity, the summed quotient co-occurrence value is of no reliable utility in a water quality management program.

Bay's slide "Numeric SQOs," indicates that AETs, ERMs, regression and equilibrium partitioning will be used. This is technically wrong. There is no point in spending any of the $2.5 million that the State Board made available for this effort on ERMs, AETs or equilibrium partitioning. Other highly talented and experienced individuals have already been down this path and have had to give it up. The focus of the sediment quality objectives development for California should be on developing a best professional judgment triad weight-of-evidence approach for evaluating sediment quality objectives.

In 2002 proceedings of an international weight-of-evidence conference were published in *Human and Ecological Risk Assessment.* There are several important review papers in this publication (Burton, et al., 2002a,b; Chapman, et al., 2002) that provide important background information on how to develop appropriate weight-of-evidence approaches for contaminated sediments and, for that matter, the water column. Lee and Jones-Lee (2002a) have discussed the importance of properly incorporating chemical information into a weight-of-evidence approach, pointing out that total concentrations, such as those used in a co-occurrence-based approach, are not reliable chemical components of a weight of evidence. They could readily skew the results of the weight of evidence to lead to an incorrect conclusion on the cause of toxicity and the sources of the constituents responsible for the toxicity. As discussed in my previous comments on the failed attempt by the State Board staff to develop sediment quality objectives in the original BPTCP, this was one of the significant errors made by the State Board staff in formulating the BPTCP and presenting the results. My previous comments on this matter are available from my website, www.gfredlee.com, in the Contaminated Sediment section.

With respect to Bay's slide "Bioaccumulation SQO Support," where it is stated, *"Resulting framework will identify method and data needs for future application,"* it is important that the focus of the bioaccumulation work not be on mathematical models, but on guidelines on how to make site-specific evaluations of bioaccumulation, in which sediments are evaluated with respect to the bioavailability of sediment-associated constituents that tend to bioaccumulate and the sources of the constituents of concern. As I mentioned in my previous comments, I have reviewed the mathematical models available for bioaccumulation (Lee and Jones-Lee, 2002b). None of these models provides reliable results without significant site-specific field evaluation to tune the model to site-specific conditions to develop a biota sediment accumulation factor.

With respect to the implementation program for the use of the sediment quality objectives, it will be important that the State Board staff, early in the program, develop some

representative data on sediment characteristics and then discuss how these data will be used to regulate the composition of sediments and the need for sediment remediation and source control (in an Aquafund program). This approach, if properly carried out, will show whether the sediment quality objectives that are proposed to be developed are compatible with their use in a sediment quality management program that can be administered at the Regional Board level.

S. Bay, at the July 29 meeting, stated, in response to a comment, that the SETAC Pellston Workshop on Use of Sediment Quality Guidelines and Related Tools for the Assessment of Contaminated Sediments concluded that co-occurrence-based sediment quality guidelines are reliable. I have discussed this situation with several individuals who participated in this workshop. I have also heard several others (such as Burton, 2002; Chapman, 2002; Engler, 2003; DiToro, 2002; Bridges, 2003; Wenning, 2003) discuss the results of this workshop. What was said by Bay at the July 29 meeting in response to comments and what the above individuals have presented at conferences/workshops are just the opposite, with respect to the reliability of co-occurrence-based sediment quality guidelines as a regulatory tool for contaminated sediments.

The issue that has to be addressed is whether co-occurrence (coincidence) based approaches, which involve the use of total concentrations of chemicals, rather than toxic available forms, can be used as sediment quality objectives that are to be used as a regulatory tool for defining sediments that need remediation and defining sources of constituents that need to be controlled to prevent the adverse impacts of sediment-associated contaminants derived from a source. A critical review of the conclusions from the SETAC Pellston workshop on sediment quality guidelines shows that the workshop focused primarily on scientific issues, and not on regulatory issues. There can be no valid conclusion that co-occurrence-based values represent a reliable component of a regulatory tool for managing contaminated sediments.

While, in the hands of experts, the chemically based sediment quality guidelines have the potential to be of assistance as limited-scope screening values, as discussed by Lee and Jones-Lee (1993, 1996, 2002b), this can readily lead to incorrect conclusions with respect to predicting sediment toxicity. Further, the existence of co-occurrence (coincidence) based sediment quality guidelines is causing what the author calls “horror stories” with respect to developing water pollution control programs. These horror stories are examples of where large amounts of public funds are being spent in the name of sediment cleanup and source control, based solely on an exceedance of a Long and Morgan or MacDonald co-occurrence-based “guideline” value.

As discussed in the author’s previous writings, an example of this inappropriate approach occurred in the Santa Monica Bay Restoration Program (SMBRP), where the State Board staff responsible for the BPTCP guided the SMBRP to accept that a single lead concentration in Santa Monica Bay sediments above a Long and Morgan sediment quality guideline was sufficient justification to cause the public in the Santa Monica Bay watershed to have to spend $42 million in treating urban stormwater runoff to control lead. Those responsible for formulating the Santa Monica Bay Restoration Program, which included the Los Angeles Regional Water Quality Control Board, the State Water Resources Control Board and the US EPA Region 9, all supported the position that lead in urban stormwater runoff needed to be controlled, because of the exceedance of a co-occurrence-based value in the sediments, which indicated that it was

potentially toxic to aquatic life. The SMBRP managers and the oversight regulatory agencies refused to conduct the suggested toxicity testing to determine whether the sediments that had the "excessive" lead was toxic from any cause, much less lead. Those familiar with highway and street runoff-derived lead (see review by Lee and Jones-Lee, 1997, and Lee and Taylor, 1998) know that this lead is in a nontoxic form and remains in this form in many freshwater and all marine systems.

Another example of a horror story in the use of co-occurrence-based sediment quality guideline values occurred with the US EPA Region 9 using these values to establish the TMDL goal for control of excessive bioaccumulation of organochlorine "legacy" pesticides and PCBs in Upper Newport Bay sediments in Orange County, California. The Region 9 staff responsible for this approach obviously did not understand that the Long and Morgan organochlorine and PCB guideline values do not incorporate bioaccumulation, but focus on a toxic response. Such guideline values – even if they had validity for toxicity – would have no validity for bioaccumulation.

Recently, the authors have become aware of another significant horror story with respect to using Long and Morgan sediment quality guideline values as regulatory values, where the California Department of Fish and Game (DFG) personnel responsible for Chinook salmon habitat development were using mercury-laden gold mine dredger tailings as a source of river gravel. The DFG staff used the Long and Morgan co-occurrence-based sediment quality guideline values to determine the concentrations of mercury in the gravel that were "safe" to add to a river. Again, the Long and Morgan co-occurrence-based so-called "sediment quality guideline" value for mercury is not reliable for sediment toxicity – much less for estimating the potential for bioaccumulation of mercury. In an effort to provide guidance to DFG and others on the current state of information on regulating mercury to prevent excessive methylmercury bioaccumulation in edible fish tissue, Lee (2003c) developed a write-up on this issue. This write-up provides additional information on why total mercury and co-occurrence-based sediment quality guidelines for mercury are not reliable for estimating the potential for mercury in sediments to lead to excessive mercury tissue residues in edible fish.

These are just a few of the many examples of how these so-called "screening" values have become regulatory limits, in which large amounts of public and private funds have been devoted to projects based on these values. So long as there are individuals working with regulatory agencies and others who do not take the time to understand the lack of a technical base for the Long and Morgan co-occurrence (coincidence) "guideline" values, there will be misuse of these values. It would be far better if these values were totally eliminated from the literature.

At the end of the July 29 meeting C. Beegan posed a question about what happens if S. Bay fails to demonstrate the reliability of chemically based numeric sediment quality guidelines for developing sediment quality objectives, and, therefore, there is need to develop sediment quality objectives based on a best professional judgment triad weight-of-evidence approach. Until this point in the meeting there was no suggestion that there is any question about chemical-specific sediment quality objectives based on co-occurrence being unreliable. As someone who has been involved since the mid-1970s in developing sediment quality criteria and their use for

regulatory purposes, I can unequivocally state that S. Bay's proposed approach for developing sediment quality objectives based on total concentrations of constituents in sediments will prove to be largely a waste of time and money.

The legislative requirements for developing sediment quality objectives, per the BPTCP, require adequate protection of the most sensitive organism. State Board staff and their consultants have repeatedly made this statement as to requirements for these objectives. However, what they have not said and what needs to be understood is that, under Porter-Cologne, the sediment quality objectives must be protective without significant unnecessary overprotection. The current approach could readily lead to overprotection and an expenditure of public and private funds well beyond that needed to protect the designated beneficial uses of the waterbody. Further, since the current approach does not incorporate TIEs, it could readily fail to detect the constituents in sediments that are responsible for toxicity or other adverse impacts on the beneficial uses – i.e., it could be underprotective. The overprotection issue must be incorporated into the sediment quality objectives development program, where guidance is provided on how to be protective, without significant overprotection – i.e., when the public or private interests spend money for control of contaminated sediments, these funds are being used in a technically valid, cost-effective manner. Further, the underprotection issue must be addressed, to be reasonably sure that adequate investigation is conducted associated with a particular sediment quality problem to properly identify the cause of the problem and thereby focus the control on the constituents responsible.

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