Comments on
"'Draft Staff Report Substitute Environmental Document Proposed Amendments to the Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality for the Protection of Fish and Wildlife' Report of
State Water Resources Control Board Division of Water Quality
January 28, 2011"

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Summary of Comments

The development of narrative sediment quality objectives can be a major step toward effecting reliable evaluation and regulation of pollutants in aquatic sediments provided that the SQO implementation is grounded in reliable evaluation of sediment toxicity and excessive bioaccumulation of chemicals that are a threat to human health for those who use aquatic organisms as food. Chemical concentration-based approaches should not be used in the estimation of sediment toxicity. Properly developed, technically sound TIEs are essential to the reliable identification of the cause of the sediment toxicity.

There is need to immediately correct the technical shortcomings and errors reflected in the Part 1 SQOs, including the elimination of the grandfathering of previously adopted sediment TMDL goals developed through co-occurrence-based sediment quality guidelines.

Unreliable approaches for sediment toxicity identification, including the statistical correlations and gradient analysis, should be removed from the toxicity identification procedures suggested in the current SQOs.

The chemical concentration-based so-called "chemistry" component of the current SQOs should be abandoned for use in evaluating sediment quality since it has been well-established that there is no relationship between the total concentration of a chemical in sediments and aquatic life toxicity.

The list of focus chemicals that can cause sediment toxicity needs to be expanded to include ammonia, nutrient-caused low-DO situations, and pyrethroid pesticides; those parameters in particular, should be given high priority for attention.

List of Primary Actions That Should Be Adopted by the SWRCB

- The Draft report fails to address several significant deficiencies in the September 16, 2008 SQO Plan that undermine the Plan's technical validity. For example, use of co-occurrence-based sediment quality objectives is allowed by the September 16, 2008 SQO Plan if the Regional Board had incorporated them into TMDL goals adopted prior to February 19, 2008. Co-occurrence-based objectives and regulatory instruments should not be allowed. As

discussed below there is immediate need to amend the Part1 SQO plan to correct this significant error.

- The studies conducted by SWRCB contractors in developing the Part 1 SQOs Plan clearly demonstrated what had been demonstrated in the 1970 by Lee and his associates: there is no relationship between the total concentration of a chemical in sediments and its toxicity to or bioaccumulation within aquatic life. The wording in this Draft Report needs to state emphatically in that such approaches are not to be used in association with screening, evaluation, or management of sediments.

- One of the most significant deficiencies in the current SQOs is their limited scope of pollutant types that are addressed. The deliberate exclusion of ammonia, low-DO conditions caused by nutrient discharges to a waterbody, pyrethroid-based pesticides, and others and the inclusion of only a few of the well-known, and even less concerning, pollutants in aquatic sediments represents a very significant shortcoming in the current SQOs Plan that should be immediately corrected. Ammonia, pyrethroid-based pesticides, and low-DO conditions are among the most significant causes of real sediment toxicity. Large amounts of money will be spent in "remediating" sediments targeted because of their heavy metal content that may or may not be causing water quality problems, while ignoring known, more important causes of sediment toxicity is contrary to the public interests.

- The Part 1 SQO Plan should be immediately amended to eliminate the grandfathering of previously adopted, unreliable TMDL remediation goals based on co-occurrence-based approaches.\

- Because of their inherit unreliability for this purpose, total contaminant concentrations should be eliminated from the SQO protocols used to evaluate "sediment quality" and sediment toxicity. Instead, narrative SQOs based on direct measurement of toxicity should be used as the primary tool for assessing sediment quality with respect to toxicity to aquatic life.

- Statistical correlations should not be used to try to identify the cause of sediment toxicity.

- The SWRCB/State of California needs to take aggressive action to prevent the US EPA Region 9 from further imposition of technically invalid co-occurrence-based TMDLs and remediation goals on California stormwater management agencies and other California dischargers.

Specific Comments

As part of reaching an agreement with the California Sportsfishing and Protection Alliance the California State Water Resources Control Board (SWRCB) agreed to propose updated sediment quality objectives (SQOs) for California coastal bays and estuaries. On January 28, 2011 the SWRCB released a "Draft Staff Report Substitute Environmental Document Proposed Amendments to the Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality for the Protection of Fish and Wildlife" (draft report). This draft report is available online at http://www.swrcb.ca.gov/water_issues/programs/bptcp/docs/sediment/012811staff_rpt.pdf.

The "1 INTRODUCTION" states,
"*1.1 Purpose*
This draft staff report represents the State Water Resources Control Board (State Water Board) formal water quality planning and substitute environmental document (SED) to support amendments to the Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (Part 1) adopted September 16, 2008, and effective August 25, 2009. Part 1 protects benthic invertebrates from direct exposure to toxic pollutants in sediment and human consumers of resident fish and shellfish from contaminants in fish tissue that were transferred through the food web from sediments into finfish and shellfish. Part 1 and the associated 2008 Staff Report are both incorporated by reference and available at http://www.waterboards.ca.gov/water_issues/programs/bptcp/sediment.html

Because pollutants in sediment can harm other receptors, staff is proposing the following amendments:

- *A proposed narrative sediment quality objective that protects wildlife and resident finfish from the effects caused by exposure to pollutants in sediment*
- *A proposed process for implementing these narrative objectives*
- *Proposed definitions added to the glossary in support of the narrative objectives described above*

Staff is also proposing amendments that address typographical errors and omissions."

Page 19 of the draft report states at the end of *"Section 4.3.2 Water Quality Objectives,"*
"*State Water Board – Division of Water Quality*
The Water Quality Control Plan for Enclosed Bays and Estuaries Part 1 Sediment Quality contains receptor exposure specific narrative SQOs, neither of which, are intended to be directly protect [sic] *fish or wildlife though some protection is provided secondarily by the protecting the benthic community, a primary food source for many bay and estuarine fish and birds. These narratives are*

- *Aquatic Life – Benthic Community Protection - Pollutants in sediments shall not be present in quantities that, alone or in combination, are toxic to benthic communities in bays and estuaries of California (pg 3).*
- *Human health - Pollutants shall not be present in sediments at levels that will bioaccumulate in aquatic life to levels that are harmful to human health (pg 3)."*

The statement that the sediment quality objective document adopted in 2008 "*protects benthic invertebrates from direct exposure to toxic pollutants in sediment and human consumers of resident fish and shellfish from contaminants in fish tissue that were transferred through the food web from sediments into finfish and shellfish."* is not technically reliable as discussed in our previous writings on the subject that are available on our website [www.gfredlee.com] in the Contaminated Sediment section. As noted further below, there is need to update and correct the 2008 SQOs Plan to more reliably protect the beneficial uses of the waterbodies in which the contaminated sediments are located. As discussed in comments we made to the Board at the time of the SQO Plan adoption, there are technical deficiencies in the 2008 SQOs Plan that will cause public and private interests to spend large amounts of funds in the name of sediment

"remediation" – "remediation" that is not based in sound technical evaluation and that cannot be relied upon to address real causes of sediment toxicity.

As discussed in our writings, regulatory approaches for controlling adverse impacts of pollutants in sediments should focus on

- identifying and eliminating *sediment toxicity* that significantly adversely impacts the beneficial uses of the waterbody overlying the sediments
- identifying and addressing sediments that contribute bioaccumulatable chemicals that are a threat to human health and wildlife.

The 2008/2009 SQOs Plan for characterizing sediment quality is first and foremost, technically invalid for identifying sediments that may be causing adverse impacts, for identifying the cause(s) of sediment toxicity or other problems, and for directing and assessing the efficacy of "remediation" approaches. Even if it were technically valid, it is overly complex and very expensive – beyond the resources of the typical Regional Boards.

The proposed revisions of the SQOs Plan provide an opportunity to develop narrative SQOs that address the technical shortcomings and more offer a mechanism for reliably protecting the beneficial uses of waterbodies from chemical contaminants in aquatic sediments without unnecessary expenditures for misdirected sediment remediation and source control. The SWRCB staff's proposed "*amendments that address typographical errors and omissions*." incorporated into the draft report need to be significantly expanded to address major technical problems in the 2008 SQOs Plan and their implementation. Guidance on the proposed expansion of the narrative SQOs is provided in these comments.

The key to affording appropriate protection of the aquatic resources from pollutants in aquatic sediments rests with how the revised SQOs narrative objective is implemented into regulatory programs at the State Water Board and Regional Board levels. There are potential significant technical problems with the implementation guidance outlined in the draft report such as on page 19, ***"4.4 Ambient and Receiving Water Monitoring***
4.4.1 Regional Monitoring
In order to assess the status of the beneficial uses described in Section 4.3 above, monitoring is required. In California, water and sediment quality monitoring are routinely performed by the Water Boards, U.S. EPA, other state and federal agencies, academic institutions and other public research organizations, the regulated community, environmental advocacy organizations and stakeholders in bays and estuaries. Collaborative regional monitoring programs are probably best suited for assessing the health of many of these beneficial uses for several reasons:

- *Monitor large areas that for many resident species represent a significant portion of the entire foraging area or habitat.*
- *Apply multiple indicators to develop a comprehensive understanding of the health of these beneficial uses."*

Concentrations of chemicals in sediment or "criteria" based on, or indexed to, sediment concentrations should not be included among "multiple indicators" of the health of beneficial uses. Such measures are unrelated to impacts of sediment associated chemicals and serve only to skew assessments of sediment quality in an arbitrary manner.

The foundation of the implementation of the proposed narrative SQOs is the reliable measurement of

- toxicity within sediments and resulting from suspension of bedded sediments, and
- excessive bioaccumulation of pollutants in edible aquatic life which poses a threat to health of those who eat the aquatic organisms and wildlife.

Information on the potential impacts of nutrients leading to toxicity to aquatic life due to low DO is presented in,

> Lee, G. F. and Jones-Lee, A., "Role of Aquatic Plant Nutrients in Causing Sediment Oxygen Demand Part I – Origin of Rapid Sediment Oxygen Demand," Report of G. Fred Lee & Associates, El Macero, CA, May (2007). http://www.gfredlee.com/Sediment/NutrientSOD1RapidOD.pdf
>
> Lee, G. F., and Jones-Lee, A., "Role of Aquatic Plant Nutrients in Causing Sediment Oxygen Demand Part II – Sediment Oxygen Demand," Report of G. Fred Lee & Associates, El Macero, CA, June (2007). http://www.gfredlee.com/Sediment/NutrientSOD2SOD.pdf
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> Lee, G. F., and Jones-Lee, A., "Role of Aquatic Plant Nutrients in Causing Sediment Oxygen Demand Part III – Sediment Toxicity," Report of G. Fred Lee & Associates, El Macero, CA, June (2007). http://www.gfredlee.com/Sediment/NutrientSOD3Tox.pdf

There have been and continue to be attempts made by the State and Regional Boards to try to use concentrations of sediment-associated chemicals together with some correlative factor to "estimate" toxicity and the potential for excessive bioaccumulation. However, it has been well-established in the technical literature and in practice that the concentration of a contaminant or group of contaminants in an aquatic sediment is not a reliable predictor of sediment toxicity or bioaccumulation. It has also been well-established that "co-occurrence"-based "sediment quality guidelines" such as those developed by Long and Morgan and subsequently by MacDonald are technically invalid for use as screening or regulatory limits to establish "impairment" of sediments or as TMDL sediment remediation goals. As discussed below those technically invalid approaches are also being used by the US EPA Region 9 TMDLs for Oxnard Drain 3, February 2011, Draft in regulating chemicals in aquatic sediments and for other California waterbodies. Such chemical concentration-based approaches are trapping the public, commerce, and industry into costly sediment "remediation" programs that fail to address the real cause and sources of aquatic toxicity in the sediments.

As quoted above from the draft staff report section, *"1.1 Purpose,"* the proposed narrative sediment quality objective incorporates, *"Quality Control Plan for Enclosed Bays and Estuaries – Part 1 Sediment Quality (Part 1) adopted September 16, 2008, and effective August 25, 2009. Part 1.*" While the SWRCB staff and its advisors have included "*proposed amendments that address typographical errors and omissions,"* the Draft report fails to address several significant deficiencies in the September 16, 2008 SQO Plan that undermine the Plan's technical validity. For example, use of co-occurrence-based sediment quality objectives is allowed by the

September 16, 2008 SQO Plan if the Regional Board had incorporated them into TMDL goals adopted prior to February 19, 2008. Co-occurrence-based objectives and regulatory instruments should not be allowed. **As discussed below there is immediate need to amend the Part1 SQO plan to correct this significant error**.

Section "4.5.3 Site Assessment and Cleanup" on page 24 of the Draft Plan describes in general terms the incorporation of a conceptual model approach for identifying receptors of concern and focus of sediment cleanup activities. The Draft states,
"*For many receptors, risk is estimated by comparing pollutant concentrations in sediments and prey tissues to calculated risk thresholds developed specifically for those receptors. For other receptors, such as benthic invertebrates, direct measurements such as benthic community composition, sediment toxicity and chemistry may be applied instead."*

It has already been noted in these comments, and discussed at length by us and in the broader technical literature, there is no cause-and-effect coupling between total concentrations of contaminants in sediment and adverse impact or "risk" of impact associated with those chemicals that is essential for meaningful and technical valid evaluation and management. Further, the term "sediment chemistry" is misused in that passage as it refers to chemical composition and concentration rather than "chemistry." Chemistry should refer to reactions and rates of reactions that lead to chemical composition of a sediment. As discussed in our original comments on the then-proposed SQOs (cited below), sediment chemical composition is not a reliable approach for site assessment and cleanup goals.

> Lee, G. F., and Jones-Lee, A., "Comments on 'Draft Staff Report, Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1. Sediment Quality Developed by State Water Resources Control Board, California Environmental Protection Agency July 18, 2008'" and Answers to SWRCB Staff Responses to Comments on September 2007 Proposed SQO Development Approach. Submitted to State Water Resources Control Board, Sacramento, CA. Report of G. Fred Lee & Associates, El Macero, CA, September 5 (2008).
> http://www.gfredlee.com/Sediment/SQOCommentsAnswers.pdf

Rather than simply providing another assessment parameter, inclusion of sediment chemical composition in site assessment and cleanup goals renders the assessment and goals technically unreliable.

Section *5.4 Implementation of the Sediment Quality Objectives,"* beginning on page 29 of the draft report states,
"5.4.1 Assessment
The methodology used to assess sediment quality relative to the proposed SQO is just as important as the narrative itself. However there are few scientifically defensible options available. Mechanistic sediment quality guidelines (SQGs) based on equilibrium partitioning theory is one potential option. Equilibrium partitioning theory incorporates factors relating to bioavailability and toxicity and can be used to predict pore water concentrations of contaminants from dissolved concentration of contaminants in the water column for select classes of contaminants. Empirical SQGs derived from the statistical analysis of matched sediment chemistry and biological effects data present another option. Examples of empirical

SQGs for the marine environment include the effects range-median (ERM) probable effects level (PEL), apparent effects level (AET) as described in the 2008 Staff Report. An advantage to these approaches is the relative ease of use compared to more complex approaches and minimal need for best professional judgment. However, there are significant limitations in the application of mechanistic and empirical SQGs for these receptors as well. None of these SQGs were developed to protect higher level organisms from effects associated with the accumulation of contaminants through trophic transfer (Wenning et al, 2005)."

That section does not sufficiently describe the serious technical deficiency of incorporating co-occurrence-based approaches, including ERM, PEL, AET, for estimating sediment toxicity. As discussed in several of our papers and reports on our website, including:

> Lee, G. F. and Jones-Lee, A., "Appropriate Incorporation of Chemical Information in a Best Professional Judgment 'Triad' Weight of Evidence Evaluation of Sediment Quality," Presented at the 2002 Fifth International Symposium on Sediment Quality Assessment (SQA5), IN: Munawar, M. (ed.), Aquatic Ecosystem Health and Management 7(3):351-356 (2004).
> http://www.gfredlee.com/Sediment/BPJWOEpaper.pdf
>
> Jones-Lee, A. and Lee, G. F., "Unreliability of Co-Occurrence-Based Sediment Quality Guidelines for Contaminated Sediment Quality Evaluation at Superfund/Hazardous Chemical Sites," Journ. Remediation 15(2):19-34 (2005).
> http://www.gfredlee.com/Sediment/SQGSuperfund2.pdf

and in our previous comments to the SWRCB, the co-occurrence-based approaches that serve as the foundation of ERMs, ERLs, PEL, among other such surrogates, are technically invalid and should not be used for any evaluation or management purpose. The studies conducted by SWRCB contractors in developing the Part 1 SQOs Plan clearly demonstrated what had been demonstrated in the 1970 by Lee and his associates: there is no relationship between the total concentration of a chemical in sediments and its toxicity to or bioaccumulation within aquatic life. **The wording in this Draft Report needs to state emphatically in that such approaches are not to be used in association with screening, evaluation, or management of sediments.**

In the 1970s Dr. G. Fred Lee conducted an approximately $1-million, five-year study of the release, prediction of release, and toxicity impacts of sediment-associated contaminants for the US Army Corps of Engineers Dredged Material Research Program. In addition to the comprehensive literature assessment, that investigation involved the evaluation of aquatic sediments from about 100 urban/industrial waterway sites across the US for their concentrations of about 30 contaminants (including organochlorine legacy pesticides (DDT), PCBs, heavy metals, several other potential pollutants), the release of contaminants from those sediments in a variety of laboratory and field conditions, and the aquatic life toxicity of those sediments. The results of that study were published by the Corps of Engineers in a 2-part, 1,500 page report:

> Lee, G. F., Jones, R., Saleh, F., Mariani, G., Homer, D., Butler, J., and Bandyopadhyay, P., "Evaluation of the Elutriate Test as a Method of Predicting Contaminant Release during Open Water Disposal of Dredged Sediment and Environmental Impact of Open Water Dredged Materials Disposal, Vol. II: Data Report," Technical Report D-78-45, US Army Engineer Waterway Experiment Station, Vicksburg, MS, 1186 pp., August (1978).

Jones, R. A., and Lee, G. F., "Evaluation of the Elutriate Test as a Method of Predicting Contaminant Release during Open Water Disposal of Dredged Sediment and Environmental Impact of Open Water Dredged Material Disposal, Vol. I: Discussion," Tech Report D-78-45, US Army Engineer Waterway Experiment Station, Vicksburg, MS, August (1978).

With his colleagues, Lee also developed numerous papers and reports addressing their findings in that and subsequent related studies, many of which are available on Lee's website in the Contaminated Sediments section [http://www.gfredlee.com/psedqual2.htm#dredge], including:

Lee, G. F., and Mariani, G., "Evaluation of the Significance of Waterway Sediment-Associated Contaminants on Water Quality at the Dredged Material Disposal Site," IN: Aquatic Toxicology and Hazard Evaluation, ASTM STP 634, American Society for Testing and Materials, pp. 196-213 (1977). [http://www.gfredlee.com/Sediment/Lee-Mariani-ASTM.pdf]

Lee, G. F., Lopez, J., and Mariani, G., "Leaching and Bioassay Studies on the Significance of Heavy Metals in Dredged Sediments," Proc. Internat. Conf. on Heavy Metals in the Environment, Toronto, Ontario, Canada, Oct 27-31, pp. 731-764 (1975). [http://www.gfredlee.com/Sediment/Lee-Lopez-Mariani-HMDredge.pdf]

Those Corps of Engineers studies served as the technical basis for the past and current regulatory approach used by the US EPA and the Corps of Engineers for regulating dredged sediment disposal. While the studies showed that many of the US waterway sediments studied contained high concentrations of many potential pollutants such as heavy metals, pesticides, and PCBs, those chemicals were not in toxic forms. The toxicity caused in the laboratory toxicity tests of those sediments was found to be due to ammonia derived from the accumulation of particulate organic nitrogen that decomposed to ammonia. Long and Morgan used the Lee et al. database in developing the so-called sediment quality guidelines (ERLs and ERMs) but failed to include information on the presence of ammonia in the sediments that has been found to be the most likely cause of the sediment toxicity found in those studies.

Issues That Should Have Been Corrected in Updating the SQOs Developed under Plan 1

Presented below is a discussion of several of the technical issues that should be addressed and corrected in the amendments to the *"Water Quality Control Plan for Enclosed Bays and Estuaries - Part 1 Sediment Quality Effective August 25, 2009"* [http://www.swrcb.ca.gov/water_issues/programs/bptcp/docs/sediment/sed_qlty_part1.pdf].

Many of these deficiencies were discussed in our comments on the then-proposed SQOs in:

Lee, G. F., and Jones-Lee, A., "Comments on 'Draft Staff Report, Water Quality Control Plan for Enclosed Bays and Estuaries – Part 1. Sediment Quality Developed by State Water Resources Control Board, California Environmental Protection Agency July 18, 2008'" and Answers to SWRCB Staff Responses to Comments on September 2007 Proposed SQO Development Approach. Submitted to State Water Resources Control Board, Sacramento, CA. Report of G. Fred Lee & Associates, El Macero, CA, September 5 (2008).
http://www.gfredlee.com/Sediment/SQOCommentsAnswers.pdf

and in other of our writings submitted to the SWRCB that are available on our website [www.gfredlee.com].

Scope of Pollutants

Page 1 of the *"'Water Quality Control Plan for Enclosed Bays and Estuaries - Part 1 Sediment Quality' Effective August 25, 2009"*states:

"I. INTENT AND SUMMARY

A. INTENT OF PART 1 OF THE WATER QUALITY CONTROL PLAN FOR ENCLOSED BAYS AND ESTUARIES (PART 1)

It is the goal of the State Water Resources Control Board (State Water Board) to comply with the legislative directive in Water Code §13393 to adopt sediment quality objectives (SQOs). Part 1 integrates chemical and biological measures to determine if the sediment dependent biota are protected or degraded as a result of exposure to toxic pollutants in sediment and to protect human health. Part 1 is not intended to address low dissolved oxygen, pathogens or nutrients including ammonia."*

One of the most significant deficiencies in the current SQOs is their limited scope of pollutant types that are addressed. **The deliberate exclusion of ammonia, low-DO conditions caused by nutrient discharges to a waterbody, pyrethroid-based pesticides, and others and the inclusion of only a few of the well-known, and even less concerning, pollutants in aquatic sediments represents a very significant shortcoming in the current SQOs Plan that should be immediately corrected.** Ammonia, pyrethroid-based pesticides, and low-DO conditions are among the most significant causes of real sediment toxicity. Large amounts of money will be spent in "remediating" sediments targeted because of their heavy metal content that may or may not be causing water quality problems, while ignoring known, more important causes of sediment toxicity is contrary to the public interests.

Incorporation of Unreliable Approaches

Also on Page 1 of the *"'Water Quality Control Plan for Enclosed Bays and Estuaries - Part 1 Sediment Quality' Effective August 25, 2009"* it is stated:

"*II. USE AND APPLICABILITY OF SQOs*

B. RELATIONSHIP TO OTHER NARRATIVE OBJECTIVES

1. Except as provided in 2 below, Part 1 supersedes all applicable narrative water quality objectives and related implementation provisions in water quality control plans (basin plans) to the extent that the objectives and provisions are applied to protect bay or estuarine benthic communities from toxic pollutants in sediments.

2. The supersession provision in 1. above does not apply to existing sediment cleanup activities where a site assessment was completed and submitted to the Regional Water Board by February 19, 2008."

As noted above, it is contrary to the interests of the State and the public to grandfather-in technically invalid, co-occurrence-based (ERM. ERL etc.) sediment quality guideline approaches that some Regional Boards (e.g., LA Regional Board) adopted for TMDL remediation goals. The SWRCB also adopted co-occurrence-based approaches into Colorado Lagoon and McGrath Lake TMDL remediation goals for PCBs, and organochlorine legacy pesticides developed to attempt to correct sediment toxicity. As discussed below this approach is technically invalid.

The Part 1 SQO Plan should be immediately amended to eliminate the grandfathering of previously adopted, unreliable TMDL remediation goals based on co-occurrence-based approaches.

Chemical Score Index and California Logistic Regression Model

Page 7 of the *"'Water Quality Control Plan for Enclosed Bays and Estuaries - Part 1 Sediment Quality' Effective August 25, 2009"* states in Section "V. BENTHIC COMMUNITY PROTECTION":

"H. SEDIMENT CHEMISTRY

1. All samples shall be tested for the analytes identified in Attachment A – This list represents the minimum analytes required to assess exposure. In water bodies where other toxic pollutants are believed to pose risk to benthic communities, those toxic pollutants shall be included in the analysis. Inclusion of additional analytes cannot be used in the exposure assessment described below. However, the data can be used to conduct more effective stressor identification studies as described in Section VII. F.

2. Sediment Chemistry Guidelines—The sediment chemistry exposure shall be assessed using the following two methods:

a. Chemical Score Index (CSI), that uses a series of empirical thresholds to predict the benthic community disturbance category (score) associated with the concentration of various chemicals (Table 6). The CSI is the weighted sum of the individual scores (Equation 1).

Equation 1. $CSI = \sum(w_i \times cat_i) / \sum w$

Where: cat_i *= predicted benthic disturbance category for chemical I;*

w_i *= weight factor for chemical I;*

$\sum w$ *= sum of all weights.*

b. California Logistic Regression Model (CA LRM), that uses logistic regression models to predict the probability of sediment toxicity associated with the concentration of various chemicals (Table 7 and Equation 2). The CA LRM exposure value is the maximum probability of toxicity from the individual models (P_{max}*)*

Another significant error in developing the current SQOs Plan is the use of the "Chemical Score Index" and the "California Logistic Regression Model" approaches that are simply mathematical manipulations of total concentrations of selected sediment-associated contaminants. While those approaches give the appearance of reliability in correlating the total concentration of a chemical and sediment toxicity than the ERM/PEL approaches, they are in fact rooted in what is known to be an unfounded assumption, namely that there is a quantitative and causative relationship between the total concentration of a chemical and sediment toxicity. The SWRCB staff has stated that it understands that such approaches can be in error in identifying impaired sediment and causes of sediment toxicity, but claims that such inherent unreliability in the approaches can be corrected by using the pollutant identification approaches listed in the SQO Part 1. That position is not technically defensible; perpetuation of the application of technically unreliable evaluation and management instruments will continue to result in unreliable and wasteful evaluation and "management" of sediments. As discussed in our comments on the then-proposed SQOs Part 1, several of the proposed Pollutant Identifications approaches are also not

technically valid for identification of the true cause of sediment toxicity. **Because of their inherit unreliability for this purpose, total contaminant concentrations should be eliminated from the SQO protocols used to evaluate "sediment quality" and sediment toxicity. Instead, narrative SQOs based on direct measurement of toxicity should be used as the primary tool for assessing sediment quality with respect to toxicity to aquatic life.**

Identifying Cause of Toxicity/Bioaccumulation

In the "F. STRESSOR IDENTIFICATION" section of the *"'Water Quality Control Plan for Enclosed Bays and Estuaries - Part 1 Sediment Quality' Effective August 25, 2009"* it is stated on pp. 18 and 19:

"2. Pollutant Identification—Methods to help determine cause may be statistical, biological, chemical or a combination. Pollutant identification studies should be structured to address site-specific conditions, and may be based upon the following:

a. Statistical methods—Correlations between individual chemicals and biological endpoints (toxicity and benthic community).

Statistical correlation is not a valid TIE procedure for identifying the cause of sediment toxicity. We recently again discussed this issue at length in:

> Lee, G. F., and Jones-Lee, A., "Comments on the Unreliability of Using Sediment Chemical Concentrations for Evaluating Cause of Sediment Toxicity and Altered Benthic Organism Assemblages in San Diego Bay Sediments," Report of G. Fred Lee & Associates, El Macero, CA, December 4 (2010).
> http://www.gfredlee.com/Sediment/ChemConc-SD-SedToxicity.pdf

as part of commenting on the paper:

> Thompson, B., Melwani, A.R., and Hunt, J.A., "Estimated Sediment Contaminant Concentrations Associated with Biological Impacts at San Diego Bay Clean-up Sites," SWRCB Agreement No. 08-194-190, Contribution No. 584, Aquatic Science Center, Oakland, CA (2009).
> http://www.aquaticsciencecenter.org/ASC_SanDiegoReport_Final.pdf

In those comments we pointed out a fundamental and insurmountable technical flaw of such approaches, namely that they are not founded in documented, quantitative, cause-and-effect couplings between sediment-associated contaminants and impact. There are no documented cause-and-effect *"Correlations between individual chemicals and biological endpoints"* of toxicity and bioaccumulation; based on total chemical composition and toxicology, no simple usable correlation would be expected. "Statistical methods" outlined in item (a) should not be applied unless and until their foundation in "cause-and-effect" has been documented and their predictive capability have been demonstrated with "before and after" data. The application of "statistical correlations" as a substitute for cause-and-effect-based TIEs/biological response studies can be expected to lead to incorrect labeling of problem sediments, "identification" of causes of "impacts" (e.g., heavy metals, organic chlorine legacy pesticides, PCBs), and anticipated "benefits" associated with any given "remediation" since that approach ignores the aquatic chemistry of these chemicals in sediments. The fact that a "statistical relationships" can be developed between parameters does not mean that the "relationships" have any capability to reliably predict changes in sediment toxicity/water quality characteristics that would result from changes in chemical concentrations in sediments. Such a demonstration of cause-and-effect is

essential for the development of reliable sediment cleanup objectives. Any statistical relationship between chemical concentrations in sediments and sediment toxicity must be solidly grounded in fundamental mechanisms (cause-effect) that influence how a chemical in sediments could impact sediment toxicity. Without such a foundation, the statistical relationship is simply game-playing.

The unreliability of "statistical correlations" for reliably establishing true cause-and-effect relationships is discussed in:

> Siegfried, T., "Odds Are, It's Wrong: Science Fails to Face the Shortcomings of Statistics," Feature in Science News 177(7):26 March 27 (2010). http://www.sciencenews.org/view/feature/id/57091/title/Odds_Are,_Its_Wrong

Statistical correlations should not be used to try to identify the cause of sediment toxicity.

b. *"Gradient analysis—Comparisons are made between different samples taken at various distances from a chemical hotspot to examine patterns in chemical concentrations and biological responses. The concentrations of causative agents should decrease as biological effects decrease."*

Gradient analysis is not reliable for identifying the cause of sediment toxicity. As discussed above, this would require that an undemonstrated cause-and-effect reflect relationship be presumed. Further, it would be quite unexpected for the concentrations of only the unique identifiable responsible chemical to change with distance from a "hotspot." It presumes also that the cause of an impact is not only a known chemical but also one that is included in the limited suite of chemicals measured. Even with a known cause of toxicity, the manifestation of toxicity may not be seen to decrease with decreasing concentration if the contaminant bioavailability is not properly taken into account or if the available concentration remains above a toxic threshold.

c. *"Additional Toxicity Identification Evaluation efforts—A toxicological method for determining the cause of impairments is the use of toxicity identification evaluations (TIE). Sediment samples are manipulated chemically or physically to remove classes of chemicals or render them biologically unavailable. Following the manipulations, biological tests are performed to determine if toxicity has been removed. TIEs should be conducted at a limited number of stations, preferably those with strong biological or toxicological effects."*

A properly designed and conducted TIE is a valid approach for identification of the cause of sediment toxicity.

d. *"Bioavailability*—Chemical pollutants may be present in the sediment but not biologically available to cause toxicity or degradation of the benthic community. There are several measures of bioavailability that can be made. Chemical and toxicological measurements can be made on pore water to determine the availability of sediment pollutants. Metal compounds may be naturally bound up in the sediment and rendered unavailable by the presence of sulfides. Measurement of acid volatile sulfides and simultaneously extracted metals analysis can be conducted to determine if sufficient sulfides are present to bind the observed metals. Similarly, organic compounds can be tightly bound to sediments. Measurements of sediment organic carbon and other binding phases can be conducted to*

determine the bioavailable fraction of organic compounds. Solid phase microextraction (SPME) or laboratory desorption experiments can also be used to identify which organics are bioavailable to benthic organisms."

These approaches if correctly implemented can be a useful tool to identify the potential bioavailability of a chemical in sediments. However caution should be exercised in relating bioavailability of a particular chemical to the cause of sediment toxicity as measured in toxicity tests.

e *"Verification—After specific chemicals are identified as likely causes of impairment, analysis should be performed to verify the results. Sediments can be spiked with the suspected chemicals to verify that they are indeed toxic at the concentrations observed in the field. Alternately, animals can be transplanted to suspected sites for in situ toxicity and bioaccumulation testing."*

If properly conducted, the "verification" step identified in item (e) is a potentially powerful tool to help reliably identify the cause of sediment toxicity. While not named as such in the discussion, that approach is basically the "standard additions" approach widely used in analytical chemistry to estimate the concentration of a chemical that cannot be measured directly. Description of the standard additions approach is available in such internet sources as http://en.wikipedia.org/wiki/Standard_addition and http://www.asi-sensors.com/ASI/learning/standard_addition.pdf. Basically it involves adding the suspected toxicant (in appropriate chemical form) in small increments and measuring the resultant toxicity response. If the chemical of potential concern is responsible for the initially observed toxicity, an increase in toxicity somewhat proportional to the addition would be expected. Critical to appropriate use of this approach for "verification" is the understanding that the behavior of a chemical as a toxicant may change with time after the addition due to chemical transformations that can take place in the sediments. As a result, it is important to conduct the standard additions over aging time to see if the toxic response is also related to incubation time. Care must also be exercised in over-reading or over-extrapolating the results of such "verification."

Assessing Sediments as Source of Bioaccumulatable Chemicals

The potential for aquatic sediments to be a major source of chemicals that bioaccumulatable in aquatic organisms such that they are a threat to human health and wildlife should be based on first finding whether or not there is excessive bioaccumulation of hazardous chemicals in edible aquatic life. If there is a documentable problem of excessive bioaccumulation in aquatic organisms, it needs to be determined whether or not the sediments are a significant source of those chemicals. The authors discuss how such assessments can be made in their report, cited below, covering their study of sediments of Smith Canal in the city of Stockton to examine whether those sediments were a possible source of PCBs present in edible fish in the canal.

> Lee, G. F., Jones-Lee, A., and Ogle, R. S., "Preliminary Assessment of the Bioaccumulation of PCBs and Organochlorine Pesticides in Lumbriculus variegatus from City of Stockton Smith Canal Sediments, and Toxicity of City of Stockton Smith Canal Sediments to Hyalella azteca," Report to the DeltaKeeper and the Central Valley Regional Water Quality Control Board, G. Fred Lee & Associates, El Macero, CA, July (2002). http://www.gfredlee.com/HazChemSites/SmithCanalReport.pdf

Some of the information being developed as part of the SWRCB's current "indirect effects" assessment work for contaminants in sediments can be used to assess the significance of a sediment as a source of excessive bioaccumulatable chemicals in aquatic organisms.

SWRCB Approval of Colorado Lagoon Sediment TMDL Remediation Goal

Presented below is a discussion of problems presently being faced by stormwater dischargers as a consequence of how sediment remediation goals are being developed/approved by the SWRCB in November 2010.

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Issues Concerning the Unreliability of LARWQCB/SWRCB TMDL Goals for Organochlorine Legacy Pesticides, PCBs, Heavy Metals, and Toxicity in Sediments
Example: Colorado Lagoon Sediments

G. Fred Lee, PhD, PE, BCEE, F.ASCE and Anne Jones-Lee, PhD
Report of G. Fred Lee & Associates
El Macero, CA
gfredlee@aol.com www.gfredlee.com

The Los Angeles Regional Water Quality Control Board (Los Angeles Water Board; LARWQCB) adopted "Resolution No. R09-005 on October 1, 2009 incorporating a TMDL for OC pesticides, PCBs, sediment toxicity, PAHs, and metals in Colorado Lagoon."

According to the SWRCB November 16, 2010 information discussion of this issue "*Colorado Lagoon (Lagoon) is located within the City of Long Beach, Southern California. The Lagoon is a 15-acre, V-shaped tidal lagoon connected to Alamitos Bay and the Pacific Ocean via a box culvert to Marine Stadium. It serves three main functions: 1) hosting sensitive estuarine habitat; 2) providing public recreation; and 3) retaining and conveying storm flows. The lagoon is abundant in wildlife and acts as an important stop for thousands of migratory birds, including endangered species, every year. In addition, the lagoon is heavily used for recreational activities, including swimming, fishing, wildlife-viewing and picnicking. The Lagoon is used by hundreds of visitors from communities within and surrounding the City of Long Beach. The Colorado Lagoon watershed is approximately 1,172 acres, and it is divided into five sub-basins that discharge storm water and urban dry-weather runoff to the Colorado Lagoon. Each of the sub-basins are served by a major storm sewer trunkline along with supporting appurtenances that collect and transport storm water and urban dry weather runoff to the Colorado Lagoon. Surface water runoff within the watershed occurs as overland runoff into curb inlets and catch basins, and as sheet flow from near shore areas."*

"*Mass-based waste load allocations for MS4 permittees, including the City of Long Beach, Los Angeles County Flood Control District, and Caltrans, are allocated to the five major storm drain outfalls that currently discharge to the lagoon. Concentration-based waste load allocations for sediment are assigned to MS4 permittees including the City of Long Beach, Los Angeles County Flood Control District, and Caltrans*."
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On November 16, 2010 the California State Water Resources Control Board (SWRCB) approved a TMDL developed by the LARWQCB that is said to be directed to eliminating "toxicity" in the Colorado Lagoon sediments. That TMDL has as a goal of achieving "Effects Range Low" (ERL) concentrations of organochlorine legacy pesticides, PCBs, and several heavy metals in the lagoon's sediments. It stipulates that the responsible parties for the targeted chemicals in stormwater runoff (city of Long Beach, Caltrans, and Los Angeles County Flood Control District) are to remediate the lagoon sediments and control the sources to eliminate the exceedances of the ERLs for the target chemicals in the Colorado Lagoon. The Boards' actions notwithstanding, that TMDL and associated requirements are technically invalid and indefensible; they are not based on technically valid concepts, principles, or findings. Not only are the TMDL approach and requirements unreliable for addressing sediment quality issues in the Colorado Lagoon, but also they provide misleading precedent for sediment quality evaluation and management elsewhere. Failure to develop and implement technically valid TMDL goals for controlling appropriately targeted chemicals will lead to the expenditure of large amounts of public funds by parties responsible for stormwater runoff to the Colorado Lagoon, without the justified expectation of their elimination of the real, significant water quality impairments caused by lagoon waters/sediments.

The SWRCB also considered a TMDL for control of so-called sediment toxicity due to PCBs and organochlorine legacy pesticides in sediment of McGrath Lake in Ventura County. That TMDL, whose goal is the achievement of ERLs, is similarly technically invalid. Information on the McGrath Lake TMDL is available at:
http://www.swrcb.ca.gov/water_issues/programs/tmdl/docs/mcgrathlake/agnd113010.pdf.

The Colorado Lagoon TMDL and the McGrath Lake TMDL, both directed toward controlling aquatic sediment toxicity for PCBs and organochlorine legacy pesticides using technically invalid ERL-based approaches adopted by the LARWQCB several years ago, need to be revised to focus on the real, significant water quality problems in those waterbodies. Ed Long of Long and Morgan has stated that the ERM/ERL should not be used for bioaccumulatable chemicals such as PCBs.

At the November 17, 2010 SWRCB meeting in which the Colorado Lagoon TMDL was discussed, Dave Smith of the US EPA Region 9 stated that the US EPA supports the development of that TMDL with the stated ERL goal. In response to the presentation of similar unreliable and erroneous information concerning the use of ERL by US EPA Region 9 representatives, Lee developed the following report:

> Lee, G. F., "Comments on US EPA Region 9's Response to DSCSOC's Request for Technical Review of the Reliability of Using Co-Occurrence-Based SQGs in a LEHR Site Ecological Risk Assessment," Report submitted by G. Fred Lee & Associates to DSCSOC, February (2005).
> http://www.gfredlee.com/Sediment/ComUSEPAReg9SQG.pdf

In his presentation Mr. Smith failed to indicate that Region 9 had approved the SWRCB

Sediment Quality Objectives (SQOs), which were explicit in concluding that the use of "ERL" and "ERM" values is not technically valid for assessing sediment quality. The US EPA Region 9 staff is erratic and inconsistent in its support for the use of ERL approaches and values in evaluating sediment quality; the staff supports the use of the approach as part of the TMDL goal for the Colorado Lagoon but also supports an SWRCB SQO development approach that is rightly and highly critical of using the ERL approach for evaluating sediment quality. This issue is discussed further in:

> Lee, G. F., and Jones-Lee, A., "Use of Unreliable Sediment Quality Evaluation in the LEHR Superfund Site Ecological Risk Assessment" Report to DSCSOC by G. Fred Lee & Associates, El Macero, CA, November 29 (2009). Available at, http://www.gfredlee.com/DSCSOC/2009/LEHRSedQualEvalERA.pdf

Urban Pesticides as a Cause of Sediment Toxicity

Based on findings in similar situations, to the extent that there is aquatic life toxicity in Colorado Lagoon sediments it is most likely due to pyrethroid-based pesticides derived from the use of such pesticides in residential properties in the Colorado Lagoon watershed. Lee has had extensive experience in water quality impacts of pyrethroid pesticides; his work was the first to find that these types of pesticides were a cause of part of the aquatic life toxicity in the tributaries of Upper Newport Bay, CA. On behalf of the Santa Ana Regional Water Quality Control Board he and his colleagues conducted a major study of aquatic life toxicity in those tributaries during stormwater runoff events and developed several reports discussing the findings, including:

> Lee, G. F. and Taylor, S., "Results of Aquatic Toxicity Testing Conducted During 1997-2000 within the Upper Newport Bay Orange County, CA Watershed," Report of G. Fred Lee & Associates, El Macero, CA (2001). http://www.gfredlee.com/Watersheds/295-319-tox-paper.pdf

Lee's Stormwater Runoff Water Quality Newsletters 1-1, 2-1, 3-5, 3-6, 6-3, 6-4, 7-6/7, 8-1/2, 9-3, 9-4, 9-6, 9-7, 9-8, 10-3, 10-8, 10-12, 11-4, 11-7/8, 12-4, 12-7/8, 13-1, 13-2 available at, http://www.gfredlee.com/newsindex.htm provides discussion of many aspects and issues of aquatic life toxicity in urban stormwater runoff. Since completing the original studies in the 1990s he and others have found that pyrethroid pesticides are a common cause of aquatic life toxicity in water and sediments of urban waterbodies. They are likely to be the cause of aquatic life toxicity in Colorado Lagoon sediments, as well, and this toxicity will likely continue for many years to come since the pesticide regulatory agencies have indicated that it will likely be a number of years before the pyrethroid based pesticides are regulated to control aquatic life toxicity in urban stormwater runoff and waterbody sediments. Since the PCBs in the sediments of Colorado Lagoon are unlikely to be contributing to toxicity of those sediments, and since pyrethroid pesticides and other real potential causes of toxicity are not being addressed in a reliable manner, in this TMDL the dredging of the lagoon sediments to remove PCBs will not address, much less remedy, the toxicity problem. Information on the role of PCBs and other bioaccumulatable chemicals in aquatic sediments in impacting a waterbodies water quality is available in,

> Lee, G. F., and Jones-Lee, A., "PCBs as an Unlikely Cause of Urban Aquatic Sediment

Toxicity: Colorado Lagoon Sediment TMDL," Report of G. Fred Lee & Associates, El Macero, CA, December 3 (2010).
http://www.gfredlee.com/Sediment/PCBs-SedToxicity.pdf

Overall Assessment of the Unreliability of TMDL ERL Targets

Overall, the ERLs-based TMDL goal adopted by the SWRCB on November 16, 2010 for the Colorado Lagoon has its foundation in what is recognized in the technical community to be a technically invalid approach. The TMDL goal needs to be redefined and re-focused on the real significant water quality problems in the Lagoon. Aquatic organisms need to be evaluated for excessive bioaccumulation of hazardous chemicals. If PCBs are found in edible aquatic organisms, studies need to be conducted to define the sources of the PCBs, including caulk found in demolition materials from buildings and concrete. Studies are also needed to determine whether the lagoon sediments are toxic; if they exhibit aquatic life toxicity the cause(s) of the toxicity and sources of the toxic materials need to be defined, with particular attention to pesticides used on residential and commercial properties in the lagoon watershed. Adoption and proper implementation of this approach can lead to a reliable definition of the true significant water quality problems in the Colorado Lagoon, and provide a foundation for the control of these problems in a technically valid, cost-effective manner. Proceeding to implement the current TMDL ERL-based goals will cause the public to spend large amounts of funds without addressing and solving the real, significant water quality problems in this lagoon.

Questions on this discussion of this matter should be directed to Dr. G. Fred Lee gfredlee@aol.com. Information on Dr. Lee's expertise and experience is appended to these comments.

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US EPA Region 9 TMDLs for Oxnard Drain 3, February 2011, Draft in regulating chemicals in aquatic sediments.

In February 2011 the US EPA Region 9 released a draft for regulating aquatic life toxicity in Oxnard Drain Sediments. Information is available at,
http://www.epa.gov/region9/water/tmdl/la-lakes/Oxnard-drain3-TMDLs.pdf

The Internet statement on this issue states,
"*The United States Environmental Protection Agency (USEPA) Region IX entered into a consent decree with several environmental groups on March 22, 1999 which required development of TMDLs for many waterbody pollutant combinations, including Oxnard Drain 3, by March 2012 (Heal the Bay Inc., et al. v. Browner C 98-4825 SBA). To meet the consent decree deadline, USEPA is establishing Total Maximum Daily Loads (TMDLs) in Oxnard Drain 3 for bifenthrin, chlordane, chlorpyrifos, DDT, dieldrin, PCBs, toxaphene, and sediment toxicity.*"

Page 12 states
"*Sediment Quality Guideline Concentrations*
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There are no WQOs in the Basin Plan for pesticides and PCBs in sediments. Instead, the Regional Board assesses the quality of sediments using the freshwater Probable Effects Concentration (PEC), saltwater Threshold Effects Level (TEL), saltwater Probable Effects Level (PEL), or saltwater Effects Range Medium (ERM) values for all pollutants except DDT (MacDonald et al., 2000 and Long et al., 1995). The Oxnard Drain 3 TMDLs Feb 2011 saltwater DDT assessment concentration was determined in an EPA Superfund Record of Decision (1994). Sediment quality guidelines (SQGs) are developed from field and laboratory studies to predict the toxicity of pollutants on sediment-dwelling organisms. MacDonald et al. (2000) compiled a set of all the published SQGs and used the resulting geometric mean value to establish concentration based SQGs for threshold and probable effect concentrations of individual contaminants. The PEC, TEL, PEL, and ERM are the concentrations at which harmful effects on sediment-dwelling organisms are expected to occur, whereas the freshwater threshold effect concentration (TECs) and saltwater Effects Range Low (ERL) describes the level of contaminant that is not expected to have harmful effects on sediment-dwelling organisms. PECs, TELs, PELs, and ERMs were used to assess impairments, while TECs and ERLs are more conservative and were therefore used as targets for TMDLs. The sediment quality guidelines are designed to protect benthic dwelling organisms."

As is well-documented and noted herein, co-occurrence-based ERMs, ERLs, etc. are not valid for estimating sediment toxicity. The US EPA Region 9's approach for establishing sediment TMDL goals based on co-occurrence-based "sediment quality guidelines" perpetuates these technically invalid approaches for regulating sediment "quality." These issues are discussed in:

> Lee, G. F., "Comments on US EPA Region 9's Response to DSCSOC's Request for Technical Review of the Reliability of Using Co-Occurrence-Based SQGs in a LEHR Site Ecological Risk Assessment," Report submitted by G. Fred Lee & Associates to DSCSOC, February (2005).
> http://www.gfredlee.com/Sediment/ComUSEPAReg9SQG.pdf

Such chemical concentration-based approaches as proposed by the US EPA Region 9 for the Oxnard Drain 3 will trap the public, commerce, and industry into costly sediment "remediation" programs that fail to address the real cause and sources of aquatic toxicity in the sediments.

In the early 2000s Lee and Jones-Lee developed a review for the Central Valley Regional Water Quality Control Board of regulatory issues pertinent to controlling water quality impacts of organochlorine "legacy" pesticides and PCBs. That review included the following report:

> Lee, G. F., and Jones-Lee, A. "Unreliability of Sediment Co-Occurrence-Based Approaches for Evaluating Aquatic Sediment Quality," Excerpts from Lee, G. F. and Jones-Lee, A., "Organochlorine Pesticide, PCB and Dioxin/Furan Excessive Bioaccumulation Management Guidance," California Water Institute Report TP 02-06 to the California Water Resources Control Board/Central Valley Regional Water Quality Control Board, 170 pp, California State University Fresno, Fresno, CA, December 2002, updated August (2003). http://www.gfredlee.com/Sediment/UnrelSedCooccur.pdf

That report includes the following statement:
"*One of the most significant recent inappropriate uses of co-occurrence-based approaches for regulating sediment quality has been proposed by the US EPA (2002) Region 9. The Agency*

used the Buchman (1999) "NOAA Screening Quick Reference Tables (SQuiRTs)" to obtain TMDL targets for managing excessive bioaccumulation of organochlorine pesticides and PCBs in Upper Newport Bay, Orange County, CA, and its tributary San Diego Creek. The organochlorine chemicals of concern (for which there is excessive bioaccumulation in the Upper Newport Bay and its tributaries) are chlordane, dieldrin, DDT, PCBs and toxaphene."

In 2009, in response to a request from the Orange County, CA the National Water Research Institute (NWRI) organized a panel of experts to review the US EPA Region 9's that had been adopted by the Santa Ana Regional Water Quality Control Board as its proposed Basin Plan Amendments to establish TMDLs for control of organochlorine legacy pesticides and PCBs in Newport Bay sediments. The NWRI issued a report of that panel's deliberations as:

> National Water Research Institute (NWRI), "Assessment of TMDL Targets for Organochlorine Compounds for the Newport Bay" Final Report of the April 7-8, 2009, Meeting of the Independent Advisory Panel for the August 4, 2009 Fountain Valley, CA http://www.swrcb.ca.gov/water_issues/programs/tmdl/docs/newport_bay/crompton.pdf

That report states,

"*Purpose and History of the Panel*

In 2009, the County of Orange (County) requested that the National Water Research Institute (NWRI) of Fountain Valley, California, form an Independent Advisory Panel (Panel) to review the methods and underlying data used to develop total maximum daily loads (TMDLs) for organochlorine compounds for the Newport Bay Watershed, located in central Orange County, California. TMDLs are the maximum amount of a pollutant that a water body can receive and still attain water quality standards."

That panel also addressed several questions including,

"*2. Question 1*

Are the methods and underlying data used to develop the targets for the organochlorine TMDLs in the Newport Bay Watershed, as well as the targets proposed by the stakeholders, based on the best available science?

Findings

The Panel finds that neither the targets used in the TMDLs nor the targets proposed by the stakeholders are based on the best available science. Each target is discussed in turn. The Regional Board's sediment target is based on Threshold Effects Levels (TELs) for DDT and Effects Range Median (ERM) levels for chlordane. The Panel noted two limitations regarding the use of these values. The first is that TELs and ERMs do not relate to the impairments for which the TMDLs are being derived; instead, they are screening values for direct toxicant effects on exposed benthic invertebrates. The Panel notes that TELs and ERMs are used in the organochlorine TMDLs as a practical estimate of contaminant levels that might lead to the bioaccumulation of sediment-borne contaminants in higher trophic levels. However, no functional relationship exists between contaminant levels associated with toxicity to benthic organisms due to direct exposure to contaminated sediments and those associated with bioaccumulation. Guidance, such as that developed at the 2002 Pellston workshop on sediment quality guidelines (Moore et al., 2005), specifically refers to the inappropriateness of using such sediment quality guidelines for interpreting the risk of bioaccumulated toxicants. Secondly, the

Panel concludes that the derivation of these screening values is subject to considerable scientific uncertainty. Both TELs and ERMs are derived from statistical estimates of the level of contaminants in sediment at which effects to sediment organisms are observed in toxicity tests, using data aggregated from numerous separate studies. Dr. Byard pointed out at the April 2009 Panel meeting that the TEL database has numerous undocumented inconsistencies and apparent flaws. Though individual studies from which the TEL database extracted data have been peer reviewed, the data screening and aggregation process and related quality assurance procedures on which the database itself was built have not been thoroughly reviewed and vetted. The Panel believes that this lack of transparency and documented quality control seriously undermines confidence in the applicability of the derived TELs even for purposes related to direct sediment toxicity."

This NWRI review of co-occurrence-based sediment quality guidelines as a basis for sediment classification, specific SQOs, as well as a basis for TMDL remediation targets found this approach to be technically unreliable and inappropriate. Despite the vast technical literature on this issue and the findings of the NWRI review, co-occurrence-based so-called sediment quality guidelines have been, and continue to be, used by the US EPA Region 9 and some California Regional Water Quality Control Boards in developing/implementing regulations for potential pollutants in aquatic sediments.

The SWRCB/State of California needs to take aggressive action to prevent the US EPA Region 9 from further imposition of technically invalid co-occurrence-based TMDLs and remediation goals on California stormwater management agencies and other California dischargers.

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Summary

The development of narrative sediment quality objectives can be a major step toward effecting reliable evaluation and regulation of pollutants in aquatic sediments provided that the SQO implementation is grounded in reliable evaluation of sediment toxicity and excessive bioaccumulation of chemicals that are a threat to human health for those who use aquatic organisms as food. Chemical concentration-based approaches should not be used in the estimation of sediment toxicity. Properly developed, technically sound TIEs are essential to the reliable identification of the cause of the sediment toxicity.

There is need to immediately correct the technical shortcomings and errors reflected in the Part 1 SQOs, including the elimination of the grandfathering of previously adopted sediment TMDL goals developed through co-occurrence-based sediment quality guidelines.

Unreliable approaches for sediment toxicity identification, including the statistical correlations and gradient analysis, should be removed from the toxicity identification procedures suggested in the current SQOs.

The chemical concentration-based so-called "chemistry" component of the current SQOs should be abandoned for use in evaluating sediment quality since it has been well-established that there

is no relationship between the total concentration of a chemical in sediments and aquatic life toxicity.

The list of focus chemicals that can cause sediment toxicity needs to be expanded to include ammonia, nutrient-caused low-DO situations, and pyrethroid pesticides; those parameters in particular, should be given high priority for attention.

Qualifications of Commenters

Dr. G. Fred Lee is president of G. Fred Lee and Associates, an environmental quality consulting firm that specializes in addressing advanced technical aspects of impacts of chemical contaminants on water quality as they affect water supply water quality, water and wastewater treatment, water pollution control, and solid and hazardous waste impact evaluation and management. Drs. G. Fred Lee and Anne Jones-Lee are the principals of the firm, which serves myriad clients in governmental agencies, industry, public interest groups.

After earning his B.A. degree from San Jose State College in 1955, Dr. Lee earned his Master of Science in Public Health degree from the University of North Carolina in 1957 focusing on water quality, and his PhD degree from Harvard University in 1960 in Environmental Engineering with emphasis on aquatic chemistry. For 30 years, Dr. Lee held university graduate faculty positions in civil/environmental engineering at several US universities. During that time he taught graduate-level courses in environmental engineering and environmental sciences, conducted over $5-million in research, and published more than 475 professional papers and reports. Active as a part-time consultant during his university teaching and research career, Dr. Lee has been a full-time consultant, with Dr. Jones-Lee, since retiring from university teaching and research in 1989.

Dr. Lee's academic and professional expertise is focused on aquatic chemistry – the sources, fate, behavior, and impacts of chemicals in aquatic systems; Dr. Jones-Lee's academic and professional expertise is in aquatic biology and toxicology. Together they have pioneered in integrating aquatic chemistry/aquatic biology-toxicology in the evaluation of the water quality impact of chemicals in aquatic sediments with particular emphasis on developing sediment quality criteria. One of the areas of their specialization is the development of technically valid water quality investigations and cost-effective pollutant control programs to protect the designated beneficial uses of waterbodies without significant unnecessary expenditures for constituent control. Over the past 20 years in private consulting, they have developed another 600 professional papers and reports on their work, and have for the past 13 years published the "Stormwater Runoff Water Quality Newsletter." Drs. G. Fred Lee and Anne Jones-Lee have established a website, www.gfredlee.com, where they list and make available their recent papers, reports, and Newsletter.

Drs. Lee and Jones-Lee have served as consultants to numerous governmental agencies and industry in matters of sediment quality evaluation and management. Dr. Lee began investigating the water quality impacts of chemical contaminants in aquatic sediments in the early 1960s when he directed the Water Chemistry Program at the University of Wisconsin, Madison. There he worked with about 30 graduate students in the conduct of their MS thesis and PhD dissertation studies of sediment quality issues. Dr. Anne Jones–Lee has worked with Dr. Lee on sediment

quality issues since the mid-1970s. They have conducted approximately $1.5-million in related sponsored research, including an approximately $1-million study for the US Army Corps of Engineers devoted to assessing the contaminant composition, release, and toxicity of sediment-associated contaminants, and to developing dredged sediment quality criteria. Those studies included the composition and leachability of about 30 potential pollutants in about 100 waterway sediments from urban/industrial areas across the US, as well as toxicity of the sediments to aquatic organisms. Lee and his associates have published more than 90 professional papers and reports on their sediment quality and impact work, many of which are available on Dr. Anne Jones-Lee and his website [www.gfredlee.com] in the Contaminated Sediment Section [http://www.gfredlee.com/psedqual2.htm]. Additional information on Dr. G. Fred Lee's and Jones-Lee's professional activities is on their qualifications to support these comments is available on their website www.gfredlee.com in "About G. Fred Lee & Associates" at, http://www.gfredlee.com/gflinfo.htm and available upon request.