Comments on the SWRCB December 2, 2003, Draft Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List

Comments Submitted by
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February 17, 2004

On December 2, 2003, the State Water Resources Control Board (SWRCB) staff made available a Draft Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List. This draft Policy establishes a proposed approach for future Clean Water Act section 303(d) listing of waterbodies in California. The stated purpose of the Policy is to establish a standardized approach for developing the 303(d) list. The proposed approach is drastically different from the approach that has been used in the past and that should be followed to protect aquatic-life-related beneficial uses of the State's waters and that is necessary to properly implement the Clean Water Act.

Overall Comments

The State Board staff's proposed 303(d) listing approach is technically invalid and strongly contrary to protecting the beneficial uses of the state of California's waters. The draft Policy is based on a fundamentally flawed interpretation of the federal Clean Water Act's key provisions regarding the intent and approach that is to be followed in protecting and, where degraded, improving the beneficial uses of the nation's waters. Basically, the SWRCB staff are attempting to rewrite key provisions of the Clean Water Act (CWA) which govern attainment of water quality standards, through relaxing the requirements for defining violations of water quality standards and the approach for achieving compliance with water quality standards through the Total Maximum Daily Load (TMDL) provisions of the CWA.

In 1972, the federal Congress established in the CWA the requirement that the US EPA establish, as part of implementation of the CWA, national water quality criteria that will be protective of the beneficial uses of waterbodies. These water quality criteria are to be used by the states to establish the states' water quality standards. As required in the CWA, violations of the states' water quality standards are to be corrected through TMDLs to control the sources of pollutants that cause the water quality standards violations. California, like many other states and the US EPA Regional Administrators, ignored the TMDL provisions of the CWA regarding attainment of water quality standards where violations occurred. Finally, environmental groups filed suit against the US EPA to require that the Regional Administrators implement the TMDL requirements of the CWA so that there is attainment of water quality standards.

While some are complaining about the cost of implementing TMDLs to eliminate violations of water quality standards (WQSs) and thereby restore the beneficial uses of waterbodies, rather than devoting the necessary resources to eliminate the violations of WQSs,

the California SWRCB staff, through the draft Policy for developing the 303(d) listing, proposes to use an approach which would make it more difficult to list a waterbody for violations of WQSs, thereby weakening the key provisions of the CWA for attainment of WQSs. Basically, the SWRCB staff are attempting to be able to ignore WQS violations so that there will be fewer TMDLs to have to be addressed. This approach is obviously technically invalid and in direct violation of the CWA. In accordance with the CWA, violations of WQSs should be corrected by controlling the pollutants at the source.

As the senior author has discussed in his comments on the TMDL program (Lee, 2001), in accordance with US EPA policy, the proper implementation of TMDLs requires that a determination first be made as to whether the violation of the WQS represents an administrative exceedance due to the national water quality criteria being designed, in accordance with CWA requirements, to be protective in all waters. The US EPA national criteria are to be adjusted using US EPA (1994) guidance for site-specific factors that influence the toxicity/bioavailability of a potential pollutant. This approach is ignored by the SWRCB staff in their draft Policy and in their Functional Equivalent Document for the draft Policy. This is an example of the SWRCB staff failing to incorporate adequate aquatic chemistry/biology into the draft 303(d) listing Policy. The lack of reliable incorporation of aquatic chemistry into policies has been a chronic problem with the SWRCB staff in developing and implementing water pollution control programs in California. The SWRCB needs to provide a discussion in its 303(d) listing Policy on how to implement the existing CWA requirements for defining and addressing water quality standards violations.

The SWRCB's proposed approach for 303(d) listing will lead to a chaotic situation where WQS violations will occur in California waters and not be controlled through the TMDL requirements. This will lead to California waterbodies being in violation of CWA requirements for attainment of water quality standards, yet California Regional Water Quality Control Boards not being required to address these WQS violations. This situation will not be protective of the designated beneficial uses of the State's waters. As discussed in these comments, highly degraded water quality can occur in a waterbody yet not be listed as a 303(d) impaired waterbody. This approach is neither logical nor appropriate.

Since 1989 we have had the opportunity to become familiar with many of the water quality issues in the state of California. We have yet to find that under the existing 303(d) listing approach there is an improper 303(d) designation of a waterbody as impaired. In fact, it is our assessment that there are waterbody segments that are not now designated as impaired, which should be. Under the State Board's draft Policy, it will become extremely difficult, if not impossible under the current level of funding for water quality monitoring in the State, to develop the necessary information to list waterbodies or waterbody segments that are truly impaired – i.e., do not meet water quality standards.

Rather than the SWRCB adopting a 303(d) listing approach that will significantly weaken water quality protection in California by allowing violations of WQSs in California waterbodies, the SWRCB should work toward developing the financial and other resources that are needed to develop site-specific WQSs that are protective without significant unnecessary costs for TMDL implementation – i.e., properly implement the CWA requirements for defining a WQS violation.

The SWRCB staff has failed to provide information on how US EPA water quality criteria are developed, which is directly pertinent to evaluating allowable exceedances. As discussed in the attached summary of our background pertinent to making these comments, the senior author was involved in the early 1980s as an advisor to the US EPA in developing the current national water quality criteria development approach. This approach already has built into it an allowed impairment of the aquatic-life-related beneficial uses, where the national criteria are to be implemented as an impairment of aquatic-life-related beneficial uses when more than one exceedance of a criterion/standard occurs in a three-year period. The three-year period is based on the time that it will likely take damaged aquatic ecosystems to recover from toxicity. It is also understood now that the national criteria development approach protects about 95% of the species. About 5% of the species can be expected to be harmed from toxic available forms of certain chemicals even though the criterion is not exceeded. The State Board staff, through the draft 303(d) listing Policy and its proposed minimum 10% allowed violations, are proposing to allow even greater harm to aquatic ecosystems than is inherently incorporated in the current water quality standards implementation approach.

The SWRCB 303(d) listing approach should be based on any exceedance of a WQS that occurs more than once every three years being a CWA WQS violation – i.e., the current US EPA requirements. The policy must include provisions and the required funding and other resources to enable the Regional Boards to determine that the WQS violation is a real, significant impairment of the beneficial uses of the waterbody in which the violation occurs. The SWRCB staff's approach of assuming that an arbitrary minimum 10% of the WQS violations is allowable, is not protective and is technically invalid based on how potential toxicants impact aquatic life.

Based on how US EPA national water quality criteria and state WQSs are developed and in light of the severe funding constraints that exist in California for adequate, reliable monitoring of the State's waterbodies, there should be no allowable exceedance of WQSs beyond that specified in the US EPA criteria document. The proposed approach in the draft Policy focuses on developing statistical evaluation of the data. Rather than statistical manipulation of the data being the focus of the effort, the focus should be on protection of water quality. Most statistical manipulation of water quality data does not properly reflect how chemicals impact aquatic-life-related beneficial uses of waterbodies. Toxicants do not impact fish based on the mean, median, mode, maximum, range, etc. Toxicity is based on a concentration of toxic chemical forms-duration of exposure relationship for a particular chemical and type of organism. The US EPA national criteria and state standards based on these criteria are designed to be protective in all types of waters and for most organism types. The allowed frequency of exceedance is protective for many types of organisms and chemicals in many waterbodies. However, it is not overly protective, since it allows for adverse impacts to about 5% of the species.

The criteria development approach was dictated by the US Congress as part of developing the Clean Water Act. Deviation from the current approach for assessment of WQS violations requires that the Clean Water Act be changed to reflect a different level of protection of the nation's water quality. The SWRCB staff should not try to change the CWA just for California to allow the SWRCB to provide less water quality protection than the federal Congress specified in the CWA. The SWRCB has for many years failed to adequately work to

gain the funding from the state legislature and the governor's office needed to provide California with a high degree of water quality protection. For years the focus of the SWRCB has been on water resources development and management, with limited attention to the quality of the water.

As individuals who have worked on water quality issues in many parts of the US over the past 43 years, we find that California's water quality monitoring and management programs are considerably less effective than in many other areas of the country. Water quality problem definition and work on management has been and continues to be a grossly neglected area of attention. It is for this reason that many of the State's waterbodies have a 303(d) listing and are listed for TMDL development. Based on our knowledge of California waterbodies' water quality, rather than trying to make it more difficult to have a waterbody listed on the 303(d) list as proposed in the draft Policy, there is need to increase the number of waterbodies that are listed as beneficial use CWA "impaired."

As discussed below, other significant problems with the State Board staff's draft Policy include that the staff have proposed a number of technically invalid approaches as listing parameters, such as the Long and Morgan/MacDonald co-occurrence-based sediment quality guidelines and the California SWRCB "NAS criteria." Further, as discussed below, there are significant problems throughout the draft 303(d) listing Policy where chemical concentrations of potential pollutants are used, assuming that there is a direct relationship between the total concentration of a constituent in water or sediments and an adverse impact on the beneficial uses of waterbodies. Those familiar with how chemicals impact aquatic-life-related beneficial uses know that frequently, the total concentration of a constituent is an unreliable indicator of a beneficial use impact. This issue has been discussed in detail by Lee and Jones-Lee (1995).

Overall, the State Board needs to start over with respect to drafting a 303(d) listing policy that properly incorporates protection of aquatic life from adverse impacts of chemical constituents, which reflects how US EPA national water quality criteria are to be used to protect the designated beneficial uses of waterbodies. The redrafted 303(d) listing approach should include abandonment of the minimum 10% allowed violations, the assumption that chemical concentrations can be directly related to water quality impacts, and all chemically based sediment quality guidelines, including the "NAS criteria," as parameters that can be used in the listing process.

Specific Comments

Page Appendix-3, in section 3.1.1 Numeric Water Quality Objectives and Criteria for Toxicants in Water, states that a waterbody shall be listed if

> *"Numeric water quality objectives for toxic pollutants, including maximum contaminant levels where applicable, or California/National Toxics Rule water quality criteria are exceeded in 10 percent of the samples with a confidence level of 90 percent using a binomial distribution (Table 3.1). For sample populations less than 20, when 5 or more samples exceed the water quality objective, the segment shall be listed."*

This approach is not necessarily protective or technically valid in terms of protecting aquatic life from toxicants. A single exceedance of a water quality objective for a toxicant can have a

disastrous effect on the aquatic-life-related beneficial uses of a waterbody. The arbitrary "10 percent of the samples" should be changed to include the potential for evaluating whether a single exceedance represents a significant adverse impact on the beneficial uses of the waterbody.

The same comment applies to section 3.1.2 Numeric Water Quality Objectives for Conventional or Other Pollutants in Water. The approach of listing a waterbody if 10 percent of the samples show an exceedance is not a valid approach and should be abandoned in favor of a more appropriate assessment of what constitutes an excessive concentration of a constituent in a particular waterbody.

In the second paragraph under 3.1.2, with respect to DO depletions related to nutrients, the impact of nutrients needs to be carefully examined in terms of what constitutes a nutrient that leads to excessive fertilization and diel DO changes. Often this is not done correctly. Of particular concern is the time of day that measurements of DO are made. Since at least the CVRWQCB does not indicate when DO measurements are to be made, data can be generated that do not properly assess DO violations of the water quality objective.

Page Appendix-6, section 3.1.9 Degradation of Biological Populations and Communities states in the first paragraph that a water segment shall be listed if

> *"A water segment exhibits significant degradation in biological populations and/or communities as compared to reference site(s) and associated water or sediment concentrations of pollutants as described in section 3.1.6."*

The approach that is used to "associate" potential pollutants in sediments with observed adverse effects that was adopted in the SWRCB BPTCP program, which was based on total concentrations, should not be used. This is a technically invalid approach that can improperly assess the cause of degraded populations. The only reliable way to determine the cause of the toxicity is through sediment toxicity assessments and through sediment TIEs.

The next paragraph states,

> *"For population or community degradation related to sedimentation, the water segment shall be placed on the section 303(d) list if degraded populations or communities are identified and effects are associated with clean sediment loads in water or those stored in the channel."*

This approach can readily be in error, since what is defined as "clean" versus "polluted" depends on the analyses performed and the comprehensiveness of the search for pollutants. There can be a number of pollutants in sediments which are not measured yet can be significantly toxic to aquatic life. The approach should be based not on chemical analyses, but on toxicity assessments in the particular area of concern.

Section 3.1.10 Trends in Water Quality states that a water segment shall be listed if

"A water segment exhibits concentrations of pollutants or water body conditions for any listing factor that shows a trend of declining water quality standards attainment."

Once again, there is a potential for significant errors in focusing on concentrations, as opposed to constituents responsible for impacts, since the concentrations of constituents in the sediments and water column can readily be unreliable in defining cause and effect. This approach should not be adopted, since it can readily lead to an erroneous assessment of trends in water quality. As an example, if the lead concentrations in a waterbody's sediments have decreased significantly, this could lead someone to believe that there is an improvement in water quality-beneficial uses. In fact, with very few exceptions, the total concentration of lead in sediments does not reflect a water quality issue, since the lead that accumulates in sediments derived from the use of lead as an additive in gasoline has been known since the 1960s to be inert, and does not affect the numbers and types of organisms present.

On page Appendix-7, in the numbered list for assessing trends, again, this should be based on true water quality (impairment of uses) and not chemical concentrations, since chemical concentrations are not reliable for assessing water quality.

On page Appendix-7, under section 3.1.11 Alternate Data Evaluation, the most important parameter in evaluation of concentration data is to determine whether the concentration is a cause of toxicity or is a source of excessive bioaccumulation. The presence of a constituent above some numeric guideline, such as is specified in section 6.2.3, is not a valid approach for listing the waterbody as impaired.

Table 3.1, which presents the maximum number of measured exceedances, as discussed above, is not a valid approach, since there can be significant adverse impacts on aquatic-life-related beneficial uses at less than the proposed allowed minimum 10-percent exceedance rate.

Page Appendix-9, under section 3.3 Enforceable Program Category Factors, in the fourth bulleted item, uses the terminology "Best Management Practices (BMPs)." That is an improper terminology in accordance with the current understanding of management practices. The term that should be used is "Management Practices (MPs)."

It is not clear from this discussion whether the ag waiver program would be considered a program that would be sufficient to claim that there is an adequate program underway to control runoff/discharges from irrigated agriculture. As discussed in the comments provided to the SWRCB (Lee, 2004), while there is a program that has been developed by the CVRWQCB, this program, as currently constituted, is not a valid program for controlling excessive concentrations of a variety of potential pollutants derived from agricultural runoff/discharges, since the basis for the program is an inadequately developed and unreliable monitoring program. So long as this exists, the program cannot possibly achieve the goals set forth in the CVRWQCB Order No. R5-2003-0826.

Page Appendix-10, section 4.1 Numeric Water Quality Objectives, Criteria, or Standards for Toxicants in Water, again uses the minimum 10-percent approach. This is not a valid approach for protection of beneficial uses of waterbodies, since it is arbitrary. There can readily

be fewer exceedances than 10 percent which can still be significantly adverse to the waterbody, or many more exceedances than 10 percent without an adverse impact. The focus should be on assessment of the impact on beneficial uses, instead of some arbitrary percentage of samples with exceedances.

This same comment applies to section 4.2 Numeric Water Quality Objectives for Conventional or Other Pollutants in Water, as well as section 4.3 Numeric Water Quality Objectives for Bacteria in Water.

Section 4.5 Bioaccumulation of Pollutants in Aquatic Life Tissue has the same chronic error in this draft Policy, where it states,

> *"Numeric pollutant-specific evaluation guidelines are exceeded in fewer than 10 percent of the samples with a confidence level of 90 percent using a binomial distribution (Table 4.1)."*

What constitutes excessive tissue residues depends on fish consumption rates. The typical approach that is used today does not adequately consider fish consumption rates for certain key populations who depend on fish from a waterbody as their primary source of food. This issue needs to be considered.

Page Appendix-11, section 4.6 Water/Sediment Toxicity states,

> *"Water/Sediment Toxicity or associated water or sediment quality guidelines are exceeded in fewer than 10 percent of concurrently collected samples with a confidence level of 90 percent using a binomial distribution (Table 4.1)."*

Again, this is the same chronic error that occurred in the BPTCP program, where State Board staff are trying to legitimatize the sediment quality guidelines that exist. We have provided a detailed discussion in the State Water Resources Control Board report (Lee and Jones-Lee, 2002) on the unreliability of sediment quality guidelines based on the Long and Morgan or MacDonald approach. The section of this report which discusses the unreliability of so-called sediment quality guidelines is attached to these comments.

This same problem occurs in a number of other areas where the minimum 10-percent value is used. This should be deleted and replaced with a proper evaluation of biological and other impacts.

On page Appendix-12, Table 4.1 is another example of the technically invalid minimum 10-percent approach which should not be used.

On page Appendix-13, in the presentation of the Schedule for the High, Medium and Low priorities, the Low priority should specify that a TMDL is to be completed within no more than 10 years.

Page Appendix-14, section 6.2.1 Definition of Readily Available Data and Information, in the third bullet states,

> *"Information on water quality problems in documents prepared to satisfy Superfund and Resource Conservation and Recovery Act requirements."*

As an individual who has been involved in Superfund site investigations at several locations, the senior author has documented that Superfund programs do not necessarily provide reliable data. A prime example is the LEHR site on the UC Davis campus, where for 10 years unreliable monitoring of mercury runoff from the site has been conducted by UCD and DOE, with the permission of the remediation program managers (RPMs). Information on this problem is provided on the DSCSOC website, http://members.aol.com/dscsoc/dscsoc.htm.

Page Appendix-15, the third bullet states,

> *"Dilution calculations, trend analyses, or predictive models for assessing the physical, chemical, or biological condition of streams, rivers, lakes, reservoirs, estuaries, coastal lagoons, or the ocean."*

Great care must be exercised in allowing dilution or other predictive models. Most of the predictive models do not adequately relate cause and effect. They simply tune data to a limited dataset, and likely have little or no predictive capability. Dilution calculations can give erroneous results under conditions where the constituents of concern can accumulate at certain locations in the waterbody, such as those that accumulate in sediments.

The next bulleted item states,

> *"Applicable water quality data and information from SWAMP, USEPA's Storage and Retrieval Database Access (STORET), the Bay-Delta Tributaries Database, Southern California Coastal Water Research Project, and the San Francisco Estuary Regional Monitoring Program."*

The data in each of the databases listed are not necessarily valid and must be critically evaluated with respect to their validity in properly assessing water quality. The same applies to the last bulleted item,

> *"Water quality problems and existing and readily available water quality data and information reported by local, state and federal agencies (including receiving water monitoring data from discharger monitoring reports), citizen monitoring groups, academic institutions, and the public."*

The dataset should be critically evaluated with respect to its reliability and applicability to properly characterizing water quality, independent of who generates the data.

On page Appendix-17, under I. Summary of non-numeric data and information, it is important that this not be based on chemical concentration data but on data that relate to impacts, through proper TIE or other valid and appropriate studies.

With respect to section 6.2.3 Evaluation Guideline Selection Process, great care must be exercised in how this is done. It is our experience that, typically, Regional Boards (and, for that matter, the State Board) are not well equipped technically and financially to properly evaluate numeric water quality objectives. We have seen this happen in the Upper Newport Bay situation, where an arbitrary approach was adopted by the Santa Ana Regional Board to establish numeric objectives for controlling excessive fertilization of Upper Newport Bay. There is widespread agreement among those who understand excessive fertilization and the relationship with nutrients that the approach adopted by the Regional Board and the US EPA is technically invalid. With respect to nutrient impacts, as part of our work on excessive fertilization, we were asked by the CVRWQCB staff to specifically address how to determine excessive fertilization of a waterbody. We provided detailed comments in our report,

> Lee, G. F. and Jones-Lee, A., "Review of Management Practices for Controlling the Water Quality Impacts of Potential Pollutants in Irrigated Agriculture Stormwater Runoff and Tailwater Discharges," California Water Institute Report TP 02-05 to California Water Resources Control Board/Central Valley Regional Water Quality Control Board, 128 pp, California State University Fresno, Fresno, CA, December (2002).
> http://www.gfredlee.com/BMP_Rpt.pdf

On page Appendix-18, under 1. Sediment Quality Guidelines for Marine, Estuarine, and Freshwater Sediments, it is stated that,

> *"RWQCBs may select sediment quality guidelines that have been published in the peer-reviewed literature or by state or federal agencies. Acceptable guidelines include selected values: effects range-median, probable effects level, probable effects concentration, and other sediment quality guidelines. Only those sediment guidelines that are predictive of sediment toxicity shall be used (i.e., those guidelines that have been shown in published studies to be predictive of sediment toxicity in 50 percent or more of the samples analyzed)."*

This is more of the technically invalid approach that was foisted on the State Water Resources Control Board by the Board's BPTCP staff. Sediment quality guidelines based on co-occurrence, such as those of Long and Morgan, MacDonald, etc., including the so-called "NOAA" SQUIRT values, are not valid assessments of water quality impacts. This is an inappropriate approach and should not be included in this Policy. As discussed in the attached, an evaluation of sediments should be based on toxicity and aquatic organism assemblage information, including trend analysis of organism assemblages. If this Policy is to have any credibility with respect to its applicability to sediments, this section must be deleted from the Policy. Otherwise, significant technical errors will be made in properly assessing the impacts of constituents in sediments.

With respect to item 2. Evaluation Guidelines for the Protection of Consumption of Fish and Shellfish, no provisions are necessarily included in this to protect populations whose subsistence depends on fish and shellfish. So long as the regulatory agencies do not include appropriate consumption rate information when establishing critical levels, the populations may not be protected.

Item 3. Evaluation Guidelines for Protection of Aquatic Life from Bioaccumulation of Toxic Substances states, *"RWQCBs may select the evaluation values for the protection of aquatic life published by the National Academy of Science."* This is another of the technically invalid approaches foisted on the State Water Resources Control Board by its staff. As discussed in the attached discussion of so-called California SWRCB NAS values, these are not valid. They are not supported by the National Academy, by the US EPA or by anyone who understands how these values were developed and the inappropriateness of using them today. This issue is discussed in detail in the attached comments.

Item 4, fourth bulleted item states, *"Scientifically-based and peer reviewed."* This can be highly subjective. As an individual who has published over 800 professional papers and reports over the years, many of which have been peer reviewed, and who has been on editorial boards of several environmental journals, the senior author can unequivocally state that peer review does not necessarily lead to a credible or reliable discussion. Further, with respect to "scientifically-based," there is a lot of so-called "science" in the environmental field that is not reliable and must be critically evaluated.

Item 4, eighth bulleted item states, *"Identifies a range above which impacts occur and below which no or few impacts are predicted."* This can easily be an erroneous approach, especially if it is based on sediment quality guidelines.

Page Appendix-19, under section 6.2.4 Data Quality Assessment Process, not all of the data produced by the agencies/entities listed in the second paragraph are reliable. To simply assume that data are reliable because they were generated by one of these specific groups is technically invalid. All data that are used should be specifically examined for their validity prior to use. Just because a program has generated data with a current QA/QC program that is approved by the State or Regional Board does not mean that the data are reliable or appropriate for assessing water quality. Substantial amounts of unreliable data are generated that pass the QA/QC testing, which are not applicable to an evaluation of water quality.

Page Appendix-21, section 6.2.5.3 Spatial Representation, states that, *"Samples shall be collected to be representative of spatial characteristics of the water segment."* The second paragraph states, *"Samples collected within 200 meters of each other shall be considered the same station or location."* This is an arbitrary approach that should not be followed. Site-specific evaluations of how replicate samples collected at one time and location vary should be the approach that is used – not some arbitrary definition of distance as set forth in this draft Policy.

Page Appendix-21, section 6.2.5.4 Temporal Representation, states,

"Samples shall be collected to be representative of temporal characteristics of the water body. Samples used in the assessment must be temporally independent. If the majority of samples were collected on a single day or during a single short-term natural event (e.g., a storm, flood, or wildfire), the data shall not be used as the primary data set supporting the listing."

This is a technically invalid approach, especially with respect to runoff from agricultural areas or urban areas where pesticide toxicity occurs only during a runoff event. Such an event can have a significant adverse effect on the beneficial use of waterbodies.

Page Appendix-22, section 6.2.5.8 Quantitation of Chemical Concentrations, states,

"When available data are less than or equal to the quantitation limit and the quantitation limit is less than or equal to the water quality standard:
…
B. One-half of the value of the quantitation limit shall be used in statistical analyses."

If using the value at one-half leads to a particular conclusion on listing, then this is an inappropriate approach. Usually, a more appropriate analytical method can be used to define the actual concentrations.

References

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Summary of Drs. G. Fred Lee and Anne Jones-Lee's Expertise and Experience Pertinent to Developing Water Quality Management Programs

Dr. G. Fred Lee is President of G. Fred Lee and Associates, which consists of Drs. G. Fred Lee and Anne Jones-Lee (Vice President) as the principals in the firm. They specialize in addressing advanced technical aspects of water supply water quality, water and wastewater treatment, water pollution control, and solid and hazardous waste impact evaluation and management.

After obtaining a bachelor's degree at San Jose State University in 1955, a Master of Science Degree in Public Health from the University of North Carolina in 1957 and a PhD from Harvard University in 1960 in Environmental Engineering and Environmental Sciences, Dr. Lee taught graduate-level university environmental engineering and environmental science courses for 30 years at several major U.S. universities. During this time, he conducted over $5 million of research and published over 850 papers and reports.

Dr. Lee was active as a part-time consultant during his 30-year university teaching and research career. Drs. Lee and Jones-Lee have been full-time consultants since 1989. Dr. Lee has extensive experience in developing approaches that work toward protection of water quality without significant unnecessary expenditures for chemical constituent control. He has been active in developing technically valid, cost-effective approaches for the evaluation and management of chemical constituents in domestic and industrial wastewater discharges and urban and rural stormwater runoff since 1960.

Dr. Anne Jones-Lee was a university professor for a period of 11 years in environmental engineering and environmental sciences. She has a BS degree from Southern Methodist University and obtained a PhD in Environmental Sciences in 1978 focusing on water quality evaluation and management from the University of Texas at Dallas. At the New Jersey Institute of Technology she held the position of Associate Professor of Civil and Environmental Engineering with tenure. She and Dr. G. F. Lee have worked together as a team since the mid-1970s.

Dr. G. F. Lee has been a member of the APHA, *et al*., (1998) Standard Methods committee for development of Standard Methods for the Examination of Water and Wastewater since the early 1960s. Also during this time, he has been a member of the ASTM Committee D-19 on Water. This committee work involves his periodically reviewing new or revised analytical methods for water and wastewater components. It enables him to stay current with analytical methods development and their appropriate utilization. This is pertinent to relating measured concentrations of constituents to water quality impacts.

Dr. G. F. Lee has over 40 years of experience working on helping to develop, implement and evaluate water quality criteria and state standards based on US EPA criteria. This experience includes advising a number of states (such as Wisconsin, Texas and Colorado) on the development of appropriate water quality criteria/standards. Further, Dr. G. F. Lee was part of the National Academies of Science and Engineering's peer review panel that developed the "Blue Book" of water quality criteria in 1972. In the late 1970s he was a member of the

American Fisheries Society Water Quality Section panel that reviewed the US EPA "Red Book" of water quality criteria released in 1976. Further, in the early 1980s Dr. G. F. Lee was a US EPA invited peer reviewer for the then proposed water quality criteria development approach. This is the approach that is still being used today to develop new water quality criteria. In addition, Dr. G. F. Lee served as an invited peer reviewer for several sections of the US EPA "Gold Book" of water quality criteria (ammonia and copper) as part of promulgating the Gold Book criteria in 1986.

During the 1990s, he provided detailed comments on the California State Water Resources Control Board's proposed water quality objectives that were adopted by the State Board in the early 1990s, and then rescinded by the court because the State Board did not comply with Porter-Cologne requirements for conducting an economic evaluation of the impact of adopting these criteria. Further, Dr. G. F. Lee has been an active participant in review of the California Toxics Rule criteria that were adopted in July 2000. At this time he is an active participant in the US EPA RTAG nutrient criteria development program for California and the Central Valley.

Overall, Dr. G. F. Lee is highly familiar with how water quality criteria have been developed, their strengths and weaknesses, and, most importantly, their proper application in water quality management programs. He and Dr. Jones-Lee published an invited paper, "Appropriate Use of Numeric Chemical Water Quality Criteria," discussing how the US EPA criteria and state water quality standards based on these criteria should be implemented, considering the approach for their development and their appropriate use to regulate constituents in ambient waters from various sources.

Unreliability of Sediment Co-Occurrence-Based Approaches for Evaluating Aquatic Sediment Quality[1]

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Beginning in the 1980s, several individuals ignored the then-well-established fact that the total concentration of a constituent in sediments is an unreliable predictor of aquatic life toxicity. The most notable of the inappropriate approaches that have been advocated for evaluating sediment quality is the co-occurrence-based approach first developed by Long and Morgan. Long and Morgan (1990) proposed co-occurrence-based sediment quality "guidelines" to predict the impact of sediment-associated chemicals on aquatic life living within or upon sediments. The co-occurrence-based approach as used by Long and Morgan and others such as MacDonald (1992) involves compiling sets of sediment data that contain some information on sediment biological characteristics, such as laboratory measured toxicity, or benthic organism assemblages (numbers and types of organisms) and the **total** concentration of potential pollutants. The potential pollutants are those that are typically considered in water quality assessments that have been found in some other non-sediment-related situations to be toxic to aquatic life. In the development of the Long and Morgan "guideline" values, the literature-reported concentrations are ranked according to increasing concentration. The sediment concentration which has a so-called "effect" is used to develop a co-occurrence between a sediment chemical concentration measured as a total concentration and a water quality "effect."

Lee and Jones-Lee (1996a,b, 2002a) have provided a detailed discussion of the lack of technical validity of the co-occurrence-based approach for evaluating sediment quality. As they point out, this approach has a number of inherent, invalid assumptions. First, the approach presumes that there is a causal relationship between the concentration of each contaminant considered in sediment and the water quality impact of that sediment. Second, it presumes that the "effect" reported for each sediment was caused independently by each of the measured chemical contaminants in that sediment. Third, it presumes that no other chemical or condition not included in the database has any influence on the manifestation of the "effect" that co-occurs with the particular chemical of focus; ignored are several sediment-associated contaminants and conditions that are well-recognized to cause aquatic life toxicity, including ammonia, hydrogen sulfide, and low dissolved oxygen. Fourth, it presumes that the assessments made of "effects" of the sediments relate in some meaningful way to adverse impacts on beneficial uses of the waterbody in which the sediments are located.

In regulatory applications, co-occurrence information has been used or proposed for use, albeit incorrectly, to establish various "effects threshold" values. That is, applying statistics to the ranked listing of co-occurrence information of a given chemical, it was determined for that data set the concentration of the chemical that has a given probability of co-occurring with an impact, or the lowest concentration with which "no effect" co-occurred for that set of sediments.

[1] Excerpts from Lee and Jones-Lee (2002b). Updated in August 2003.

Examples of these approaches are the "Apparent Effects Threshold" (AET), and numeric values developed from Long and Morgan's (1990) data presentation in the form of ER-L and ER-M values, and "Probable Effects Levels" (PEL) values derived from MacDonald's (1992) co-occurrence compilations. If a sediment contains a chemical in concentrations above the AET, PEL, or similar value, the sediment is considered by some regulators or proposed regulations to be "polluted," and to require special consideration such as "remediation," alternate methods of dredged sediment disposal, or control of permitted discharges to the waterbody of a chemical that accumulates in the sediments.

As discussed by O'Connor (1999a,b, 2002), O'Connor and Paul (2000), O'Connor, *et al*. (1998), Engler (pers. comm.), Ditoro (2002), Chapman (2002), Burton (2002), Lee and Jones (1992), and Lee and Jones-Lee (1993; 1996a,b; 2000, 2002a), the co-occurrence approach is not a technically valid approach for assessing the potential impacts of chemical constituents in sediments. It has been well-known for over 30 years that the total concentration of a chemical constituent in sediments is not a valid measure of the toxic/available forms of constituents that can impact aquatic life through toxicity or cause other impacts. Further, and most important, co-occurrence is not a valid basis for simple systems with a limited number of constituents for evaluating the cause of a measured impact. Co-occurrence is obviously not valid for relating the concentrations of sediment-associated potential pollutants to observed laboratory-measured toxicity or altered organism assemblages in which the chemical constituent of concern is measured. In normal situations, there is no valid cause-and-effect relationship between the total concentration of a chemical constituent in a sediment and its responsibility for some measured "impact."

As more and more data were accumulated that showed that the Long and Morgan and MacDonald guideline values were not reliable predictors of sediment toxicity and other impacts, Long and his associates tried to improve the reliability of the co-occurrence-based approach by using the normalized summed quotients for several chemical constituents to establish the value for comparison with the biological characteristic of the sediments determined by their co-occurrence evaluation. While not discussed by Long and Morgan and others who advocate this approach, the magnitude of the normalized summed value depends on the constituents included in the data review. While for highly degraded areas there is some claimed success for the expanded approach, the expanded co-occurrence approach is also not valid to relate the concentration of a single chemical constituent or a group of constituents' impacts on sediment and overlying water quality/beneficial uses. DiToro (2002) has termed this claimed success of the expanded co-occurrence approach in predicting adverse impacts as a coincidence that has no cause-and-effect basis. The constituents responsible for the altered organism assemblages could be due to constituents not measured in the studies that served as the basis for establishing the coincidence. This is especially true since only a few of the many thousands of chemicals that are typically present in sediments receiving wastewater discharges from municipal, industrial and agricultural sources are measured in a sediment quality evaluation.

Even though it is well-recognized that the Long and Morgan (and, subsequently, MacDonald) co-occurrence approaches are not valid tools to evaluate the potential significance of a chemical constituent in a sediment, there is continuing use of the co-occurrence-based guideline values as regulatory goals upon which control programs, such as TMDLs, are based.

This arises from a lack of knowledge and understanding of sediment chemistry and toxicology/biology by those who are responsible and/or interested in sediment quality management.

Those who advocate use of co-occurrence-based sediment guidelines frequently claim that there are insufficient funds available to conduct the needed biological-effects-based evaluation of sediment chemistry and toxicology/biology to properly evaluate the water quality significance of a constituent in sediments. Since total chemical concentration data are frequently available for sediments, and since co-occurrence approaches superficially seem to provide a way to use these data in sediment quality evaluation, the co-occurrence-based approach receives use by regulatory agencies in order to provide some "information" on sediment quality without having to spend any significant amount of additional funds in sediment quality evaluation. There is also a strong desire by some to do something in addressing sediment quality even if there is an inadequate technical information base to enable a reliable sediment quality evaluation to be made. Such an evaluation would require detailed study of the sediments' aquatic chemistry/toxicology/biology.

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 discussing numeric targets for organochlorine TMDLs, the US EPA (2002) states,

> *"As discussed in Section II, EPA evaluated the applicable water quality criteria and sediment and tissue screening levels to determine the appropriate numeric targets for these organochlorine TMDLs. We have prioritized sediment quality guidelines over tissue screening values and water column criteria. This decision is based on the following factors:*
>
> *1) these pollutants are directly associated with sediments (i.e., fine particulate matter);*
> *2) sediments are the transport mechanism for these organochlorine compounds from freshwaters to salt waters;*
> *3) limited water column data are available to adequately describe the past or current conditions; and*
> *4) attainment of the sediment targets will be protective of the water column criteria and tissue screening values."*

This approach and the reasoning in support of it are fundamentally flawed from several perspectives. First, the so-called "NOAA SQUIRT values" are co-occurrence-based values that evolved out of the Long and Morgan and MacDonald work. The biological effect used to establish these values did not consider bioaccumulation. The problem with these organochlorine chemicals in sediments is that they tend to bioaccumulate to excessive levels in edible fish tissue. Further, critical human health bioaccumulation concentrations in edible fish are frequently far

below any concentration that is adverse to the host organism (fish). There is no relationship between the co-occurrence values of Long and Morgan and MacDonald and the potential for a chemical constituent in sediments to bioaccumulate to excessive levels in edible fish tissue.

With respect to the US EPA's first and second justification listed above in support of this approach, the fact that a chemical tends to become associated with sediments is not justification for using co-occurrence to predict excessive bioaccumulation. As for the validity of the third justification, those familiar with bioaccumulation situations know that measurement of constituents of concern in the water column is not a reliable approach for predicting the bioaccumulation of organochlorine pesticides, PCBs, dioxins, etc. With respect to the fourth justification in support of this technically invalid approach, because of its fundamental unreliability, it is inappropriate to say that it is either under- or over-protective.

There is no reliable way to relate sediment concentrations of organochlorine pesticides and PCBs to excessive bioaccumulation of these chemicals in edible fish tissue except through site-specific studies. This issue is discussed in a subsequent section. The US EPA Region 9 has made a serious error in using the Buchman SQUIRT co-occurrence-based values. This approach should be immediately abandoned in favor of fish tissue target values developed by the CA Office of Environmental Health Hazard Assessment. These values are appropriate TMDL goals for managing the excessive bioaccumulation of organochlorine pesticides and PCBs.

In April 2003 the US Army Corps of Engineers and the US EPA held a three-day international workshop on Environmental Stability of Chemicals in Sediments. This workshop focused on having experts in the field discuss the current state of knowledge of the water quality significance of chemicals in sediments. A number of the presentations dealt with sediment quality guidelines. None of the presenters supported the use of Long and Morgan co-occurrence-based approaches as regulatory guidelines for evaluating the water quality significance of chemicals in sediments. A number of the presenters discussed the unreliability of this approach. The PowerPoint presentation made at this workshop are being posted at www.sediments.org.

In summary, co-occurrence-based so-called sediment quality guidelines should not be used for any purpose, including as screening values. For mercury, depending on the form of the mercury and the sediment characteristics, these values can underestimate or overestimate the water quality significance of mercury in sediments with respect to its potential to bioaccumulate to excessive levels in edible fish in the waterbody in which the sediments are located. The characteristics of the sediments influence the conversion of the various forms of mercury that can occur in sediments into methylmercury and its bioaccumulation in edible fish tissue to excessive concentrations. These issues can only reliably be addressed through site-specific investigations.

The issue of developing sediment quality guidelines is an issue that we have been concerned about since the early 1970s. During the 1970s we had over $1 million in support from the Corps of Engineers to develop dredged sediment disposal criteria. A summary of our work on this effort has been published in

Lee, G. F. and Jones-Lee, A., "Water Quality Aspects of Dredging and Dredged Sediment Disposal," In: Handbook of Dredging Engineering, Second Edition, McGraw Hill, pp. 14-1 to 14-42 (2000).

This chapter in this handbook is available from http://www.gfredlee.com/ dredging.html or directly from me at gfredlee@aol.com. As discussed, it is not possible to develop reliable numeric chemically-based sediment quality guidelines. The US EPA and Corps of Engineers in the 1970s adopted a dredged sediment regulatory approach based on chemical impacts, rather than concentrations.

The approach that should be followed in evaluating the water quality/sediment quality significance of a chemical constituent in sediments was defined by the US EPA and the Corps of Engineers in the 1970s for regulating contaminated dredged sediments. The US EPA/US ACOE (1991, 1998) developed dredged sediment quality evaluation manuals which provide detailed guidance on determining whether the management of a contaminated dredged sediment in a particular manner will impact water quality of the receiving waters where the management/disposal of the dredged sediment takes place. These agencies used a biological-effects-based approach rather than a chemical-concentration-based approach.

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Unreliability of SWRCB's Use of "NAS Criteria" to Evaluate Pesticides Impacts on Aquatic Life[2]

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The SWRCB staff, as part of the Toxic Substances Monitoring Program (TSMP), NAS Criteria has been using what they call "NAS" criteria for evaluating excessive fish tissue concentrations. These values are numeric concentrations that were suggested by the National Academy of Science (NAS) and the National Academy of Engineering (NAE) in their 1972 Blue Book of water quality criteria (NAS/NAE, 1973). These values are presented in Table 1.

The NAS/NAE (1973), as part of discussing the development of these values, stated:

"Present knowledge is not yet sufficient to predict or estimate safe concentrations of these compounds in aquatic systems. However, residue concentrations in aquatic organisms provide a measure of environmental contamination. Therefore, specific maximum tissue concentrations have been recommended as a guideline for water quality control.

For the protection of predators, the following values are suggested for residues in whole fish (wet weight): DDT (including DDD and DDE) – 1.0 mg/kg; aldrin, dieldrin, endrin, heptachlor (including heptachlor epoxide), chlordane, lindane, benzene hexachloride, toxaphene, and endosulfan – 0.1 mg/kg, either singly or in combination.

Aquatic life should be protected where the maximum concentration of total PCB in unfiltered water does not exceed 0.002 µg/L at any time or place, and the residues in the general body tissues of any aquatic organism do not exceed 0.5 µg/g."

The senior author of this report (G. Fred Lee) was an invited peer reviewer to the NAS/NAE for the "Blue Book" water quality criteria. He is, therefore, familiar with how these criteria were developed and the considerable uncertainty associated with critical tissue residue levels for protection of aquatic life in higher-trophic-level organisms. Upon learning that the SWRCB and the Regional Boards were using these values in evaluating excessive bioaccumulation of chemicals in fish tissue, he contacted the Chair of the Blue Book water quality criteria committee (Carlos Fetterolf), the National Academy of Sciences, the US EPA, and others to obtain their assessment of the reliability of the suggested critical tissue residues presented in the Blue Book (which were largely based on 1960s information) as appropriate for use today to judge excessive concentrations of bioaccumulatable chemicals in aquatic life.

[2] Excerpt and adapted 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). http://www.gfredlee.com/OClTMDLRpt12-11-02.pdf

Table 1
Recommended Maximum Concentrations of Organochlorine Pesticides in Whole (Unfiltered) Water, Sampled at Any Time and Any Place

Organochlorine Pesticides	Recommended Maximum Concentration (µg/L)	Suggested Values for Tissue Residues (mg/kg), wet weight
Aldrin	0.01	0.1
DDT	0.002	1
TDE	0.006	
Dieldrin	0.005	0.1
Chlordane	0.04	0.1
Endosulfan	0.003	0.1
Endrin	0.002	0.1
Heptachlor	0.01	0.1
Lindane	0.02	0.1
Methoxychlor	0.005	
Toxaphene	0.01	0.1
PCBs	0.002	0.5

Source: NAS/NAE (1973)

The chairman of the NAS/NAE (1973) Blue Book Criteria Committee (Fetterolf, pers comm., 1996), who was also former chief biologist for the state of Michigan water pollution control program and former executive secretary of the Great Lakes Fisheries Commission, indicated that it is inappropriate to use the 1972 "NAS" Blue Book values as being reliable today for estimating excessive concentrations of chemicals in aquatic life tissue. The US EPA, any state other than California, and the National Academy of Sciences do not recognize the "NAS" values used by the SWRCB and the Regional Boards as reliable screening values for determining excessive concentrations of chemicals in aquatic organism tissue.

The National Academy of Sciences Committee on Evaluation of the Safety of Fishery Products, Food and Nutrition Board, Institute of Medicine, staff member F. Ahmed was contacted regarding whether the NAS recognized the NAS/NAE Blue Book of fish tissue guidelines. While the NAS has published a book on Seafood Safety (Ahmed, 1991), Ahmed did not know that the 1972 Blue Book so-called "guidelines" existed, and indicated that they are not recognized by the NAS as being reliable today.

A comparison between the late 1960/early 1970 state of information on the critical concentrations of OCls to cause aquatic life toxicity, as shown in Table 1, and the US EPA (2000) CTR criteria, (Table 2) shows that there have been significant changes in a number of these values. This is to be expected, based on the large amount of work that has been done since the late 1960s in relating the concentrations of chemicals to their effects on aquatic life. Ankley (pers. comm., 2002), of the US EPA National Health and Environmental Effects Research Laboratory Mid-Continent Ecology Division, Duluth, MN, has commented that, *"The fact that the values are the same (0.1 mg/kg) for whole host of OCs with differing mechanisms of action should be a tip off as to how reliable they may be."* Dr. Ankley is an internationally recognized expert on aquatic organism health effects of tissue residues.

Table 2
Freshwater Column Target Values for Organochlorine Compounds

Constituent	Freshwater		Human Health (10^{-6} risk for carcinogens) For consumption of:	
	CMC (acute) (µg/L)	CCC (chronic) (µg/L)	Water & Organisms (µg/L)	Organisms Only (µg/L)
Aldrin	3	--	0.00013	0.00014
Chlordane	2.4	0.0043	0.00057	0.00059
DDT*	1.1	0.001	0.00059	0.00059
Dieldrin	0.24	0.056	0.00014	0.00014
Endosulfan	0.22	0.056	110	240
Endrin	0.086	0.036	0.76	0.81
Heptachlor	0.52	0.0038	0.00021	0.00021
Heptachlor Epoxide	0.52	0.0038	0.00010	0.00011
Hexachlorocyclohexane (including lindane), gamma-BHC	0.95	--	0.019	0.063
PCBs	--	0.014	0.00017	0.00017
Toxaphene	0.73	0.0002	0.00073	0.00075
Dioxins/Furans	--	--	0.000000013	0.000000014

Source: US EPA (2000)
-- no value provided
Criteria are based on carcinogenicity of 10^{-6} risk.
* DDT value cited for 4,4' DDT, but value will apply to one isomer or sum of all isomers detected.

As part of developing regulatory approaches for disposal of contaminated dredged sediments, the US Army Corps of Engineers (US ACOE, 1997) developed "The Environmental Residue-Effects Database (ERED)." This database is a compilation of information on the concentrations of chemicals in aquatic organism tissue and their apparent effects on aquatic life. The ERED is available electronically from http://ered1.wes.army.mil/ered/index.cfm. It was last updated June 2001. It now contains 3,463 results of 736 studies on 188 species for 222 analytes.

The issue of critical concentrations of bioaccumulatable chemicals in aquatic life tissue is one that has been addressed by the US EPA. Jarvinen and Ankley (1999) have published a review, Linkage of Effects to Tissue Residues: Development of a Comprehensive Database for Aquatic Organisms Exposed to Inorganic and Organic Chemicals. This publication presents a comprehensive, critically-reviewed, literature-based assessment of the concentrations of chemicals found in aquatic organisms relative to observed effects on the organisms. The Jarvinen and Ankley (1999) database has well over 3,000 entries for 200 chemicals, and is based on 500 references. The organochlorine pesticide database includes 15 organochlorine pesticides, with 473 endpoints and 91 references, representing 68 aquatic species, 46 of which were freshwater.

The Jarvinen and Ankley toxicity/residue database as published by SETAC press is available in an Access database format at the web site http://www.epa.gov/med/databases/tox_residue.htm. Examination of Appendix B shows that there is a wide range of values of DDT concentrations in fish and other aquatic life that have been found to be adverse to the host organism. A comparison between the information presented in Appendix B for DDT residue concentrations relative to effects on aquatic life and the "NAS" guideline value presented in Table 1 shows that there are concentrations well above the guideline value that have been found to not be adverse to aquatic life. There are also situations where concentrations below the "NAS" value were adverse. The conclusion is that the "NAS" values are not reliable values for evaluating the potential impacts of OCls on aquatic life that host the OCl residue, or higher-trophic-level organisms that use the residue host as food.

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Comments on the SWRCB December 2003 Draft Functional Equivalent Document Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List

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February 17, 2004

In December 2003 the State of California Water Resources Control Board (SWRCB) (State Water Board) Division of Water Quality staff released a draft Policy for developing California's Clean Water Act 303(d) list of impaired waterbodies. Associated with this draft Policy was a draft Functional Equivalent Document (FED) that is supposed to provide justification for the approach that the State Water Board staff have adopted for developing the draft Policy. As discussed in our comments on the draft Policy (Lee and Jones-Lee, 2004), the draft Policy is based on a fundamentally flawed interpretation of the federal Clean Water Act's key provisions regarding the intent and approach that is to be followed in protecting and, where degraded, improving the beneficial uses of the nation's waters. Basically, the SWRCB staff are attempting to rewrite key provisions of the Clean Water Act (CWA) which govern attainment of water quality standards, through relaxing the requirements for defining violations of water quality standards and the approach for achieving compliance with water quality standards through the Total Maximum Daily Load (TMDL) provisions of the CWA.

The SWRCB has attempted to justify in its FED several technically invalid approaches, such as the so-called California SWRCB "NAS" guidelines and the chemically based sediment quality criteria. Attached to our comments on the draft Policy are several reports that provide detailed comments with supporting references on the inappropriateness of the existing and proposed approaches for listing using the so-called "NAS" criteria and the chemically based sediment quality guidelines.

Our background in support of these comments includes about 40 years of work on water quality criteria and water quality standards development and their appropriate implementation. Our comments are also based on extensive university graduate-level research and serving as an advisor to governmental agencies and industry on water quality problem definition and control. A summary of this expertise and experience is attached to the comments on the draft Policy. Additional information on our qualifications is provided on our website, www.gfredlee.com, where we list and make available many of our papers and reports that serve as background to these comments.

Specific Comments on Technical Deficiencies in the FED

Issue 3 Weight of Evidence for Listing and Delisting

We strongly support the use of a properly developed Weight of Evidence (WOE) approach in evaluation of the existence of water quality impairment and its cause. We have recently presented two papers (Lee and Jones-Lee, 2003a,b) and published a *Stormwater Runoff Water Quality Science/Engineering Newsletter* (Volume 6-9) devoted to this topic which is available at www.gfredlee.com.

The approaches discussed in these publications for conducting a weight of evidence (WOE) evaluation should be incorporated into the SWRCB 303(d) listing approach. The important issue is that high-quality science be used in listing and delisting, involving a non-numeric Best Professional Judgment which properly incorporates aquatic life toxicity, excessive bioaccumulation, aquatic organism assemblages relative to appropriate reference sites, and chemical information on the cause of adverse impacts – not total concentrations. As discussed by Lee and Jones-Lee (2003a), the use of chemical information in a WOE approach should be through TIEs to identify the cause of toxicity. The approach of using total concentrations or chemically based sediment quality guidelines as chemical information in a WOE leads to erroneous use of chemical information in sediment quality evaluation.

Issue 4D Interpreting Narrative Water Quality Objectives

Issue 4D, devoted to interpretation of narrative water quality objectives, contains Table 1 "Available Guidelines for Interpretation of Narrative Water Quality Objectives." This table contains the statement, under Aquatic Life,

> *"NAS tissue guidelines, BPTCP approaches to identify toxic hot spots, published temperature thresholds; published sedimentation thresholds; Federal agency and other state SQGs, DFG guidelines, Sediment Apparent Effects Thresholds from California and other states, toxicity guidelines"*

As discussed in the attachments to our comments on the technical deficiencies in the State Water Board staff's draft Policy (Lee, 2002), NAS tissue guidelines, chemically based sediment quality guidelines and sediment apparent effects thresholds from California and other states are not technically valid for any purpose associated with water quality assessment. Additional information is needed on what is meant by "toxicity guidelines," and (in the table under Fish Consumption) "USEPA screening," to determine if the particular guideline is technically valid.

Further, under Fish Consumption, "NAS tissue guidelines," is listed as a guideline for judging excessive fish tissue concentrations. As discussed in the attachment to our comments on the technical deficiencies in the draft Policy, the so-called "NAS tissue guidelines" are not technically valid and should not be used. Instead, the US Army Corps of Engineers (US ACOE, 1997) Environmental Residue-Effects Database (ERED) and the US EPA (Jarvinen and Ankley, 1999) should be used.

This section also states,

"In order to make sure the guidelines are selected transparently and are applicable to the circumstance before the RWQCB, an alternate evaluation guideline could be used if it can be demonstrated that the evaluation guideline is:

- *Applicable to the beneficial use*
- *Protective of the beneficial use*
- *Linked to the pollutant under consideration*
- *Scientifically-based and peer reviewed*
- *Well described*
- *Previously used or specifically developed to assess water quality*
- *conditions of similar hydrographic units*
- *Not more limiting than the natural background concentration (if applicable)*
- *Identifies a range above which impacts occur and below which no or few impacts are predicted. For non-threshold chemicals, risk levels shall be consistent with comparable water quality objectives or water quality criteria."*

A number of these bulleted items have been and can readily be misused. For example, the "Linked to pollutant" evaluation must be done carefully and in a technically valid manner. This cannot be based on a total concentration but should be based on TIE information on the constituent(s) responsible for the toxicity and its source(s). In order to be "Scientifically-based," there must be a critical review of the validity of the science used. Also the "Previously used…" specification may have no technical validity in light of the current science on the issue.

Issue 4E Interpreting Aquatic Life Tissue Data

Issue 4E devoted to interpreting aquatic life tissue data states,

"*The USFDA has also established maximum concentration levels for some toxic substances in human foods (USFDA, 1985) and NAS has established recommended maximum concentrations of toxic substances in animals (NAS, 1972).*"

* * *

"*The NAS limits were established not only to protect organisms containing toxic compounds, but also to protect species that consume these contaminated organisms. The NAS has set guidelines for marine fish but not for marine shellfish."*

This section also states,

"*The NAS (1972) has evaluated tissue residues for several chemicals and has made recommendations that reflect scientific understanding of the relationship between aquatic organisms and their environment. Screening values (Table 2) represent levels that are protective of aquatic life.*"

As discussed in Lee and Jones-Lee (2002a), part of which is appended to our comments on the draft Policy, the NAS limits are no longer considered reliable by anyone except the California State Water Resources Control Board staff. As discussed by Ankley of the US EPA, the Table 2 values are not reliable for estimating critical concentrations in water that lead to adverse impacts

in aquatic life. These values were superseded by the US ACOE (1997) ERED and US EPA (Jarvinen and Ankley, 1999) compilation of data.

Issue 4G Interpreting Nutrient Data

Issue 4G devoted to interpreting nutrient data has several technical errors. For example, the statement,

> "*Establishing the role of nutrients may be accomplished by: (1) using computer models; (2) reviewing relevant scientific literature; (3) making comparisons with historical data for the area; (4) comparing monitoring data with similar water bodies that are not impaired; or (5) any scientifically defensible method that demonstrates the observed nutrient concentrations result in excessive aquatic growths."*

There are several aspects of this guidance that can lead to errors in assessing nutrient-caused water quality problems that can lead to a 303(d) listing for excessive fertilization. For example, computer models are not necessarily reliable. Also, reviewing the literature without a detailed understanding of excessive fertilization can lead to significant errors. Comparing data from various waterbodies may not be valid. Lee and Jones-Lee (2002b) have provided guidance on an appropriate approach for addressing excessive fertilization water quality issues.

Issue 5 Listing and Delisting With Multiple Lines of Evidence

Issue 5, devoted to listing and delisting with multiple lines of evidence, lists "H. Trends in Water Quality." In implementing this approach it is important that the trend is assessed based on true water quality parameters that are related to a waterbody's beneficial uses, and not chemical concentrations. Far too often those who do not understand the relationship between chemical concentrations and beneficial use impairment make the error of assuming that there is a direct relationship between the total concentration of a potential pollutant and the chemical impacts on aquatic life and/or waterbody beneficial uses. Since many chemicals exist in a variety of chemical forms, only some of which impact the beneficial uses of waterbodies, it is necessary to incorporate advanced levels of aquatic chemistry and water quality impact evaluation into assessing water quality trends.

Item 5C Interpreting Toxicity Data

Several tables in this section list a toxicity test using Urchin (*Strongylocentrotus purpuratus*) fertilization as a valid toxicity test protocol. It is our experience that this test for toxicity has many false positives that are not related to toxicity.

Persistence of Toxicity. Section 3 devoted to Weight of Evidence to determine the cause of toxicity states,

> "*In general, pollutants need to be identified before a TMDL can be developed for a water placed on the section 303(d) list (40 CFR 130.7; USEPA, 2003b)."*

While it is desirable to properly identify the cause of toxicity, this is not necessary. Through toxicity reduction evaluation (TRE) and forensic studies using toxicity, it is possible to control toxicity without identifying the specific chemical(s) responsible.

The statement is made in this section that,

"*There are several approaches available that can be used to assess if pollutants in ambient water or sediment contribute to toxic or other effects. These approaches include:*

- *Toxicity Identification Evaluations;*
- *Sediment Quality Guidelines;*
- *Statistical Correlation; and*
- *Measures of toxicological response."*

Sediment quality guidelines and statistical correlations should not be used to attempt to identify the cause of toxicity. They are not reliable for this purpose. Properly conducted TIEs should be used for this purpose.

The section devoted to Sediment Quality Guidelines (SQGs) states,

"*When SQGs are used to determine the toxic effect of a sample, concurrently collected measurements of chemical concentrations can be used to associate toxic effects with toxicity or other biological effects. SQGs are widely used, empirically derived guidelines that predict or associate the chemical concentrations likely to be associated with the measurable biological response.*

Several evaluation guidelines are available that can be used to assess association between toxicity or other measures of effect and the pollutants that may cause or contribute to the observed effects.

The predictability of toxicity using the sediment values reported (Long et al., 1998) are reasonably good and are most useful if accompanied by data from biological analyses, toxicological analyses, and other interpretative tools. These measures are most predictive of toxicity if several values are exceeded. Since these values often are not good predictors of toxicity alone, SQGs that predict toxicity in 50 percent or more samples, should be used in making decisions to place a water body on the section 303(d) list. The guidelines presented in Table 11 are the guidelines most predictive of biological effects."

These statements do not properly characterize the reliability of the co-occurrence (coincidence) based sediment quality guidelines such as those listed in Table 11 developed by Long and MacDonald. These are not reliable for any purpose. As discussed in our review of this topic (Lee and Jones-Lee, 2003c), those who critically review how these guidelines are developed and understand aquatic chemistry/toxicity know that these guidelines are not reliable for any purpose including reliably screening for the cause of toxicity.

Issue 6D Critical Rate of Exceedances of Water Quality Standards

According to the draft FED,

"*The* critical exceedance rate *is the proportion of samples that exceed an applicable water quality criterion ("the proportion of exceedances") providing overwhelming evidence that a water segment fails to meet water quality standards for a particular pollutant.*"

This wording is biased against listing and water quality protection. The SWRCB/RWQCBs' primary function should be protection of water quality. If there are questions about whether a water quality standard (WQS) violation is occurring the Boards should err on the side of protection of water quality and list the waterbody on the 303(d) list. The TMDL implementation approach should, as the first step, verify the reliability of the listing with respect to current violations of the WQS. This evaluation should include determination of the need for adjusting the WQS for site-specific conditions. After this evaluation, if the validity of the listing is confirmed through special-purpose studies, then it is appropriate to proceed to implement the TMDL to control the WQS violation.

This section of the draft FED focuses on developing statistical evaluation of the data. Again the emphasis is wrong. Rather than statistical manipulation of the data being the focus of the effort, it should be on protection of water quality. Most statistical manipulation of water quality data does not properly reflect how chemicals impact aquatic-life-related beneficial uses of waterbodies. Toxicants do not impact fish based on the mean, median, mode, maximum, range, etc. Toxicity is based on a concentration of toxic chemical forms-duration of exposure relationship for a particular chemical and type of organism. The US EPA national criteria and state standards based on these criteria are designed to be protective in all types of waters and for most organism types. The allowed frequency of exceedance is protective for many types of organisms and chemicals in many waterbodies. However, it is not overly protective, since it allows for adverse impacts to about 5% of the species.

Potentially Significant Adverse Environmental Effects

The draft FED contains a section on Potentially Significant Adverse Environmental Effects of the differences between the proposed Policy and the existing RWQCB practices, which includes a subsection that states:

"Potential Adverse Environmental Effects
The development of this Policy will not have an adverse effect on the environment. The Policy will provide a consistent methodology for placement of water bodies on the section 303(d) list according to the type of water quality problem, availability of data, information, and actions that are being implemented in identified water bodies.

Potentially Significant Adverse Environmental Effects
None."

These statements are in error since if the proposed Policy is adopted as proposed, properly defining the waterbodies with impaired beneficial uses which need attention will be inadequately addressed. There will be far fewer 303(d) listed waterbodies than really exist in accordance with CWA requirements.

Overall

Overall, the draft FED falls far short of presenting a credible discussion in support of the staff's draft Policy. It contains numerous technical problems, which reflect a lack of understanding of how chemical constituents potentially impact the beneficial uses of waterbodies and, most importantly, how the US EPA national water quality criteria and state standards based on these criteria should be used in developing the CWA 303(d) list of impaired waterbodies in California.

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