Comments on
Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California
Dated September 11, 1987

Comments Submitted by

G. Fred Lee, PhD, DEE
G. Fred Lee & Associates
El Macero, CA
Ph: (530) 753-9630
Fx: (530) 753-9956
Em: gfredlee@aol.com
Website: (http://www.gfredlee.com)

December 7, 1997

Overall

There are a number of significant technical deficiencies in the Water Resources Control Board's (WRCB) proposed approach for implementation of the California Toxics Rule (CTR). Basically the proposed approach represents a perpetuation of many of the technically invalid approaches that were promulgated by the US EPA for implementation of the Clean Water Act for the control of toxics. In the early 1980s, as part of formulating a revised approach for controlling pollution due to chemical constituents, the US EPA abandoned focusing on chemical impacts in favor of regulating chemical concentrations. While this approach is bureaucratically more easily implemented, it is often technically invalid and readily leads to significant over-regulation of regulated constituents i.e. those for which there are water quality criteria, and fails to regulate at all or inadequately the vast arena of chemical constituents which can be significantly detrimental to the beneficial uses of the State's ambient waters.

The Board's draft CTR implementation approach continues the significant errors that have prevailed over the last 15 years of failing to properly incorporate current knowledge on aquatic chemistry, aquatic toxicology and water quality in implementing US EPA water quality criteria into state standards (objectives), and NPDES permits. The draft Policy continues to use the word "pollutant" when it should be using the word(s)chemical constituent or potential pollutant. A "pollutant" by Clean Water Act and Porter-Cologne Water Quality Control Act is a constituent that impairs the designated beneficial uses of a waterbody. It is technically invalid and fundamentally contrary to the public's interest to assume as has repeatedly been done in the draft CTR implementation Policy that every chemical constituent for which there is a CTR water quality criterion is an automatic pollutant. Those familiar with the principals of aquatic chemistry, aquatic toxicology and water quality that were established in the 1960s and 1970s and that prevail today are well aware that many chemical constituents exist in aquatic systems in a variety of chemical forms, only some of which are toxic/available to impact the beneficial uses of a

waterbody. If the WRCB adopts this draft Policy without making a distinction between chemical constituent (potential pollutant) and pollutant then the Board will perpetuate the technically invalid approaches that the US EPA adopted in the early 1980s as part of beginning to regulate potentially toxic constituents such as the heavy metals and some of the organics which are now labeled as "toxic pollutants."

Part of the problems with the WRCB draft Policy for the proposed CTR implementation approach is that the draft Policy proposes to mechanically implement the technically invalid approaches that the US EPA has been following in formulating a program for the control of toxics. The current US EPA administration in Washington, D.C. recognizes and admit many of the significant problems that exist in the Clean Water Act and its implementation for regulating toxics. The Agency however, is trapped into a situation of not having an adequate database to counteract the political power of those who wish to continue the control of chemical concentrations approach because of the bureaucratically simple implementation and detection of violations of water quality objectives. The State of California Water Resources Control Board must, if it is going to adequately represent the people's interest of protecting and where degraded, enhancing the designated beneficial uses of the State's waters without significant unnecessary expenditures for chemical constituent control, clearly delineate in the Policy FED where technically invalid approaches are being forced on the State by the US EPA.

The WRCB should incorporate into the Policy the opportunity for point and non-point source dischargers and the public to demonstrate on a site-specific basis through appropriately conducted studies that the approach of focusing on chemical concentrations rather than chemical impacts can readily result in large-scale waste of public and private funds beyond that needed to protect/enhance the beneficial uses of a waterbody. Based on the author's over 37 years work in the water pollution control field, he has repeatedly found that when a proper database is developed which adequately demonstrates that technically invalid approaches are being used in regulating constituents, that ultimately the regulatory agencies and others who are promulgating the technically invalid approach will either voluntarily or through the courts, be forced to adopt a more technically valid approach for protecting the public's interest.

It is recommended that the WRCB appoint a special advisory panel that would advise the Board and public on the changes that need to be made in the Clean Water Act and its implementation approach to ensure that funds spent for chemical constituent control are directed toward controlling real water quality use impairments and not on "administrative" exceedances of overly protective water quality criteria that when mechanically implemented into state standards (objectives) force the public into devoting its financial and other resources into the control of chemical constituents which are not pollutants. This panel should develop specific guidance on how dischargers/the public can develop the information base needed to determine what, if any, real water quality use impairments are associated with the exceedance of a water quality objective as well as detection of water quality use impairments associated with under protective water quality objectives, such as the US EPA's CTR criterion for chromium VI. Further, this panel should specifically address approaches that can be adopted for protection of beneficial

uses from the unregulated constituents that enter the State's waters and impair their uses independent of the sources of the constituents. The adoption of the recommended approach will ultimately provide the information needed to revise the Clean Water Act and its implementation approach to address the obviously technically invalid approaches that are proposed to be followed in the WRCB's proposed implementation of the CTR. Basically the Board as part of implementation of the CTR must work toward changing the regulatory approach from the control of chemical concentrations to the control of chemical impacts in the most technically valid, cost-effective manner.

Drs. G.F. Lee and A. Jones-Lee have previously provided a number of comments on deficiencies on current regulatory approaches for potentially toxic constituents. These comments include a discussion of the potential problems with the US EPA proposed CTR for regulating potentially toxic constituents in California (See Lee, G.F. "Initial Comments on US EPA 40 CFR Part 131 Water Quality Standards for the State of California as Proposed on Tuesday, August 5, 1997). Further, in response to the US EPA's recent request for comments on the Clean Water Action Plan issues Lee ("Comments on Current Deficiencies in US EPA/USDA Water Pollution Control Programs: Suggested Revisions as Part of the Clean Water Action Plan," 1997) submitted comments on various aspects of the US EPA and USDA water pollution control programs that need revisions in order to protect the designated beneficial uses of the nation's waters without significant, unnecessary expenditures for chemical constituent control.

The problems with developing regulatory approaches for potentially toxic chemicals based on chemical concentrations rather than chemical impacts (toxicity) have been well recognized for many years. The National Academies of Science and Engineering, (NAS/NAE 1973) in the Bluebook of water quality criteria recognized that heavy metals can not be cost-effectively regulated based on concentrations and recommended that toxicity tests be used for regulatory purposes. As discussed by Lee ("Chemical Aspects of Bioassay Techniques for Establishing Water Quality Criteria" 1973), Lee and Jones (Interpretations of Chemical Water Quality Data" 1979), Lee and Jones ("Problems in Implementation of US EPA Water Quality Criteria into State Water Quality Standards"1981) and Lee and Jones ("Translation of Laboratory Results to Field Conditions: The Role of Aquatic Chemistry in Assessing Toxicity" 1983) the basic problem is that those responsible for developing water pollution control programs at the federal and state level ignore the basic principals of aquatic chemistry and their relationship to aquatic toxicology in formulating water pollution control programs. Lee et al. (1982a,b) reviewed these problems in their papers "Water Quality Standards and Water Quality" and "Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents." Lee and Jones ("Assessment of the Degree of Treatment Required for Toxic Wastewater Effluents" 1987) have discussed alternative approaches for managing potentially toxic constituents in point source discharges which are based on a proper incorporation of aquatic chemistry, aquatic toxicology and water quality issues into regulatory programs.

The 1987 revisions of the Clean Water Act mandated that the US EPA develop toxic pollutant control programs. This lead to the Agency proposing the National Toxics Rule. Drs. Lee and Jones-Lee ("Comments on US EPA's November 19, 1991 Proposed Rule for Compliance with Water Quality Standards Regulations Governing State Development of Numeric Water Quality Standards for Toxic Chemicals" 1991) discussed the significant technical deficiencies in the US EPA's then proposed National Toxics Rule. They discuss that the Agency's proposed approach of mechanically using US EPA-developed water quality criteria as state standards and NPDES- permitted discharge limits will result in massive unnecessary expenditures for potentially toxic chemical constituents. Many of the problems discussed in the 1980s and early 1990s still exist today. The US EPA as part of their Advanced Notice of Proposed Rulemaking for water quality standards/regulations released in draft form in 1996 have recognized many of the over-regulation issues that are occurring in implementation of the Clean Water Act. Lee and Jones-Lee ("Comments on Interim Draft Advance Notice of Proposed Rulemaking US EPA 40CRF Part 131 (FRL-)W- ?) Water Quality Standards Regulation," 1996) discussed issues that need to be addressed by the US EPA as part of revisions of the US EPA water quality standard regulations. The comments that the author(s) have submitted over the years on these issues as well as references cited in their papers, discuss the significant problems with regulating chemicals based on chemical concentration approaches and provide guidance on biological effects based approaches that will regulate true pollutants in a technically valid, cost-effective manner.

Some of the regulated community assert that the basic problem that leads to the current over- and in some instances under-regulation of toxics lies with the US EPA's approach for developing water quality criteria. As a member of the US EPA peer review panel that formulated the criteria development approach, the author points out that such assertions are inappropriate. The US EPA water quality criteria are in general, appropriately developed. These criteria must be protective under worst-case conditions in order to serve as national criteria that provide the foundation for regulating potentially toxic chemicals. The basic problem is not the criterion values or their development approach, the problem lies with how the criteria are implemented into state standards (objectives) and permitted NPDES-discharge limits. There has always been a significant disconnect within the US EPA between those that developed the criteria and those that formulate criteria implementation approaches.

The fundamental problem is that the US EPA water quality criteria were never intended to be mechanically implemented into state standards and discharge limits where with little or no regard for aquatic chemistry, aquatic toxicology and water quality the criterion values are used as standards. While this approach is bureaucratically simple to administer it has been well known since the early 1970s to be technically invalid with respect to developing state water quality standards and NPDES permit limits that will protect the designated beneficial uses of waterbodies without significant, unnecessary expenditures for potentially toxic chemical constituent control. One of the reasons why the US EPA has had significant problems getting the states to adopt the Agency's water quality criteria as state standards, is that the states and the regulated community in general understand the gross over-regulation that occurs associated with the US EPA's implementation

approach for the criteria. Unfortunately the US EPA, as part of the Clean Water Act mandated imposition of the California Toxics Rule on the state of California, is perpetuating what are well known to be technically invalid approaches for cost-effectively regulating toxic chemicals. As discussed herein the key to addressing this problem is for the state of California Water Resources Control Board to develop a CTR implementation approach that allows the flexibility of demonstrating that the mechanical implementation approach for CTR criteria into state water quality objectives and NPDES discharge limits, currently required by the US EPA is strongly contrary to the public's interest.

Comments on specific issues of concern in the draft implementation Policy of the CTR are presented below.

Specific Comments

Section 1.1 "Selection of Pollutants:" The term "pollutant" has been used inappropriately throughout the draft policy. A "pollutant," in accord with the Clean Water Act and Porter-Cologne Act, is a constituent that impairs the designated beneficial uses of a waterbody. The authors of this section have used the term "pollutant" where they should have, in most instances, used "chemical constituent" or "potential pollutant." There are many instances where the chemical constituent could occur at concentrations and in specific chemical forms which do not impair beneficial uses of concern to the public. It is important to start to distinguish between potential pollutants and pollutants, i.e. those constituents that have been found to cause beneficial use impairment. Section 1.1 "Selection of Pollutants" should be re-titled "Selection of Potential Pollutants" and the word "potential" should be added before "pollutant" in this section throughout the section and in most instances throughout the draft Policy.

It is important that this distinction be made to stop the current over-regulation of chemical constituents associated with using US EPA water quality criteria which were developed primarily for Lake Superior conditions or at other locations, where the characteristics of the water in the system being regulated are significantly different than those that occur in Lake Superior.

On page 3, under step 9, mention should be made of the use of tissue residue data for edible fish to determine whether the excessive bioaccumulation of potentially hazardous chemicals has occurred. Many of the chemicals of concern that tend to bioaccumulate can cause excessive bioaccumulation at concentrations less than the detection limit for the constituent. The most reliable method of determining whether a real water quality impairment due to bioaccumulation has occurred is through measurement of actual tissue residues, rather than trying to predict such measurements from water concentrations. Additional information on this issue is provided in the1996 report developed by Drs. G.F. Lee and Anne Jones-Lee "Summary of Issues Pertinent to Regulating Bioaccumulatable Chemicals." A copy of this and other papers and reports referenced herein is available from their website (http://www.gfredlee.com) or directly from them.

On page 4, the second paragraph mentions that the RWQCB may exempt low-volume discharges from monitoring requirements. The issue is not the volume of the discharge per unit time, but the mass/volume of the discharge relative to the stream flow. Even low-volume discharges in effluent dominated streams can have severe adverse impacts on the beneficial uses of waterbodies. It is therefore important that any exemptions from monitoring be based on there being a strong showing that there is little likelihood of adverse impacts.

The State Board needs to work with the regional boards and the public to develop guidance on how regional boards should establish credible water quality impact monitoring programs to provide a reasonable degree of reliability in determining whether a particular discharge is having an adverse impact on receiving water beneficial uses. Currently, regional boards are developing arbitrary monitoring programs which have limited reliability in actually detecting adverse impacts of permitted discharges. The issue of appropriate monitoring for chemical constituents and toxicity needs to be addressed by the State Board in cooperation with others, to develop the guidance that is needed to avoid the kind of inadequate regulation problems that exist today.

On page 9, first paragraph, it should be understood that there are situations where US EPA water quality criteria for potentially toxic constituents do not protect the designated beneficial uses of waterbodies due to aquatic life toxicity. The way the US EPA criteria are developed and implemented can result in significant toxicity to key forms of aquatic life at concentrations below the criterion value. A case in point is chromium VI. The proposed California Toxics Rule criterion is 11 µg/L for chronic exposure to chromium VI. However, it is well established from US EPA and other literature that chromium VI is toxic to key forms of zooplankton at concentrations less than 1 µg/L. Drs. G.F. Lee and A. Jones-Lee presented a poster session paper titled "Chromium Speciation: Key to Reliable Control of Chromium Toxicity to Aquatic Life" at the American Chemical Society's national meeting held in San Francisco in 1997 which discusses the inadequate regulatory approaches being used for chromium.

The focus on chemical concentrations as opposed to chemical impacts causes regulatory boards such as the Central Valley Regional Water Quality Control Board (CVRWQCB) to ignore the literature on the aqueous environmental chemistry of chromium. It is well established in the refereed literature that chromium III converts to chromium VI at a slow rate in oxygenated ambient waters. In such waters chromium VI is the thermodynamically stable species. The CVRWQCB allowed a NPDES-permitted discharger to discharge up to 50 µg/L of chromium III to streams where there is little or no dilution of the wastewater discharge. This approach ignores the fact that chromium III is expected to convert to chromium VI under these conditions. In response to the public's comments on the deficiencies of the Board's NPDES permit for such discharges, the CVRWQCB established a single, arbitrarily selected sampling point downstream of the discharge. No consideration was given to whether this sampling location would be expected to determine whether chromium III discharged at 50 µg/L could be converted in the receiving waters to chromium VI at concentrations above 0.5 µg/L and therefore be toxic to zooplankton. Such technically invalid approaches arise from the focus of

pollution control programs on chemical concentrations rather than chemical impacts and ignore aquatic chemistry issues that must be considered in properly regulating the discharge of toxic constituents to the state's waters.

On page 10, mid-page, states that a translator study may be conducted by one or more dischargers having the same receiving waterbody. That statement should be expanded to include review of effluent characteristics which can cause a translator developed for one type of effluent such as a domestic or industrial wastewater to not be applicable to all discharges in the region.

On page 12, mid-paragraph, RWQCB limiting the size of mixing zones for carcinogenic, mutagenic, teratogenic and persistent bioaccumulated chemical impacts, can readily result in overly restrictive discharge limitations. Mixing zones should be sized based on consideration of the site- specific characteristics of the waterbody and discharge relative to the potential for the diluted constituent to adversely impact the beneficial uses of the waterbody. Generally today regional boards are over regulating discharges through under-sizing of mixing zones. Larger mixing zones could be allowed which would save the public and private interests considerable funds without impairing the designated beneficial uses of a waterbody. The Policy should allow the discharger to develop site-specific mixing zones which would be protective and cost-effective.

Page 16 is devoted to intake credits. The approach followed in the draft Policy is not necessarily valid. A discharger could take in a constituent in a certain chemical form and discharge it in the same mass in a different chemical form, which may be more or less adverse to the beneficial use of the receiving waters. This draft Policy reflects a lack of application of the aquatic chemistry of constituents in regulating water pollution control.

Page 17, under "Compliance Schedules," states that compliance schedules should not be allowed in permits for new dischargers. Previously in that same paragraph, mention is made that compliance schedules apply to stormwater dischargers. As written, this could mean that new stormwater dischargers shall be required to immediately achieve water quality objectives in the receiving waters for the discharge. That is an inappropriate approach. They should have the same ten year period as existing dischargers for compliance with the Policy requirements of achieving water quality objectives for the receiving waters for the discharge.

It should be understood that the proposed approach for stormwater dischargers of compliance with this Policy is technically invalid and can readily result in massive expenditure of public funds for collection, storage and treatment of stormwater runoff, which will not result in a significant impact on the designated beneficial uses of waterbodies receiving the stormwater runoff. US EPA water quality criteria, including the California Toxics Rule, were not designed for urban area and highway stormwater runoff situations. The application of this Policy to those situations can result in expenditures of 1 or 2 dollars per person per day for the constituents in a regulated stormwater dischargers community. A specific temporary waiver to achieving water

quality standards in the discharge water should be provided. This issue is discussed further in a subsequent section.

Page 19, mid-paragraph, states laboratories analyzing monitoring data shall be certified. The wording is incorrect. These laboratories are not analyzing monitoring data, they are performing analyses to provide monitoring data. As indicated above, the State Board needs to develop guidance on how to properly conduct water quality monitoring to eliminate the significant deficiencies that exist today in the monitoring programs being approved by the regional water quality control boards.

Page 20, second paragraph, states that the discharger should have the responsibility of ensuring that the analytical methods proposed are applicable to reliably determining the concentrations of the constituents in the discharge and ambient waters receiving the discharge. There are situations where, due to interference constituents in waters, the US EPA specified procedures are not reliable for measurement of the constituents of concern. This reliability can underestimate or overestimate the actual concentrations due to interferences.

Page 21, upper part of the page, constituents which are of concern because of bioaccumulation the dischargers should be required to monitor for bioaccumulation that has actually occurred in the receiving water fish. This is a far more reliable approach for detecting excessive bioaccumulation than the approach outlined herein. As specified on page 21, the measurement of fish tissue for bioaccumulatable chemicals would be a special condition. It should become the routinely used approach, rather than a special condition since it is not possible to reliably extrapolate from water concentrations to fish tissue residue concentrations.

It should be understood that the approach being used in the draft Policy, which is based on total concentrations except for a few dissolved metals, significantly over regulates many constituents. It has been well established in the professional literature (see Allen and Hansen "The Importance of Trace Metal Speciation to Water Quality Criteria" 1996) that only some of the dissolved forms of many of these constituents are available in toxic available forms. As it stands now, the implementation of this Policy will result in many "administrative" exceedances of water quality objectives in receiving waters which do not represent real water quality use impairments of concern to the public. A prime example is the regulation of copper in ambient waters such as in San Francisco Bay. Drs. G.F. Lee and A. Jones-Lee presented a paper titled "Regulating Copper in San Francisco Bay: Importance of Appropriate Use of Aquatic Chemistry and Toxicology" at the Fourth International Conference on the Biogeochemistry of Trace Elements held in Berkeley, CA in 1997 which discusses the significant over-regulation of copper in San Francisco Bay that is occurring under current Clean Water Act requirements. The US EPA CTR and the WRCB's proposed implementation Policy for the CTR will continue this over-regulation. Provisions should be incorporated into this Policy to allow a discharger to determine, on a site-specific basis, if the exceedance of a water quality standard/objective in the receiving waters associated with the discharge adversely impacts the designated beneficial uses of the waterbody. For potentially toxic chemicals this determination

should be based on an assessment of an altered number, types and characteristics of desirable forms of aquatic life in the waters, excessive bioaccumulation of hazardous chemicals and inedible fish tissue, or other discernable adverse impacts.

Page 23 states under "Chronic Toxicity Objective" that "Surface waters outside of an allowed mixing zone shall be free from lethal or sub-lethal toxicity at levels which impair the designated aquatic life beneficial uses." This statement should be interpreted to mean that there can be toxicity in a discharge or receiving waters associated with the discharge which does not, because of the short duration or the types of organisms potentially impacted, impair the designated beneficial uses of the waterbody. It should also be understood that all regional board basin plans, which now contain the statement "no toxic in toxic amounts," will have to be modified to incorporate the concept of toxicity which impairs the designated beneficial uses of a waterbody.

One of the issues that needs to be addressed by the state Board in the implementation of this Policy is to develop guidance on what constitutes aquatic life toxicity that impairs designated beneficial uses. A definition of persistent toxicity needs to be incorporated into this statement, since toxicity associated with runoff from agricultural fields or other unregulated non-point source discharges is typically a short-term episodic event. It is highly likely that measurements over time during known runoff events will show no toxicity but large-scale potentially significant toxicity could occur for a short period of time lasting a week or two. An example is a diazinon dormant spray situation that occurs in the Sacramento/San Joaquin River Delta each late winter.

The statement on page 23, under "Water Quality Based Toxicity Control" should be modified to require that all dischargers under this Policy shall at least on a quarterly basis for several years conduct chronic toxicity tests, using the US EPA three species procedures to determine whether or not their effluent, alone and/or in combination with the receiving waters is chronically toxic. If toxicity is found, then the frequency of testing should be increased to monthly.

On page 24, table 4, for fathead minnow testing only includes larval survival, it should be larval survival and growth.

One of the areas that needs immediate attention is the development of guidance on what constitutes excessive magnitude persistence of *Ceriodaphnia* toxicity as influenced by organophosphate pesticides, such as diazinon and chlorpyrifos. Organophosphate pesticides are causing widespread *Ceriodaphnia* toxicity throughout the state. This is a special type of toxicity situation that needs specific attention as the result of the limited types of organisms that are impacted by these types of chemicals. There is need to appoint a special advisory committee who would develop specific guidance on how regional boards should determine whether *Ceriodaphnia* toxicity represents a significant water quality use impairment in a waterbody. This activity could be an outgrowth of the Central Valley Regional Water Quality Control Board, the San Francisco Regional Water Quality Control Board and the author's activities with the Santa Ana Regional Water Quality Control Board's Urban Pesticide Committee.

Page 24, under "Toxicity Reduction Requirements," the second paragraph states that "non-point source discharges shall be required to conduct a TRE." This requirement will have significant impacts on the use of pesticides within California. This is an important provision of this Policy, since the current situation of non-point source dischargers being allowed to discharge toxicity with essentially no control, while point source dischargers are required to control toxicity is highly inconsistent and strongly contrary to protecting the designated beneficial uses of the waters of the State.

Page 24, under "Toxicity Reduction Requirements," the third paragraph states that specific guidance needs to be developed by the WRCB on the repeat testing procedure when toxicity is found in an effluent and/or receiving waters associated with an effluent. This guidance should include discussion of a finite time period during which if the toxicant is not controlled at the source or within the existing treatment plant, the discharger must through a TRE implement additional treatment works to control the effluent and/or ambient water toxicity. Other states have specific requirements in this area. The state of California should adopt a specific set of requirements to eliminate the kind of situation that has existed now in California for a number of years where regional boards look the other way with respect to enforcing toxic regulations since there are no prescribed requirements for such enforcement.

Page 25, under 5.1 "Storm Water," this area leaves too many questions unanswered as to what is the current Policy of the State Water Resources Control Board and regional water quality control boards for stormwater management. Of particular concern is the question of compliance with water quality objectives within a specified period of time. This should be clearly specified so the ambiguity that exists now is eliminated. Further, as discussed in the attached materials, the Water Resources Control Board should adopt a temporary variance procedure for exemptions from attainment of water quality standards in receiving waters during runoff events. This approach has been adopted by the state of Maine for combined sewer overflows. It is being discussed as a possible way of handling the administrative exceedances of water quality standards associated with urban area stormwater runoff. This approach should become part of this Policy.

On page 25, 5.2 "Nonpoint Source Discharges," the same ambiguity exists with respect to non-point source dischargers complying with water quality standards. The State Board, as part of adopting this Policy, should clearly delineate what the key components of the Policy are with respect to this compliance with water quality standards and Basin Plan objectives for non-point source discharges/runoff. Failure to do so will lead to the continuation of the over-regulation of domestic wastewater discharges and inadequate or under-regulation of non-point source discharges which in many situations are the primary cause of water quality impairment.

On page 25, 5.3 "Site-Specific Objectives," at the end of the first paragraph, an additional statement making provisions for the development of temporary variances for permitted discharges which cause administrative exceedances of water quality standards which do not impair the designated beneficial uses of a waterbody other than through a short-term exceedance of the standard at or near the point of discharge, should be added.

Page 26 should include as an additional paragraph the issuance of a temporary waiver from wet weather flow-caused exceedances of water quality standards where it is demonstrated by the discharger that such exceedances do not impair the designated beneficial uses through such impacts as aquatic life toxicity that significantly alter the numbers, types and characteristics of desirable forms of aquatic life, excessive bioaccumulation of hazardous chemicals, excessive growths of algae and other aquatic plants, accumulation of constituents in sediments that leads to a significant adverse impact on beneficial uses of a waterbody, etc.

On page 27, first paragraph, where it states, "…and protect the designated beneficial uses of the receiving water." within that context should not be a requirement to achieve water quality standards under conditions where the standards have been demonstrated to be overly-protective for aquatic life or other beneficial uses.

On page 29, under "TMDLs and Watershed Management," in the second paragraph, the term "pollutant" should be strictly defined as a constituent that causes a significant water quality use impairment of the waterbody, not simply one that exceeds an over-protective water quality criterion/standard.

On page 29, under the steps listed for implementation of a TMDL, the first step should be the demonstration of a significant, real water quality use impairment and not simply be based on exceedance of an overly-protective standard, such as in the case of copper for San Francisco Bay. In this case, after extensive study, copper is not found to be toxic in San Francisco Bay waters, even though it exceeds the US EPAs national criterion and the site-specific criterion developed by the San Francisco Regional Water Quality Control Board.

On page 31, under "Case-by-Case Exceptions," additional information should be provided with particular reference to stormwater runoff where the exceedance of the water quality standard is an administrative exceedance that relates to the overly-protective nature of both the US EPA national criterion and those developed by the water effects ratio (WEF) in accord with the US EPAs recommended procedures.

The current guidance does not properly address the aquatic chemistry of constituents in waters as they may impact aquatic life toxicity or bioaccumulation. This guidance does not properly incorporate the issues of equilibration of constituents used in the test procedures for determining toxicity vs. those that occur in the ambient waters.

On page 31, under "Special Studies," mention is made of contaminant fate and transport monitoring, but no recognition is given to the fact that the aqueous environmental chemistry of many constituents is such that only some of the forms of a constituent are toxic. The remainder are non-toxic. The special studies should include a focus on specific toxic forms through toxicity tests.

The "Special Studies" section should mention that a key component of the special studies would be for a technical advisory committee of the watershed management group to

focus on defining real water quality use impairments in the receiving waters. Drs. G.F. and Jones-Lee have developed the Evaluation Monitoring approach which specifically addresses the deficiencies in conventional monitoring and shifts the monitoring from the edge of the pavement or end of the pipe, to receiving water evaluation (See Lee and Jones-Lee "Evaluation Monitoring as an Alternative to Conventional Stormwater Runoff Monitoring and BMP Development"1997) and ("Assessing Water Quality Impacts of Stormwater Runoff"1996). They have developed a comprehensive guide for Evaluation Monitoring program development and implementation (See "Development and Implementation of Evaluation Monitoring for Stormwater Runoff Water Quality Impact Assessment and Management" 1997). Evaluation Monitoring has proven to be highly effective in developing new watershed-based water quality evaluation and management programs. This approach focuses the monitoring funds on defining real water quality use impairments, determining the cause and the source of the constituents that cause the impairments and then through a cooperative effort, focus on controlling the constituents at the source.

In the Appendix on page 1-2, under "Incompletely-Mixed Discharge,"it has been my experience that a system should be considered completely mixed if there is less than 10% variation in the concentration at the point where the discharge mixes with the receiving waters.

Pages 1-3, under "Toxicity Reduction Evaluation (TRE)," do not have to include identification of the toxic agent. That is part of a TIE. TREs can be conducted without identifying the toxic agent.

Appendix 3 presents the "Pre-Evaluation for Special Studies Decision Tree with Attached Narrative Discussion." On the page that is labeled "Draft Appendix 2-1" under "Narrative Discussion of Decision Tree," in several of the items the term, "water quality," is used, however "water quality" is not explicitly defined. "Water quality" should be defined in terms of, for potentially toxic constituents, the control of toxicity which impairs the designated beneficial uses of the receiving waters through altering the numbers, types and characteristics of desirable forms of aquatic life. For excessive bioaccumulation, it should be defined as causing or contributing to the excessive accumulation of tissue residues of hazardous chemicals, impairing the use of the organisms for human food.

Under Item 2b, on page 2-1, "Best Management Practices" should be real best management practices that address specific water quality use impairments and not the BMPs that are typically used today for urban area and highway stormwater runoff.

On page 2-2, Item 5, focuses on the question of whether the criteria are under-protective. This must be expanded to include whether the criteria are overly-protective. To discuss under-protection without discussing over-protection is a biased presentation of information in favor of perpetuating technically invalid approaches.

On page 2-2, Item 6, the author suggests that the temporary waiver from achieving water quality standards during wet weather runoff situations should be included in the list of

potential options. Additional information on the temporary waiver approach is appended to these comments.

Page IV-5, first paragraph under "Water Quality Conditions," uses the term "dredging spoils." "Spoil" is a badly out-of-date term that should be replaced by "dredged sediments."

Page V-5, under "ISSUE DESCRIPTION," states,

"'Reasonable potential' determinations are intended as a screening tool to identify pollutants in the effluent that may adversely affect ambient water quality. Effluent limitations can then be developed to control these pollutants. Once effluent limitations have been established for a pollutant, monitoring must be performed regularly by the discharger to assess compliance with the effluent limitations (see Chapter 2 for discussion on compliance determination and monitoring and reporting requirements.)"

While this is the procedure that is being used, the implementation of this procedure is, in a number of instances, fundamentally flawed at the regional board level. The most fundamental problem with this approach is the fact that the focus is on the control of chemical constituents rather than the impact of chemical constituents. Further, the term "pollutant" is used in this discussion when "chemical constituent" should have been used. "Pollutants" by definition are those constituents which impair the designated beneficial uses of waterbodies. While constituting an "administrative" exceedance of the regulatory requirements, in many cases, especially for potentially toxic constituents, exceedance of a water quality objective in the discharge waters does not constitute a real use impairment of the beneficial uses of the receiving waters.

Another fundamental deficiency with the current regulatory approach is that the water quality monitoring programs established by the regional boards for implementation of this approach are often a waste of time and money. They are based on arbitrary selection of sampling points, frequency of sampling, parameters for measurement, etc. Overall, at this time, regional boards are mechanically following this approach where in many instances, discharges are allowed to occur which impair the beneficial uses of the receiving waters, even though they follow this prescription for implementation of US EPA criteria into state standards and discharge limits. In other instances, the discharges are grossly over-regulated. Specific examples of the fundamentally flawed nature of how this approach is being implemented by the regional boards is provided by the documentation that Dr. Lee has provided to the State Board on the Central Valley Regional Water Quality Control Board's issuance of NPDES-permitted discharge limits and required monitoring for the University of California, Davis' wastewater discharges to Putah Creek. Lee, in ("Petition to the State Water Resources Control Board to Review the Waste Discharge Requirements, Order 96-227, Issued by the Central Valley Regional Water Quality Control Board on August 9, 1996 to the University of California at Davis for the UCD Campus Landfill Ground Water Cleanup System" 1996), ("Comments on 'Tentative Waste Discharge Requirements and Cease and Desist Order NPDES NO. CA0077895 for University of California Davis Campus Wastewater Treatment Plant

Yolo and Solano Counties" 1997) and Lee ("Comments on Tentative Waste Discharge Requirements and Cease and Desist Order NPDES No. CA0077895 for University of California, Davis Campus Wastewater Treatment Plant Yolo and Solano Counties Dated August 27, 1997" 1997) document the inadequacies and lack of technical validity of the current regulatory approach for protecting the beneficial uses of the State's waters.

The State Board should develop an advisory panel who would specifically address the fundamental deficiencies with how the regional boards are implementing toxics control requirements. The issues that should be addressed include:

- how to provide relief to dischargers when implementation of this approach results in over-regulation of constituents in NPDES-permitted sources of wastewaters and stormwaters;
- how to more reliably predict the designated beneficial uses of receiving waters from point source and non-point source discharges; and, most importantly,
- how regional boards should establish credible receiving water and effluent water quality monitoring programs that will protect designated beneficial uses without significant, unnecessary expenditures for chemical constituent control.

One of the fundamental problems with the above-quoted approach is the requirement that a specific numeric limitation be included in the NPDES permit if there is a "reasonable potential" for exceedance of the water quality standard in the receiving waters associated with the discharge. The State Board and other state officials should work toward changing the regulatory requirements which dictate that this approach be followed. The regulation of constituents that impair the beneficial uses of waterbodies should not have to require that the NPDES permit be re-opened or modified to include a specific numeric limitation in the discharge permit. The discharge of a constituent that impairs the beneficial uses should be sufficient to enable control programs to be implemented without having to re-open or modify the permit. The current approach allows recalcitrant polluters to claim that since the Regional Board did not include a specific numeric limitation for toxic constituents responsible for the toxicity whose cause had not been identified after TIE studies, that there was no violation of the discharge permit which prohibited the discharge of toxic constituents. The approach that should be followed is to stop trying to establish numeric limitations in NPDES permits for specific constituents based on chemical concentrations, but regulate based on chemical impacts where an adequate monitoring program is conducted to determine whether a particular constituent independent of whether there is a criteria/standard for the constituent or combination of constituents, is responsible for toxicity or excessive bioaccumulation.

Page V-6, fifth paragraph, is basically a restatement of what was quoted above. It contains the same problems. It is fundamentally flawed in that it ignores how chemical constituents impact the beneficial uses of waterbodies and can readily result in massive waste of public and private funds in unnecessary treatment while ignoring adverse impacts of chemical constituents in wastewater discharges and stormwater runoff that are not regulated by water quality criteria.

Beginning on page V-35 is a discussion of the "Translators for Metals and Selenium." While the approach outlined is required based on how the US EPA implements the Clean Water Act, it should be understood that this approach is fundamentally flawed and technically invalid for cost-effective regulation of heavy metals and for many other constituents that exist in ambient waters in a variety of forms where particulate forms are involved. It has been known for over 20 years that particulate forms of constituents are non-toxic/non-available. While the US EPA in May 1995, has finally modified their regulatory program to focus on dissolved forms of some metals, the current approach still over-regulates even dissolved metals since many of the constituents of concern, even in dissolved forms, are not in toxic/available forms due to complexation or colloid formation.

The State Board and others should work toward changing the technically invalid approaches that the US EPA is using in implementing the US EPA water quality criteria into state standards and discharge limitations by focusing on chemical constituent impacts rather than concentrations. This means that there would be need to stop trying to estimate toxicity or bioaccumulation based on concentrations in the water relative to water quality standards, but instead measure toxicity and bioaccumulation directly. This approach is readily implementable and is technically valid. In order to implement this approach it will be necessary for the US EPA to abandon its ill-conceived Independent Applicability policy where chemically based criteria have to be met even though toxicity measurements show that the potentially toxic constituents are in non-toxic forms. Lee and Jones-Lee have discussed in their "Appropriate Use of Numeric Chemical Water Quality Criteria" (1996) and "Independent Applicability of Chemical and Biological Criteria/Standards and Effluent Toxicity Testing"(1995) the appropriate use of US EPA chemically based water quality criteria where they recommend that an exceedance of the criterion should be used as an indication of potential water quality problems. The discharger(s) responsible for the discharge that leads to the exceedance should be given the opportunity to determine on a site-specific basis whether the exceedance is an "administrative" exceedance which is an artifact of the overly-protective approach that the US EPA has adopted in criteria development and especially their implementation, or represents a real water quality use impairment of concern to the public.

The adoption of the recommended approach will require that the US EPA abandon its Independent Applicability policy. The Agency as part of its Advanced Notice of Proposed Rulemaking for water quality standards has recognized the problems with the Independent Applicability policy and has proposed to make changes in it. Abandoning this Policy would be a major step in correcting the significant over-regulation that is occurring in the implementation of US EPA water quality criteria into state standards and NPDES permit discharge limits.

Page V-41 begins a discussion on "Mixing Zones and Dilution Credits." In general, the approach presented will lead to an overly-restrictive mixing zone compared to that which could be allowed and still protect the designated beneficial uses of a waterbody. Mixing zones should be sized based on the area allowed for mixing which protects the designated beneficial uses of the receiving waters.

Beginning on page V-60 is a discussion of "Intake Water Credits." This is another section that is technically invalid with respect to developing appropriate discharge limitations. If this section was re-worded so that it focused on chemical impacts, then the combined upstream and downstream constituents added by a discharger would eliminate all legitimate discussion about appropriate upgradient credits.

Page V-90, "Alternative 2" which is recommended by the staff involving general Policy language is not adequate. Specific guidance needs to be developed by the State Board on how the regional boards should formulate monitoring requirements. Leaving the development of the monitoring programs nebulous and basically in the hands of the regional boards, will result in continued unreliable monitoring.

On page V-108, in accord with standard Policy, the green alga, *Selenastrum capricornutum*, is listed as a standard test organism. While this is normally done in accord with current procedures, it should be understood that there is a significant difference in adversely affecting algal growth through toxicity compared to adversely affecting zooplankton or fish larvae. As discussed by Lee and Jones-Lee ("Planktonic Algal Toxicity Testing in Regulating Point and Non-Point Discharges and Its Implications for Use of Dissolved Metal Criteria/Standards" 1996) at this time it is not possible to reliably interpret algal toxicity test results relative to an impairment of the designated beneficial use of a waterbody. Even the interpretation of toxicity to zooplankton is proving to be extremely difficult in terms of relating toxicity test responses to impairment of beneficial uses.

Page V-115, indicates that the staff recommend multiple samples to confirm the occurrence and persistence of chronic toxicity. This Policy section must be supplemented with specific details on the testing frequency that should be used. The current approach is too nebulous and will lead to further inappropriate implementation of toxicity control by the regional boards.

Beginning on page V-117 is a discussion of stormwater and urban runoff permitting issues. The staff recommend a continuation of the current approach in order to allow for flexibility in permitting stormwater discharges. This section should be expanded to include recommendations for adoption of a temporary waiver from meeting water quality standards and use attainability associated with urban and highway stormwater runoff. Attached is a summary statement and draft temporary waiver which provides guidance on the approach that should be considered by the State Board in ensuring that urban area and highway stormwater dischargers do not spend large amounts of public funds controlling chemical constituents in stormwater runoff that have no impact on the beneficial uses of the receiving waters for the runoff.

Beginning on page V-120 is a non-point source pollution discharge discussion of issues. Appended to these comments is a set of comments that the author submitted to the US EPA/USDA in connection with their Water Quality Action Plan request for comments which discusses some of the problems that exist in trying to use current regulatory approaches for non-point source chemical constituent/potential pollutant control.

Basically, the approach of focusing on chemicals rather than chemical impacts will lead to significant over-regulation of chemical constituents from non-point sources. While chemical constituents in stormwater runoff and irrigation return water are causing real water quality use impairments, the reliable detection of the use impairments cannot be based on exceedances of California Toxics Rule water quality criteria/standards. At least for urban area and highway stormwater runoff and non-point source runoff from agricultural and rural lands, there is an opportunity through the use of BMPs to the MEP approach to focus programs on pollutant control as opposed to chemical constituent control. This should be the program the State Board adopts in implementing its watershed initiative.

Beginning on page V-124 is the initiation of a discussion of site-specific objectives. While it is well known that site-specific adjustment of the US EPA national criteria, including the California Toxics Rule criteria, are necessary, thus far neither the US EPA nor the State have provided guidance on how this can be reliably done to avoid unnecessary expenditures for chemical constituent control. The US EPA's guidance manuals for the water effects ratio adjustment do not adequately consider the aqueous environmental chemistry of constituents that influences their toxicity in ambient waters.

The reason for the need for site-specific objectives is the aqueous environmental chemistry of the constituents. It is essential that if California is to move away from its fundamentally technically invalid approaches for regulating chemical constituents into a proper regulation, the State Board and regional boards must incorporate aquatic chemistry as one of the components of developing site-specific objectives.

The WER procedure discussed on page V-131 still tends to under-estimate the aqueous environmental chemistry that influences the availability of constituents and their toxicity. As long as the US EPA's Independent Applicability policy stands, there will be over-regulation of chemical constituents. Biological effects-based approaches utilizing appropriately conducted toxicity tests and actual bioaccumulation must over-ride chemical-specific numeric criteria/objectives. The State Board should as part of its implementation plan, provide guidance on how this can be done. If the US EPA objects, then this matter may have to be taken to court to force the US EPA to develop technically valid approaches for regulating chemical constituents based on the impacts and not on their concentrations.

The bottom of page V-131, under Item 6(b), lists the expertise of the scientific panel to include aquatic toxicology and water quality criteria development and methodology. This statement reflects one of the fundamental problems with the State Water Resources Control Board's approach toward regulating chemical constituents in that, thus far, aquatic chemistry has not been appropriately incorporated into the regulatory process. The panel must consist of at least one individual with a high degree of expertise in aquatic chemistry, another in aquatic toxicology and a third in water quality issues. Leaving out any one of these three will jeopardize the technical ability of the panel to meaningfully address the issues that must be addressed in developing site-specific objectives.

It is understood that someone with a chemistry background is paid less by the WRCB than someone with a geology or biological science background for equivalent expertise and education. This may explain why there is such a lack of understanding of aquatic chemistry by the Board staff and the failure to incorporate aquatic chemistry into Board regulations. The Board should revise its salary structure so that individuals hired with chemical backgrounds receive the same degree of compensation as other sciences that are pertinent to reliable water quality evaluation and management.

Drs. G.F. and Anne Jones-Lee have developed a discussion ("Aquatic Chemistry/Toxicology in Watershed-Based Water Quality Management Programs" 1996) which discusses the importance of reliably incorporating aquatic chemistry into water quality management programs. As discussed, aquatic chemistry is not chemical analysis per se, it is the thermodynamics and kinetics of the chemical reactions that determine the chemical species that are present in an aquatic system. All state and regional board staff who work in the water quality field who assert that they are familiar with aquatic chemistry should be required to demonstrate that they have sufficient knowledge of this field to pass comprehensive exams based on the elementary text by Stumm and Morgan, Aquatic Chemistry, Chemical Equilibria and Rates in Natural Waters, Third Edition, 1996. There should be at least the same number of individuals with chemistry backgrounds who are familiar with aquatic chemistry on state and regional board staffs as there are biologists, geologists, etc. Adoption of this approach would significantly improve the technical quality and reliability of the state and regional boards' development and implementation of water quality management programs.

On page V-134 is a presentation of Alternative 2 which is recommended by the staff. Part of Alternative 3 needs to be incorporated into Alternative 2 so the State Board and regional boards, as well as the regulated community and the public, develop guidance on how to formulate technically valid, site-specific objectives that will protect the designated beneficial uses of waters without wasting public and private funds for unnecessary chemical constituent control.

Overall, the site-specific objective section of this draft CTR implementation policy needs further public discussion and refinement to ensure that the key component of the State Board's implementation of the US EPA's CTR objectives protects the designated beneficial uses of the State's waters without significant unnecessary expenditures for chemical constituent control.

Page V-135 starts a discussion on the "Watershed Management Approach and TMDLs." Page V-136 outlines the current US EPA approach for implementing TMDLs. This approach is fundamentally flawed in that it has as a basic component Independent Applicability and the inability to properly correct for site-specific conditions that influence the aqueous environmental chemistry of potentially toxic or bio-available constituents. Drs. Lee and Jones-Lee in ("Development of TMDLs from Evaluation Monitoring Program Results" 1997) have discussed how TMDLs should be developed for toxic constituents. This write-up specifically focuses on stormwater runoff issues, such as those associated with urban area and highway stormwater runoff as well as agricultural

and rural area runoff. It provides guidance on how the State Board and regional boards should proceed to develop TMDLs.

Page V-141 initiates a discussion on "Exceptions." The temporary waiver for wet-weather flow conditions meeting water quality standards and use attainability discussed previously could be considered an exception which could be covered in this section as a general Policy that exists throughout the state.

Page V-145 presents "CHAPTER 6 SPECIAL STUDIES." This could be one of the most important provisions of the implementation of the California Toxics Rule. It should be strongly supported by the State Board to address many of the issues that have been raised by others and are discussed in these comments.

One of the more significant deficiencies with this draft Policy for implementation of the CTR is the failure to include a chapter on bioaccumulation issues. One of the most important impacts of "toxics" in California waters is excessive bioaccumulation of hazardous chemicals in fish tissue that cause the fish to be considered hazardous for use as human food. The bioaccumulation regulatory issues should be discussed in the Policy FED. The State Board should be formulating a special Policy to address this problem. It should not be assumed, as apparently is being done now, that meeting California Toxics Rule water quality criteria or state standards based on these criteria for constituents that are of concern because of the potential to bioaccumulate to excessive levels within aquatic life tissue, will be protective without significant waste of public and private funds. An example of this kind of problem occurs with mercury. Currently the US EPA "Gold Book" criterion for mercury which is based on excessive bioaccumulation is 12 ng/L. The US EPA CTR revised value is 50 ng/L. Both of these values are based on the total recoverable mercury. Raising the criterion value from 12 ng/L to 50 ng/L does not mean that the US EPA is relaxing the mercury criterion, but instead reflects a temporary change in the approach the Agency is using in regulating mercury. It is understood that within a year or so, the US EPA, as part of its national mercury review, will decrease the mercury standard for bioaccumulation to on the order of 5 ng/L total recoverable mercury. Drs. Lee and Jones-Lee recently presented an overview paper ("Development of Technically Valid, Cost-Effective Hg Control for Sacramento River Delta & Upper San Francisco Bay"1997) discussing the mercury regulation issues at the national Society for Environmental Toxicology and Chemistry meeting that was held in San Francisco in mid-November 1997. They point out that the regulatory approaches for mercury are changing so that mercury's toxicity and bioaccumulation are being regulated separately. Further, the mercury criterion while temporarily being increased under the California Toxics Rule to 50 ng/L will within a year or so be decreased to 5 ng/L based on total recoverable mercury. This is going to cause significant problems for domestic waste water dischargers in California as well as elsewhere

It is well understood by those familiar with the aqueous environmental chemistry of mercury and its bioaccumulation within fish tissue that the 12 ng/L total recoverable mercury is not a reliable value for predicting mercury bioaccumulation in aquatic systems. With few exceptions, that value significantly over-estimates the mercury

bioaccumulation that will actually occur from a mercury discharge. The situation will be worse when the criterion becomes 5 ng/L. There will be few POTWs in the state that can meet an objective based on that criterion. This is another case where focusing on chemical concentrations as opposed to chemical impacts, i.e. excessive bioaccumulation, is an example of US EPA's inappropriate approach for regulating an important chemical constituent.

The State Board, as part of developing the CTR implementation approach, must address the excessive bioaccumulation issues for mercury and other constituents in order to develop an approach where dischargers that cannot meet the 5 ng/L objective can demonstrate on a site-specific basis that the fish in the receiving waters do not have excessive mercury or that forcing the POTWs and other dischargers to meet the criterion will not result in significantly changing the overall mercury excessive bioaccumulation situation in the receiving water fish. A special advisory committee needs to be appointed to address this issue. A revised CTR implementation plan needs to devote a specific section to discussing this problem and how the state proposes to address it.

Page VIII-1 states under the "Executive Summary," second paragraph,

"The U.S. EPA estimated the costs that could be incurred by point source dischargers in meeting water quality-based effluent limitations (WQBELs) based on the proposed CTR criteria, and the benefits attributable to regulating those point sources."

The US EPA's economic analysis fell far short of properly addressing the costs associated with implementation of the CTR to NPDES-permitted point source dischargers. The regulated POTW community apparently finds, based on comments, that the US EPA's estimates of the costs are low compared to the actual costs that will have to be incurred by POTWs. From the author's review of the US EPA's economic analysis that the Agency has significantly over-estimated the benefits of achieving water quality objectives based on CTR criteria since much of what will be accomplished in achieving these objectives is to alleviate the administrative exceedances of water quality standards

Comments on
"Draft Supplement to Functional Equivalent Document
for the proposed Policy for Implementation of
Toxics Standards for Inland Surface Waters,
Enclosed Bays, and Estuaries
of California"
dated October 16, 1997

In general, this presentation of economic issues suffers from the same deficiencies as the US EPA's CTR economic analysis.

Page S-III-10 discusses pesticide issues in streams and rivers focusing on the diazinon dormant spray issue. The key issue that needs to be addressed is the airborne transport associated with "volatilization" at the time of application. Studies by the Central Valley Regional Water Quality Control Board staff (Dr. Val Connor) have shown that over 200 miles of the Northern and Central Valley are toxic associated with the dormant spray applications each winter. This is not a problem that can be solved by cover crop development.

Appendix 1 presents proposed minimum levels where chromium VI is listed with an FAA of 4.06. FAA is not a suitable procedure for measuring chromium VI. Being able to measure concentrations of less than 0.5 mg/L are necessary to detect potentially toxic levels.

Over-Regulation of Urban Stormwater Runoff
Arising from Ultimately Having to Meet US EPA California Toxics Rule
Water Quality Criteria/State of California Water Quality Objectives

Statement of Issues
Presented at Water Resources Control Board Hearing
on "Draft Policy for Implementation of Toxics Standards
for Inland Surface Waters, Enclosed Bays,
and Estuaries of California"
November 17, 1997

Submitted by

G. Fred Lee, PhD, DEE

Presented below is a summary of the issues discussed by Dr. G. Fred Lee at the Water Resources Control Board's (WRCB) November 17, 1997 hearing on the "Draft Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California."

Overall Issue

The issue of concern is that California urban area and highway stormwater dischargers will under the current regulatory approach have to meet water quality objectives in the receiving waters for NPDES-permitted stormwater dischargers. This requirement will result in massive public expenditures for chemical constituent control in urban area and highway stormwater runoff with little or no expected improvement in the designated beneficial uses of the receiving waters for the stormwater runoff.

The fundamental technical issue is that the US EPA water quality criteria including the CTR proposed criteria were not developed for urban area and highway stormwater runoff

situations. It is now well established that many of the regulated constituents of greatest concern in urban area and highway stormwater runoff such as heavy metals, are in non-toxic, non-available forms. Also, of concern is the short duration of exposure that aquatic organisms can typically receive associated with stormwater runoff events to toxic/available forms compared to the critical duration of exposure that is adverse to aquatic organisms through aquatic life toxicity. There is need to develop a more appropriate regulatory approach for urban area and highway stormwater runoff associated constituents than is currently being implemented by the US EPA and the WRCB

Experience

Dr. G. Fred Lee has worked on urban area and highway stormwater runoff water quality impacts since the 1960s. His work has shown that large amounts of potentially toxic constituents in urban area and highway stormwater runoff are in non-toxic, non-available forms.

Dr. Lee has also served as an advisor to numerous state and federal agencies and the US EPA in developing water quality criteria and standards and has extensive experience in implementing criteria and standards into discharge limits that will protect designated beneficial uses of receiving waters for the discharge without significant unnecessary expenditures for chemical constituent control.

Overall Finding

The US EPA California Toxics Rule (CTR) draft water quality criteria if implemented into state standards (objectives) numerically equal to the criteria are overly-protective when applied to urban area and highway stormwater runoff if only one exceedance of a standard/objective value is allowed every three years. Urban area and highway stormwater runoff contains a variety of constituents which will cause a greater number of exceedances than are allowed under current regulatory approaches. While for now, NPDES-permitted urban area and highway stormwater dischargers must address these exceedances through implementing ever-increasingly more stringent best management practices (BMPs) to the maximum extent practicable (MEP), ultimately, under Clean Water Act requirements and US EPA policy, NPDES-permitted urban and highway stormwater dischargers will have to achieve compliance with water quality objectives in the receiving waters for the discharge. It appears that the maximum time that urban area and highway stormwater dischargers will be exempt from having to meet water quality objectives in the receiving waters is 10 years. Many stormwater dischargers will likely face environmental group litigation to force compliance with water quality objectives in the receiving waters during this time.

The US EPA Region 9's California Toxics Rule proposal was significantly deficient in failing to conduct an economic analysis of the application of the CTR criteria as state standards to urban area and highway stormwater runoff.

The cost of having to achieve water quality objectives in urban area stormwater runoff will be at least $1 to $2 per person per day to construct the collection, storage and treatment works as well as to operate and maintain these works so that there is no more than one exceedance of a water quality objective in the receiving waters for stormwater runoff. Such expenditures will address the "administrative" exceedances of water quality standards that will arise from the overly-protective nature of US EPA water quality criteria and state standards based on these criteria. This expenditure will not likely, from what is known now, result in any significant improvement in the designated beneficial uses of the receiving waters for the stormwater runoff.

The Water Resources Control Board's proposed approach for implementing the California Toxics Rule includes the control of toxicity in ambient waters which impairs the beneficial uses of the receiving waters. The implementation of the California Toxics Rule for potentially toxic heavy metals, organics, etc. requires their control so there is no more than one exceedance of a water quality standard every three years for potentially toxic constituents, even though the exceedance does not result in potentially significant toxicity in the receiving waters. This approach represents gross over-regulation of urban area and highway stormwater runoff that can lead to a massive waste of public and private funds in developing unnecessary treatment works. There is need to change the Clean Water Act and how it is implemented so that the control of toxics focuses on control of toxicity that significantly, adversely impacts the beneficial uses of the receiving waters.

Alternative Regulatory Approaches

The 1995 proposed Clean Water Act revisions contained funds for the US EPA to develop wet weather water quality criteria that would address the deficiencies in the current criteria development approach that leads to the over-regulation and administrative exceedances associated with the non-toxic, non-available forms and the short-durations of exposure that occur for organisms exposed to toxic - available forms in stormwater runoff events. Congress chose not to address re-authorization of the Clean Water Act in the fall of 1995, with the result that the funds did not become available for wet weather criteria development.

The US EPA, in February 1996, as part of the Advanced Notice of Proposed Rulemaking for water quality standards proposed a suggested alternative approach for regulating stormwater runoff exceedances of water quality standards based on the state of Maine's temporary waiver of water quality standards and use attainability during wet weather flow conditions. The state of Maine's approach was directed to violation of water quality standards during combined sewer overflows. The US EPA suggested that the temporary waiver approach could be a viable approach for addressing the over-regulation associated with urban area and highway stormwater runoff-associated constituents having to meet water quality standards of no more than one exceedance every three years.

Dr. Lee proposes that the State Water Resources Control Board develop a temporary waiver from having to meet water quality standards and use attainability requirements for

urban area and highway stormwater runoff during wet weather flow conditions. Attached is a draft temporary waiver approach that Dr. Lee has prepared for the Board's consideration.

The focus of the proposed temporary waiver approach is to address the administrative exceedance of water quality objectives due to stormwater runoff-associated constituents. The waiver focuses on a watershed-based approach in which all waterbody stakeholders work to determine on a site-specific basis if the exceedance of the CTR-based criteria/objectives is an administrative exceedance due to the overly-protective nature of the criteria and how they are implemented or represents a real water quality use impairment which for toxic constituents would be an expected altered types, number and characteristics of desirable forms of aquatic life.

If the exceedance is determined after appropriately conducted studies to be an administrative exceedance, then the regional boards could issue a temporary waiver from having to meet water quality objectives and use attainability during wet weather flow conditions.

A component of the temporary waiver is that the Water Resources Control Board would work with all interested parties in developing guidance on how to develop a temporary waiver to be used by the regional boards.

Proposed Temporary Waiver for Meeting Water Quality Objectives and Use-Attainability During Wet-Weather Flow Conditions
State of California Water Resources Control Board:
An Act to Create Temporary Waivers for Exceedance of Water Quality Objectives Associated with Urban Area and Highway Stormwater (Wet-weather) Runoff

Background and Need

Urban area and highway stormwater runoff contains chemical constituents at concentrations that exceed US EPA water quality criteria and state standards/objectives based on these criteria. While the presence of heavy metals and other constituents at concentrations above water quality standards /objectives represent a violation of US EPA Clean Water Act and state of California water pollution control regulatory requirements, numerous studies by various urban area NPDES-permitted stormwater runoff management agencies and others have shown that the exceedances of the water quality standards/objectives do not represent a real impairment of the designated beneficial uses of the receiving waters for the runoff. These exceedances are best characterized as "administrative" exceedances that reflect the overly-protective nature of using US EPA criteria as the basis for regulating chemical constituents in urban area and highway stormwater runoff.

Currently, the US EPA urban area and highway stormwater runoff management program requires that NPDES-permitted dischargers control pollution of the receiving waters for the stormwater discharges to the maximum extent practicable (MEP) using best management practices (BMPs). It is becoming increasingly recognized that the Clean Water Act requirement of attainment of water quality standards/objectives in the receiving waters for the discharge so that there is no more than one exceedance of a standard/objective every three years will be expensive and generally represents overly-protective approaches for regulating urban area and highway stormwater runoff.

Pollution is defined in the Clean Water Act as an impairment of the designated beneficial uses of a waterbody. It is known that many of the forms of the regulated chemical constituents in urban area and highway stormwater runoff are non-toxic and non-available to impact the designated beneficial uses of the receiving waters for runoff. Further, for the stormwater runoff associated constituents that are in toxic-available forms, the duration of exposure that aquatic organisms can experience during a runoff event is short compared to the time-concentration of toxic chemicals relationship that the organisms can experience without adverse impacts to them. Therefore, the exceedances of water quality standards/objectives associated with urban area and highway stormwater runoff for potentially toxic chemicals do not necessarily represent pollution-use-impairment of the receiving waters by the runoff-associated constituents.

Under the proposed approach for implementing the California Toxics Rule, the maximum period of time that the NPDES-permitted urban and highway stormwater discharges will be allowed to cause violations of Clean Water Act requirements of attaining water quality standards/objectives in the receiving waters, will be 10 years. During this ten-year period the regional boards will be issuing two NPDES permit revisions where the stormwater discharger will be required to ratchet down the BMPs toward achieving the goal of only one violation of a water quality standard due to the discharge associated constituents, every three years. Environmental groups are already taking legal action against regional boards and stormwater dischargers, claiming that the current NPDES permits and associated BMPs do not represent adequate progress toward achieving water quality standards. This situation could readily result in litigation against urban area and highway stormwater runoff water quality managers and state agencies.

Compliance with the requirement of no exceedances of water quality standards/objectives for more than once in three years by urban area and highway stormwater runoff, will mean that the public in those areas regulated by stormwater runoff NPDES permits will be spending at least $1 to $2 per person per day forever for the construction, operation and maintenance of the advanced treatment processes/facilities needed to address the administrative exceedances of water quality criteria/standards caused by urban area and highway stormwater runoff. In some communities, such as Alameda County in the San Francisco Bay region, it is estimated that over several billion dollars will have to be spent in the acquisition of property for the construction of storage and treatment facilities to treat a two-inch in one day precipitation event in order to comply with proposed California Toxics Rule water quality criteria/state of California objectives. From the

information available such expenditures will not likely result in an improvement in the designated beneficial uses of the receiving waters for the stormwater runoff.

Urban area and highway stormwater runoff water quality managers face significant problems associated with environmental groups and others attempting to utilize the violation of water quality standards associated with stormwater runoff-associated constituents as the basis for legal action against the stormwater quality managers which results in settlement agreements that provide support for the environmental groups' activities. If violation of water quality standards/objectives represented a real water quality use impairment in the receiving waters for the urban area and highway stormwater runoff, it could be appropriate to consider that the best management practices for controlling the exceedances of the water quality criteria/standards included the development of advanced (beyond tertiary treatment) technology for removal of trace concentrations of heavy metals and organics to concentrations less than those required by US EPA criteria/standards under worst-case conditions for protection of receiving water beneficial uses. However, under the conditions that exist today where real water quality use impairments associated with the exceedances of water quality criteria and standards in urban area and highway stormwater runoff have not been found to cause impairment of the designated beneficial uses of the receiving waters in terms of altered numbers, types and characteristics of desirable forms of aquatic life in these waters for potentially toxic chemicals, then it should be concluded that appropriate modification of the current regulatory approach should be implemented to protect public agencies and others from having to "settle" lawsuits which provide support for the activities of those filing the suit.

It is proposed that temporary waiver of the water quality standards and use-attainability analysis/beneficial uses be allowed, associated with urban area and highway stormwater runoff (wet-weather flow conditions). This administrative relief from the overly-protective character of US EPA water quality criteria and state standards/objectives based on these criteria when applied to urban area and highway stormwater runoff, is designed to protect the public from unnecessary expenditures for chemical constituent and pathogenic indicator organism control in urban area and highway stormwater runoff that will protect the designated beneficial uses of the receiving waters for such runoff without significant, unnecessary expenditures for chemical constituent and pathogenic organism indicator control in the runoff.

Proposed Regulatory Requirements

It is proposed that temporary waiver of the water quality standards, designated beneficial uses and use-attainability analysis be granted to NPDES-permitted stormwater discharges under conditions where such a waiver will protect the designated beneficial uses of the waterbody from real use impairment associated with chemical constituents and pathogenic organism indicators in NPDES-permitted urban area and highway stormwater runoff.

When the designated uses of a waterbody are not being met as a result of urban area and highway stormwater runoff causing an exceedance of a water quality standard/objective,

the Regional Board and State Board may, consistent with this subsection and 40 Code of Federal Regulations, Part 131, temporarily remove designated uses that are not existing uses and create a temporary urban area and highway stormwater runoff subcategory. This subcategory shall be used to designate the uses that are maintained during stormwater runoff (wet weather) flow conditions.

This Act requires that the State Water Resources Control Board develop guidance that can enable NPDES-permitted stormwater dischargers to obtain a temporary waiver of water quality standards/objectives and the attainment of designated beneficial uses of a waterbody under the conditions where the NPDES-permitted discharger demonstrates to a reasonable degree of reliability, that the exceedance of water quality standards/objectives in the receiving waters associated with stormwater runoff events does not represent a significant adverse impact on the designated beneficial uses of the receiving waters. For the purpose of this Act, the exceedance of a US EPA water quality criterion/state standard/objective is not considered a significant, adverse impact on the designated beneficial uses of the receiving waters for urban area and highway stormwater runoff.

The State Water Resources Control Board shall develop guidelines that can be used by the regional boards to evaluate on a site-specific basis, whether NPDES-permitted urban area and highway stormwater runoff associated constituents discharged to a particular waterbody has the potential to, and in fact does, represent a significant adverse impact on the designated beneficial uses of the waterbody. These guidelines shall include the requirement for stormwater NPDES-permitted dischargers to demonstrate that the exceedance of water quality criteria/standards/objectives in the receiving waters for the runoff do not represent significantly altered numbers, types and characteristics of desirable forms of aquatic life within the receiving waters for the runoff, cause or significantly contribute to excessive bioaccumulation of hazardous chemicals within fish and other edible organism tissue that represent hazards to humans who use these organisms as food, significantly contribute to the excessive fertilization of a waterbody through the introduction of aquatic plant nutrients (nitrogen and phosphorous compounds) that would not occur to essentially the same degree if the urban area and highway stormwater runoff associated nutrients were not discharged to the waterbody of concern, impair the sanitary quality of the receiving waters for contact recreation and/or shellfish harvesting, adversely impact a domestic water supply water quality, significantly alter fish and other aquatic life and wildlife habitat, cause excessive siltation, oil and grease accumulation, or cause other adverse impacts on the designated beneficial uses of the waterbody.

In addition to demonstrating, on a site-specific basis for representative stormwater discharge points of entry into a receiving waterbody which, because of the stormwater runoff, has exceedances of water quality standards/objectives at the point of runoff entry into the waterbody, the protocols for developing a temporary waiver of water quality standards shall include guidance on the approach that should be used to determine whether the exceedance of water quality standards/objectives in the receiving waters associated with urban area and highway stormwater runoff represent "administrative"

exceedances related to the overly protective characteristics of the US EPA water quality criteria and state standards based on these criteria or represent water quality use impairments that are of significance to the public. For example, for potentially toxic constituents, such as heavy metals, toxicity of the stormwater runoff should be measured using the standard US EPA three-species testing procedures or other suitable testing procedures approved by the regulatory agencies. If this testing shows that the ambient waters are non-toxic for both acute and chronic toxicity as evaluated by these procedures or that the magnitude, areal extent and duration of toxicity in the receiving waters is insufficient to be adverse to the aquatic life beneficial uses, then it can be concluded that the exceedance of the US EPA water quality criterion in the stormwater runoff from urban areas and highways is an "administrative" exceedance that does not represent a real water quality problem in the receiving waters for the runoff.

Similarly, if the chemical analysis of aquatic organism tissue for organisms obtained in the vicinity of the stormwater runoff does not show excessive concentrations of chlorinated hydrocarbon pesticides, PCBs, mercury or other constituents in the stormwater runoff that represent human health threats to those who use the organisms as food, then the exceedance of the water quality standards/objectives in the stormwater runoff for potentially bioaccumulatable chemicals, is an "administrative" exceedance that is not manifested in excessive bioaccumulation in edible organism tissue.

Similar approaches would be followed for determining whether the pathogenic organism indicators such as total and fecal coliforms, aquatic plant nutrients, oil and grease, silt, etc. present in urban area and highway stormwater runoff are significantly impacting the beneficial uses of the receiving waters for the runoff. In each case a site-specific evaluation of the relative contribution of these potential pollutants would be made to assess whether real water quality problems due to the total load of a constituent to a waterbody is causing a real waterbody use impairment is occurring. The basic issue that would be addressed by the State Water Board guidance for obtaining a temporary waiver of achieving water quality standards during wet-weather conditions is whether the constituents in the runoff cause or significantly contribute to water quality use impairments that would potentially justify the treatment of the runoff waters to control the input of the constituents responsible for the impairment.

The temporary waiver from attaining water quality standards/objectives could be granted for a maximum of five years. The permittee that is granted such a waiver would be required to examine representative receiving waters for the stormwater runoff every five years to determine whether the conditions that served as a basis for granting this waiver which indicated that it would protect the designated beneficial uses of the receiving waters, were still applicable. At the time of the five year review, consideration would have to be given to whether there are new constituents in the urban area and highway stormwater runoff that are adversely impacting the beneficial uses of the runoff and/or whether the concentrations and forms of constituents previously considered had changed sufficiently during the five year period so that their impacts on the beneficial uses of the receiving waters were no longer insignificant. The State Water Resources Control Board

would provide guidance for the stormwater NPDES permitees on the approach that should be followed for the renewal of the temporary waiver.

The State Water Resources Control Board's development of the guidance for initial granting and renewal of the temporary waiver would be done in a public review process which would enable all interested parties to participate in the development of this guidance and its implementation.

Value of the Temporary Waiver Approach

In addition to providing administrative relief for urban area and highway stormwater runoff water quality managers from having to implement ever-increasingly more stringent/expensive BMPs through a ratcheting down process associated with NPDES permit renewal, the adoption of this temporary waiver approach would stimulate urban area and highway stormwater runoff water quality managers to focus their resources on determining what real, if any, significant adverse impacts on the beneficial uses of a waterbody are occurring due to urban area and highway stormwater runoff-associated constituents. While at this time, the urban area and highway stormwater water quality managers have demonstrated that the regulated chemical constituents in runoff waters that are of greatest concern such as some of the heavy metals, (copper, zinc, cadmium and lead) are in non-toxic, non-available forms, and therefore the exceedance of the water quality standards/objectives for these constituents is an "administrative" exceedance, this does not mean that there are no real water quality problems caused by the unregulated constituents in the runoff waters. Of particular concern in urban areas is the presence of organophosphate and other pesticides for which the US EPA has not yet developed or has not been implementing water quality criteria. Rather than devoting resources to copper, zinc and lead in urban area and highway stormwater runoff because they cause exceedance of water quality standards/objectives, the urban area and highway stormwater runoff water quality managers could devote their resources to evaluating whether other regulated and unregulated constituents in the runoff such as organophosphate pesticides are significantly adversely affecting the beneficial uses of the receiving waters for the runoff.

Proposed Temporary Waiver for Meeting Water Quality Standards and Use-Attainability Associated with Dredging and Dredged Sediment Management in the Sacramento and San Joaquin River Delta

Proposal

It is proposed that the State Water Resources Control Board as part of developing state policy for implementation for the CTR, include the development of a temporary waiver from meeting water quality standards and use-attainability associated with dredging of the Sacramento San Joaquin River Delta and its tributaries and management of dredged sediments withing the Delta. Of particular concern is the beneficial use of dredged

sediments within the Delta for Delta levee stability enhancement and shallow water habitat development.

Justification

The author (Dr. G. Fred Lee) has conducted over one million dollars in research associated with developing dredged sediment management criteria. His pioneering work in the 1970s serves as a foundation for the US EPA, US Corps of Engineers dredged sediment water quality regulatory approaches that are in use today. The technically valid management of contaminated dredged sediments is similar to the proper management of the water quality problems associated with urban area and highway stormwater runoff associated constituents. Both sources have large amounts of particulate, potentially toxic chemical constituents that are in non-toxic, non-available forms. The current regulatory approach for managing dredging and dredged sediment disposal, including beneficial uses within the Delta conforms to Clean Water Act requirements which allow only one exceedance of a water quality standard/objective outside of a mixing zone for the waters associated with the dredged sediments that leave the dredging or disposal/management area. This approach tends to significantly over-regulate dredging and dredged sediment management activities. This over-regulation is well recognized to be a significant impediment to the beneficial uses of dredged sediments for Delta levee enhancement and shallow water habitat development. It is proposed that the temporary waiver from complying with water quality standards and use-attainability proposed for urban area and highway stormwater runoff associated constituents be expanded to include dredging and dredged sediment disposal/management within the Delta and its tributaries.

As with the proposed temporary waiver for urban area and highway stormwater runoff having to meet water quality standards and use-attainability during wet-weather flow conditions, the temporary waiver governing Delta dredging and dredged sediment management would also require that the sponsors of the project demonstrate to a reasonable degree that the issuance of a temporary waiver does not result in a significant, adverse impact in the beneficial uses of Delta waters and/or its resources. Basically the temporary waiver would be designed to address the "administrative" exceedances of water quality standards/objectives associated with the overly protective characteristics of the California Toxics Rule criteria when implemented into state standards which allows only one exceedance of a standard outside of the mixing zone every three years. It is well known that significant exceedances in excess of those currently allowed can occur associated with dredging and dredged sediment management without adversely impacting the beneficial uses of the receiving waters where the exceedances occur.

It is recommended that the WRCB and other interested agencies develop a Delta dredging/dredged sediment management advisory panel that would work with all interested stakeholders in developing guidance that can be used by the CVRWQCB and the San Francisco Regional Water Quality Control Board (SFRWQCB), for granting temporary waivers associated with dredging and dredged sediment management projects. This panel would develop detailed guidance on the pre-, during and post- project activities that are directed toward developing the information base needed to assure

within a reasonable degree that the dredging and dredged sediment management activities are not significantly adverse to the beneficial uses of the Delta and its resources.

This issue has been reviewed by members of the Resources Agency Delta Levees and Habitat Advisory Committee and was supported by members of the committee in attendance of a meeting that was held December 5, 1997.

The State Board's adoption of this approach as part of developing state policy governing the implementation of the California Toxics Rule would be strongly supportive of the CALFED mission of developing increased Delta levee stability and shallow water habitat.

List of References

Allen, H.E and Hansen, D., "The Importance of Trace Metal Speciation to Water Quality Criteria," Water Environment Research, 68: (1) 42-54, January/February (1996).

Lee, G.F., "Chemical Aspects of Bioassay Techniques for Establishing Water Quality Criteria," Water Res. 7:1525-1546 (1973).

Lee, G.F., "Petition to the State Water Resources Control Board to Review the Waste Discharge Requirements, Order 96-227, Issued by the Central Valley Regional Water Quality Control Board on August 9, 1996 to the University of California at Davis for the UCD Campus Landfill Ground Water Cleanup System," G. Fred Lee & Associates, El Macero, CA, 23pp, September 9, (1996).

Lee, G.F., "Comments on 'Tentative Waste Discharge Requirements and Cease and Desist Order NPDES NO. CA0077895 for University of California Davis Campus Wastewater Treatment Plant Yolo and Solano Counties," Report of G. Fred Lee & Associates, El Macero, CA, April (1997).

Lee, G.F., "Initial Comments on US EPA 40 CFR Part 131 Water Quality Standards for the State of California as Proposed on Tuesday, August 5, 1997," September (1997).

Lee, G.F., "Comments on Tentative Waste Discharge Requirements and Cease and Desist Order NPDES No. CA0077895 for University of California, Davis Campus Wastewater Treatment Plant Yolo and Solano Counties Dated August 27, 1997," Report by G. Fred Lee & Associates, El Macero, CA, October (1997).

Lee, G.F., "Comments on Current Deficiencies in US EPA/USDA Water Pollution Control Programs: Suggested Revisions as part of the Clean Water Action Plan," Submitted to the US EPA and USDA, November 24, (1997).

Lee, G.F. and Jones, R.A., "Interpretation of Chemical Water Quality Data," IN: Aquatic Toxicology, ASTM STP 667, ASTM, Philadelphia, pp 302-321 (1979).

Lee, G.F. and Jones, R.A., "Problems in Implementation of US EPA Water Quality Criteria into State Water Quality Standards," Proc. US EPA Symposium, "Development, Use, and Value of Water Quality Standards," Washington, D.C., US EPA pp 93-116 (1981).

Lee, G.F. and Jones, R.A., "Translation of Laboratory Results to Field Conditions: The Role of Aquatic Chemistry in Assessing Toxicity," IN: Aquatic Toxicology and Hazard Assessment: 6th Symposium, ASTM STP 802, ASTM Philadelphia, pp 328-349 (1983).

Lee, G.F., and Jones, R.A., "Assessment of the Degree of Treatment Required for Toxic Wastewater Effluents," Proc. Int. Conf. On Innovative Biological Treatment of Toxic Wastewaters, US Army Construction Engineering Research Laboratory, Champaign, IL, pp 652-677 (1987).

Lee, G.F. and Jones-Lee, A., "Comments on US EPA's November 19, 1991 Proposed Rule for Compliance with Water Quality Standards Regulations Governing State Development of Numeric Water Quality Standards for Toxic Chemicals," Submitted to the US EPA Washington, D.C, December (1991).

Lee, G.F. and Jones-Lee, A., "Independent Applicability of Chemical and Biological Criteria/Standards and Effluent Toxicity Testing," The National Environmental Journal, 5(1):60-63, (1995), Part II, "An Alternative Approach," 5(2):66-67 (1995).

Lee, G.F. and Jones-Lee, A., "Appropriate Use of Numeric Chemical Water Quality Criteria," Health and Ecological Risk Assessment, 1:5-11 (1995). Letter to the Editor, Supplemental Discussion, 2:223-234 (1996).

Lee, G.F. and Jones-Lee, A., "Aquatic Chemistry/Toxicology in Watershed-Based Water Quality Management Programs," In: Proc. Watershed '96 National Conference on Watershed Management, Water Environment Federation, Alexandria, VA, pp. 1003-1006 (1996).

Lee, G.F. and Jones-Lee, A., "Planktonic Algal Toxicity Testing in Regulating Point and Non-Point Discharges and Its Implications for Use of Dissolved Metal Criteria/Standards," Report of G. Fred Lee & Associates, El Macero, CA, (1996).

Lee, G.F. and Jones-Lee, A., "Comments on Interim Draft Advance Notice of Proposed Rulemaking US EPA 40CRF Part 131 (FRL-)W- ?) Water Quality Standards Regulation," Submitted to US EPA Office of Water, Water Quality Standards and Regulation Development, Washington, D.C., 15 pp, May (1996).

Lee, G.F., and Jones-Lee, A., "Summary of Issues Pertinent to Regulating Bioaccumulatable Chemicals," Report of G. Fred Lee & Associates, El Macero, CA, September (1996).

Lee, G.F. and Jones-Lee, A., "Assessing Water Quality Impacts of Stormwater Runoff," North American Water & Environment Congress, Published on CD-ROM, Amer. Soc. Civil Engr., New York, 6pp (1996).

Lee, G.F., and Jones-Lee A., "Chromium Speciation: Key to Reliable Control of Chromium Toxicity to Aquatic Life," Presented at the American Chemical Society National Meeting poster session, San Francisco, CA, April (1997).

Lee, G.F. and Jones-Lee A., "Regulating Copper in San Francisco Bay: Importance of Appropriate Use of Aquatic Chemistry and Toxicology," Presented at the Fourth International Conference on the Biogeochemistry of Trace Elements, Berkeley, CA, June (1997).

Lee, G.F. and Jones-Lee, A., "Evaluation Monitoring as an Alternative to Conventional Stormwater Runoff Monitoring and BMP Development," SETAC News, 17(2): 20-21 (1997).

Lee, G.F. and Jones-Lee, A., "Development of TMDLs from Evaluation Monitoring Program Results," Report of G. Fred Lee & Associates, El Macero, CA, May (1997).

Lee, G.F. and Jones-Lee, A., "Development and Implementation of Evaluation Monitoring for Stormwater Runoff Water Quality Impact Assessment and Management," Report of G. Fred Lee & Associates, El Macero, CA, June (1997).

Lee, G.F. and Jones-Lee, A., "Development of Technically Valid, Cost-Effective Hg Control for Sacramento River Delta & Upper San Francisco Bay," Presented at Society of Environmental Toxicology & Chemistry 18th Annual Meeting, San Francisco, CA, November (1997).

Lee, G.F., Jones, R. A., and Newbry, B.W., "Water Quality Standards and Water Quality," Journ. Water Pollut. Control Fed. 54: 1131-1138 (1982a).

Lee, G.F., Jones, R. A. and Newbry, B. W., "Alternative Approach to Assessing Water Quality Impact of Wastewater Effluents," Journ. Water Pollut. Control Fed. 54:165-174 (1982b).

NAS/NAE. "Water Quality Criteria of 1972." National Academies of Science and Engineering, U.S. EPA, EPA/R3-73-033, Washington, D.C. (1973).

Stumm, Werner and Morgan, James J., Aquatic Chemistry Chemical Equilibria and Rates in Natural Waters Third Edition, Wiley: New York, (1996).

Dated September 11, 1987,' Report of G. Fred Lee & Associates El Macero, CA, December (1997)."