

**Proposal to
CALFED Bay-Delta Program
Water Quality Technical Group**

for

**Implementation of the Evaluation Monitoring Approach
for Development of Pollution Control Programs
from Urban and Industrial Runoff**

Submitted by:

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Synopsis of Proposal

A critical review of the current CALFED Water Quality Technical Group's Urban and Industrial Runoff water quality management program shows that, as proposed now, this program has technical deficiencies that could readily lead to significant waste of public funds and fail to address real water quality issues caused by urban area, highway and industrial stormwater runoff. Technical deficiencies exist in defining "parameters of concern" and "priority actions" to reduce impacts of urban and industrial runoff. The currently proposed CALFED WQTG Urban and Industrial Runoff stormwater water quality management program does not reflect the large amount of work that has been done beginning in the 1960s and especially in the 1990s toward defining real water pollutants, i.e. constituents that impair beneficial uses, in urban area and highway stormwater runoff. This program could readily result in the expenditure of large amounts of public and private funds for chemical constituent control that has little or no impact on the designated beneficial uses of the Delta and its tributary waters. Further, this program could readily fail to address real water quality use impairments arising from urban area and highway stormwater runoff such as associated with aquatic life toxicity due to regulated constituents that are not listed as "parameters of concern" as well as unregulated and under-regulated constituents in urban area, highway, and industrial stormwater runoff. There is an immediate need for CALFED to redirect the Urban and Industrial Runoff water quality management program so that it more appropriately addresses the definition and management of real water quality issues of concern to Delta water quality-beneficial uses.

It is proposed that CALFED provide support for Dr. G. Fred Lee and Mr. Scott Taylor to work with the CALFED Water Quality Technical Group to develop an approach for managing chemical constituents and pathogenic organism indicators present in urban area, highway and industrial stormwater runoff that are significantly adverse to the designated beneficial uses of the Sacramento - San Joaquin River Delta. Dr. Lee has approximately 30 years of professional experience in evaluating and managing urban area stormwater runoff water quality. He has pioneered the development of the Evaluation Monitoring approach for defining and managing real water quality use impairments arising from the input of chemical constituents and pathogenic organisms in urban area and highway stormwater runoff. He and Mr. Scott Taylor are currently conducting a watershed-based water quality management program Evaluation Monitoring Demonstration Project in the Upper Newport Bay and lower Santa Ana River watersheds in Orange County, California. With support of this project, Dr. Lee and Mr. Taylor would work with CALFED management and others, as appropriate, to apply the Evaluation Monitoring approach to defining the real water quality use impairments of Delta waters that are caused by constituents in urban area, highway and industrial stormwater runoff. This effort would lead to the development of a stakeholder watershed-based water quality management program designed to control real water quality problems in the Delta watershed arising from urban area, highway and industrial stormwater runoff in accord with current regulatory requirements to the maximum extent practicable using best management practices.

Beginning immediately, Dr. Lee will become an active observer and if there is interest on the part of CALFED management, a participant in the CALFED WQTG water quality program development. He plans to attend the February 4, 1997 workshop and the February 14, 1997 WQTG meeting. If there is interest in support of this proposal, he will meet with CALFED WQTG management to discuss its development and implementation. As planned now, Dr. Lee would upon award of the contract begin to review all information pertinent to assessing the water quality impacts of urban area, highway and industrial stormwater runoff-associated constituents on the beneficial uses of the waters near the point of runoff as well as upstream of and within the Delta. This assessment will lead to the development of a draft issues paper discussing what is known about current water quality impacts and the data gaps that exist in formulating a water quality management program to manage the adverse impacts of urban area, highway and industrial stormwater runoff on the Delta watershed and Delta.

While the WQTG December 9, 1996 meeting materials did not discuss highway issues, highways should be included with urban and industrial stormwater runoff management since they are regulated through a stormwater NPDES permit and since they can be an important local source of chemical constituents which are often alleged to be and, in some cases can actually be, adverse to the beneficial uses of a waterbody. Of particular concern are large highways which cross small streams which are used for salmonid and other fish reproduction. It is possible that some highway stormwater runoff could be adverse to Delta fisheries through adversely impacting fish reproduction in tributary streams. This is an area with which Dr. Lee is familiar and can readily incorporate into this project's activities.

The draft issues paper would be developed in cooperation with CALFED management and all interested stakeholders where Dr. Lee would take the lead in developing the draft write-up and interested stakeholders would have the opportunity to help formulate issues addressed and their discussion. After approval by CALFED management, the draft issues paper would then be circulated among the greater CALFED community for their review and comment. Dr. Lee, working with Mr. Taylor, would revise the urban area, highway and industrial stormwater runoff water quality management issues paper and, if appropriate, recirculate and then finalize it.

This paper would serve as a blueprint for the implementation of CALFED's water quality management program in urban area, highway and industrial stormwater runoff. As discussed herein, Dr. Lee and Mr. Taylor have already followed this same procedure in their work in Orange County, California devoted to development and implementation of the Evaluation Monitoring Demonstration Project for managing stormwater runoff-caused water quality impairments in Upper Newport Bay and its tributaries, as well as the lower Santa Ana River.

The project can begin as soon as funds are available. Phase 1 of the project is anticipated to be a six-month effort in which Dr. Lee would spend approximately two days per week, and Mr. Taylor would spend one day per week devoted to the development of a program for managing real water quality problems due to urban area, highway and industrial stormwater runoff in the Delta watershed that are of importance to the beneficial uses of the Delta. The total proposed budget

for this project is \$97,450. Due to the critical nature of this program in the protection of the Delta resources, Dr. Lee and Mr. Taylor propose to donate consulting services to this project in the amount of approximately \$50,000.

Budget

Budget period is six months.
The project is to be initiated upon award of contract.

Personnel:

Dr. G. Fred Lee, PhD, PE, DEE	
20 hrs/week for six mos. @ \$125/hr.	\$60,000.00
Scott Taylor, PE	
8 hrs/week for six mos. @ \$100/hr.	19,200.00
Hourly help	
500 hrs @ \$18/hr.	9,000.00
Secretarial	
150 hrs @ \$15/hr.	<u>2,250.00</u>
Total Personnel	\$90,450.00

Travel:

S. Taylor	
10 trips	
Irvine to Sacramento and return @ \$150/ea	\$1,500.00
Auto rental 10 times at \$50/ea	500.00
Miscellaneous travel Sacramento region	500.00

Supplies:

Telephone/Fax/Photocopies	\$4,500.00
Total Travel and Supplies	<u>\$7,000.00</u>

Total Budget: \$97,450.00

Discussion of Budget:

Dr. Lee proposes to spend an average of two ten-our days per week devoted to CALFED WQTG urban area, highway and industrial stormwater runoff water quality management program

development for a six-month period. He has proposed to adjust his normal consulting rate from the current \$225 per hour to \$125 per hour for this project. He will, therefore, donate \$48,000 in support of CALFED WQTG activities during the course of this project.

Mr. Taylor proposes to spend an average of one eight-hour day per week over a six-month period devoted to this project. Mr. Taylor's normal billing rate, through his firm, is \$125 per hour. He/RBF is proposing to donate \$4,800 in support of this project.

The billing rates for Dr. Lee and Mr. Taylor are rates which include their total costs. There are no overhead/indirect costs, multipliers, fees or separate profit items associated with these rates.

While no funds are budgeted for the support of Dr. Anne Jones-Lee (Dr. G. Fred Lee's wife), she will, as needed, be an active participant in the project. Her activities will be primarily focused on providing advice on the aquatic biology/aquatic toxicology components of the project, as well as in the project report preparation. She will donate her time on behalf of the project as needed.

While the focus of Dr. Lee's activities will be the development of a technically valid, cost-effective urban area, highway and industrial stormwater runoff water quality management program for the Delta watershed, Dr. Lee will be available to CALFED as an advisor on other aspects of the CALFED water quality management program.

Background

The CALFED Bay-Delta Program Water Quality Technical Group (WQTG, 1996) has established the goal,

"to maintain or improve water quality in the Sacramento-San Joaquin Delta (Delta) so that all beneficial uses are protected (e.g. municipal, industrial and agricultural water supply, recreation, fish and wildlife)."

WQTG has specifically delineated **urban and industrial runoff** as a source of pollutants that are adversely impacting the Delta. The WQTG (1996) has established an objective,

"to reduce the loading and/or concentration of water quality parameters of concern attributable to URBAN AND INDUSTRIAL RUNOFF within the Sacramento River and San Joaquin River Basins, Delta and Suisun Marsh."

The WQTG geographic scope of pollutant control from urban and industrial stormwater runoff includes the following:

"areas within the Delta [and] areas outside of the Delta in which biological resources that use the Delta are impacted areas outside of the Delta that are significant source areas for parameters of concern in the Delta"

The WQTG (1996) had developed a list of 17 *"parameters of concern attributable to industrial and urban stormwater runoff"* and have defined estimated study area urban/industrial runoff loads for a number of these parameters. WQTG (1996) has also developed five *"priority actions to reduce impacts of urban and industrial runoff."*

The principal investigator for the proposed project, Dr. G. Fred Lee, has been involved as a researcher and in a leadership management role in evaluating water quality impacts and managing urban area and highway as well as industrial stormwater runoff since the 1960's. He has conducted extensive research on this topic, served as an advisor to numerous governmental agencies and industry and published numerous papers and reports in the topic area. Further, he is active now in implementing an Evaluation Monitoring Demonstration Project in Orange County, California, specifically designed to develop water pollution control programs for urban area and highway stormwater runoff as they may impact Upper Newport Bay and its tributaries as well as the Santa Ana River below Prado Dam. Dr. Lee finds, upon review of the CALFED WQTG December 9, 1996 meeting packet as well as R. Woodard's December 18, 1996 memorandum to the WQTG covering the December 9, 1996 WQTG meeting, there are significant deficiencies in the WQTG proposed pollution control program for managing pollutants in stormwater runoff from urban and industrial areas as they may impact the "Delta's" designated beneficial uses. Significant deficiencies exist in the list of parameters of concern, the estimated pollutant loadings, and the proposed "Priority CALFED Water Quality Actions."

The proposed urban and industrial runoff program will, based on Dr. Lee's expertise and over 30 years of experience, if implemented as proposed, result in waste of public funds in controlling chemical constituents listed as parameters of concern in urban and industrial stormwater runoff which have limited potential to be adverse to the designated beneficial uses of the Delta and its tributaries. Further, there are other constituents that are not listed as parameters of concern derived from urban area and industrial stormwater runoff which have a significant potential to be adverse to the designated beneficial uses of the Delta of concern to CALFED.

There is an immediate need for CALFED to restructure the urban and industrial runoff component of its water quality program so that it utilizes the funds and other resources available in a much more technically valid, cost effective manner to control real pollutants derived from urban area and industrial stormwater runoff than is proposed in the WQTG December 9, 1996 meeting minutes. Support of this proposal would enable Dr. Lee, with the assistance of Mr. Scott Taylor, to apply his extensive expertise and experience in urban area, highway, and industrial stormwater runoff water quality impact evaluation and management to work toward achieving CALFED's water quality technical group's objectives of reducing the pollution of the Delta and its tributaries by constituents derived from urban area, highway, and industrial stormwater runoff.

It is proposed that Dr. Lee assume a leadership/facilitator role in the CALFED WQTG by working with urban area, highway, and industrial stormwater runoff managers, regulatory agency personnel, and those concerned about the water quality impacts of urban area, highway, and industrial stormwater runoff associated constituents on the designated beneficial uses of the Delta and its tributaries. This effort would be specifically directed to being the first step in developing technically valid, cost effective urban area, highway, and industrial stormwater runoff pollution control programs for the "Delta."

Considerable information has been collected on the chemical characteristics and the pathogenic organism indicator content of stormwater runoff from urban areas and highways. This information shows that elevated concentrations of a variety of chemical constituents and human pathogenic organism indicators (coliforms) are present in this runoff that represent potential threats to impairing the designated beneficial uses of receiving waters for the runoff. Typically, the designated beneficial uses of greatest concern are aquatic life propagation and maintenance and domestic water supplies.

The judgement that there is a potential threat to receiving water quality from constituents in urban area stormwater runoff is not based on actually finding adverse impacts in receiving waters from stormwater runoff from urban areas and highways. Instead, it is based on the concentrations of constituents of concern in the runoff waters relative to the US EPA water quality criteria such as those set forth in the US EPA "Gold Book," Quality Criteria for Water 1986, (US EPA, 1987) as well as state standards based on these criteria. However, as discussed by Lee and Jones (1991a) and Lee and Jones-Lee (1994a, 1995a), the US EPA water quality criteria were developed for available/toxic forms of chemical constituents that have significantly different potential impacts than many of those associated with urban area and highway stormwater runoff.

The constituents in urban area and highway stormwater runoff of potential concern are largely in non-toxic, non-available forms. Further, the durations of exposure to critical concentrations that aquatic organisms can receive from such runoff are short compared to the conditions that were used to develop the critical concentrations that are set forth in the water quality criteria/standards. While there is an attempt in the implementation of the criteria to account for short-term exposures, i.e. one hour maximum values, it is widely recognized that this approach is not a technically valid approach for most constituents and tends to over-regulate discharges/runoff of toxic/available forms of constituents. Lee and Jones-Lee (1995b) have provided additional discussion of why US EPA water quality criteria and state standards based on these criteria tend to significantly over-regulate stormwater runoff-associated chemical constituents in runoff from highways and urban area streets.

One of the problems with the highway stormwater runoff water quality management field is that typically those working in this field equate concentrations of chemical constituents to water quality impacts. With few exceptions, true water quality impacts cannot be reliably assessed based on the exceedence of an existing water quality criterion or standard. As discussed by Lee and Jones-Lee (1995b), water quality must be judged by actual use impairments of the receiving waters for the stormwater runoff. For example, concentrations of lead or other heavy metals in stormwater runoff from urban area and highway do not adversely impact the designated beneficial uses of the receiving waters unless they alter the numbers, types or characteristics of desirable forms of aquatic life in these waters. In general, the coupling of chemical concentration of constituents to real use impairments, i.e. real water quality impairment, cannot be reliably assessed based on the traditional approaches of measuring chemical concentrations in runoff waters. In this proposal, the term "water quality" does not mean the concentration of a chemical constituent, but focuses on the relationship between the constituent concentration and the impact of the constituent on the designated beneficial uses of waterbodies.

There is need to develop guidance that CALFED WQTG can use on how to properly evaluate on a site-specific basis whether there is a significant potential for real water quality use impairments associated with stormwater runoff from urban areas, highways and industrial areas. This information is needed to ensure that stormwater runoff management systems associated with urban areas and highway are effective in controlling real water quality use impairments in the receiving waters for the runoff without significant unnecessary capital and maintenance expenditures for stormwater runoff water quality management.

Basically, the Evaluation Monitoring approach is a common sense engineering approach in which those responsible for stormwater runoff water quality management for the highway work with the regulatory agencies and others to define the real water quality use impairments of the receiving waters for the runoff that are due to highway stormwater runoff-associated constituents. This approach determines for each of the receiving waters for the runoff weather runoff-associated constituents are or could be significantly impairing the waterbody's beneficial uses. Where such impairment is found, the urban area stormwater management entity works with the regulatory agencies to control to the maximum extent practicable (MEP) the constituents responsible for the

impairment at their source. Only if it proves to be impossible to control constituents at the source would the BMPs involve the development of structural BMPs to treat the stormwater runoff.

The Evaluation Monitoring approach is basically one of finding a real water quality problem in the receiving waters for the runoff and managing it in a technically valid, cost-effective manner. This approach is significantly different from the current traditional approaches for "managing" stormwater runoff water quality where it is assumed, without proper evaluation, that heavy metals and other constituents in highway stormwater runoff are having significant adverse impacts on the receiving waters that require structural BMPs to control the so-called impacts. Additional information on the Evaluation Monitoring approach is provided in this proposal and in publications developed by the project investigators (Lee and Jones-Lee, 1996a,b) listed in the references to this proposal.

While the focus of this project is developing guidance for evaluating and managing water quality impacts associated with chemical constituents and pathogenic organisms in stormwater runoff from urban areas and highway, the results will have general applicability to assisting others on how to evaluate on a site-specific basis whether stormwater runoff from any type of land use is adverse to beneficial uses of the receiving water beneficial uses.

Approach

The approach that would be followed is the approach that is being used by Dr. Lee and Mr. Taylor in their Evaluation Monitoring Demonstration Project that is currently underway in Orange County, California. The Evaluation Monitoring approach was originally developed by Drs. G. Fred Lee and Anne Jones-Lee as an alternative to the conventional stormwater runoff monitoring and best management practices (BMP) development approaches. As discussed herein, it is now becoming widely recognized that the conventional urban area and highway stormwater runoff monitoring and BMP development has highly significant technical deficiencies which can cause the waste of large amounts of private and public funds in implementing unnecessary stormwater runoff constituent control programs that do not address real water quality problems of concern to the public. For example, the amount of copper or several other heavy metals which are potentially toxic to aquatic life are present in a waterbody such as the Delta is not technically. The valid concern is whether the aquatic life resources of a waterbody are significantly impaired due to toxic constituents or other factors. Also, it is the amount of mercury in aquatic life tissue that is of concern not the amount in the water or sediments..

The basic problem, however, is that for administrative ease, the US EPA in the early 1980's chose to change the emphasis of the water pollution control programs of the U.S. to focus on chemical constituents rather than real water quality problems of concern to the public. Rather than focusing on aquatic life toxicity, which can be fairly directly related to impaired beneficial uses or excessive bioaccumulation of hazardous chemicals in aquatic life tissue which is a direct measure of an impairment of a use, the US EPA and the states are focusing on chemical constituents, which in some often ill-defined way may be adverse to aquatic life or humans through

toxicity or excessive bioaccumulation. Direct measurements of aquatic life related impairment of beneficial uses through toxicity tests and aquatic life tissue residue measurements have been possible for many years. It is not necessary to try to define use impairments based on chemical constituent concentration in an attempt to extrapolate to water quality impacts such as aquatic life toxicity or bioaccumulation. The direct measure of impacts is a much more reliable approach toward defining real water quality use impairments of concern to the public. Because of the limited funds available for water quality management, it is important to focus the funds on controlling directly measured real water quality use impairments rather than focusing these funds on the control of chemical constituents which may have little or no influence on water quality use impairments. This issue is discussed further in this proposal.

It has been well known for over 30 years that heavy metals and many other constituents exist in urban area, highway, and industrial, as well as agricultural, stormwater runoff in a variety of chemical forms, only some of which are toxic/available. The December 9, 1996 WQTG Urban and Industrial Runoff Program is basically a brute force mechanical approach to urban area and industrial stormwater runoff water quality problem identification and management which ignores the vast literature that has been developed over the past 30 years on aquatic chemistry, aquatic toxicology, water quality, and the characteristics of urban area and industrial stormwater runoff constituents and events on water quality of the receiving waters for the runoff. While this mechanical brute force approach might be appropriate if there were unlimited funds to control chemical constituents in urban area and industrial stormwater runoff, the funding situation today is such that the available resources must be used to address, as the first priority, real, significant designated beneficial use impairments of concern to the public. As these types of problems are solved, then more subtle, yet to be recognized problems, can and should be addressed.

The Evaluation Monitoring approach is a true watershed-based water quality evaluation and management program that specifically focuses on the following:

- finding real, significant water quality use impairments for the waterbodies of concern,
- determining the cause of these impairments, i.e. the chemical constituents and/or pathogenic or other organisms responsible for the use impairment,
- and through forensic analysis, determining the source of the specific constituents responsible for the use impairment,
- and, for urban area, highway, and industrial stormwater runoff derived constituents, controlling the constituents (true pollutants) responsible for the use impairment at their source using BMPs to the maximum extent practicable (MEP).

A clear distinction is made in the Evaluation Monitoring approach between chemical constituents in a waterbody irrespective of their impact on water quality, such as total copper, total lead, total mercury, etc., and the toxic available forms of the heavy metals and other constituents that cause the water quality use impairment, i.e. real pollution. Evaluation Monitoring also recognizes that some of the current regulatory approaches for control of water pollution tend to significantly overestimate the water quality use impairments that are due to the regulated constituents, such as

heavy metals (i.e. those for which there are water quality criteria), and the vast arena of unregulated or under-regulated constituents, such as many of the organophosphorus pesticides which have been found to cause significant aquatic life toxicity in waters in California and throughout the U.S.

Through the Evaluation Monitoring program, it is possible for stakeholders to understand that building detention basins to control heavy metals and urban area stormwater runoff because the total metals in the receiving waters for the runoff exceed a worst case US EPA water quality criterion will almost certainly be of limited value to enhancing or, for new developments, protecting the water quality of a waterbody receiving the urban area runoff. The stakeholders will learn that the US EPA official policy as of May 1995 focuses on controlling dissolved metals in ambient waters for all heavy metals except mercury and selenium. It is also important to point out that these types of "control" programs ignore current development, and the problems associated with current development, in that it is not economical to structurally retrofit existing urbanized areas. Technically based source control programs will be much more effective in the reduction or elimination of receiving water beneficial use-impairments since a watershed approach may be used. The Agency has now implemented, what has been known for over 30 years and was well documented in the early 1970's by the National Academies of Science and Engineering in their Blue Book of Water Quality Criteria, that particulate forms of heavy metals are nontoxic. The stakeholders will also know, as part of the Evaluation Monitoring program, the US EPA recognizes a number of other significant technical deficiencies in its current approach for implementing the Clean Water Act such as its Independent Applicability policy which requires that potentially toxic chemical constituents be controlled through the TMDL process even though properly conducted toxicity tests show that the constituents being controlled are in nontoxic forms. This type of situation leads to administrative exceedances of water quality standards without a real use impairment of concern to the public.

The Agency, through its "Interim Draft Advance Notice of Proposed Rulemaking" on the water quality standards regulation at 40 CFR 131 (US EPA, 1996) is proposing to correct a number of the administrative problems associated with the way in which previous administration and congress have developed and implemented the Clean Water Act. Further, the Agency, through its advisory committees devoted to urban area stormwater runoff, is formulating a much more technically valid approach for evaluation and management for water quality problems associated with urban area, highway, and industrial stormwater runoff that is proposed in the December 9, 1996 WQTG program for urban and industrial runoff. The net result of the more appropriate approaches that are being proposed by the US EPA for managing urban area, highway, and industrial stormwater runoff could, if implemented as proposed, significantly change the approach that is being used in this country and in the Delta watershed for assessment of water quality problems due to urban area, highway, and industrial stormwater runoff and their management. As discussed herein, a number of the action items in the WQTG urban area and industrial runoff program are already recognized as being technically inappropriate and wasteful of public funds. It is important that CALFED WQTG incorporate better science, engineering, and

regulatory policy into its urban and industrial stormwater runoff water quality management program.

Formulation and Implementation of the Evaluation Monitoring Approach

About two years ago, Dr. Lee, working with Mr. Taylor, began to develop the Evaluation Monitoring approach for managing highway stormwater runoff water quality impacts. Part of the implementation plan for the Evaluation Monitoring approach is the development and implementation of an Evaluation Monitoring Demonstration Project in which the stakeholders (those concerned about Upper Newport Bay and/or lower Santa Ana River water quality) would work together to define, within the Evaluation Monitoring framework, the real, significant water quality use impairments that exist that are due to urban area, highway, rural agriculture, and undeveloped land stormwater runoff. This is a three year Demonstration Project which was initiated July 1, 1996.

Dr. Lee and Mr. Taylor are responsible for the development and implementation of the Project. The principal stakeholders in the Project at this time are the Santa Ana Regional Water Quality Control Board, the Orange County Environmental Management Agency (NPDES stormwater permit holder for the Orange County municipalities with populations greater than 100,000), the Orange County Health Care Agency, Department of Fish and Game, the Transportation Corridor Agencies, Caltrans and for the Santa Ana River Component - the Orange County Water District. There are many others who have an interest in and are expected, during the latter phase of the Demonstration Project, to become active participants.

Prior to June 1996, Dr. Lee developed the conceptual framework for the Evaluation Monitoring Approach that is now evolved to serve as a basis for developing TMDLs for the control of toxics in the Upper Newport Bay watershed. Since July 1, 1996, with the initiation of the Demonstration Project, Dr. Lee has been responsible for conducting a comprehensive review of all information pertinent to defining the real water quality use impairments associated with Upper Newport Bay and its tributaries as well as the lower Santa Ana River. These waterbodies have the same suite of designated beneficial uses as the Delta and its tributaries. At this time, Dr. Lee is completing a Phase 1 report which provides about 100 pages of information that has evolved from his review of existing water quality information for the Upper Newport Bay watershed and the lower Santa Ana River.

One of the areas Dr. Lee identified as part of formulating the Evaluation Monitoring program as an area that needed immediate attention was the lack of information on aquatic life toxicity of the major tributaries entering Upper Newport Bay. Under the direction of Dr. Lee with the assistance of Mr. Taylor, a limited scope water quality sampling program has been initiated for stormwater runoff to Upper Newport Bay that is specifically designed to address the issue of whether stormwater runoff to the Bay is toxic to aquatic life using the US EPA standard short-term, chronic, three species toxicity tests. It has been found, through the sampling conducted in the fall of 1996 for two different stormwater runoff events, that San Diego Creek which is a major

tributary to Upper Newport Bay has high levels of aquatic life toxicity to certain forms of aquatic life that is only present during the runoff event. At the point of sampling, the San Diego Creek watershed is about 40% urban, 40% agricultural, and about 20% undeveloped land. In excess of eight toxic units have been found in stormwater runoff waters. This means the waters can be diluted by over eight times with nontoxic water and still be toxic. Expanded TIE work will be conducted during 1997 to identify the cause of the toxicity.

Dr. Lee's Evaluation Monitoring Demonstration Project Phase 1 report, which should be available for public distribution within about one month, not only discusses the aquatic life toxicity issues, but also the current information base and need for additional information on excessive bioaccumulation of the chlorinated hydrocarbon pesticides, PCBs, dioxins, and mercury. Further, Dr. Lee's report addresses the issue of sediment toxicity within Upper Newport Bay based on the recently collected but not yet published WRCB and US EPA BPTCP and EMAP data for the Bay. Dr. Lee's report also considers information available on the impairment of other designated beneficial uses such as domestic water supply, excessive fertilization, oil, grease, and litter, and excessive siltation.

Support of this CALFED proposal would enable Dr. Lee and Mr. Taylor to apply their expertise and experience in defining real water quality problems in the Delta and its tributaries that are likely due to urban area, highway, and industrial stormwater runoff within the Delta watershed. Dr. Lee proposes to spend an average of two and half days per week over the next six months devoted to developing a synthesis report that would review the potential for urban area, highway, and industrial stormwater runoff to cause water quality problems within the Delta or "downstream" as well as to be adverse to Delta aquatic biological resources that would be impacted by urban area highway or industrial stormwater runoff upstream of the Delta. This synthesis report preparation would be patterned after the work that is just being completed in Orange County, California for the Upper Newport Bay and lower Santa Ana River watersheds. It would serve as a technically valid base for CALFED to develop urban area, industrial, and highway stormwater runoff management programs that would address, in the most technically valid, cost effective manner, the control of real pollutants in urban area, highway, and industrial stormwater runoff to the MEP using BMPs.

One of the major accomplishments from this initial six month effort would be the delineation of what data gaps exist in the Delta watershed current water quality information base that need to be addressed to determine what, if any, real water quality use impairments of Delta waters arising from real pollutant loads that are derived from urban area, highway, and industrial stormwater runoff through Delta tributaries and within the Delta. Also, data gaps with respect to formulating pollutant control programs from urban area, highway, and industrial stormwater runoff and their potential effectiveness would be identified. Dr. Lee is already familiar with much of the data that has been collected on Delta water quality. Further, he is active at this time in the Sacramento River Watershed Toxics Control Program, where he has had an opportunity to review the current water quality monitoring programs that are being conducted by various entities on Delta tributary waters in the Sacramento River watershed.

This proposal is an outgrowth of the work that Dr. Lee has been doing in connection with the Sacramento River Watershed Toxics Control Program. Beginning in the spring of 1996, with the initiation of this program, Dr. Lee, without support and affiliation with any particular group, because of his interest in seeing that up-to-date science and engineering is used in water quality management has been an active participant in the Sacramento River Watershed Toxics Control Program. This participation has included attending many of the meetings for both the Toxics and the Monitoring Committees. He has provided extensive written comments on issues that need to be considered as part of developing a technically valid, cost effective "toxics" control program for the Sacramento River system, including the Delta downstream water users and San Francisco Bay. Copies of some of his comments are appended to this proposal which provide background information on his activities in the Program that are pertinent to review of the proposal. The overall focus of Dr. Lee's efforts in the development of the Sacramento River Watershed Toxics Control Program have been to try to get those developing the Program to focus on defining, and then managing, real water quality problems of significance to the public who are impacted in any way by Sacramento River tributaries and Delta water quality.

The Sacramento River Watershed Toxics Control Program Monitoring Committee meeting held on January 16, 1997, where the Monitoring Committee is, after a nine month deliberation, beginning to meaningfully address the formulation of a Sacramento River Toxics Monitoring Program. It appears now that the Program that is being formulated is a traditional monitoring program that will gather significant amounts of data that will have to be stored in a file cabinet or computer database because it cannot be meaningfully used to reliably characterize real water quality issues of concern to the public. This situation applies not only to the monitoring program that will be conducted as part of the Sacramento River Toxics Control Program, but is also a characteristic of the USGS NAWQA Program. With respect to the USGS Program, large amounts of high quality heavy metal and other constituent data is being generated on the Sacramento River system. However, no information is being developed on whether the measured constituents are causing real water quality problems of concern to the public such as aquatic life toxicity, excessive bioaccumulation, etc.

As it stands now, unless significant changes are made in Sacramento River Watershed Toxics Control Program subsequent committee meetings, half a million dollars of public funds are going to be spent collecting data where much of it, while of high quality, will have limited utility in serving as a technically valid base for formulating water quality management programs that address real water quality issues that should be a high priority for attention for CALFED supported pollution control efforts.

Dr. Lee has spent much of his over 35 year professional career educating engineers and scientists in university graduate level teaching and research programs on how to obtain reliable water quality data and, most importantly, how to use it in technically valid, cost effective water quality management programs. Through Dr. Lee's consulting over the past 30 years, he has with governmental agencies, etc. had extensive opportunity to observe large amounts of high quality chemical constituent and pathogen indicator monitoring data that is not and cannot be meaningfully

used in a water quality management program. This situation arises from the fact that the data is derived from conventional constituent monitoring in which a suite of parameters is measured at certain locations at certain intervals. While this approach is suitable for assessment of regulatory compliance with NPDES permits, it has limited utility in defining real water quality use impairments of concern to the public. As discussed above, the public is not concerned with the concentrations of soluble orthophosphate or total lead or some other constituent in water unless that constituent does, in fact, impact the uses of the water of importance to the public. With few exceptions, there is a poorly understood coupling between the concentrations of chemical constituents in a waterbody and its real water quality. As a result, water pollution control programs directed at chemical constituents rather than properly evaluated and defined pollutants are often ineffective and wasteful of public funds. It is this lack of being able to translate chemical concentrations to adverse impacts that caused Dr. Lee to develop the Evaluation Monitoring approach for developing technically valid, cost effective water quality management programs.

While this proposal is somewhat of an outgrowth of the Sacramento River Watershed Toxics Control Program Monitoring and Toxics Committee activities, it is not a committee proposal, per se, although a number of committee members present at the January 16, 1997 meeting supported the submission of this proposal as an activity that would provide important information to developing a comprehensive water quality monitoring/management program for the Sacramento River watershed system.

Deficiencies in the Urban and Industrial Runoff Proposed Water Quality Management Approach

Upon receipt of R. Woodard's December 18, 1996 memo on January 14, 1997 summarizing the December 9, 1996 WQTG deliberations, Dr. Lee sent R. Woodard comments on some of the significant technical deficiencies in the WQTG proposed approaches for addressing water quality problems. Excerpts from Dr. Lee's January 15, 1997 letter to R. Woodard are incorporated into this proposal since they address important issues that need to be considered in formulating a more appropriate approach for evaluation and management of urban and industrial stormwater runoff associated constituents on "Delta" water quality than is being proposed now in the WQTG. At the time Dr. Lee provided comments to R. Woodard on the technical deficiencies in the proposed approaches for water quality management that came out of the December 9, 1996 meeting, he had not yet obtained the CALFED Bay-Delta Program Water Quality Technical Group December 9, 1996 Meeting Packet. Upon receipt of this material on January 17, 1997, it was found that a number of the problems with the Urban and Industrial Water Quality Management Program activities apparently arise from how this Program was established prior to the December 9, 1996 meeting. Comments on these issues are also provided herein.

Parameters of Concern: A number of important errors and problems occurred in the Urban and Industrial Runoff Group's write-up covering the proposed approach for managing urban area and industrial stormwater runoff associated constituents. For example, the second bulleted item states, *"Chlorpyrifos should be removed from the list of parameters of concern associated with urban*

runoff because it is not used in urban areas. Used on rice.” Chlorpyrifos is extensively used in urban areas by commercial applicators and by homeowners. Some of the most commonly used ant control materials that can be purchased in any hardware store in the Sacramento area, such as Chevron’s Ortho-Klor “Ant Killer Dust,” is chlorpyrifos. It has been routinely found in stormwater runoff from urban areas in a number of parts of the state, including the Sacramento area. It is an important cause of aquatic life toxicity in stormwater runoff from urban areas. In the Orange County area, chlorpyrifos is used almost exclusively for “structural” pest control. It is certainly extensively used in the Delta watershed region for this purpose as well.

The WQTG December 9, 1996 meeting packet only lists three pesticides as “parameters of concern.” This is a significant technical deficiency. There are a number of other pesticides that are used in the Delta watershed in general and in urban areas that must be considered in a technically valid CALFED WQTG program for control of adverse impacts of pesticides on “Delta” water quality. A review of the County Ag Commissioner’s pesticide use information for the Delta watershed shows there are a large number of pesticides that must be considered as potential threats to aquatic life within Delta tributaries and the Delta. This is the same problem Dr. Lee faced in formulating the Evaluation Monitoring program for Upper Newport Bay. Rather than trying to address the problem of pesticide toxicity based on a chemical by chemical approach, which apparently is the approach being used in the WQTG, Dr. Lee addressed the problems in terms of directly assessing water quality impacts such as aquatic life toxicity.

Aquatic Life Toxicity: As discussed herein, the Evaluation Monitoring approach focuses on defining water quality impacts as opposed to chemical constituent concentrations in water or sediments. The only reliable approach to determine whether a particular chemical constituent, such as a pesticide used in urban areas or at industrial facilities in the Delta watershed is the cause of aquatic life toxicity in the receiving waters for urban area and industrial stormwater runoff, is to determine whether the runoff waters are toxic to sensitive forms of aquatic life. If toxicity is found, then through a toxicity investigation evaluation (TIE), determine the cause of the toxicity. It was through this approach that Dr. Lee was able to identify four specific pesticides associated with stormwater runoff in the Upper Newport Bay watershed which could be significantly adverse to Upper Newport bay tributary and Bay water quality. This is the approach that has been used by Chris Foe and Val Connor of the Central Valley Regional Water Quality Control Board in their pioneering work on this topic. It is a well established, reliable approach for evaluating pesticide toxicity. This approach is also applicable to determining whether heavy metals in stormwater runoff from urban areas and industrial properties are toxic to aquatic life.

Rather than trying to follow the traditional approach of measuring the concentrations of pesticides and heavy metals in runoff waters and then trying to extrapolate to aquatic life toxicity, it is far more valid to measure toxicity directly and then determine its cause. This is the approach that is used as the fundamental component of evaluating potential aquatic life impacts for the Evaluation Monitoring program. Aquatic life toxicity should be listed as a CALFED WQTG “parameter of concern attributable to urban and industrial runoff” since appropriately made toxicity measurements on runoff waters and in the receiving waters can provide direct information on

potentially significant water quality use impairments by a large suite of potential pollutants in urban area, highway, and industrial stormwater runoff. For example, five of the 17 parameters of concern in the December 9, 1996 meeting packet can be screened for by appropriate toxicity tests in runoff waters. Further, such screening addresses the large number of other constituents that could be toxic in urban and industrial stormwater runoff within the Delta watershed that are not listed as a parameter of concern. This issue is discussed further in another section of the proposal and in the attachments to this proposal.

As part of the Sacramento River Watershed Toxicity Control Program, Dr. Lee has been a spokesman for shifting the funding away from traditional suite of parameter periodic monitoring to toxicity measurements to screen for the integrated impacts of regulated as well as unregulated chemicals in the Sacramento River watershed. While there is some toxicity monitoring being done as part of this effort by Dr. Val Connor at the Central Valley Regional Water Quality Control Board, there is need to significantly expand this monitoring effort in order to provide the database necessary to evaluate whether toxicity is, in fact, a potentially significant cause of aquatic life use impairments in the Delta and its tributaries. Recently, Dr. Connor made available to Dr. Lee a copy of her proposal to CALFED "Identification of Constituents Responsible for Aquatic Toxicity in the Sacramento River Watershed." From Dr. Lee's experience and expertise, he strongly recommends CALFED support Dr. Connor's proposal since there is an urgent need for information of this type. It is Dr. Lee's intent, as part of his continued Sacramento River Watershed Toxics Control Program activities to be an active participant in promoting direct measurement of toxicity and its cause as proposed by Dr. Connor and the interpretation of its water quality significance as C. Foe and the Contaminant IP group is doing. Dr. Lee's activities during phase 1 of this proposal will be closely integrated with the ongoing work designed to determine the presence of aquatic life toxicity and to evaluate its significance.

The basic issue that has to be assessed once a particular chemical, such as a pesticide or heavy metal, has been identified as toxic in runoff waters is whether the toxicity in the receiving waters is of sufficient magnitude and duration to cause significant aquatic life toxicity to be adverse to the beneficial uses of these waters. For example, Sacramento stormwater runoff has been found to have aquatic life toxicity due to pesticides. There is also some toxicity in the receiving waters for these runoff waters. However, as of yet, the water quality significance of the toxicity in the runoff waters/receiving waters to impacting the designated beneficial uses of the River and Delta has not been addressed. As part of formulating the Evaluation Monitoring approach for Upper Newport Bay, Dr. Lee has incorporated a major component of this effort to developing a technical advisory panel of experts who would work with the stakeholders for the Evaluation Monitoring Demonstration Project to develop guidance on how to determine whether runoff water toxicity is of sufficient magnitude and duration to be of significance to the Upper Newport Bay aquatic life related beneficial uses. The US EPA 205j funding that has been allocated for Upper Newport Bay watershed studies beginning July 1, 1997 will have as a major component field studies designed to measure the extent, duration, and magnitude of stormwater runoff aquatic life toxicity. Dr. Lee has already developed preliminary plans for the field studies that will be conducted as part of the 205j funding.

Chris Foe of the Central Valley Regional Water Quality Control Board is leading the Contaminant IP group in the Central Valley, which is specifically addressing the issue of how to determine whether the aquatic life toxicity due to organophosphorus pesticides derived from urban agricultural sources is a significant cause of water quality impairment in the Delta. Dr. Lee has become a member of this group and will concentration his efforts specifically on developing guidance that can be used to determine whether urban area, highway, and industrial stormwater runoff associated toxicity is of significance to the near field - near the point of stormwater discharge- aquatic life resources as well as to Delta aquatic life resources. While it is appreciated that it will not be possible to definitively determine whether toxicity in any runoff waters to the Delta and its tributaries is a significant cause of impairment for aquatic life related beneficial uses in the Delta and its tributaries, it will be possible, through a watershed-based stakeholder driven approach of the type Dr. Lee is developing for the Upper Newport Bay watershed, to formulate approaches that will provide guidance to regulatory agencies and others on whether there is need to develop toxicity control programs that would limit the amount of toxic stormwater discharges to the Delta tributaries and to the Delta.

Sediment Toxicity: A component of the Evaluation Monitoring program developed by Dr. Lee is sediment toxicity. Many aquatic sediments show some toxicity to certain forms of aquatic life. As discussed by Drs. Jones-Lee and Lee in their fall 1996 Water Environment Federation national meeting invited paper "Evaluation of the Water Quality Significance of the Chemical Constituents in Aquatic Sediments: Coupling Sediment Quality Evaluation Results to Significant Water Quality Impacts," sediment toxicity arises, in part, from the discharge of constituents from urban, highway and industrial sources. Stormwater runoff from these areas contribute particulate and dissolved constituents to waterbodies which can become part of the waterbodies' sediments and, under some conditions, cause aquatic life toxicity. This toxicity can be significantly detrimental to the beneficial uses of a waterbody.

One of the areas in which there is limited information at this time is whether the sediments in the Delta and its tributaries are toxic to aquatic life. From work in other areas, it is likely that Delta as well as Delta tributary sediments will be toxic to some forms of aquatic life at some locations. As part of applying the Evaluation Monitoring program to the CALFED WQTG water quality management program, Dr. Lee will develop guidance on approaches that should be used by CALFED to determine whether constituents derived from urban area, highway, and industrial stormwater runoff are, in fact, toxic and, most importantly, how to evaluate whether the anticipated toxicity which will be found at some locations is significantly adverse to the beneficial uses of the Delta waters.

This area is of particular importance to evaluating whether urban area and highway stormwater runoff is significantly adverse to the beneficial uses of the receiving waters for the runoff since such runoff typically contains many of the potentially toxic constituents in particulate forms which will accumulate in the receiving water sediments. The Urban and Industrial Runoff December 9, 1996 summary states in item 6, "*Storm water detention basins should be built in urban watersheds shown to be a major source of metals. (Action 17).*" This statement reflects a

lack of understanding of modern day water quality evaluation and management as applied to urban area and highway stormwater runoff. Study after study across the country has shown that heavy metals in such runoff are in non-toxic, non-available particulate forms. Detention basins are only effective in potentially removing particulate forms. There is no point in wasting the public's money building detention basins to remove particulate forms of metals in urban stormwater runoff if they are not adverse to the beneficial uses of the receiving waters for the runoff. Further, those familiar with this topic area know that in May 1995, the US EPA officially adopted the policy of only regulating dissolved heavy metals in ambient waters, except for mercury and selenium, as part of implementation of the National Toxics Rule. Therefore, not only is it technically invalid to attempt to control particulate forms of heavy metals in stormwater runoff from urban, residential and commercial areas through detention basins and/or filters, but also, it is not required by current federal regulations.

While there are some who assert that detention basins should be built to control particulate heavy metals in urban and highway stormwater runoff because they will accumulate in the sediments of the receiving waters for the runoff, such assertions reflect a lack of understanding of sediment water quality issues. Dr. Lee has conducted over \$2 million of research and published over 100 professional papers on this topic and can unequivocally state it would be indeed rare that particulate heavy metals in urban area and highway stormwater runoff will be adverse to the receiving water beneficial uses due to their accumulation in the receiving water sediments. Further, there are well-defined procedures developed in the 1970's by the US Army Corps of Engineers and the US EPA such as sediment bioassays that have been used for over 20 years for regulating contaminated dredge sediments that can be used to determine on a site-specific basis whether any constituents, including heavy metals in the sediments of a particular waterbody, are adverse to the beneficial uses of the waterbody.

While it is unlikely that particulate heavy metals in urban area stormwater runoff will be adverse to receiving water quality in the water column or sediments, there is a potential for some constituents, such as chlorpyrifos, which tends to accumulate in sediments, to be toxic to aquatic life associated with the sediments. In the Upper Newport Bay studies, chlorpyrifos has been found to be present in the sediments near the point where San Diego Creek enters the Bay. While ordinarily conversion of a dissolved species into a particulate form detoxifies the chemical, there are situations with certain types of organics where this detoxification may not occur. It is not known at this time whether chlorpyrifos or other toxic forms of constituents in urban area stormwater runoff is in a toxic or nontoxic form when incorporated into sediments. Dr. Lee's work under this project will provide guidance on how to determine whether chlorpyrifos and other potentially toxic constituents present in urban area as well as other area stormwater runoff are toxic to sediment aquatic life and, therefore, potentially may need to be controlled from this perspective as well.

Variability of Urban Stormwater Runoff Characteristics: The third bulleted item of the December 9, 1996 WQTG summary, under Urban and Industrial Runoff states, *"Later analysis should use urban runoff data from individual cities rather than assume that Sacramento data is applicable*

everywhere." While this statement is not clear, as presented it appears to imply that there is need to monitor stormwater runoff from a number of cities that contribute to Delta tributary waters and to the Delta because there might be some differences between stormwater runoff among the various cities. Those familiar with this topic area, however, know that typically urban area, residential and commercial stormwater runoff, while variable in composition at any one location, is on the average remarkably similar between locations. Dr. Lee published a paper on this topic "Suggested Approach for Assessing Water Quality Impacts of Urban Stormwater Drainage" (Lee and Jones, 1991a) a number of years ago which presented the summary results from the US EPA NURP on the chemical characteristics of stormwater runoff from cities across the US.

Further, as discussed in the enclosed summary write-up on Evaluation Monitoring that will be published in the Society for Environmental Toxicology and Chemistry's *SETAC News*, a number of professional organizations, such as the Engineering Foundation and the American Society of Civil Engineers (ASCE), have held workshops concerned with urban area and highway stormwater runoff monitoring. The conclusion of the professionals involved in this topic area from across the country (see Urbanos and Torno, 1994; Herricks, 1995; Lee and Jones-Lee, 1994a, 1996c) is that there is no need for further runoff monitoring. What is needed is to provide guidance on how regulatory agencies and others can determine on a site-specific basis whether the regulated as well as unregulated constituents present in urban area and highway stormwater runoff are adverse to the designated beneficial uses of the receiving waters for the runoff. It was because of this situation that Dr. Lee and Dr. Jones-Lee developed and are now implementing the Evaluation Monitoring approach for defining real water quality problems in Upper Newport Bay due to urban area, highway and agricultural runoff.

Implementing Stormwater Runoff Regulations: The December 9, 1996 WQTG write-up for Urban and Industrial Runoff in the last bulleted item, states, "*Action 18 should be reworded to read 'Reduce urban and industrial water quality parameter of concern loadings to the Delta and its tributaries through enforcement of existing storm water permit conditions.'*" The December 9, 1996 meeting packet, Table 1, presents "Estimated Study Area Urban/Industrial Runoff Loads" for a number of parameters where the second column next to the "constituent list" is labeled "Total Pollutant Load (tons/yr)." This information is an example of the brute force, technically invalid approach that evolved from the WQTG deliberations prior to and at the December 9, 1996 meeting in the area of developing a water quality management program for urban area and industrial stormwater runoff. This approach represents a 1960's level of understanding of water quality issues where no consideration is given to aquatic chemistry, aquatic toxicology, water quality, and, for that matter, current regulatory requirements. Examination of Table 1 shows that there are 14.2 tons per year of copper added to Delta tributary waters from urban area/industrial stormwater runoff. Those familiar with the characteristics of this runoff know that the copper in such runoff is rarely in a toxic available form nor does it convert to toxic available forms in the receiving waters. It is largely in particulate forms, which the US EPA does not, as of May 1995, require the states control. The same types of significant deficiencies occur with many of the other constituents listed in Table 1.

It is important to note that this information on constituents in stormwater runoff being nontoxic nonavailable is not new. Dr. Lee's graduate students, working on this topic in the 1960's, demonstrated that urban area and highway stormwater runoff lead was in nontoxic nonavailable forms. While lead is one of the elevated constituents in urban area stormwater runoff, it has never been shown to be adverse to water quality. This is because it is in a particulate form. The National Academies of Science and Engineering recognized this situation in 1972 in the publication of their Blue Book of Water Quality Criteria where they recommended bioassay toxicity tests be used to determine whether heavy metals in a particular discharge/runoff are, in fact, toxic. As discussed above, however, the US EPA, in the early 1980's tried to oversimplify the regulation of toxic constituents by focusing on the total recoverable forms rather than toxic available forms. The Agency is only now beginning to correct the errors that were made then in developing its regulatory requirements for potentially toxic constituents. It is important that CALFED not perpetuate the badly out of date, technically invalid approaches for assessing what are real pollutants in urban area, highway, and industrial stormwater runoff.

It is inappropriate for CALFED to pursue controlling constituents in urban area, highway, and industrial stormwater runoff as set forth in the December 9, 1996 meeting summary where the CALFED activities would be directed toward a few heavy metals and other constituents without regard to whether any of them are having an adverse impact on the beneficial uses of the waterbody which the runoff enters, much less the Delta. A reliable Table 1 cannot be developed at this time. Dr. Lee and Mr. Taylor's efforts during Phase 1 of this project would develop a technical base for construction of a reliable Table 1 in which a column labeled "pollutant loads" would, ultimately, represent real pollutants, i.e. constituents that impair beneficial uses of waterbodies and not chemical constituents.

Because of the unreliable information provided in other aspects of Urban and Industrial Runoff, Dr. Lee is concerned that the statement about controlling parameters of concern through enforcing existing source control regulations (Action 18) reflects more inappropriate approaches where the implication is the Central Valley Regional Water Quality Control Board is not enforcing existing stormwater permit conditions for NPDES stormwater runoff permit holders. If that is the intent of this bulleted item, then those who authored this item and those who reviewed it do not understand what is actually being done today in NPDES stormwater runoff permit enforcement. The facts are that the permits require that stormwater runoff-caused pollution be controlled to the maximum extent practicable through the use of BMPs. The basic problem is that during the first five-year permit the focus of the monitoring program associated with implementing the program was on runoff monitoring. However, those who understand water quality monitoring know that runoff monitoring cannot be used to define true water quality impairment in the receiving waters for the runoff. While the City of Sacramento has done some receiving water studies associated with stormwater runoff, the amount and character of these studies has been severely limited compared to that needed to properly define what real pollution-use impairment occurs and, most importantly, the control programs that need to be implemented to control this pollution in a technically valid, cost-effective manner.

The issue of control of heavy metals occurs in a number of the CALFED Water Quality Program write-ups as water quality problems. While there are real water quality problems in the Delta watershed due to mine discharges, typically, these problems disappear within a relatively short distance downstream of the discharges in the receiving waters for the discharge. This is true of the Iron Mountain Mine's copper, zinc and cadmium discharges that occur near Redding. While these discharges increase the concentration of total metals in the Sacramento and other river systems as they enter the Delta, there has been no demonstrated water quality problems due to heavy metals other than mercury and possibly selenium in the Delta. Chris Foe of the Central Valley Regional Water Quality Control Board, who is highly familiar with this topic area, has confirmed that Dr. Lee's assessment of this situation is in accord with his understanding of it.

In Dr. Lee's discussions with WQTG consultant staff in early December, a staff member made the statement that the literature had documented many water quality problems due to heavy metals, such as copper, zinc and cadmium, in the Delta. This staff member is part of the support staff for the Urban and Industrial Runoff group. Dr. Lee asked for any documentation that the staff member was aware of that would support the position that heavy metals other than mercury were significant causes of water quality problems in the Delta. As of yet, the staff member has not provided such information, although she claimed that it was available.

In the case of copper in the Delta and San Francisco Bay, while the concentrations found exceed water quality criteria/objectives for both total and dissolved copper, studies by the San Francisco Estuary Institute over the past three years have conclusively demonstrated that the copper as well as other constituents in the water column are in non-toxic, non-available forms. Through the use of the same organism used to develop the water quality criterion for copper in marine waters, it has been found that there is no real water quality problem in San Francisco Bay waters due to copper. Further, while there is toxicity in some San Francisco Bay sediments, there is an inverse relationship between the copper concentration and toxicity. It appears that copper is not responsible for this toxicity.

The problem with copper in San Francisco Bay is an administrative problem, not a real water quality problem, that is related to an inappropriate approach that is being used by the US EPA in implementing its water quality criteria into state standards related to the Agency's Independent Applicability Policy. Dr. Lee has published a summary of the problems with the Agency's Independent Applicability Policy entitled "Independent Applicability of Chemical and Biological Criteria/Standards and Effluent Toxicity Testing" (Lee and Jones-Lee, 1995c) and "Appropriate Use of Numeric Chemical Water Quality Criteria" (Lee and Jones-Lee, 1995b). The Agency understands this problem and has proposed to correct it as part of its 1996 Interim Draft Advance Notice of Proposed Rulemaking on the water quality standards regulation at 40 CFR 131 (ANPRM). Therefore, the administrative water quality problem due to copper in San Francisco Bay and the Delta will likely disappear when the Agency corrects the error it made several years ago in adopting the Independent Applicability Policy. It would certainly be inappropriate to throw Prop. 204 funds at copper issues because the total copper in the Delta or San Francisco Bay exceeds an overly-protective water quality criterion/standard that does not properly reflect what

has been known for over 20 years about the aqueous environmental chemistry of copper and its toxicology.

For over a year now, Dr. Lee has been concerned about a real water quality use impairment due to a heavy metal, mercury, in the Delta and San Francisco Bay. Some of the fish in this area have excessive mercury. This is a real water quality use impairment. Dr. Lee has been following the work that Chris Foe and others have been doing on identifying the sources and significance of mercury contributed to the Delta through Cache Creek. Dr. Lee is part of a group that Chris Foe has organized that specifically addresses an issue that he raised over a year ago when the high concentrations of mercury were reported by Mr. Foe in the high flows of Cache Creek and the Sacramento River system. Dr. Lee pointed out that it is important that efforts be made to determine whether the particulate mercury present in the high flows was a significant contributor to excessive mercury bioaccumulation within fish tissue in the Delta and the Bay. Through his work on mercury at other locations, he is well aware of the literature on mercury methylation and specifically that it is not possible to utilize total mercury concentrations to evaluate potential mercury problems due to excessive bioaccumulation within aquatic life tissue. He has suggested to Mr. Foe a set of studies that should be conducted to determine whether the mercury present in the high flows does, in fact, lead to increased methyl mercury production within the Delta and San Francisco Bay. Based on the responses he has received from Mr. Foe's ad hoc mercury group to his suggestions, there seems to be agreement that this is an area that needs to be addressed.

While not a major source of mercury, urban stormwater runoff also has elevated mercury compared to US EPA water quality criteria. The city of Sacramento has found excessive mercury compared to US EPA criteria in the Sacramento River. However, neither the City nor any one else at this time has addressed the bottom line issue of whether the mercury that exceeds the US EPA water quality criterion is, in fact, in a form that is convertible to methyl mercury at a sufficient rate to significantly contribute to the excessive mercury tissue concentrations in Delta and San Francisco Bay fish. This issue must be addressed before any attempts are made to control mercury inputs to the Sacramento River system in order to reduce the 0.2 tons per year of total mercury (see "Meeting Packet" Table 1) that is estimated to be present in urban/industrial runoff to Delta tributaries. Dr. Lee's work would provide specific guidance on how CALFED should proceed to evaluate the need for the control of mercury in urban area stormwater runoff to the Delta in order to reduce the excessive bioaccumulation problems that are occurring within Delta and San Francisco Bay fish.

Development of BMP for Stormwater Runoff Water Quality Management: The CALFED WQTG December 9, 1996 meeting packet states that source control is not effective in controlling water pollution caused by urban and industrial stormwater runoff. Under "Action 18" it states,

"Expected Benefits: This action would involve increasing regulatory pressure to ensure that existing source control regulations are fully enforced. Source control measures are probably more effective for industrial rather than urban runoff."

This section refers to Table 2 which presents "Effectiveness of Proposed Actions." While the technical base for the estimates of "effectiveness" are not provided, it is likely that the information provided in Table 2 is not reliable. Further, and most importantly, the Table 2 "effectiveness" information cannot be translated to water quality improvement in the Delta and/or its tributaries since it focuses on chemical constituents rather than real pollutants. The superficial approach used to define water quality problems in the Urban and Industrial section leads to the erroneous conclusion that installing a few detention basins will meaningfully address the stormwater problems caused by urban stormwater runoff. However as discussed by Lee and Jones-Lee (1996d) detentions basins, filters and other so-called BMPs are only real BMPs for situations where erosion cannot be controlled at the source. They are not effective for controlling real water quality problems due to toxic or bioaccumulatable chemical constituents. A proper analysis of this situation will show that the management of toxic constituents in urban area runoff by treatment in order to meet water quality standards in the receiving waters for the stormwater runoff so that there is no more than one exceedance in every three years will cost urban dwellers from \$1 to \$2/person/day. Massive treatment works using advanced treatment processes, which, on a rational basis are uneconomical to construct and maintain, will have to be constructed to achieve water quality standards in urban area stormwater runoff. It is therefore important that real water quality use impairments be found that require control before urban area stormwater management programs be formulated. While some support the approach the WQTG Urban and Industrial Runoff group have advocated of building detention basins for a cosmetic treatment of stormwater runoff, such approaches are largely a waste of public and private funds.

Pathogenic Organisms: One of the parameters of concern listed in the WQTG's Urban and Industrial section December 9, 1996 meeting packet is "pathogens." This is an important area that needs to be addressed since urban areas and, at some times and locations, highways contain large numbers of fecal indicator organisms. Because of Dr. Lee's public health background, he is familiar with this topic area and has frequently worked on it during his career. This work has included developing a report to the Cal EPA Comparative Risk Project, "Public Health Significance of Waterborne Pathogens in Domestic Water Supplies and Reclaimed Water" (Lee and Jones-Lee, 1993). This Project addressed the issues of the public health and environmental significance of environmental chemicals and pathogenic organisms in the state of California. Dr. Lee served as a member of the Human Health Advisory Committee of the Project. As part of this effort, he took the lead in domestic water supply water quality issues where he and Dr. Jones-Lee developed several reports for the committee, including the above-cited pathogens report. His work resulted in the committee ranking *Cryptosporidium* and enteroviruses in treated domestic water supplies as one of the major causes of illness in California today. His review of this topic included Delta water quality issues with respect to what was known then about *Cryptosporidium* and enteroviruses in Delta waters as they may impact domestic water supply water quality as well as contact recreation.

During his professional career he has frequently been involved in advising governmental agencies and others on waterborne pathogen issues, including pathogens derived from urban stormwater runoff for the Yellowhouse Canyon Lakes in Lubbock, Texas and the New Jersey

coastal shore. For the latter, he was an advisor to the state of New Jersey Medical Society's studies on the state of New Jersey pollution of nearshore beach waters by pathogenic organisms.

This past spring, Dr. Lee served as an advisor to the City of Newport Beach in evaluating the potential water quality problems associated with the discharge of Irvine Ranch Water District's reclaimed domestic wastewaters to Upper Newport Bay. As part of this effort, he reviewed the potential for urban stormwater runoff to be a source of pathogenic organisms in the Bay. His review considered not only the classical coliforms, but also *Cryptosporidium* and enteroviruses.

As part of the Sacramento River Watershed Toxics Control Program, Dr. Lee has been a strong supporter of expanding this program to include pathogenic organisms. Further, he has been an advocate of not only considering domestic water supply issues, but also contact recreation as it may be impacted by both domestic wastewater and urban and rural stormwater runoff-associated pathogenic organisms. Dr. Lee's report that would be developed by support of this proposal would specifically discuss the issues associated with urban stormwater runoff as a source of pathogenic organisms that would impact downstream water supplies as well as contact recreation within the Delta watershed and Delta.

Excessive Fertilization. The CALFED WQTG December 9, 1996 meeting packet lists ammonia and nitrate as "parameters of concern." No discussion is provided on why these parameters were listed. Presumably, this listing is because of the potential for these two chemicals to contribute to the excessive fertilization of Delta waters. As discussed herein, Dr. Lee's involvement with Delta water quality issues was initiated in 1989 when he served as a consultant to a private developer on evaluating the potential water quality that would develop in Delta island reservoirs where high winter flow Delta waters would be stored on several islands for subsequent release during low Delta flow periods. This consulting activity caused him to conduct a comprehensive review of the information available at that time on excessive fertilization issues of the Delta. Several years later, Dr. Lee developed a review on source water quality issues focusing on the Delta as a domestic water supply source. At that time, he updated the information available on the excessive fertilization issues of the Delta and published a report, "Regulating Drinking Water at the Source" (Lee and Jones, 1991b).

Further, Dr. Lee critically reviewed the impact of the seven-year drought on Delta water quality issues for the CA/NV AWWA Source Water Quality Committee. He issued a report, "Impact of the Current California Drought on Source Water Supply Water Quality" (Lee and Jones, 1991c). Dr. Lee's reports on Delta water quality issues focused primarily on the use of Delta waters for domestic water supply purposes. He discussed that there are significant eutrophication-related water quality problems in water supply reservoirs for water utilities that utilize Delta waters as a raw water source. These problems relate to excessive growths of algae which, in addition to causing taste and odor problems, also in some locations contribute to TTHMs.

In Dr. Lee's review of these topics, he pointed to the importance of determining Delta watershed sources of trihalomethane precursors as part of the efforts that need to be initiated to begin to control the excessive precursor content of Delta waters. He recommended that work be done to establish TOC/DOC export coefficients from various types of land use, including urban areas, as part of developing a better understanding of the potential for controlling THM precursors at their source. While some work has been done along this line, this work has yet failed to adequately address the issues raised by Dr. Lee in his 1991 report on this topic.

Beginning in the 1960s, Dr. Lee pioneered in the development of nutrient (nitrogen and phosphorus compounds) export coefficients for various types of land use as part of managing the excessive fertilization of waterbodies. His studies of that time showed that urban area stormwater runoff can contribute about 10 times the amount of nutrients per unit area as agricultural runoff. His work in this topic area was summarized by Rast and Lee (1983). In the 1970s, he conducted the US EPA's OECD eutrophication studies for US waterbodies and was a member of the advisory panel for the international OECD eutrophication studies. The Organization for Economic Cooperation and Development (OECD) conducted a 22-country, 200-waterbody, five-year \$50 million program designed to examine the relationship between nutrient loads to waterbodies and their eutrophication-related water quality. Dr. Jones-Lee and Dr. Lee have continued the OECD studies and have expanded the database to now over 750 waterbodies located in various parts of the world. They have published extensively on this work. A summary was published by Jones and Lee (1986). In their 1991 review of Delta water quality issues, they examined the potential for applying OECD eutrophication study results to the Delta water supply water quality problems and found that, at times, the Delta's planktonic algal chlorophyll at the export pumps matched the predicted chlorophyll concentrations based on the OECD eutrophication studies. However, at other times, there was poor agreement between predicted and measured. This is to be expected based on the relative significance of nitrogen vs. phosphorus as a controlling factor in limiting algal growth in the Delta and downstream waterbodies, as well as hydraulic residence time issues within the Delta.

Dr. Lee's analysis included determining from the information available at that time the amounts of nitrogen and phosphorus contributed to the Delta from upstream sources considering domestic wastewater discharges, agricultural and urban stormwater runoff, etc. Dr. Lee is therefore familiar with these issues and would, as part of support from this project, consider current information on the significance of urban area and industrial stormwater runoff-associated nutrients and TOC as a cause of Delta water quality problems. These problems would include the excessive fertilization problems that are occurring within and downstream of the Delta in domestic water supply reservoirs. They would also consider the issues of the role of algae that developed within the Delta and downstream reservoirs as a THM precursor source.

One of the areas that needs greater attention than to the knowledge of Dr. Lee has not been adequately addressed is the impact of excessive fertilization of the Delta on recreational uses of Delta waters. Some Delta waters are experiencing excessive growths of various types of algae and macrophytes which are impairing recreational use of Delta waters. Dr. Lee's review of the

excessive fertilization issues as part of the proposed project would include addressing this issue, as well. Dr. Lee has considerable experience in work on attached algae and floating macrophyte water quality problems through his over 35 years of work in the US and other countries on problems of this type. He would apply his expertise and experience to the Delta's excessive aquatic plant growth problems as part of this project where he would define the magnitude of the problems and the potential benefits of controlling nitrogen and phosphorus compounds present in urban stormwater runoff on the excessive fertilization of the Delta.

Groundwater Quality Protection: One of the issues that is not addressed in the CALFED WQTG December 9, 1996 meeting materials that needs to be addressed as part of the development of a water quality management program for the Delta is groundwater quality protection. As Carl Hauge has pointed out, groundwaters and surface waters in the Delta watershed are intimately linked. It is not possible to reliably consider them as separate issues. The pollution of groundwaters by urban and agricultural activities ultimately affects Delta water quality through placing greater emphasis on the need for surface waters as a source and through the discharge of the polluted groundwaters as part of groundwater quality remediation programs to surface waters that ultimately enter the Delta.

A key component of the Delta water quality management program should be the protection of the Delta watershed's groundwater quality. This is a topic area in which Dr. Lee has extensive expertise and experience. He tried as part of the Sacramento River Watershed Toxics Control Program to get those responsible for the development of this program to include groundwater quality protection as an integral component. While there is general agreement among the stakeholders in the Toxics and Monitoring Committees that this should be done, thus far, little progress has been made towards initiating this activity.

Urban and industrial activities through solid waste management and groundwater recharge have been and continue to be important causes of groundwater pollution in the Delta watershed. It is well recognized that today's Water Resources Control Board's Chapter 15-approved single composite lined landfills, at best, only postpone for a few years when groundwater pollution by landfill leachate will occur, rendering the groundwaters unusable for domestic or many other purposes. Further, one of the methods often advocated for managing stormwater runoff in urban areas is the construction of infiltration basins. As discussed by Lee and Jones-Lee in "Water Quality Aspects of Groundwater Recharge: Chemical Characteristics of Recharge Waters and Long-Term Liabilities of Recharge Projects" (Lee and Jones-Lee, 1995d), groundwater recharge with poor quality waters such as urban area stormwater runoff can result in groundwater pollution. While recharge basins in some areas are situated in a hydrogeologic regime that protects the groundwater from becoming impaired by constituents in the recharge waters, at other locations the soils and geological strata have limited ability to remove constituents in the recharged waters, with the result that the groundwaters can become polluted by stormwater management. Dr. Lee's report that arises from this project would provide specific guidance on how to evaluate whether stormwater management by groundwater recharge will lead to groundwater pollution and thereby ultimately cause deteriorated water quality in the Delta.

Further, this report will discuss the issue of solid waste management in the Delta watershed and the need for changing the design, operation, closure and especially post-closure care of industrial and municipal landfills so that the landfills will, in fact, protect the groundwaters from impaired use, as required by Chapter 15, for as long as the wastes will be a threat. Dr. Lee has published extensively on this topic, including a 1995 report entitled, "Recommended Design, Operation, Closure and Post-Closure Approaches for Municipal Solid Waste and Hazardous Waste Landfills" (Lee and Jones-Lee, 1995e).

Dr. Lee is already involved in groundwater quality protection efforts in the Sacramento Valley region through a Petition that he has filed with the State Water Resources Control Board that is directed towards causing the State Board to review the Central Valley Regional Water Quality Control Board's approach towards permitting landfills that are acknowledged by Board staff and others that will ultimately pollute groundwaters. While there is widespread understanding that today's landfills will not protect groundwaters, there is reluctance on the part of regulatory boards to change the approach that has been used since the mid-1980s in permitting landfills to incorporate the new information that has been developed since then on the ability of landfill liner systems and groundwater monitoring systems of the type being used today to protect groundwater from pollution by landfill leachate for as long as the wastes in the landfill will be a threat. The CALFED WQTG activities in this area could be an important impetus to correcting the regulatory approaches that are being used today in the permitting of landfills and other waste management units within the Delta watershed.

Watershed Approach: The CALFED WQTG water quality management program is based on a watershed-based water quality management approach. Dr. Lee has been involved in watershed-based water quality management approaches since the early 1960s where through his work at the University of Wisconsin, Madison he served in a leadership role for developing management approaches for water quality in the Madison, Wisconsin lakes. This work included considering the importance of urban, ag and forest land uses and groundwater as a source of constituents that were impairing the lakes' beneficial uses. It was this early watershed work that led to Dr. Lee's pioneering urban stormwater runoff water quality research with his graduate students in the mid-1960s. With renewed interest in the watershed approach for water quality evaluation and management, Dr. Lee has published a number of guidance papers such as, "Aquatic Chemistry/Toxicology in Watershed-Based Water Quality Management Programs" (Lee and Jones-Lee, 1996f) as well as "Valid Pollutant Credit Trading" (Lee and Jones-Lee, 1994b) that discuss how watershed-based water quality evaluation and management programs should be formulated to properly consider the information available in aquatic chemistry, aquatic toxicology and water quality in formulating pollutant control programs and pollutant trading programs in a technically valid, cost-effective manner. To the extent that there is interest on the part of CALFED WQTG management, Dr. Lee can serve as a technical resource to all aspects of CALFED WQTG activities on how to incorporate current scientific and engineering principles/information into CALFED water quality management programs.

Dr. Lee plans to make extensive use of currently available as well as soon-to-be-developed data, reports, etc. in formulating his synthesis report on issues that should be addressed in formulating the CALFED's urban area and highway stormwater runoff water quality management programs. This is the approach that he has used in the Upper Newport Bay watershed review that is just being completed as part of the Phase 1 report for the Evaluation Monitoring Demonstration Project that he and Mr. Taylor are conducting in Orange County, California. They are already experienced in developing a synthesis report of the type that is needed by CALFED to more appropriately address the development of management programs for urban area, highway and industrial stormwater runoff water quality impacts/management than is presented in the December 9, 1996 CALFED WQTG documents.

Dr. Lee's extensive watershed-based water quality evaluation and management experience has demonstrated the importance of stakeholder participation in the development of the water quality management program for a waterbody. He has observed a number of watershed-based water quality management programs that have failed to address issues in a meaningful way arising from a lack of strong technical leadership in program formulation and implementation. Already, the CALFED WQTG program is gaining a reputation among some important stakeholders that this program is technically weak and mis-directed. At the January 10, 1997 State Storm Water Task Force meeting comments were made by urban stormwater dischargers who had seen the December 9, 1996 WQTG materials for the Urban and Industrial Runoff program to the effect that this program is technically weak and does not propose to address real issues of concern. Dr. Lee has been an active participant in the State Storm Water Task Force and was present at the January 10, 1997 meeting where the critical comments on the CALFED activities were voiced. At that time, he had not seen any CALFED WQTG documents which served as the basis for these comments. He had, however, heard several others, including individuals who attended the December 9, 1996 meeting, make similar comments on the problems with the way in which the CALFED WQTG was being organized and implemented.

As discussed herein, now that Dr. Lee has had the chance to review the WQTG activities, he is also critical of how this program has been organized. Dr. Lee believes he understands the concerns of these individuals and knows the technical problems of concern to them as well as to himself with CALFED's proposed water quality management activities and believes that his many years of work on this type of situation can be of significant assistance to CALFED WQTG management and stakeholders to direct their activities so that stakeholders in the Urban and Industrial Runoff program will become supportive of CALFED activities. Dr. Lee's role in these activities will be that of a leader, facilitator, implementer and technical resource. In order to avoid further justified negative comments on the development of CALFED water quality management activities, it is important that CALFED management immediately begin to address the issues of concern to the stakeholders. If CALFED management decides they do not want to support this proposal, then someone with Dr. Lee's expertise, experience and ability to complete activities in a timely manner must immediately assume a leadership role in the development of the urban area, highway and industrial stormwater quality management program if CALFED is to

achieve stakeholder support and appropriate use of funds available for water quality management in this area.

Resolving Technical Conflicts: One of the issues that will need to be addressed is how to resolve conflicts between "experts" on water quality issues. Dr. Lee would be surprised if those who made the suggestions at the December 9, 1996 meeting that he has commented on in this proposal to the effect that chlorpyrifos is not used in urban areas, the need to remove heavy metals from urban stormwater runoff by detention basins, etc. would not attempt to claim that their views on this matter as presented in the December 9, 1996 meeting documents were technically correct. Dr. Lee has frequently observed situations where individuals with limited understanding of issues, especially in the areas of aquatic chemistry, aquatic toxicology and water quality, will make off-the-cuff comments on issues which if properly peer reviewed would be shown to be technically invalid. Further, he has frequently observed that individuals representing various entities will try to impose the entities' position on issues through claiming that their position is supported by the technical information available on the topic. The net result is that policy makers in the water quality field with limited expertise conclude that there are equal opposite views on the topic by experts and therefore they can ignore both views and make their decisions based on political or other bases which largely ignore the technical information available that should be incorporated to the maximum extent possible into the decision-making process.

This issue has been of sufficient concern to Dr. Lee over the years so that Dr. Jones-Lee and he have developed a professional paper, "Practical Environmental Ethics: Is There an Obligation to Tell the Whole Truth?" (Lee and Jones-Lee, 1995f) that discusses how to resolve conflicts of this type. Basically, Dr. Lee has found that in a situation in which there is controversy on technical issues, those who represent the different viewpoints should be required to document their viewpoints with any appropriate references to the literature, etc. and present these in a peer review arena for full, in-depth public review.

With few exceptions, Dr. Lee has found that the public peer review approach quickly identifies the self-serving positions held by those who wish to use technical information to attempt to advance their own position on issues as well as those that arise from a lack of understanding of current water chemistry, toxicology and water quality issues. It is urged that the CALFED Water Quality Program consider utilizing a full, public peer review process to resolve any differences on technical issues. For example, in the case of the comments made in this proposal on the technical problems with the currently proposed approach set forth in the WQTG December 9, 1996 Urban and Industrial Runoff discussions, if someone disputes the technical validity of the position set forth in them, that individual/organization should be required to provide for public peer review a statement of the technical basis for their position on the issue. Dr. Lee will provide similar information beyond that which is already provided in this proposal. The respective views can be peer reviewed in a public arena where both those who oppose Dr. Lee's assessment as well and Dr. Lee have the opportunity to present supporting evidence for their positions. The CALFED Delta stakeholders can then evaluate the relative merits of the respective positions on the issues in dispute.

Delta and Sacramento River Water Quality Experience

Dr. Lee's work on Delta water quality began in 1989 while Dr. Lee was living in New Jersey when one of Dr. Lee's clients (Delta Wetlands, Inc.) had him review the potential water quality that would develop in several water supply reservoirs that that firm proposed to construct on Delta islands. At that time he became familiar with the water quality database on the Delta and its tributaries. Since then he has continued to review the data as they become available and has been active in a number of areas designed to try to get more appropriate review of Delta water quality issues than has been done in the past. Prior to that time, in the 1970s, Dr. Lee became involved as an advisor to the San Francisco District of the Corps of Engineers on dredged sediment water quality management issues in San Francisco Bay. When he moved back to California in 1989, he became involved with the Port of Oakland on managing contaminated dredged sediments which included a review of research devoted to evaluating the potential for disposal of contaminated dredged sediments as materials for reinforcing Delta levees.

In the early 1990s, Dr. Lee was asked by the University of California Water Resources Center to develop a review on water supply source water quality issues as they relate to Delta water quality. This review included developing a report, "Regulating Drinking Water Quality at the Source" (Lee and Jones, 1991b). Part of this report was published in a WRC conference proceedings as "Managing Delta Algal Related Drinking Water Quality: Tastes and Odors and THM Precursors" (Lee and Jones, 1991b). As part of developing this review, Dr. Lee updated his review of the Delta water quality issues pointing out a number of areas that are only now beginning to be addressed as needing attention.

Also as part of the CA/NV American Water Works Association Section activities, Dr. Lee developed a review for the Section's Source Water Quality Committee, "Impact of the Current California Drought on Source Water Supply Water Quality" (Lee and Jones, 1991c). This review pointed to the importance of Delta water quality in influencing the use of the Delta as a domestic water supply source and specifically addressed issues of excessive fertilization of the Delta as a cause of water supply water quality deterioration.

About 1.5 years ago, Dr. Lee was asked to make a presentation at a Toxics and Water Quality Modeling Workshop organized by the Bay Delta Forum, held in August 1995. He discussed "Water Quality Modeling Issues in the Delta & San Francisco Bay" (Lee, 1995). A number of the issues that need to be addressed as part of the CALFED Water Quality Program were summarized in his presentation.

As part of the Sacramento River Watershed Toxics Control Program that was initiated about one year ago, Dr. Lee worked to get this program to consider Delta water quality issues and developed a write-up discussing the importance of properly addressing these issues in evaluating the impact of constituent discharges/runoff to the Sacramento River system on "downstream" water quality. He has continued to be active with both the Toxics and Monitoring Committees where he has developed a number of guidance documents, such as "Water Column and Sediment

Toxics Assessment and Management Issues for the Sacramento River Watershed," (Lee and Jones-Lee, 1996g), which provide background information for formulating approaches that should be considered by the stakeholders in developing and implementing this program.

Since last summer, Dr. Lee has been working to get the DeltaKeeper involved in conducting toxicity monitoring studies in the Delta to examine the aquatic life toxicity that occurs in various parts of the Delta at various times of the year. While previous studies have demonstrated that there are potential problems due to organophosphorus pesticides causing aquatic life toxicity in the Delta, these studies have not continued to be carried out due to restrictions in funding. The proposed DeltaKeeper toxicity studies parallel similar studies that Dr. Lee is conducting in Orange County with respect to Upper Newport Bay water quality which have been described herein.

Qualifications

Principal Investigator

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The principal investigator for this project is Dr. G. Fred Lee. He will be assisted in the water quality area by Dr. Anne Jones-Lee (his wife). They are respectively President and Vice-President of G. Fred Lee & Associates, a specialty environmental consulting firm located in El Macero, California. Dr. Lee received a Bachelor's degree in environmental health sciences from San Jose State College in San Jose, California in 1955. He obtained a Master of Science degree in Public Health, focusing on aquatic chemistry and water quality at the University of North Carolina, Chapel Hill in 1957, and he obtained a Ph.D. degree in environmental engineering, environmental sciences, specializing in aquatic chemistry, limnology and water quality at Harvard University in 1960. For the period from 1960 to 1989 he held professorial positions in university graduate programs in environmental engineering and environmental sciences. These positions included establishing the Water Chemistry Program at the University of Wisconsin, Madison which he directed for a period of 13 years. He helped establish, and then directed for a period of five years, the Institute for Environmental Studies at the University of Texas at Dallas. Further, for a period of five years he was Director of the Hazardous Waste Research Center, Site Assessment and Remediation Division of a university consortium located at the New Jersey Institute of Technology. At NJIT he held a Distinguished Professorship in Civil and Environmental Engineering.

Dr. Lee is a registered professional engineer in the state of Texas, and a Diplomate in the American Academy of Environmental Engineers. He serves as chief examiner for the AAEE for the north-central California area.

During his university research and teaching career, he conducted over \$5 million in research in various aspects of water quality, and he has published over 650 professional papers and reports devoted to various aspects of his research and advisory roles with governmental agencies and industry in the US and other countries.

Dr. Anne Jones-Lee holds a Bachelor's degree in biology from Southern Methodist University and obtained Master's and Ph.D. degrees in environmental sciences focusing on aquatic toxicology and water quality from the University of Texas at Dallas. For a period of 11 years she held graduate-level university professorial positions, where in 1989 she held an Associate

Professorship with tenure in the Department of Civil and Environmental Engineering at the New Jersey Institute of Technology.

Drs. G. Fred Lee and Anne Jones-Lee have worked together as a team since the mid-1970s on various aspects of water quality and solid and hazardous waste evaluation and management. Dr. Lee's expertise and experience in aquatic chemistry, public health, environmental engineering combined with Dr. Jones-Lee's expertise in aquatic biology, aquatic toxicology and water quality make them highly effective in conducting research and serving as advisors to governmental agencies and industry on water quality evaluation and management. In addition to their extensive university teaching and research experience, which includes considerable activities devoted to stormwater runoff water quality evaluation and management, they have many years of practical experience working with governmental agencies and private industry/business on addressing specific problem areas at the real-world operating level. Therefore, they have not only the research background but also the practical experience of how to apply research results in the public policy arena.

Dr. Lee's experience with stormwater quality evaluation and management began in the 1960s when he, working with his graduate students, conducted some of the first research ever done on the amounts of chemical constituents present in urban stormwater runoff that could potentially adversely impact the beneficial uses of receiving waters for the runoff. His initial stormwater runoff water quality work was done as part of the International Biological Program while he was at the University of Wisconsin, Madison. These studies established for the first time the amounts of certain constituents in urban area and highway stormwater runoff on a per year/per unit area basis, i.e. export coefficients. His work also established the fact that many of the constituents in urban stormwater runoff, such as lead among the heavy metals and phosphorus as a nutrient, were largely in non-toxic or non-available forms. The pioneering work done on stormwater runoff water quality evaluation and management that was done in Madison, Wisconsin was expanded to Rochester, New York through the International Field Year for the Great Lakes where the amounts of nutrients and their algal availability derived from urban areas was assessed.

In the 1970s, Dr. Lee conducted a major study on behalf of the Dallas, Texas water utility devoted to evaluating the impact of land use within the Lake Ray Hubbard watershed on water quality. Part of this watershed was urbanized where he again evaluated the amounts of nutrients and other constituents in stormwater runoff from urban areas.

In the late 1970s and early 1980s, Dr. Lee worked with several Colorado Front Range communities, including Fort Collins, and the City and County of Denver, to evaluate the impact of urban stormwater runoff on receiving water quality. At Fort Collins, he focused his attention on a trout stream which received large amounts of urban stormwater runoff that ran through the center of the city. It had high concentrations of a variety of total heavy metals associated with stormwater runoff events, yet the trout in the stream were naturally reproducing. This indicated that the heavy metals and other constituents present in the urban stormwater runoff were in largely non-toxic, non-available forms.

In the mid-to-late 1980s, Dr. Jones-Lee and Dr. Lee were involved in research in the New York City - Northern New Jersey areas where there was concern about the impact of urban runoff from Manhattan and Northern New Jersey on the Hudson River Estuary and the New Jersey coast. It was at this time that they established that CSO discharges to this estuary caused significant sediment toxicity problems due to the accumulation of particulate nitrogen which converted to ammonia in the sediments. Their work on this topic was the first to demonstrate that ammonia is an important toxicant in aquatic sediments.

In the 1990s, Dr. Lee and Dr. Jones-Lee were involved in a number of projects concerned with urban area and highway stormwater runoff water quality impact evaluation and management. These included work with Hammond, Indiana in helping that community evaluate stormwater runoff and combined sewer overflow impacts on the Grand Calumet River. Beginning in 1992, Dr. Lee became involved as a participant in the state of California Storm Water Quality Task Force. He has served on the Legislative Committee and Industrial General Permit Committee for that Task Force, helping to develop legislation to more appropriately regulate stormwater runoff from urban areas and highways than what has been done as part of implementing the US EPA's 1990 Federal Register setting forth the national stormwater runoff NPDES permit program. He is active at this time in the Task Force's Watershed Committee, specifically addressing issues of TMDL development that incorporates urban and industrial stormwater runoff-derived constituents.

In 1995 Dr. Lee became an advisor to Silverado Constructors of Irvine, California. Silverado represents a consortium of engineering and construction firms that are designing and constructing the Eastern Transportation Corridor in Orange County, California. This is a new, \$800 million, 26-mile toll road that traverses Orange County from Irvine to SR 55 just south of Prado Dam on the Santa Ana River. In this project he has worked closely with Mr. Scott Taylor who heads up the Silverado team for stormwater runoff water quality BMP development. It is in connection with the work on the Eastern Transportation Corridor that the Evaluation Monitoring approach was developed as an alternative to conventional monitoring and conventional BMP utilization.

Dr. Lee has a long history in working with public and private clients on urban area stormwater quality evaluation and management programs. In addition to the work mentioned above, Dr. Lee also assisted Caltrans (Los Angeles District 7) in evaluating the potential water quality impacts of highway runoff on Santa Monica Bay water quality. At this time, Dr. Lee is involved in San Francisco Bay water quality issues with particular reference to the impact of highway and urban area stormwater runoff on San Francisco Bay water quality. An issue of particular importance in the Bay region is copper derived from auto brake pads that cause highway and street runoff to have significantly elevated concentrations of copper compared to state water quality standards. Lee and Jones-Lee (1996e), have reported that this copper is in a non-toxic, non-available form, and it stays in this form in San Francisco Bay waters. This results in a situation where there is no technical justification to require the stormwater managers, such as Caltrans, and the communities bordering on San Francisco Bay to remove/control copper in the stormwater runoff from the Bay area highways.

Dr. Lee has assisted the city of Chicago in developing a stormwater runoff management program that would enhance water quality in ponds located in Chicago's Lincoln Park that were adversely impacted by stormwater runoff-associated constituents. His work has included evaluation and development of management programs for lakes impacted by stormwater runoff from urban areas on lakes located in Madison, Wisconsin; Olathe, Kansas and Lubbock, Texas.

His private client stormwater runoff water quality work includes assisting Rockwell International Rocketdyne Division, Canoga Park, California in stormwater runoff water quality NPDES permit revisions associated with space shuttle engine testing facilities. Dr. Lee has worked with several private developers throughout the US in the development of stormwater quality management plans that would protect the beneficial uses of the receiving waters for the stormwater runoff from the development. This work includes assisting Trammel Crow, Inc., Dallas, Texas in the Crystal Lake development in West Orange, New Jersey for a new office complex as well as Inland Steel Development Corporation in Lake Monroe, Indiana; Mission Viejo Development near Denver, Colorado; and N.E. Issacson & Associates in Central Wisconsin in developing approaches for stormwater quality management for residential developments.

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Mr. Scott Taylor holds the position of Director of Flood Control Engineering with RBF of Irvine in California and has over 13 years of experience in hydrologic, hydraulic and flood control design. He is a registered professional engineer who has extensive experience in the design of regional and local flood control improvements associated with transportation and other public works projects.

Mr. Taylor holds a Bachelor's degree in Civil and Environmental Engineering and a Master's degree in Civil and Water Resources Engineering. He teaches a P.E. License Review course on the subject of hydrology and is a part-time lecturer at the University of California at Irvine and California State University at Long Beach, teaching courses in hydrology and hydraulic design. Mr. Taylor has extensive experience in floodplain modeling and the hydraulic modeling of bridge structures. Mr. Taylor is experienced with the application of both one and two-dimensional flow models such as HEC-2 and FESWMS 2DH.

Mr. Taylor has developed stormwater pollution prevention plans (SWPPP) for numerous public and private sector clients, including specialized post-construction stormwater quality plans.

In 1995, Mr. Taylor authored a paper, "A National Survey of Design and Maintenance Practices for Flood Control Systems in the United States," which was presented at the First International Conference on Water Resources, held in San Antonio, Texas in August 1995. As a part of the research for this paper, Mr. Taylor contacted most of the DOTs within the United States to complete a written survey. This background information will be useful in again contacting the DOTs for the proposed project.

Robert Bein, William Frost and Associates (RBF) is a private engineering consulting firm specializing in water resources and transportation projects. The firm was founded in 1944 and is comprised of about 350 people in seven offices located throughout California. RBF works primarily in the area of water resources and transportation projects and has a dedicated structural design group specializing in highway bridge design. RBF has annual billings of about \$40 million. RBF has completed several large projects for Caltrans, most recently a \$90 million construction project at the I-5/I-405 confluence and the \$700 million ETC. RBF was also selected by the Los Angeles District Corps of Engineers to complete a Plans, Specifications and Estimate package for Reaches 3 and 4 of the Santa Ana River Mainstem Project, a \$1.4 billion flood control improvement program.

RBF has extensive experience in the preparation of Stormwater Quality Plans, development of storm water policy and water quality monitoring and groundwater quality investigations. RBF was one of the Silverado consortium of engineering and construction firms responsible for the design and construction of the Eastern Transportation Corridor (ETC). RBF (Scott Taylor) had the specific responsibility for the development a stormwater quality program for the ETC.

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A set of Dr. Lee's papers and reports have been made available to CALFED WQTG. Many of their papers and reports are available as downloadable files from Web site <http://members.aol.com/gfredlee/gfl.htm>. Copies of Dr. G. Fred Lee's and Dr. Anne Jones-Lee's papers and reports on stormwater runoff water quality impacts and management as well as other topic areas in which they are active are available from Dr. Lee upon request.