

Evaluation Monitoring for  
Evaluating & Managing Water Quality Issues

Submitted to Delta Independent Science Board

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From their professional experience and work over the past five decades, Drs. Lee and Jones-Lee have described an “Evaluation Monitoring” approach for developing and executing water quality evaluation and management studies, and discussed how it is more effective and reliable than the monitoring schemes that are typically used today (citations discussed below). The background to their development of that approach is discussed in this report.

Drs. Lee and Jones-Lee have been involved in developing and conducting a myriad water quality monitoring programs, as well as reviewing the results of others’ such programs, with the intent of determining the state of “water quality,” the existence of water problems, and the role of the monitored parameters in impacting water quality. Conventional monitoring programs typically involve the measurement of a limited suite of water quality-related parameters at designated locations and intervals over time, often for a year or more. At the end of the monitoring period the data are examined by comparing measured concentrations to water quality criteria/standards; if there are exceedances of the criteria, the water is classified as “impaired.” This mechanical approach to evaluating water quality is relatively simple to legislate and implement, and requires limited understanding of aquatic chemistry and aquatic biology/toxicology. Unfortunately, it is also often wasteful of resources and can easily result in unreliable conclusions. As they have discussed in their writings (see below), the conventional mechanical approach to water quality monitoring can readily led to inappropriate evaluations of the impact of a chemical(s) on the beneficial uses of a waterbody that can result in expenditure of large amounts of money for controlling a chemical, chemicals, sediments, and/or discharges that do not result in improvement in water quality (beneficial uses) of a waterbody.

By contrast, “Evaluation Monitoring” is a focused, iterative approach to gathering and reviewing monitoring data to answer questions of the nature, extent, and causes of water quality (beneficial use) impact and the extent to which given measures can stem and remedy impacts. It also requires understanding of the aquatic chemistry and aquatic biology/toxicology of the aquatic system and contaminants involved.

Drs. Lee and Jones-Lee have considerable experience and expertise in developing and evaluating the appropriate application of water quality criteria and state water quality standards. Their experience is summarized in:

G. Fred Lee and Anne Jones-Lee Expertise and Experience in Water Quality Standards and NPDES Permits Development and Implementation into NPDES Permitted

Discharges <http://www.gfredlee.com/exp/wqexp.htm>

Lee, G. F. and Jones-Lee, A., "Appropriate Use of Numeric Chemical Water Quality Criteria," *Health and Ecological Risk Assessment*, 1:5-11 (1995).  
<http://www.gfredlee.com/SurfaceWQ/chemcri.pdf>

Their academic backgrounds and research experience in developing focused, iterative aquatic chemistry and aquatic biology/toxicology studies as part of water quality evaluation are described in reports/papers on their website [www.gfredlee.com](http://www.gfredlee.com).

In the mid 1990 Drs. Lee and Jones-Lee were awarded a contract to undertake a study of best management practices (BMPs) appropriate for managing anticipated water quality impacts of a new \$200-million toll road (Eastern Transportation Corridor) that was to be constructed in the Upper Newport Bay Orange County watershed. This led to their developing a monitoring program that could be used to reliably inform the development of appropriate BMPs for the new highway in a manner to protect water quality. Previously conducted monitoring studies showed that stormwater runoff from existing highways in the area frequently contained several heavy metals in total concentrations that exceeded US EPA water quality criteria/standards. Following the conventional approach, that finding could lead to the requirement of conventional BMPs to treat the stormwater runoff from the new toll road to control total concentrations of heavy metals in the runoff that exceeded the water quality criteria. In fact, the group responsible for developing BMPs for the toll road had proposed to construct large filters to collect and treat the stormwater runoff from the highway to remove heavy metals. However, the consultant for the toll road development was aware of Lee and Jones-Lee reports that had shown that heavy metals in urban area street and highway stormwater runoff were present in largely non-toxic forms. Under their contract, Lee and Jones-Lee developed a monitoring/evaluation program to evaluate whether there was need for the stormwater runoff filters to remove heavy metals in the stormwater runoff from the new toll road for protection of water quality. After several years of monitoring of stormwater runoff they developed a number of reports discussing their findings, including:

Lee, G. F. and Taylor, S., "Results of Heavy Metal Analysis Conducted During 2000 in the Upper Newport Bay Orange County, CA Watershed," Report of G. Fred Lee & Associates, El Macero, CA (2001).  
<http://www.gfredlee.com/Watersheds/Heavy-metals-319h.pdf>

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

Lee, G. F., Taylor, S., and Jones-Lee, A., "Synopsis of the Upper Newport Bay Watershed 1999-2000 Aquatic Life Toxicity Results with Particular Reference to Assessing the Water Quality Significance of OP Pesticide-Caused Aquatic Life Toxicity," Report of G. Fred Lee & Associates, El Macero, CA, March (2001).  
[http://www.gfredlee.com/Watersheds/optox\\_rev\\_021801.pdf](http://www.gfredlee.com/Watersheds/optox_rev_021801.pdf)

Lee, G. F., Jones-Lee, A. and Taylor, S. "Evaluation of the Water Quality Significance of OP Pesticide Toxicity in Tributaries of Upper Newport Bay, Orange County, CA," IN: Ninth Symposium on Environmental Toxicology and Risk Assessment: Recent Achievements in Environmental Fate and Transport, ASTM STP 1381, pp 35-51 (2000). [http://www.gfredlee.com/Watersheds/oppesticide\\_unb.pdf](http://www.gfredlee.com/Watersheds/oppesticide_unb.pdf)

Through the integrated use of aquatic life toxicity studies and chemical monitoring, Lee and Jones-Lee found that some of the stormwater runoff was toxic to aquatic life. However, they also found that while the stormwater runoff to various rivers/creeks contained elevated concentrations of total forms of heavy metals, often in exceedance of water quality criteria, the metals were in non-toxic forms. They determined that the aquatic life toxicity found in stormwater runoff was caused by Pyrethroid-based pesticides in the runoff. This was one of the first studies to determine that the Pyrethroid-based pesticides are an important cause of aquatic life toxicity in stormwater runoff.

The overall approach used in their studies was what they termed "Evaluation Monitoring." By this evaluation approach, rather than following the conventional approach of monitoring for heavy metals and comparing the results to water quality criteria, they examined the runoff for toxicity; where toxicity was found, they conducted studies to determine the cause of the toxicity through a combination of aquatic life toxicity testing and application of principles of aquatic chemistry in interpretation of chemical concentration measurements.

The "Evaluation Monitoring" approach that they developed is discussed in a number of reports and publications, including:

Lee, G.F., and Jones-Lee, A., "Evaluation Monitoring vs Chemical-Constituent Monitoring: Chemical Concentrations vs Chemical Impacts," Keynote presentation at CA Water Environment Association Training Seminar, "Recent Advances in Receiving Water Monitoring," Anaheim, CA, February (1999). <http://www.gfredlee.com/SurfaceWQ/concentrationvsimpact.pdf>

Lee, G. F. and Jones-Lee, A., "Aquatic Chemistry/Toxicology in Watershed-Based Water Quality Management Programs," In: Proc. Watershed '96 Conference on Watershed Management, Water Environment Federation, Alexandria, VA, pp.1003-1006 (1996). <http://www.gfredlee.com/SurfaceWQ/watershe.pdf>

Jones-Lee, A. and Lee, G.F., "Evaluation Monitoring as an Alternative to Conventional Water Quality Monitoring for Water Quality Characterization/Management," Proc. NWQMC National Conference Monitoring: Critical Foundations to Protect Our Waters, US Environmental Protection Agency, Washington, D.C., pp. 499-512 (1998). [http://www.gfredlee.com/Runoff/wqchar\\_man.html](http://www.gfredlee.com/Runoff/wqchar_man.html)

Lee, G.F. and Jones-Lee, A., "Evaluation Monitoring for Stormwater Runoff Water Quality Impact Assessment and Management," Presented at Society of Environmental Toxicology & Chemistry 18th Annual Meeting, San Francisco, CA, November (1997). <http://www.gfredlee.com/Runoff/setace.html>

The Upper Newport Bay stormwater runoff evaluation monitoring program was conducted with the approval of the Santa Ana Regional Water Quality Control Board. The originally proposed stormwater runoff filters for treating the stormwater runoff from the new toll road were abandoned with the approval of the Regional Water Quality Board. No structural BMPs were required for the toll road thereby saving the public large amounts of money for construction and maintenance of the filters.

As part of its review of water quality evaluation in the Delta, the DISB should recommend that the Evaluation Monitoring approach be used to guide water quality evaluations for waterbodies containing contaminants in exceedance of water quality criteria/standards.

Questions on the developing the Evaluation Monitoring approach can be directed to Dr. G. Fred Lee at [gfredlee33@gmail.com](mailto:gfredlee33@gmail.com).