G. Fred Lee & Associates

27298 E. El Macero Dr.
El Macero, California 95618-1005
Tel. (530) 753-9630 • Fax (530) 753-9956
e-mail: gfredlee@aol.com
web site: http://www.gfredlee.com

April 4, 2005

VIA ELECTRONIC SUBMISSION

Attention Docket ID No. OW-2003-0063

Steven L. Johnson, Administrator
Water Docket
US Environmental Protection Agency
Mailcode 4101T
1200 Pennsylvania Ave., NW.
Washington, DC 20460

Dear Administrator Johnson:

Please find attached our comments on the US EPA February 1, 2005, Federal Register "Application of Pesticides to Waters of the United States in Compliance With FIFRA." As discussed we find that the US EPA's proposed approach to regulating the water quality impacts of the application of aquatic pesticides/herbicides is contrary to protecting the beneficial uses of the waters to which the pesticides are applied and associated waters. We strongly urge the US EPA not to adopt the proposal to eliminate the need to obtain a Clean Water Act NPDES permit or the equivalent as part of gaining permission to apply aquatic pesticides/herbicides. Justification for this recommendation is provided in the attached comments.

If there are questions on our comments please contact me.

G. Fred Lee. PhD, PE, DEE

Need for More Effective National Regulation of Aquatic Pesticide/Herbicide Use

G. Fred Lee, PhD, PE, DEE and Anne Jones-Lee, PhD
G. Fred Lee & Associates
27298 E. El Macero Drive, El Macero, CA 95618
Ph: (530)753-9630 Fx: (530)753-9956 Em: gfredlee@aol.com
www.gfredlee.com

April 4, 2005

There is controversy about the appropriate approach for regulating the non-target organism impacts of pesticides including herbicides that are applied to water to control water-associated pests and excessive growths of aquatic plants. The *Talent Decision* (2001) established the need to regulate aquatic pesticides/herbicides under Clean Water Act (CWA) NPDES permits. This decision initiated the process of issuing NPDES permits for the application of aquatic pesticides/herbicides where in some areas for the first time (such as California) the need to evaluate the potential impacts of aquatic pesticide/herbicide application to non-target organisms and other water quality/beneficial use impacts were established. Of particular importance was the need to begin to monitor the pesticide/herbicide application to determine the impacts on water quality.

During the past several years the authors have served as volunteer technical advisors to the Sacramento San Joaquin River Delta DeltaKeeper (William Jennings) and the San Francisco Bay BayKeeper (Segal Choksi) on technical aspects of assessing the water quality impacts of aquatic pesticides/herbicides. This activity is a follow up to the studies that G. F. Lee conducted in the 1960s while a Professor of Water Chemistry at the University of Wisconsin on managing the excessive growths of aquatic plants that impair the beneficial uses of waterbodies. These studies included Wisconsin Department of Conservation (state fish management agency) research on the impact of an aquatic herbicide on fish reproduction and growth. Fate and impacts of copper used for algae control in a lake were investigated. Also investigated were the relative merits of the use of chemicals to control aquatic weeds versus mechanical harvesting. A summary of G. F. Lee's experience in aquatic plant management with emphasis on evaluating the impact of using aquatic herbicides is presented in Appendix A to these comments.

G. F Lee's recent involvement in aquatic plant management/aquatic herbicide management includes reviewing the California State Water Quality Control Board (SWRCB) efforts to develop a NPDES permit for aquatic pesticide application. Lee and Jones-Lee (2003a; 2004a,b,c,d) provided comments on the need for more effective regulation of aquatic pesticide/herbicide water quality impacts and on the SWRCB draft NPDES permit. This involvement also included reviewing the results of the San Francisco Estuary Institute (SFEI) studies conducted on behalf of the DeltaKeeper/SWRCB litigation settlement on the impact of aquatic pesticide/herbicide application water quality impact studies (Lee 2003b). The focus of this effort was the development of a comprehensive water quality monitoring program associated with the application of aquatic pesticides/herbicides. The recommended program that evolved

from this effort is presented as "Developing a Reliable Program to Monitor Water Quality Impacts of Aquatic Pesticides" (Lee 2004c) (Appendix B). It is with this background that we make these comments.

Important background to these comments is the SFEI field studies on the impact of aquatic pesticide/herbicide impacts. The background to these studies is that the DeltaKeeper asked for our advice on how to insure that the use of aquatic herbicides was not causing adverse impacts to non-target aquatic life. We suggested to the DeltaKeeper that there was need for comprehensive field studies to evaluate actual impacts in representative situations which would be conducted by an independent organization. The SFEI studies evolved out of the litigation settlement between the DeltaKeeper and the California State Water Resources Control Board, where the Board made funds available to conduct these studies. The results of the SFEI studies are available in several reports on the SFEI website, www.sfei.org.

SFEI (2004) presented the results of the field studies on the potential for several of the commonly used aquatic pesticides to cause acute aquatic life toxicity and some potential secondary impacts outside the zone of application. As SFEI indicates, sufficient funds were not made available by the SWRCB to determine if the pesticides/herbicides investigated caused chronic toxicity to non-target organisms in the treated waters. SFEI also developed several other reports such as on non-chemical methods of aquatic plant control and economic aspects of aquatic plant management. These reports are on the SFEI website in the aquatic pesticide section at http://www.picosearch.com/cgi-bin/ts.pl.

Comments on US EPA Federal Register on NPDES Permits for Aquatic Pesticide Application

The US EPA, in the February 1, 2005 Federal Register, "Application of Pesticides to Waters of the United States in Compliance With FIFRA," has proposed to significantly weaken the regulation of the application of aquatic pesticides/herbicides by greatly restricting the need to obtain a NPDES permit associated with the application of aquatic pesticides/herbicides. In support of the proposed regulation of aquatic pesticides including herbicides, the US EPA, in issuing this proposed change in regulation, included the following "Interpretive Statement:"

"The application of a pesticide to or over, including near, waters of the United States consistent with all relevant requirements under FIFRA does not constitute the discharge of a pollutant that requires a NPDES permit under the Clean Water Act in the following two circumstances:

(1) The application of pesticides directly to waters of the United States in order to control pests. Examples of such applications include applications to control mosquito larvae, aquatic weeds or other pests that are present in the waters of the United States.

(2) The application of pesticides to control pests that are present over waters of the United States, including near such waters, that results in a portion of the pesticides being deposited to waters of the United States; for example, when insecticides are aerially applied to a forest canopy where waters of the United States may be present below the canopy or when pesticides are applied over, including near, water for control of adult mosquitoes or other pests.

It is the Agency's position that these types of applications do not require NPDES permits under the Clean Water Act if the pesticides are applied consistent with all relevant requirements under FIFRA (i.e., those relevant to protecting water quality)."

The adoption of this Interpretative Statement as US EPA policy for regulating the application of aquatic pesticides/herbicides is strongly contrary to protecting water quality from the potentially significant adverse impacts of aquatic pesticides applied in accord with the label. The US EPA Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), as being implemented by the US EPA Office of Pesticide Programs (OPP), is well known to not be protective of water quality outside the zone of application of aquatic pesticides/herbicides. The basic problem is that FIFRA and the Clean Water Act have markedly different approaches to protecting aquatic life.

The US EPA OPP (FIFRA) regulations allow toxicity to non-target organisms, provided that this toxicity is not significantly adverse to the beneficial uses of the waterbody. FIFRA definitions include:
"x) Protect health and the environment.--The terms 'protect health and the environment' and 'protection of health and the environment' mean protection against any unreasonable adverse effects on the environment."
3 *"(bb) Unreasonable Adverse Effects on the Environment.--The term 'unreasonable adverse effects on the environment' means (1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide, or (2) ..."*

The US EPA OPP FIFRA regulations allow other factors (such as economic and social) than impairment of beneficial uses of a waterbody to determine whether a pesticide's registration or re-registration should be limited by adverse impacts to non-target organisms. Basically, from a US EPA OPP perspective, the question becomes one of whether the numbers, types, and characteristics of non-target aquatic life present in waters treated for aquatic pests or excessive growths of aquatic plants, that experience aquatic life toxicity are being significantly adversely impacted by this toxicity, and this toxicity represents an "*unreasonable adverse effect*." While, on the other hand, the Clean Water Act requires the control of all aquatic life toxicity.

There are numerous examples of where the US EPA OPP has failed to act to limit the use of pesticides that are applied in accord with the label, that cause widespread aquatic life toxicity to important forms of aquatic life (see papers and reports in the Pesticide section of www.gfredlee.com). An example of this situation is the OPP issuance of the labels for the organophosphorus pesticides diazinon and chlorpyrifos. It has been well documented for over 10 years that the application of these pesticides on agricultural crops and residential properties results in aquatic life toxicity in stormwater runoff and discharges of water from areas where the pesticides have been applied. Yet the US EPA OPP has not taken action to restrict the use of these pesticides in agricultural areas even though this use results in aquatic life toxicity to important zooplankton organisms (larval fish food) in the receiving waters for the runoff/discharges from areas of application. Eventually the sale of these pesticides for use on urban residential properties was restricted by OPP because of potential toxicity to children. No such restrictions are

applied to agricultural use of these pesticides. However, CWA requirements are being implemented that require that the use of these pesticides not cause aquatic life toxicity in waters of the US.

There is no regulatory proactive process whereby a new or substitute pesticide is critically reviewed for stormwater runoff water quality impacts before widespread use takes place. Highly toxic pesticides to non-target organisms are allowed by OPP to be used without evaluating whether stormwater runoff and discharge waters from areas of pesticide application cause aquatic life toxicity in the receiving waters. It was based on this situation, where there is inadequate regulation of pesticide aquatic life toxicity to non-target organisms by the US EPA OPP, that Jones-Lee and Lee (2000) and Lee (2001) recommended that water quality regulatory agencies adopt a proactive approach of requiring that stormwater runoff water quality impact studies be conducted with the initial use of a new or expanded use pesticide. The results of these studies could be used to screen for aquatic life toxicity problems in stormwater runoff from areas where the pesticides are applied before widespread application occurs.

The bottom line in this issue is that the use of pesticides/herbicides in accord with the OPP issued label is not protective of aquatic life in the waterbodies receiving the applied pesticide/herbicide. The US EPA proposal to allow essentially unrestricted use of aquatic pesticides/herbicides so long as the application is in accord with the label is not protective of the aquatic life related and some other beneficial uses of waterbodies.

The US EPA in the February 1, 2005, Federal Register states that,
"\1\ Applications of pesticides in violation of the relevant requirements under FIFRA would be subject to enforcement under any and all appropriate statutes including, but not limited to FIFRA and the Clean Water Act."

Since the OPP FIFRA is ineffective in regulating toxicity to non-target organisms and secondary impacts associated with pesticide/herbicide application, the US EPA is stating by this statement that it is up to the CWA or other regulations to regulate the adverse water quality impacts of pesticide/herbicide application. However, the CWA is only effective in regulating aquatic life toxicity where there is a requirement for aquatic life toxicity testing associated with NPDES permits. Without the requirements of a NPDES permit governing the application of aquatic pesticides/herbicides, there is little likelihood that the monitoring needed to evaluate the impacts of the application of aquatic pesticides/herbicides on non-target organisms within and outside the zone of application of the pesticide/herbicide will be conducted. NPDES permits carry the regulatory tools to determine if the use of a registered aquatic pesticide/herbicide in accord with the label is protective of the beneficial uses of the waterbody to which they are applied. The NPDES permit and its associated water quality monitoring and reporting to the water quality management agency responsible for the area can be a major deterrent to illegal/inappropriate use of the pesticide/herbicide. A water quality monitoring program of the type described by Lee (2004c) should be adopted as part of aquatic pesticide/herbicide NPDES permits.

Conclusions

The removal of the NPDES permitting requirements for the application of aquatic pesticides/herbicides as proposed by the US EPA would mean that the application of the aquatic pesticides/herbicides would be unregulated with respect to impacts on non-target organisms and other beneficial uses of waterbodies. There is little possibility that states and local political jurisdictions will be able to develop adequate regulatory programs to control the adverse impacts of aquatic pesticides/herbicides to the beneficial uses of waterbodies receiving the application. There is need for strong national regulatory requirements to provide the administrative framework to properly protect water quality from the adverse impacts of aquatic pesticides/herbicides. The US EPA NPDES permit system provides this framework.

Recommendations

Rather than weakening the regulation of the application of aquatic pesticides/herbicides by eliminating the current requirements for the application to be conducted under a NPDES permit, the US EPA should strengthen this requirement and provide detailed guidance on how to develop these permits and the water quality monitoring programs that are needed to properly implement these permits.

Before the US EPA dismantles the progress that was made in beginning to effectively regulate the potential water quality impacts of aquatic pesticide/herbicide application to waters that can impact the waters of the US that resulted from the *Talent Decision* (2001), the Agency must establish a Clean Water Act permitting system that will insure that all direct and secondary impacts of aquatic pesticide/herbicide application are adequately monitored and reported to a water quality regulatory agency. The funding for this program should be provided by the users of the pesticide/herbicide.

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http://www.members.aol.com/apple27298/Aq-weed-permit-rev-com.pdf

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US EPA "Application of Pesticides to Waters of the United States in Compliance With FIFRA" US Environmental Protection Agency 40 CFR Part 122 [OW-2003-0063; FRL-7866-5] RIN 2040-AE72 Federal Register: Volume 70, Number 20 [Proposed Rules] Page 5093-5100, Washington DC, February 1, (2005).

Appendix A
Experience of G. Fred Lee, PhD, PE, DEE in Aquatic Plant Management

Dr. G. Fred Lee became involved in the control of excessive growths of aquatic plants in 1960, while he held a university professorship in water chemistry at the University of Wisconsin, Madison. In this position he developed, and then directed for a period of 13 years, a graduate-level degree program which focused on investigating and managing water quality problems in surface and ground waters. One of his primary areas of research was on the excessive fertilization of waterbodies, focusing on factors influencing and management of algae and other aquatic plants.

In the 1960s Dr. Lee was involved in a number of projects on the control of excessive growths of aquatic plants, including a project sponsored by the Wisconsin Department of Conservation (equivalent to the California Department of Fish and Game) devoted to evaluating the potential impacts of various types of herbicides for control of aquatic plants. The project included adding herbicides to fish hatchery ponds and examining the effects of the herbicides on fish, including their reproduction, growth, etc.

Dr. Lee's work on excessive fertilization management included mechanical harvesting of aquatic plants, where he served as an advisor to the predecessor of the US EPA (Federal Water Pollution Control Association) National Eutrophication Research Program on the benefits of mechanical harvesting of aquatic plants on water quality in Lake Sallie in Minnesota. Dr. Lee has been a long-term member of the Aquatic Plant Management Society, and continues to follow closely work that is done on aquatic plant management in various parts of the US.

Dr. Lee received a bachelors degree in environmental health sciences from San Jose State College in 1955, a Master of Science in Public Health degree focusing on water quality issues from University of North Carolina, Chapel Hill, in 1957, and a PhD degree from Harvard, University, Cambridge, Massachusetts, in 1960, in environmental engineering.

During the 30 years that he held university graduate-level teaching and research positions, Dr. Lee conducted over $5 million in research and published over 500 papers and reports on this work. In addition to holding professorial positions at the University of Wisconsin, Madison, he also held similar positions in the University of Texas system and at Colorado State University.

In 1989, he completed his university teaching and research career as a Distinguished Professor at the New Jersey Institute of Technology. At that time Dr. Anne Jones-Lee, with whom he has worked since the 1970s, and he expanded the part-time consulting that Dr. Lee had been doing while a university professor into a full-time activity, under the name of G. Fred Lee & Associates. Drs. Lee and Jones-Lee are the two principals in the firm.

Dr. Anne Jones-Lee has a bachelors degree in biology from Southern Methodist University, and masters and PhD degrees in environmental sciences, focusing on water quality, from the University of Texas at Dallas. She held university professorial positions for 11 years.

Drs. Lee and Jones-Lee worked on excessive fertilization problems as consultants to a number of countries, including South Africa, Israel, Jordan, Norway, the Netherlands, France, Spain, Japan, Canada, the USSR, Tunisia, Egypt and several of the US states. Their work included completion of a contract for the US EPA devoted to the US part of the Organization for Economic Cooperation and Development (OECD) eutrophication studies that were conducted in the 1970s. In that activity they developed a synthesis report on nutrient load eutrophication response relationships for about 100 waterbodies located throughout the US. The OECD eutrophication study was a five-year, $50-million, 22-country nutrient load eutrophication response investigation which involved the study of 200 waterbodies located in western Europe, North America, Japan and Australia. Subsequent to the completion of this work, Drs. Anne Jones-Lee and G. Fred Lee have expanded the database to over 750 waterbodies located throughout the world.

In 1989, when Dr. Lee completed his teaching and research career, he and Dr. Anne Jones-Lee moved to the Sacramento area to service new clients that had developed in California. This work involved examining eutrophication-related water quality issues in the Sacramento-San Joaquin River Delta, as a consultant to Delta Wetlands, Inc. Drs. Lee and Jones-Lee have been active in Central Valley water quality issues since 1989, including most recently serving as the coordinating PI for a $2-million, one-year CALFED project devoted to the low-DO problem in the San Joaquin River Deep Water Ship Channel located near Stockton, California. They have recently completed a 280-page Synthesis Report covering three years of work that has been done on the low-DO problem in the Deep Water Ship Channel. This problem is related to excessive growths of algae in the San Joaquin River watershed. This report is available on their website, as

> Lee, G. F. and Jones-Lee, A., "Synthesis and Discussion of Findings on the Causes and Factors Influencing Low DO in the San Joaquin River Deep Water Ship Channel Near Stockton, CA: Including 2002 Data," Report Submitted to SJR DO TMDL Steering Committee and CALFED Bay-Delta Program, G. Fred Lee & Associates, El Macero, CA, March (2003). http://www.gfredlee.com/SynthesisRpt3-21-03.pdf

During the mid- to late 1990s, Dr. Lee was responsible for conducting about $500,000 of 205(j) and 319(h) research on behalf of Orange County, California, and the Santa Ana Regional Water Quality Control Board, concerned with water quality problems (pesticide-caused toxicity) in the Upper Newport Bay watershed. As part of this effort he became familiar with the excessive fertilization problems of Upper Newport Bay and the approaches that need to be taken to control these problems.

During 2002 Drs. Lee and Jones-Lee completed reports for the Central Valley Regional Water Quality Control Board concerned primarily with nonpoint source water quality management issues in the Central Valley. These reports,

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

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http://www.gfredlee.com/StockDiaTMDL12-14-02.pdf

were funded in part by the US EPA through the State Water Resources Control Board on behalf of the Central Valley Regional Water Quality Control Board. Drs. Lee and Jones-Lee developed these reports as employees of the California Water Institute at California State University, Fresno. One of the key issues that is emphasized in these reports is the development of appropriate nutrient monitoring and management programs to control excessive fertilization of Central Valley waterbodies.

Additional information on Drs. Lee and Jones-Lee's expertise and experience pertinent to conducting studies on the control of aquatic weeds is available on their website, www.gfredlee.com, or from Dr. Lee at gfredlee@aol.com.

Appendix B
Developing a Reliable Program to Monitor Water Quality Impacts of Aquatic Pesticides

G. Fred Lee, PhD, DEE
G. Fred Lee & Associates
27298 E. El Macero Drive, El Macero, CA 95618
Ph: (530)753-9630 Fx: (530)753-9956 Em: gfredlee@aol.com
www.gfredlee.com

July 13, 2004

In June 2004 the California State Water Resources Control Board (SWRCB) adopted a National Pollutant Discharge and Elimination System (NPDES) statewide general permit for application of aquatic pesticides, without specific details on the required water quality monitoring that should be conducted to evaluate whether the pesticide/herbicide used, either alone or in combination with other chemicals in the water, is adverse to non-target organisms outside the zone of application. Justification for a comprehensive water quality monitoring program associated with pesticide/herbicide applications for aquatic weed control arises from the fact that the US EPA Office of Pesticide Programs (OPP) and the California Department of Pesticide Regulation (DPR) registration of pesticides **does not** ensure the prevention of significant adverse impacts to non-target aquatic life. This situation means that it is necessary for the water quality regulatory agencies, such as the SWRCB and the Regional Water Quality Control Boards (RWQCBs) to establish the requirements for comprehensive water quality monitoring to ascertain the near-term and long-term impacts associated with the application of aquatic pesticides/herbicides to waterbodies.

For years chemicals have been added to waterbodies to control excessive growths of aquatic weeds, algae and other pests, without properly evaluating the impacts of these chemicals on the aquatic-life-related beneficial uses of the waterbody. The development of a comprehensive, credible water quality monitoring program is long overdue. While those responsible for aquatic weed control assert that comprehensive monitoring of the potential adverse impacts of the pesticide/herbicide application is costly compared to the funds that have been used in the past for such evaluations, the cost of such a program should be part of the cost associated with aquatic weed control.

As part of commenting on the preliminary draft, draft and revised draft NPDES permit associated with the application of pesticides/herbicides to waterbodies for aquatic weed and other pest control, Dr. Jones-Lee and I (Lee, 2003, 2004a,b; Lee and Jones-Lee, 2003, 2004) have provided detailed comments on the need for comprehensive water quality monitoring/evaluation. In our comments we have discussed the components of such a program that should be developed. A reliable program to properly evaluate the water quality impacts of pesticides/herbicides used for aquatic weed control requires chemical monitoring, aquatic life toxicity assessment and bioassessment, and for persistent chemicals, bioaccumulation monitoring. A summary of these monitoring/evaluation program components is presented below. For further information

on monitoring associated with aquatic pesticide/herbicide impact evaluation, review Lee and Jones-Lee (2002a, 2003a).

Chemical Monitoring

The monitoring program should include comprehensive monitoring of the fate (transport) and persistence of the pesticide and any chemicals that are added with it that have the potential to be adverse to aquatic life. The purpose of this monitoring is to establish a concentration-duration of potential exposure relationship for the added pesticide and its associated chemicals within and near the area of application of the pesticide/herbicide. Data obtained from such a chemical monitoring program are compared to known critical concentrations (water quality standards) for the chemicals monitored. For most of the pesticides/herbicides used there are no water quality criteria against which the chemical concentration data obtained in monitoring can be compared, to determine if the application of the chemical and its associated chemicals violates a water quality standard (objective).

A potential approach that could be used to evaluate possible problems of aquatic life toxicity is to use the US EPA OPP pesticide registration database, which contains aquatic life toxicity data that were submitted by the registrant for several types of organisms (fish, zooplankton, algae, etc.). This database typically contains LC50 data for various periods of exposure. Since LC50 data results in the death of half of the organisms in the test system, there is need to interpret these data in light of concentrations that are not toxic to aquatic life. Typically, concentrations that are 10 to as much as 100 times less than the LC50 are indicative of chronic "safe" concentrations of chemicals. It is suggested that 0.05 times the LC50 for fish and zooplankton be used as a screening guideline for potential water quality problems.

As discussed in my comments on the preliminary draft, draft, and revised draft statewide general NPDES permit for application of aquatic pesticides/herbicides (Lee 2003; 2004a,b), concentrations of potentially toxic chemicals below the water quality standard (objective) or less than 0.05 times the LC50 for the most sensitive organisms tested in registering the pesticide can still, through additive or synergistic effects of the added pesticides with each other or with other chemicals in the water, cause adverse impacts to aquatic life. In order to begin to address these types of problems, it is necessary to conduct toxicity testing.

Chemical measurements should be made of the persistence of the pesticide/herbicide in the sediments in and near the zone of application. However, the evaluation of the water quality significance of such measurements must be done cautiously. Lee and Jones-Lee (2002b, 2003b) have discussed the unreliability of trying to interpret water quality impacts of sediment-associated constituents based on chemical concentrations of potential pollutants in the sediments. Of particular concern is the unreliability of trying to use co-occurrence-based so-called "sediment quality guidelines" to predict the toxicity of sediments. As discussed by Lee and Jones-Lee (2002b, 2003b), such an approach can, depending on the situation, overestimate or underestimate the water quality significance of a chemical constituent in sediments. A reliable approach for

assessing whether a chemical measured in sediments is adverse to aquatic-life-related beneficial uses of the waterbody is to determine first whether the sediments are toxic, and then, through toxicity investigation evaluations (TIEs), the cause of this toxicity.

Since TIE procedures may not be available for all types of pesticides/herbicides, a standard additions approach, as described below, can be used to determine whether a measured concentration of a chemical in sediments is responsible for toxicity. An example of the need to use the standard addition approach to assess whether a pesticide is responsible for sediment toxicity occurs with the pyrethroid-based pesticides. At this time there are no reliable TIE procedures for this group of pesticides because of the strong sorption tendencies of this group of pesticides for aquatic sediment particles.

Using the standard additions approach, a sediment which has been found to contain pyrethroid-based pesticides or other chemicals for which there are no TIE procedures and which has also been found to be toxic to standard test organisms such as *Hyalella*, is subjected to a series of toxicity tests using increasing small amounts of the chemical of concern to determine if the toxicity increases proportional to the addition. Several small, incremental increases in the chemical should be used. From the relationship found, it is possible to extrapolate to zero-addition conditions, and thereby gain inference on whether the toxicity in the untreated sediments is likely due to the chemical of concern. Consideration should be given to the need to use similar times of equilibration between the added chemical and the sediments to properly simulate the conditions that occurred with the pesticide application to a particular waterbody.

Toxicity Testing

A fundamental component of a program to evaluate aquatic pesticide/herbicide impacts to non-target organisms is aquatic life toxicity testing using water column and sediment organisms. The US EPA (2000, 2002a,b,c) has developed several standardized toxicity tests that can be used for this purpose. The finding of toxicity outside of the zone of application using the standardized tests is a strong indication that there are potential adverse impacts to non-target organisms. However, as discussed below, there is need to provide an evaluation of the water quality significance of aquatic life toxicity testing results to evaluate whether the laboratory-based toxicity testing results are applicable to the conditions that exist in the receiving waters for pesticide application.

Water Quality Significance of Aquatic Life Toxicity. One of the issues that should be addressed is the water quality/beneficial use significance of aquatic life toxicity found in the water column or sediments following a pesticide application. From a regulatory/legal point of view, the finding of toxicity is a violation of the Central Valley Regional Water Quality Control Board's Basin Plan requirements of no toxics in toxic amounts. Therefore, such toxicity must be controlled. It is possible, however, that toxicity can occur to a restricted type of organism, such as some forms of zooplankton, that would not be significantly adverse to the beneficial uses of the waterbody as a result of the fact that the zooplankton that is particularly susceptible to a pesticide's toxicity may not be the only source of food for larval fish or other aquatic life.

Another issue of concern is the duration of toxicity testing compared to the concentration duration of exposure relationship that exists in the waterbody at or near the zone of application of the pesticide. The toxicity found within the zone of application could be sufficiently rapidly dissipated so that laboratory toxicity tests involving several days of exposure are not relevant to the field conditions. In order to demonstrate that the toxicity found (or projected, through chemical concentration data) is not significantly adverse to the beneficial uses of the waterbody, those who wish to use the chemical will need to conduct comprehensive studies in cooperation with the regulatory agencies.

The US EPA (1994), in its Water Quality Standards Handbook, provides guidance on how to adjust chemically based criteria for site-specific conditions. It is possible that regulatory agencies at the state and federal level would accept the site-specific adjustment of toxicity criteria for particular situations, although to my knowledge, this has never been done. It is certainly appropriate, however, since there will be situations where laboratory toxicity tests will yield toxic responses that are not reliable assessments of aquatic life toxicity under field conditions.

Bioassessment

Since aquatic life toxicity testing in the water column and in sediments is not sufficiently sensitive to detect chronic toxicity, which kills, impairs reproduction and/or impairs the ability of aquatic life to forage for food, avoid predation, find home stream waters, etc., it is necessary to conduct detailed bioassessments of organism assemblages just before, during, immediately after, and for a period of time after application of the aquatic pesticide/herbicide. As discussed in my comments on the permit, there is no need to find a suitable reference site against which to compare the data. The site itself, through before and after testing in the zone of application and in nearby areas that are not impacted by the pesticide application, provides a suitable reference against which to determine whether the water column organisms, as well as those in the sediments, have been impacted by the pesticide application.

The California Department of Fish and Game (Harrington and Born, 1999; DFG, 2003) and the US EPA (Barbour, et al., 1999) have reported on bioassessment methodology that can be used to assess whether chemical additions to waterbodies are adversely affecting the biological characteristics of the waterbody. Lee and Jones (1982) discussed how the Department of Interior Instream Flow Methodology, which includes bioassessment measurements relative to habitat characteristics, could be used to evaluate point-source discharge impacts on aquatic communities. This same approach can be used to evaluate the impact of chemical additions, such as aquatic pesticides/herbicides.

Secondary Impacts

In addition to the direct impacts of aquatic pesticide applications causing toxicity to non-target organisms, there is also the potential for secondary impacts associated with aquatic weed control. Of concern is the potential for the death and decay of aquatic weeds in waterbodies of limited water circulation (mixing) leading to regions where the dissolved oxygen will be depleted below the water quality objective. The depletion of DO, either alone or in combination with toxicants (such as the pesticide, other chemicals

or ammonia released from the decay of aquatic plants) could be adverse to non-target organisms. These types of situations need to be evaluated as part of a reliable evaluation of aquatic pesticide application impacts.

Bioaccumulation

An issue that needs to be considered for chemicals that persist for a significant period of time (more than a few days to a few weeks) is the potential for bioaccumulation of the chemical or its transformation products in aquatic life, which can be adverse to the host organism or higher-trophic-level organisms through food web uptake. Excessive bioaccumulation of formerly used pesticides is one of the most significant problems facing water quality management today. As discussed by Lee and Jones-Lee (2002b), fish taken throughout the Central Valley of California have excessive concentrations of the legacy organochlorine pesticides. Many fish have sufficient concentrations of these chemicals in their edible tissue so that consumption of the fish can be hazardous to the health of those who eat the fish.

Extrapolation of Monitoring Results

There has been discussion associated with the implementation of the NPDES aquatic pesticide permit about the possibility that the results of monitoring at one site could predict what would happen at other sites. While it is possible that such extrapolation can predict some adverse impacts, it does not necessarily predict all adverse impacts, because of the fact that each site of application will have a different mix of chemicals that can interact with the pesticide and its associated chemicals, which can cause aquatic life toxicity or other adverse impacts. Therefore, there is need for comprehensive monitoring of each of the areas where pesticide/herbicide application takes place in order to properly evaluate potential impacts on non-target organisms.

Adjustment of the Monitoring Program

Ultimately, through comprehensive studies of the type described herein, it will be possible to gain sufficient experience over several years in a variety of situations, so that the amount of monitoring that is necessary for particular chemicals in particular waterbodies can be significantly reduced. However, this point will only come after a substantial database has been obtained which demonstrates the lack of adverse impacts for a particular pesticide formulated in a particular way, applied in a particular manner to a particular waterbody. Ongoing testing is necessary, however, because of the potential for other chemicals to be added to the waterbody which were not there during the original testing and which, in themselves, are not toxic, but in combination with the pesticide, yield toxic conditions.

Need for Comprehensive Monitoring Program

While many of those who have been responsible for application of aquatic pesticides/herbicides claim that there is no need for a comprehensive monitoring program of water quality impacts associated with aquatic pesticide/herbicide application based on the supposition that since problems have not been found in the past, such a position is not technically valid. The basic problem with such claims is that, with few exceptions, the monitoring programs that have been conducted in the past, including those that have been

conducted by the San Francisco Estuary Institute (SFEI, 2004) as part of the SWRCB evaluation of the potential impacts of aquatic pesticide/herbicide applications, have not adequately and reliably evaluated the full range of potential water quality beneficial use impacts associated with aquatic pesticide/herbicide application. Monitoring programs that fail to include a detailed analysis of pesticide and associated chemical fate/persistence, aquatic life toxicity testing for water column and sediment organisms, and bioassessment of aquatic organism assemblages within and near the zone of pesticide application, are deficient in properly evaluating the range of impacts that can occur.

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