F1-231

I. EXECUTIVE SUMMARY

Ia. Project Title and Applicant Names - An Evaluation of the Effects of Organophosphate Pesticides in Surface Water Runoff on the Fishery Food Chain Resources of the Sacramento-San Joaquin River Basins and the San Francisco Estuary. Dr. Scott Ogle, Pacific Eco-Risk Laboratories, Martinez, CA; Dr. Victor deVlaming, State Water Resources Control Board Sacramento, CA.

Ib. Project Description and Primary Ecological Objectives - This is a proposal to identify resident invertebrates which are key food items for priority resident fish populations in the Delta watershed, and to determine the toxicity of two pesticides, diazinon and chlorpyrifos, to these invertebrates. The immediate ecological objectives of this study are two-fold: (1) confirmation of existing laboratory test data suggesting that diazinon and/or chlorpyrifos are adversely affecting important fish food resources in the watershed, and (2) direction of remediation and management efforts to those areas within the watershed that are at greatest risk from this problem. The overall and longer-term objective of this study is the restoration of fishery food resources for priority resident fish species in areas currently being adversely impacted by these pesticides, a step that may well be necessary before currently-declining fish populations can turn the corner and begin to increase in abundance and health.

Ic. Approach, Tasks, Schedule - The basic approach to this study will be to review the available information to determine what resident invertebrate species are of critical importance as food resources to the priority fish populations in the Delta. Once identified, laboratory toxicity tests will be performed to determine the acute and chronic toxicity of diazinon and chlorpyrifos to these invertebrates. The resulting toxicity information will then be compared to the diazinon and chlorpyrifos concentrations reported for the specific types of habitat being evaluated to determine the likelihood of *in situ* toxicity. Assuming that funding is available by October, 1997, this project will be initiated in October of 1997, and will last 12 months.

Id. Justification for Project and Funding by CALFED - The most frequently discussed option for management of this pesticide problem is to implement regulatory changes throughout the watershed, a process that will likely face an uphill political battle, and as a result, be expensive and take many years to implement. The proposed study will provide information allowing for a more focused approach, and therefore, a more feasible and cost effective solution to this problem. Furthermore, this study will address the impact of these pesticides on the food resources available to larval and juvenile life stages of several resident fish species, including delta smelt, chinook salmon, longfin smelt, splittail, steelhead trout, and green sturgeon, all of which have been identified as "Priority Species" by the CALFED Bay-Delta program. In the long term, the results of this study will assist restoration of fishery food resources for these priority fish species in areas currently being adversely impacted by OP pesticides. Despite the clear need for this project, there currently is no funding in place at any of the relevant state agencies for who these results will be important. This proposal was developed through the Interagency Ecological Program's (IEP) Contaminant Effects Project Work Team (PWT). The IEP currently does not have the funding available that is needed for this project, and the IEP Contaminants Effect PWT have endorsed this proposal for CALFED Category III funding (a Letter of Support form the IEP Contaminant Effects PWT is attached).

Ie. Budget Costs and Third Party Impacts - The total cost for this study will be $110,860.00. No third party impacts are anticipated.

If. Applicant Qualifications - Both Dr. Ogle and Dr. deVlaming are eminently qualified to successfully perform the proposed work. Both have directed ambient water monitoring projects within this watershed, and have worked on projects evaluating the toxicity of pesticides to aquatic organisms in this watershed. Both have also directed studies which involved development of toxicity test procedures for non-standard test species (i.e. resident species).

Ig. Monitoring and Data Evaluation - Test data will be analyzed following EPA guidelines and using appropriate statistical software. The resulting toxicity information will then be compared to the diazinon and chlorpyrifos concentrations reported for the specific types of habitat to determine the likelihood of *in situ* toxicity. Of particular importance will be the identification of those areas within the watershed that are at the greatest risk due either to the sensitivity of the resident invertebrates, or to the magnitude and duration of OP pesticide exposure. This information will be critical for the direction of ameliorative management actions specifically towards those areas most at risk.

Ih. Local Coordination with Other Programs/Compatibility with CALFED Objectives - The proposed study is independent of any ongoing studies, although it is the necessary next step to the ambient water toxicity monitoring studies that are showing these pesticides to cause toxicity to laboratory test organisms. By providing results and information that will be immediately useful in helping to solve this problem, and in the longer term, helping to restore priority resident fish populations in priority habitats within the watershed, the objectives of this study are the same as for CALFED: ecosystem restoration and improvement of the health of the Bay-Delta system.

II. TITLE: An Evaluation of the Effects of Organophosphate Pesticides in Surface Water Runoff on the Fishery Food Chain Resources of the Sacramento-San Joaquin River Basins and the San Francisco Estuary

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RFP Project Group: Services

Date: July 28, 1997

III. PROJECT DESCRIPTION

IIIa. Project Description and Approach

Agriculture is arguably the major industry in California (worth over 21 billion dollars per year), particularly in the Central Valley. For many agricultural crops, efficient production requires the use of pesticides to control unwanted plant and insect pests. One of the most important classes of pesticides used in the Sacramento and San Joaquin Valleys are the "organophosphate" (OP) insecticides, such as diazinon and chlorpyrifos. These wide-spectrum insecticides are extremely effective in controlling invertebrate pests. However, the use of these pesticides is not without drawbacks.

Over the past 8 years, there has been a growing body of evidence indicating that these pesticides can be transported from agricultural lands into surface waters via stormwater and irrigation tailwater runoff, and that their concentrations may be high enough to cause toxicity to non-target aquatic invertebrates. Investigations of ambient water toxicity using US EPA standardized tests have indicated an alarmingly high frequency and duration of toxicity in some of these waters, and analytical chemistry and Toxicity Identification Evaluations (TIEs) have revealed that pesticides are the cause.

As the number of studies documenting ambient water toxicity to invertebrates has increased, so has the concern regarding possible adverse effects of these pesticides on important aquatic resources. This concern is not limited to maintaining healthy invertebrate communities in these waters, although their viability is important in its own right, but also to possible adverse effects such toxicity might have on fish populations which make use of these invertebrates as their main food source. While no direct link has yet been established, adverse effects of pesticides on food resources such as the invertebrates in the Sacramento-San Joaquin watersheds may play a role in the dramatic declines in fishery populations that have been observed over the past several decades.

With this in mind, we are proposing a set of sequential studies to identify important invertebrate resources in these waters and to determine the effects of insecticides on these organisms. These studies will address four out of the six research needs explicitly recommended in the recent OP pesticide risk assessment (Adams et al. 1996). Specifically, we propose to perform the following tasks:

- **Task 1.** Identify key aquatic invertebrates via review of available information; select 12-18 important species for which little or no toxicity information is available and which are important in the diet of larval and juvenile CALFED priority fish species (e.g., salmon, delta smelt, longfin smelt, splittail, green sturgeon); determine the acute and chronic toxicity of diazinon and chlorpyrifos to these invertebrates in laboratory tests; and identify areas within the watershed that are most susceptible to pesticide toxicity.

- **Task 2.** Determine the effect of these pesticides under *in situ* exposure conditions on the more sensitive invertebrates in both lab and field experiments;

- **Task 3.** Conduct biological community assessment of selected field sites 'before and after' pulses of pesticides pass through, and evaluate the effects of "*in situ*" exposures on the invertebrate resources and the ability of these resources to recover from adverse effects.

Because the specific nature of Tasks 2-3 will be dependent upon the findings of Task 1, we are submitting a complete proposal for Task 1 only, along with a brief description of the two subsequent tasks (Appendix A). This sequential, or 'phased', approach allows the review and evaluation of study results at logical endpoints before initiating subsequent study components.

IIIb. Geographic Boundaries of Project

This study will investigate pesticide toxicity to species resident to aquatic habitats throughout the Delta watershed where elevated levels of pesticides have been documented to occur. This includes at least four priority habitats identified by CALFED: tidal perennial freshwater wetlands, seasonal freshwater wetlands, instream aquatic habitat, and shaded riverine aquatic habitat.

IIIc. Expected Benefits

The most frequently discussed option for management of the pesticide problem is to implement regulatory changes throughout the watershed, a process that will likely face an uphill political battle, and as a result, be expensive and take many years to implement. The proposed study will provide information allowing for a more focused approach, and therefore, a more feasible and cost effective solution to this problem. Specifically, we will identify those resident species, and locations, within the watershed which are most at risk to adverse impacts from current OP pesticide usage. This information can then be used to focus remediation action directly on (and limited to) high impact areas.

This study will also address the impact of these pesticides on the food resources available to larval and juvenile life stages of several resident fish species, including delta smelt, chinook salmon, longfin smelt, splittail, steelhead trout, and green sturgeon, all of which have been identified as "Priority Species" by the CALFED Bay-Delta program. In the long term, the expected benefit of this study will be the restoration of fishery food resources for these priority fish species in areas currently being adversely impacted by OP pesticides, a step that may well be necessary before currently-declining fish populations can turn the corner and begin to increase in abundance and health.

IIId. Background and Biological/Technical Justification

Ambient Water Monitoring Reveals Pesticide Toxicity to Invertebrates - In 1988, the Central Valley Regional Water Quality Control Board began conducting monitoring studies of ambient water toxicity in the San Joaquin River basin. This monitoring involved laboratory toxicity testing of ambient water samples using the standard US EPA freshwater bioassays. They found that much of the San Joaquin River was toxic "about half the time" to *Ceriodaphnia dubia*, the invertebrate component of the EPA bioassays. It was hypothesized that pesticides in agricultural runoff were causing the observed toxicity; concurrent monitoring of agriculturally-dominated tributaries of the river revealed similar toxicity problems (Foe and Connor 1991). Follow-up monitoring in 1991-92 observed that 22% of the water samples collected from the San Joaquin Basin were be toxic to *Ceriodaphnia* (Foe 1995). Most of the observed toxicity could be attributed to the concentrations of four pesticides: diazinon, chlorpyrifos,

fonofos, and carbaryl, although other pesticides were also detected in the water samples. When the pesticide concentrations were normalized to their toxicity to *Ceriodaphnia* (in a Toxic Units approach), it was found that diazinon, chlorpyrifos, and parathion accounted for over 90% of all toxicity.

More recently, ambient water toxicity monitoring has been performed in the Sacramento River Basin and in the Sacramento-San Joaquin Delta. These studies also revealed frequent and significant toxicity to *Ceriodaphnia*, and concurrent Toxicity Identification Evaluations (TIEs) demonstrated that diazinon, chlorpyrifos, and carbofuran were the main causes of this toxicity (Deanovic et al. 1996)

Finally, it should be mentioned that surface water runoff contaminated with OP pesticides is not limited to agricultural land. These pesticides are also sold 'over the counter' and are commonly applied as part of routine home maintenance and gardening practices. Numerous stormwater runoff studies in urban areas have observed surface water toxicity to *Ceriodaphnia* which chemical analyses and TIEs have attributed to diazinon and/or chlorpyrifos.

TIEs Confirm Pesticides as the Cause of Observed Toxicity - TIEs have proven a valuable tool in helping to identify the cause(s) of toxicity in these ambient waters. TIE fractionation treatments have indicated that OP pesticides are responsible for most of the ambient water toxicity to *Ceriodaphnia* (Deanovic et al. 1996). Other definitive evidence is becoming available: TIE fractionation using antibodies which are chemical-specific to chlorpyrifos or diazinon have also identified these compounds as the causes of toxicity of stormwater runoff samples (Miller et al. 1996). These studies clearly demonstrate that ambient water toxicity to *Ceriodaphnia* is, in fact, due to these OP pesticides.

Is Pesticide Toxicity Occurring in the Delta Watershed? - While the information described above would seem to provide overwhelming evidence that pesticides in surface water runoff may cause toxicity to invertebrates in waters within the Sacramento-San Joaquin River basins and the San Francisco Estuary, no link has yet been conclusively established. Long-term studies of zooplankton distribution and abundance in the Sacramento-San Joaquin Delta have reported a significant decline in the number of zooplankton species in the freshwater parts of the estuary (Obrebski et al. 1992), with recent zooplankton density being 1-2 orders of magnitude lower than in the early 1970s. Use of OP pesticides like diazinon and chlorpyrifos has increased substantially since their introduction in the 1950s and 1960s, suggesting a possible link between pesticide toxicity and zooplankton declines. Similar adverse declines in benthic invertebrates may also have taken place over the past several decades: recent monitoring of benthic invertebrate resources in the Sacramento-San Joaquin basins by the US EPA EMAP have observed lower invertebrate abundance and diversity than expected from similar studies conducted elsewhere in the United States (Husby, personal communication).

One problem in developing a consensus regarding adverse effects of pesticides in natural waters is the extension of toxicity to *Ceriodaphnia* in the lab to toxicity of resident invertebrates in the field. A recent risk assessment of diazinon in the Sacramento and San Joaquin basins (Adams 1996) concluded that while cladocera (such as *Ceriodaphnia*) are sensitive invertebrates to OP pesticides, other important invertebrate groups, including copepods, mysids, amphipods, insects, and rotifers, are less sensitive and are likely not being affected by the existing OP pesticide concentrations. This might be a valid conclusion, if in fact the toxicity of OP pesticides to resident invertebrate species were known. Unfortunately, this is not the case. An examination of toxicity information availability for the important

aquatic arthropod species in the estuary (as indicated in Status and Trends Report on Aquatic Resources in the San Francisco Estuary; Herbold et al. 1992) indicates that very few resident invertebrate species have any OP pesticide toxicity information available. This suggests that toxicity from these pesticides may be occurring, but the information needed to assess this does not exist.

Why should we care about potential adverse effects on invertebrate resources? - It should be noted at the outset that maintaining healthy, viable invertebrate communities in our natural waters is and should be an objective in and of itself. However, it can be argued that an even more important role for these invertebrate resources is as food for priority fish populations. Numerous studies have documented that virtually all of the priority fishery populations in the Sacramento-San Joaquin River basins and the San Francisco Estuary rely upon these invertebrates, particularly during their vulnerable early life stages (Heubach et al. 1963; Eldridge et al. 1982; Schaffter et al. 1982; Brown 1992; Moyle et al. 1992; Meng and Moyle 1996). If pulses of pesticides through these aquatic ecosystems diminish the available invertebrate resources at critical periods, such as when fish fry are obligately using the invertebrates for food, then adverse effects on the fish populations can be expected. This potential problem is of paramount importance as the period of high pesticide concentrations in these waters (January-June) coincides with the presence of early life stages of most of the fishery populations currently in decline. This includes delta smelt, chinook salmon, longfin smelt, splittail, steelhead trout, and green sturgeon, all of which have been identified as "Priority Species" by the CALFED Bay-Delta program.

Clearly, the potential for pesticides in the Sacramento-San Joaquin watersheds to adversely impact important invertebrate resources, and indirectly important fish populations, needs to be addressed. With this in mind, we are proposing studies to identify important invertebrate resources in these waters and to determine the effects of pesticides on these resources in both the lab and in the field.

IIIe. PROPOSED STUDY

The proposed investigation will consist of a hierarchical set of studies, moving from the relatively simple and inexpensive (this proposal) to the more complex and expensive (Tasks 2 and Task 3) in a logical and cost-effective fashion. The incorporation of 'built-in stops' with this approach will allow the investigators as well as the funding agencies the opportunity to determine whether the results obtained at critical decision-making stages justify continued effort and expense for subsequent studies. As stated earlier, the specific nature of the Task 2 and Task 3 studies will depend greatly on the results of the initial study, and as a result, we are submitting a complete proposal for only Task 1 at this time, along with a brief description of subsequent tasks (Appendix A).

Task 1. Identify Important Invertebrate Resources in the Sacramento-San Joaquin River Basins and the San Francisco Estuary and Develop Acute and Chronic Toxicity Information for Diazinon and Chlorpyrifos

The recent risk assessment of diazinon in this watershed illustrated a major shortcoming with the existing information regarding the effects of OP pesticides on important invertebrate resources: there is little or no toxicity information for most of the resident invertebrate species present in these waters. We will address this information gap by identifying key invertebrate species which are primary food

organisms of one or more CALFED priority fish species, and generating diazinon and chlorpyrifos toxicity information for them.

Identification of important invertebrate species - We propose to identify and evaluate invertebrate species for use in the proposed tests by reviewing the available information from scientific literature and technical reports, as well as more current information being developed in ongoing studies, with respect to several key characteristics, such as presence in the Sacramento-San Joaquin River watershed/San Francisco estuary system, use as important food item by priority fish species of concern, feasibility of organism maintenance in laboratory, and likely sensitivity to these pesticides.

Based upon this information review, we will select 15-18 species for subsequent testing. Species will be selected so as to provide representation of the variety of habitats and communities comprising the surface waters potentially impacted by pesticides (i.e. species from both upstream (freshwater) and downstream (estuarine) habitats, and from both planktonic and benthic communities). Particular emphasis will be placed upon invertebrates which are important fish food resources.

Collection of test organisms and maintenance of lab cultures - Once the test species are identified, organisms of each will be obtained and maintained in the laboratory for subsequent testing. It is likely that some of the selected species are cosmopolitan in distribution, and may be readily available from either commercial suppliers and/or from cultures already established in other labs. Other test species are expected to be more limited in distribution and/or use. As locating and identifying these species is likely to require special expertise, much of the species collection and identification will be sub-contracted to field biologists expert in the local freshwater and estuarine zooplankton and benthos.

Once test organisms are collected and in the laboratory, they will be maintained in aquaria containing water modified so as to reflect the conditions (i.e. hardness, salinity, etc.) present in the habitat from which they were collected or from which they would be expected to occur. Feeding will be provided *ad libitum*, with water flow or water changes at a frequency so as to maintain healthy water quality.

Performance of acute and chronic toxicity tests - For each species, three toxicity tests will be performed. The first will consist of a "range-finding" toxicity test in which the organisms are exposed to a wide range of concentrations, typically covering 1-2 orders of magnitude. Based upon the results of the range-finding tests, an acute toxicity test will be performed using a finer range of test concentrations intended to provide greater resolution around the desired endpoint(s). Finally, a chronic toxicity test will be conducted to assess the effects of extended exposures on survival, and if possible, on one or more sub-lethal endpoints as well.

Those species for which existing toxicity test guidelines are available will be tested following said guidelines. Toxicity tests for the remaining species will be performed by adapting existing ASTM (1988; 1991) and US EPA test guidelines. All tests will consist of static-renewal exposures with daily renewal of test media. Tests will be performed in glass (e.g. Pyrex) containers. At present, the specific life stage to be used in testing for each species is unknown, and of course, will depend on the species. Where likely pesticide exposure and/or fish predation is limited to specific life stages of particular species, toxicity testing will be conducted on that life-stage. Otherwise, life stages will be selected so as to provide the greatest likelihood of successful testing.

Acute toxicity test duration will follow ASTM guidelines: 24-96 hrs, depending upon type of organism. The duration of chronic testing will be determined as follows: for any species lending itself to adaptation of existing 7-day test approaches for *Ceriodaphnia* and/or *Daphnia*, a modified seven-day test will be used; otherwise, the chronic toxicity test duration will extend to 10 days, with an attempt being made to incorporate sub-lethal endpoints (e.g. growth) in addition to the survival endpoint.

Analytical chemistry - Validation of the nominal diazinon or chlorpyrifos concentrations in the toxicity test solutions at each treatment will be provided using both ELISA and GC/MS analyses. For each toxicity test performed, water samples will be collected and test concentrations analyzed for the pesticide of concern using ELISA. Validation of the ELISA analyses will be made by collecting QA/QC duplicate samples analyzing for the pesticide of concern using GC/MS. Sample analyses by GC/MS will be performed by an outside contract lab.

IIIf. Monitoring and Data Evaluation

Test data will be analyzed following EPA guidelines and using appropriate statistical software (e.g. ToxCalc). The resulting toxicity information will then be compared to the diazinon and chlorpyrifos concentrations reported for the specific types of habitat to determine the likelihood of *in situ* toxicity.

Of particular importance will be the identification of those areas within the watershed that are at the greatest risk due either to the sensitivity of the resident invertebrates, or to the magnitude and duration of OP pesticide exposure. This information will be critical for the direction of ameliorative management actions specifically towards those areas most at risk.

The results of this study will also be evaluated as justification to proceed with the subsequent Tasks 2 and 3 (described in Appendix A). If resident species are found to be sensitive to OP pesticides at concentrations that are occurring in these surface waters, then Task 2 and 3 follow-up studies will be important in determining whether or not adverse impacts are occurring *in situ*.

Reporting of Results - Upon completion of all testing and all chemical analyses, a Final Report will be prepared. This report will describe and summarize the identification of the important invertebrate species, the collection and maintenance of test organisms, the performance of the toxicity tests and statistical analyses, and the analytical chemistry. More importantly, this report will also include an evaluation as to whether the invertebrate responses to these pesticides indicate the likelihood of toxicity in natural waters contaminated by pesticides in runoff. It is expected that this information will also be submitted for publication in an appropriate peer-reviewed scientific journal.

IIIg. Implementability

Collection of test organisms from the field will require obtaining a Collection Permit from the Dept. Fish & Game. These permits are issued on a routine basis in response to written requests, and obtaining such a permit will proceed without trouble.

Appendix A

Description of Task 2 and Task 3

Upon completion of Task 1, described above, a detailed proposal and study plan will be prepared for Task 2 and/or Task 3. This phased, or sequential, approach is being used because the species and corresponding field sites that would be selected in Tasks 2-3 will depend upon the observation of pesticide sensitivities exhibited by the invertebrates in Task 1. For instance, if several estuarine invertebrates are found to be particularly sensitive to one or both of the pesticides while invertebrates characteristic of upstream freshwater sites are not, then subsequent simulation of field conditions in Task 2 and/or selection of field site(s) in Task 3 should reflect that. Alternatively, if the toxicity test results reveal that the resident invertebrate species are not experiencing toxicity at the pesticide concentrations found in the waters of the Sacramento-San Joaquin River basins or the San Francisco estuary, the study can be terminated before any additional expenditure of funds. We believe that this approach is logical and almost certainly more cost-effective that arbitrary selection of such site(s) without any knowledge of the OP pesticide sensitivity of the invertebrates at that site.

Task 2. Determine the effect of 'pulsed' flow exposures of these pesticides to the more sensitive invertebrates in both lab and field experiments - Briefly, Task 2 will consist of experiments testing those invertebrates found to be sensitive to OP pesticides (from Task 1) under exposure regimes reflective of those occurring in the field. Of primary importance will be the effects of "pulsed flow" exposure of pesticides to the invertebrates, which will be evaluated in both lab and field studies. As indicated earlier, an additional component of the Task 2 studies will be to generate "definitive" LC50 information for species exhibiting unusual sensitivity to diazinon and/or chlorpyrifos in Task 1.

The study of pesticide transport in the San Francisco Estuary by Kuivila and Foe (1995) indicated that the exposure regime varies considerably at upstream vs. downstream sites. At upstream sites, the peak pesticide concentration is higher, but the exposure duration is short; at downstream sites, tidally-influenced dilution has resulted in the peak concentration being greatly reduced, but the exposure duration is much longer. In both cases, the exposure regime is very different from the constant concentration exposure used in standard toxicity tests (as described above for the Task 1 testing). In Task 1, we will have identified the type of system (upstream vs. downstream) in which the invertebrates could be expected to be impacted by OP pesticide contamination. The laboratory pulsed flow exposures will be designed to reflect the hydrologic and chemical conditions expected at the site(s) corresponding to the more sensitive invertebrates.

If significant toxicity to any of these invertebrates is observed in the lab 'pulsed' flow exposures, follow-up tests will be performed in the field at a site similar to that modeled in the lab experiment. Utilizing a simplified mobile lab adjacent to the selected water body, water will be diverted from the water body into the mobile lab where it will be used in flow-through experiments in which the test organisms will be exposed to the actual water passing through the system. The use of actual site waters will also allow for assessment of mixtures of pesticides, as well as factors which affect the bioavailability of these pesticides.

Task 3. Conduct biological community assessment of selected field sites 'before and after' pesticide exposures - In Task 1 above, we will have identified whether or not any important resident invertebrate species are sensitive to OP pesticides at concentrations expected to occur in the Sacramento-San Joaquin River basins and San Francisco Estuary. If likely toxicity is indicated, we will proceed to Task 2 in which the pesticide exposure regimes will be altered to reflect actual field conditions, issues of mixture effects and bioavailability will be addressed, and test organisms will be exposed to actual field conditions in on-site flow-through toxicity tests. If the results of Task 2 continue to indicate OP pesticide toxicity to these invertebrates, we will proceed to Task 3 in which we will evaluate the effects of OP pesticide pulses on actual *in situ* invertebrate communities.

One or more field sites will be selected based upon the expectation of likely invertebrate toxicity as indicated by the Task 1 and Task 2 studies. A baseline biological assessment, or bioassessment, will be performed in which the planktonic and benthic invertebrate communities are characterized and quantified. This baseline assessment will be scheduled so as to occur immediately prior to anticipated OP pesticide inputs (i.e. immediately prior to anticipated storm events during the dormant spray season). Subsequent bioassessments will then be repeated at these sites to monitor for any adverse impacts due to the pesticide exposure(s). If adverse impacts on the invertebrate communities are observed, bioassessment will be performed on a periodic basis to determine how long recovery from pesticide toxicity takes. In addition to the 'before and after' comparisons, an additional control site which is as similar as possible to the selected site(s) but without significant pesticide input will be identified and monitored to differentiate between pesticide impacts and hydrologic impacts (i.e. increased flow from storm events).

I-005058

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IV. COST AND SCHEDULE OF IMPLEMENTATION

IVa. Budget Costs

The budgeted costs for this study are provided in the Cost Breakdown Table on the following page. The total cost for this study will be $110,860.00. Despite the need for this project, there currently is no funding in place at any of the relevant state agencies for who these results will be important. This proposal was developed through the Interagency Ecological Program's (IEP) Contaminant Effects Project Work Team (PWT). The IEP currently does not have the funding available that is needed for this project, and the IEP Contaminants Effect PWT have endorsed this proposal for CALFED Category III funding (a Letter of Support form the IEP Contaminant Effects PWT is attached).

The proposed study may serve as the first component of a larger investigation, with resolution and justification of subsequent study elements being dependent upon the findings of the currently proposed work. It should be noted that the primary expected benefits from this work are independent of whether or not subsequent study elements are undertaken; the information from the proposed work, in and of itself, will provide the expected benefits described in Section IIIc of this proposal. Funding for subsequent study elements is not being requested at this time.

Subcontract Bid and Evaluation Process - There are two components of this study that will require subcontracting. The first will be the collection of test organisms from resident field populations. This work will be sub-contracted to field biologists familiar with the relevant aspects of the invertebrate test species' natural history. We anticipate that University graduate students and/or post-doctoral/research staff will provide the majority of these services, although, recognized experts from state and federal agencies (i.e. CA Dept. Fish and Game) may also be employed.

The second component of this study requiring subcontracting of services will be the validation of OP pesticide analyses. The state agency staff that have been conducting ambient water toxicity monitoring studies in this estuary for the past several years have considerable experience in working with contract labs for these analyses, and we will follow their guidance in selecting the lab for this work.

IVb. Schedule Milestones

It is anticipated that this study will take 12 months to complete. The following Schedule Milestones are identified, by task, for this study (schedule assumes funding will be available by October 1997):

1. Identification of important invertebrate species	October - December 1997
2. Collection of test organisms and maintenance of lab cultures	January - June 1998
3. Performance of acute and chronic toxicity tests	February - August 1998
4. Reporting of Results	September 1998

IVc. Third Party Impacts

No Third Party Impacts are anticipated for this study.

CALFED Category III - Cost Breakdown for OP Pesticide Study					
Task	Direct Labor Hours	Direct Salary & Benefits	Labor Overhead	Miscellaneous & Other Direct Costs	Total Cost
Identification of Test Species	Technician - 20 hrs	$ 14.85	$ 12.15		$ 540.00
	Scientist - 40 hrs	$ 22.00	$ 18.00		$ 1,600.00
	Study Director - 60 hrs	$ 44.00	$ 36.00		$ 6,400.00
				Photocopy Charges	$ 200.00
Collection and Maintenence of Test organisms	Technician - 40 hrs	$ 14.85	$ 12.15		$ 1,080.00
	Scientist - 40 hrs	$ 22.00	$ 18.00		$ 1,600.00
	Sr Scientist - 40 hrs	$ 33.00	$ 27.00		$ 2,400.00
	Study Director -12 hrs	$ 44.00	$ 36.00		$ 960.00
				Contract Services - (Field Biologist/Collection Experts)	$ 10,000.00
Performance of Toxicity Tests	Technician - 240 hrs	$ 14.85	$ 12.15		$ 6,480.00
	Scientist - 600 hrs	$ 22.00	$ 18.00		$ 24,000.00
	Sr. Scientist - 480 hrs	$ 33.00	$ 27.00		$ 28,800.00
	Study Director - 100 hrs	$ 44.00	$ 36.00		$ 8,000.00
				Miscellaneous Lab Supplies (glassware, chemicals)	$ 2,400.00
				ELISA Kits (for diazinon, chlorpyrifos)	$ 6,500.00
				Contract Services - (GC-MS pesticide analyses)	$ 5,500.00
Preparation of Reports	Sr. Scientist - 20 hrs	$ 33.00	$ 27.00		$1,200.00
	Study Director - 40 hrs	$ 44.00	$ 36.00		$ 3,200.00
TOTAL COSTS					**$ 110,860.00**

STATE OF CALIFORNIA — ENVIRONMENTAL PROTECTION AGENCY PETE WILSON, Governor

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD—
CENTRAL VALLEY REGION
3443 ROUTIER ROAD, SUITE A
SACRAMENTO, CA 95827-3098
PHONE: (916) 255-3000
FAX: (916) 255-3015

CALFED Bay-Delta Program
1416 Ninth Street, Suite 1155
Sacramento, California, 95814

24 July 1997

Letter of support for CALFED Category III proposal entitled "*An Evaluation of the Effects of Organophosphate Pesticides in Surface Water Runoff on the Fishery Food Chain Resources of the Sacramento-San Joaquin River Basins and the San Francisco Estuary*"

The Interagency Ecological Program's (IEP) Contaminant Effects Project Work Team (PWT) strongly recommends that the CALFED Category III program fund the proposal entitled "An Evaluation of the Effects of Organophosphate Pesticides in Surface Water Runoff on the Fishery Food Chain Resources of the Sacramento-San Joaquin River Basins and the San Francisco Estuary" by Scott Ogle *et al.*

The Contaminant Effects PWT was formed a year and a half ago at the request of the IEP Directors with the mission to "acquire and disseminante information on the effects of contaminants on aquatic resources in the Central Valley and Estuary and to provide recommendations to decision makers aimed at minimizing contaminant related effects on populations of aquatic organisms". The group is composed of about 30 aquatic toxicologists, chemists, population biologists and hydrologists from academia, state and federal agencies, and the private sector.

The PWT began by evaluating cases where pollutants were possibly exerting population level impacts. The PWT concluded that there was insufficient evidence to ascertain whether impacts were occurring although a disturbingly large number of bioassays with surface water regularly tested toxic and concentrations of some chemicals appeared higher than known adverse effect concentrations for aquatic species in both river water and tissue samples. Therefore, the PWT decided to develop proposals in key areas where the problems appeared scientifically tractable and the results of large ecologically significance. Proposals were written by small teams and were reviewed by the entire group. In addition, they were submitted to the IEP's Science Advisory Group for comments and revised appropriately.

The result of this process was the identification of the insecticide proposal which we believe merits funding by CALFED CAT III. The proposal is particularly important as it lays out a strategy for addressing in a comprehensive fashion the ecological significance of a known toxicity problem. The present study only seeks funding for the first phase of work. In addition, the proposal is important as the results can be used immediately to focus the development and implementation of urban and agricultural best management practices to reduce pesticide runoff (another action under the CAT III RFP) toward those areas of the watershed where ecological impacts are most acute. Such knowledge is essential for fulfilling CALFED's mandate to fully restore the ecological function of the Estuary. Therefore, the PWT strongly urges CAT III to fund the work.

If you have any questions please feel free to call me at (916)-255-3113.

Christopher Foe

Christopher Foe, Chair
Contaminants Effect PWT

V. APPLICANT QUALIFICATIONS

Dr. Scott Ogle, Pacific Eco-Risk Labs - Dr. Ogle will serve as Principal Investigator on this project, and as the primary Project Manager for this study, will be responsible for the preliminary information review for species selection, day-to-day management of all toxicity testing activities (which will take place at Pacific Eco-Risk Labs in Martinez, CA), and preparation of the Final Report.

In addition to his general skills and experience in the field of aquatic ecotoxicology, Dr. Ogle has directed several investigations of ambient water toxicity in the San Francisco estuary, and is currently co-directing the aquatic toxicity testing component of the San Francisco Estuary Regional Monitoring Program. In addition, Dr. Ogle recently served as Principal Investigator on a project to generate aquatic toxicity information or the development of water quality objectives for the rice herbicide Molinate; this project included several of the same types of tasks (i.e. species selection, collection and maintenance of test organisms from the field, etc) which are components of the present study.

Selected references for Dr. Ogle are provided below. A one-page "biographical sketch" for Dr. Ogle is attached.

References: Dr. Bruce Thompson, *San Francisco Estuary Institute*, (510)231-9539
Dr. Lynn Suer, *S.F. Bay Regional Water Quality Control Board*, (510)286-4268
Dr. Chris Foe, *Central Valley Regional Water Quality Control Board*, (916)255-3113
Markus Meier, Zeneca Ag Products, Inc., (510)231-1314

Dr. Victor deVlaming, State Water Resources Control Board - Dr. DeVlaming will serve as Co-Investigator on this project. Dr. deVlaming will assist in the information review and species selection for these tests, will provide guidance and expertise during the performance of the toxicity testing, and will assist in preparation and review of the Final Report.

Dr. deVlaming has directed several investigations of ambient water toxicity throughout California, including the Imperial Valley, Salinas Valley, as well as several studies within the Central Valley. Dr. deVlaming has organized workshops addressing the toxicity of OP (and other) pesticides in ambient waters in California, and has recently authored an EPA Report evaluating the interpretation of laboratory toxicity testing with regards to impacts on *in situ* populations and communities. Dr. deVlaming has also directed studies developing toxicity testing methods with fish and invertebrate species resident in the Delta.

Selected references for Dr. deVlaming are provided below. A one-page "biographical sketch" for Dr. deVlaming is attached.

References: Dr. Chris Foe, *Central Valley Regional Water Quality Control Board*, (916)255-3113
Michael Perrone, *State Water Resources Control Board*, (916)657-0660
Dr. David Hinton, *University of California, Davis*, (916)752-2516
Debra Denton, *U.S. Environmental Protection Agency, Region 9*, (415)744-1919

I-005063

RICHARD SCOTT OGLE, Ph.D.

Expertise: For over ten years, Dr. Scott Ogle has been directing and/or participating in research in the areas of aquatic ecotoxicology and environmental chemistry. A major area of Dr. Ogle's past research efforts has focused on factors affecting toxicity and bioaccumulation of selenium in aquatic systems, and have established him as an expert in this field. Current research activities include evaluation of the fate and effects of petroleum and petroleum products in the aquatic environment and the investigation of contaminants and toxicity in non-point source and stormwater runoff. Dr. Ogle has directed and participated in numerous projects encompassing all of the standardized EPA and ASTM test procedures as well as projects involving research and development of new testing procedures.

Education: Ph.D. Ecology (Aquatic Ecotoxicology), 1996 , University of California, Davis, CA; M.S. Water Science (Water Pollution Biology), 1988, University of California, Davis, CA; B.S. Fisheries Biology (Water Quality), 1984, Humboldt State University, Arcata, CA

Professional Affiliations/Honors: Society of Environmental Toxicology and Chemistry (SETAC), 1989-1990 SETAC Pre-Doctoral Fellow; Northern California Regional Chapter of SETAC (NorCal SETAC), Meeting Chair for the First, Second and Third Annual NorCal SETAC Conferences, NorCal SETAC Vice-President (1990-1993), Secretary (1993-1994); Ecological Society of America; American Fisheries Society; American Association for the Advancement of Science

Employment: 1994-Present, Principal & Lab Director, Pacific Eco-Risk Labs, Martinez, CA; 1991-1994, Senior Scientist, S.R. Hansen & Associates, Concord, CA; 1991, Teaching Assistant (Fish Physiology), University of California, Davis; 1986-1991, Research Assistant, University of California, Davis; 1985, Biological Aide, US Fish & Wildlife Service, Dixon, CA.

Representative Publications (15+ peer-reviewed publications/50+ technical reports):

- Ogle RS, Cotsifas JS (in preparation) The role of ammonia in the toxicity of estuarine/marine sediments.
- Ogle RS, Cotsifas JS (in preparation) The comparative toxicity of oil and oil products (gasolineand fuel oil) to crustaceans.
- Ogle RS, Knight AW (in review) Selenium in aquatic ecosystems. 3. The roles of waterborne uptake and foodborne uptake in the bioaccumulation of selenate and selenite by fathead minnows and bluegill.
- Ogle, R.S and A.W. Knight. 1996. Selenium in aquatic ecosystems. 1. Effects of sulfate on selenate uptake and toxicity in *Daphnia magna*. Archives of Environmental Contamination and Toxicology 30(2):274-279.
- Saiki, M.K. and R.S. Ogle. 1995. Effects of agricultural drainwater on mosquitofish reproduction from contaminated and control field sites. Transactions American Fisheries Society 124:578-587.
- Ogle, R.S. and A.W. Knight. 1989. The effects of elevated dietary selenium on growth and reproduction of the fathead minnow (*Pimephales promelas*). Archives of Environmental Contamination and Toxicology 18(6):795-805.
- Ogle, R.S., K.J. Maier, P. Kiffney, M.J. Williams, A. Brasher, L.A. Melton, and A.W. Knight. 1988. Bioaccumulation of selenium in aquatic ecosystems. Lake and Reservoir Management 4(2):165-173.

Presentations: Dr. Ogle has presented his research in over 20 presentations at Regional, National, and International Scientific Conferences.

Victor de Vlaming, Ph.D.

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

Bachelor of Science in Biology--Texas Tech University

Ph.D. in Zoology--University of California, Berkeley
Focus: Environmental and endocrine control of reproduction in fish.

Post-doctoral research position--University of Texas Marine Science Institute
Focus: Endocrine control of water/salt balance, metabolism, and biorhythms in fish

Assistant and Associate Professor on Biology--Marquette University (1971-80)
Focus: Environmental and endocrine control of reproduction, physiology, and biorhythms in fish

Visiting Associate Professor of Animal Physiology--University of California, Davis (1980-84)
Focus: Environmental and endocrine control of reproduction, physiology, and biorhtyhms in fish

Authored or co-authored over 120 pre-reviewed research reports, review articles, and book chapters

Invited symposium speaker all over the United States and in Canada, England, Wales, France, Kenya, Israel, Russia, and the Philippines

On editorial or review boards of many international journals

At California State Water Resources Control Board (SWRCB) since 1986. Engaged in diverse activities in the Special Studies, Freshwater Standards, Monitoring and Assessment, and Technical Support Units. Analysis of technical reports and data submitted to the CWRCB. Represent the CWRCB as technical expert on toxicological, biological, water quality, and ecological issues. Perform aquatic ecosystem hazard assessments. Most recent activities include design and implementation of surface water monitoring projects, contract writing, and contract managing. Prepared multiple reports/publications and delivered numerous oral presentations on various aspects of aquatic toxicity testing.

VI. COMPLIANCE WITH TERMS AND CONDITIONS

The terms and conditions provided in Appendix D of the CALFED 1997 Category III Request for Proposals are agreeable to and can be complied with by the Principal Investigator of this project.

As per RFP requirements (Table D-1: Standard contract clauses and related proposal submittal requirements), a copy of Item 8, Statement of Non-Discrimination Compliance, and a copy of item 12, Certification of Small Business Status, are attached. Item 2, Standard Clauses - Service and Consultant Service Contracts for $5,000 & Over With Non-Public Entities, will be provided before or at signing of Final Contract.

Item 8

NONDISCRIMINATION COMPLIANCE STATEMENT

COMPANY NAME: Pacific Eco-Risk Laboratories

The company named above (hereinafter referred to as "prospective contractor") hereby certifies, unless specifically exempted, compliance with Government Code Section 12990 (a-f) and California Code of Regulations, Title 2, Division 4, Chapter 5 in matters relating to reporting requirements and the development, implementation and maintenance of a Nondiscrimination Program. Prospective contractor agrees not to unlawfully discriminate, harass or allow harassment against any employee or applicant for employment because of sex, race, color, ancestry, religious creed, national origin, disability (including HIV and AIDS), medical condition (cancer), age, marital status, denial of family and medical care leave and denial of pregnancy disability leave.

CERTIFICATION

I, the official named below, hereby swear that I am duly authorized to legally bind the prospective contractor to the above described certification. I am fully aware that this certification, executed on the date and in the county below, is made under penalty of perjury under the laws of the State of California.

OFFICIAL'S NAME: Richard Scott Ogle

DATE EXECUTED: July 25, 1997

EXECUTED IN THE COUNTY OF: Contra Costa

PROSPECTIVE CONTRACTOR'S SIGNATURE: Richard Scott Ogle

PROSPECTIVE CONTRACTOR'S TITLE: Lab Director

PROSPECTIVE CONTRACTOR'S LEGAL BUSINESS NAME: Richard Scott Ogle, Principal & General Partner of Pacific Eco-Risk Laboratories

I-005067

Item 12

Agreement No. _____

Exhibit _____

STANDARD CLAUSES --
SMALL BUSINESS PREFERENCE AND CONTRACTOR IDENTIFICATION NUMBER

NOTICE TO ALL BIDDERS:

Section 14835, et. seq. of the California Government Code requires that a five percent preference be given to bidders who qualify as a small business. The rules and regulations of this law, including the definition of a small business for the delivery of service, are contained in Title 2, California Code of Regulations, Section 1896, et. seq. A copy of the regulations is available upon request. Questions regarding the preference approval process should be directed to the Office of Small and Minority Business at (916) 322-5060. To claim the small business preference, you must submit a copy of your certification approval letter with your bid.

Are you claiming preference as a small business?

X Yes* _____ No

*Attach a copy of your certification approval letter.