FIELD MONITORING PLAN

PRISM GRANT: 041355520

PROJECT NAME: INVESTIGATIONS OF SOURCES AND EFFECTS OF PYRETHROID PESTICIDES IN WATERSHEDS OF THE SAN FRANCISCO BAY ESTUARY

Project Director: Sarah Lowe (SFEI)
Project Grant Manager: Richard Condit (SWRCB)

November 30th, 2004

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Additional Coordination: Brian Anderson (UCD-GCML) and Karen Taberski (RWQCB)

This field monitoring plan covers work to be performed under Task 3.1: *Ambient Sediment Sampling, Analyses, and Toxicity Assays* under this PRISM Grant AND additional work performed by the Trace Substances' Status and Trends Monitoring Program (RMP) Episodic Toxicity Monitoring Program (2004-05). This work constitutes a combined study to investigate sediment contamination, and the potential for sediment toxicity in upper and lower reaches of six tributaries around the San Francisco Estuary, during two sampling events (November 2004 and April 2005).

OBJECTIVE

The purpose of this study is to investigate potential sediment toxicity to both freshwater and estuarine amphipods to sediments from six tributaries around the Estuary whose land uses include varying combinations of urban and agricultural practices. Bedded surface sediments will be collected targeting recently deposited sediments for toxicity and chemical analyses. A suite of California Toxics Rule priority pollutants, sediment grain-size, total organic carbon, and additional pollutants of concern (including pyrethroids and polybrominated diphenyl ethers (PBDEs)) will be characterized for each tributary (see Table 2 for a complete list).

This PRISM grant component (Task 3.1) covers only a portion of the study outlined below: the April 2005 monitoring effort to investigate sediment contamination and potential sediment toxicity to freshwater amphipods in sediments collected at up-stream sites from six tributaries around the Estuary. The number of samples and analyses paid for by the PRISM grant is presented in Table 3 (below).

APPROACH

The San Francisco Estuary Institute will coordinate execution of this work plan. Sub-contractors identified in the original PRISM proposal will provide services for this study to ensure consistency in sampling and analytical methods with the long-term data from the RMP with the exception of CDFG-MPSL, who will be analyzing sediment organic chemicals. We are using this laboratory because the current RMP Status and Trends sediment organics laboratory is presently undertaking an instrumentation change and the CDFG-MPSL is the sub-contracting laboratory for task 2 and 3 for this PRISM grant (Toxicity Dose-Response study and the TIE development) and for another RMP Special Study (Exposure and Effects Pilot Study 2004 – Sediment Dose Response). Having the same laboratory perform the chemical analyses for all these tasks is important for comparing and interpreting our study results.

Table 1. List of Subcontractors for sediment sampling and analyses performed:

1.1 Sediment Chemistry Analyses	
Trace Metals – except Hg, and meHg	BRL
Sediment Characteristics and Trace Metals - Grain size, TOC, Hg, and meHg	UCSCDET
Organics – PAHs, PCBs, Pesticides, PBDEs, and Pyrethroids	CDFG-MPSL
Sediment Toxicity - *Hyalella, Eohaustorius*	UCD-GCML
1.2 Field Work & Logistics	
Field Logistics (Coordination and Sampling)	AMS/SFEI

AMS: Applied Marine Sciences (AMS), Livermore, CA (Mr. Paul Salop)

BRL: Brooks-Rand Ltd., Seattle, WA (Dr. Colin Davies)
UCSCDET: UC Santa Cruz, Santa Cruz, CA (Dr. Russel Flegal, Ms. Genine Scelfo)
CDFG-MPSL: CA Dept. of Fish & Game, Water Pollution Control Laboratory, Rancho Cordova, CA (Mr. Dave Crane)
UCD-GCML: UC Davis- Marine Pollution Studies Lab (MPSL), Granite Canyon, CA (Mr. Brian Anderson, Mr. Bryn Phillips)

PROJECT FUNDING: This is a coordinated study funded by the following projects

1) RMP - Episodic Toxicity Monitoring Program 2004 (Year 1 of sediment toxicity investigations in Estuary tributaries),
2) PRISM – INVESTIGATIONS OF SOURCES AND EFFECTS OF PYRETHROID PESTICIDES IN WATERSHEDS OF THE SAN FRANCISCO BAY ESTUARY (subtask 3.1)

BACKGROUND

The RMP- Exposure and Effects Pilot Study (EEPS) toxicity workgroup met periodically in 2002 and 2003 to discuss the findings from the RMP's toxicity programs and to decide how to adapt the programs to monitor for potential toxicity in the Estuary and it's immediate watersheds in light of recent pesticide management measures (phasing out of diazinon and chlorpyrifos) and shifting pesticide use patterns upstream (i.e., increasing usage of pyrethroids). The workgroup recommended that the Episodic Toxicity Monitoring Program (Ep. Tox. Program) investigate sediment in Estuary tributaries in 2004. In addition, SFEI was awarded a PRISM grant to study pyrethroids in sediments that includes a field investigation to characterize sediment contamination and potential sediment toxicity in several Estuary tributaries. This workplan outlines the combined tasks for the field components of these two studies. Please refer to Appendix A: *Related Studies* section below for a brief description of each study.

WORK PLAN

This project will require execution of the following tasks:

1. Project management and coordination - SFEI will develop subcontracts, coordinate, track deliverables, and specify appropriate data reporting and quality assurance procedures.
2. Sample collection - this task will be done by subcontractors and SFEI staff.
3. Sample extraction, quantification, and data reporting - After receipt of samples, the analytical laboratory will analyze samples in accord with conditions agreed to in the contract, including data quality objectives, turnaround time, reporting formats, and specific quality assurance samples and procedures.

Sampling and toxicity testing strategy

Since estuarine taxa may be more sensitive to some pyrethroids than freshwater taxa, we will sample both above the tidal prism and near the mouth of each tributary and perform **toxicity tests with freshwater and estuarine amphipod species** where appropriate *(Hyalella and Eohaustorius, respectively).* About 5 liters of homogenized **fine-grained sediment will be collected from depositional areas in the creeks** above the tidal reach and down-stream within the tidal reach. The top 1-2 cm of sediments will be scooped into a Kynar coated bucket using Kynar coated scoops that are carefully cleaned with soap, acid, and methanol similar to the methods employed by the RMP. Sample storage and handling will be similar as employed by the RMP. Chemistry samples will be stored on dry-ice immediately after collection and toxicity samples will be stored on wet-ice. Sediment samples for meHg analyses will be directly allocated into the sample containers from undisturbed sediments collected using the scoops.

Sediment chemistry (RMP list of contaminants, and pyrethroids) will be performed in the upstream samples to characterize contaminant inputs into the Estuary (see Table 2). Similar sediment samples from the downstream sites will be collected, but these chemistry samples will be

archived. If downstream sediments are toxic, then the same list of analytes will be measured in the archived sediments. **Grain size and TOC** analyses will be performed in all samples.

Sediment toxicity tests will use the 10-d growth and survival protocol for *Hyalella azteca* (U.S. EPA 2000) for sediments collected in upstream reaches, and the 10-d survival protocol for *Eohaustorius estuarius* for sediment collected in the downstream reaches (U.S. EPA, 1994b).

If sediments are found to be significantly toxic to amphipods, up to two tributary sites will be resampled and toxicity identification evaluations (TIEs) will be performed. TIEs will be conducted to identify possible causes including using methods developed to date for identifying pyrethroids.

Note: SFEI will coordinate additional sample collection with Dr. Daniel Oros for another PRISM grant (#041345520, see Appendix A). A subset of five tributaries will be sampled in April-2005 for **water and sediment to characterize the ambient concentration of several pyrethroids**. The additional sediment samples will provide an opportunity to compare pyrethroid analyses between two laboratories (AXYS Analytical Services Ltd. (BC, Canada) and CDFG-MPSL).

Sample locations

Two locations in six tributaries around the Estuary (see Figure 1) will be sampled. Bedded depositional sediment samples will be collected in the freshwater regions of each tributary (not far above the region of tidal influence) and near the mouths of each tributary within the tidal reach.

Site selection goals include: 1) Selection of tributaries distributed around the Estuary of variable land-use types; 2) preferably sites that have been studied before so that there is some historical data to refer to (i.e. SWAMP, USGS, Alameda County Sediment Survey, NOAA/EMAP, RMP, other); 3) availability of fine-grained depositional sediments; and 4) safely accessible for sample collection.

Sampling periods

Field sampling will occur **twice**. The first samples will be collected after the “first flush” of the wet season in order to capture the potential effects of dry season pesticide usage (**November - 2004**),. The second samples will be collcted in late spring (**April - 2005**), after the winter rains and and coinciding with resumption of fresh pesticide applications in urban and agricultural settings.

Sampling and Sample Handling

Sample collection, sample handling, and laboratory methods will be the same as those employed by the RMP Status and Trends program and/or compliant with SWAMP protocols. Methods for collection of field samples and sample handling are further outlined in the Field Operations Manual: Regional Monitoring Program for Trace Substances (2001), available on the web at http://www.sfei.org/rmp/reports.htm.

Sampling Equipment

Applied Marine Science (AMS) (Livermore, CA) will coordinate with the laboratory for sample containers and sample handling instructions (contact Paul Salop (925) 373-7142 or [salop@amarine.com]). Each laboratory will be responsible for supplying pre-cleaned/certified containers to AMS at least two weeks prior to each sampling event. RMP Status and Trends sediment and water sampling equipment (e.g. buckets, scoops, cleaning supplies) will be used in this study.

Please see Appendix B for a description of the quality assurance/quality control (QA/QC), and reporting expectations.

Table 2. Parameter List, Target Method Detection Limits (MDLs), and laboratory performing analyses.

Conventional Water Quality Parameters (AMS)	**Reporting Units**
Salinity (by salinometer)	psu
Temperature	°C
Depth	m

Sediment Quality Parameters (USCSDET)	**Reporting Units**
% clay (< 4 µm)	% dry weight
% silt (4 µm–62 µm)	% dry weight
% sand (2 mm > 62 µm)	% dry weight
% gravel (> 2 mm)	% dry weight
% solids	% dry weight
Total Organic Carbon	%

Toxicity Tests — Sediment (UCDavis-GCML)	**Reporting Units**
(*Hyalella, Eohaustorius estuarius)*	
Sediment Toxicity – (Amphipod) % Survival	%
Sediment Toxicity – (QA/QC measures: sulfide, pH, etc.)	various

Trace elements analyzed in sediment samples: (BACWA-CCSF except where noted)
Target Method Detection Limits (MDLs) are in parentheses following the reporting units.

	Sediment (dry weight)
Aluminum (Al)	mg/kg (200)
Arsenic (As) - BRL	mg/kg (0.2)
Cadmium (Cd)	mg/kg (0.001)
Copper (Cu)	Mg/kg (2)
Iron (Fe)	mg/kg (200)
Lead (Pb)	mg/kg (0.5)
Manganese (Mn)	mg/kg (20)
Mercury (Hg) - UCSCDET	mg/kg (0.00001)
Methylmercury (MeHg) - UCSCDET	µg/kg (0.005)
Nickel (Ni)	mg/kg (5)
Selenium (Se) - BRL	mg/kg (0.01)
Silver (Ag)	mg/kg (0.001)
Zinc (Zn)	mg/kg (5)

Table 2 (continued). Parameter List, and Target MDLs

Trace organic parameters in sediment (µg/kg): (CDFG-MPSL)

PAHS
(Target MDLs: sediment –5 µg/kg)

1-Methylnaphthalene
2,3,5-Trimethylnaphthalene
2,6-Dimethylnaphthalene
2-Methylnaphthalene
Biphenyl
Naphthalene
1-Methylphenanthrene
Acenaphthene
Acenaphthylene
Anthracene
Fluorene
Phenanthrene
Benz(a)anthracene
Chrysene
Fluoranthene
Pyrene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(e)pyrene
Benzo(k)fluoranthene
Dibenz(a,h)anthracene
Perylene
Benzo(ghi)perylene
Indeno(1,2,3-cd)pyrene
Dibenzothiophene

SYNTHETIC BIOCIDES
(Target MDLs: sediment – 1 µg/kg)

Cyclopentadienes
Aldrin
Dieldrin
Endrin

Chlordanes
alpha-Chlordane
cis-Nonachlor
gamma-Chlordane
Heptachlor
Heptachlor Epoxide
Oxychlordane
trans-Nonachlor

DDTs
o,p'-DDD
o,p'-DDE
o,p'-DDT
p,p'-DDD
p,p'-DDE
p,p'-DDT

HCH
alpha-HCH
beta-HCH
delta-HCH
gamma-HCH

Other Synthetic Biocides
Chlorpyrifos
Diazinon
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Hexachlorobenzene
Mirex
Oxadiazon

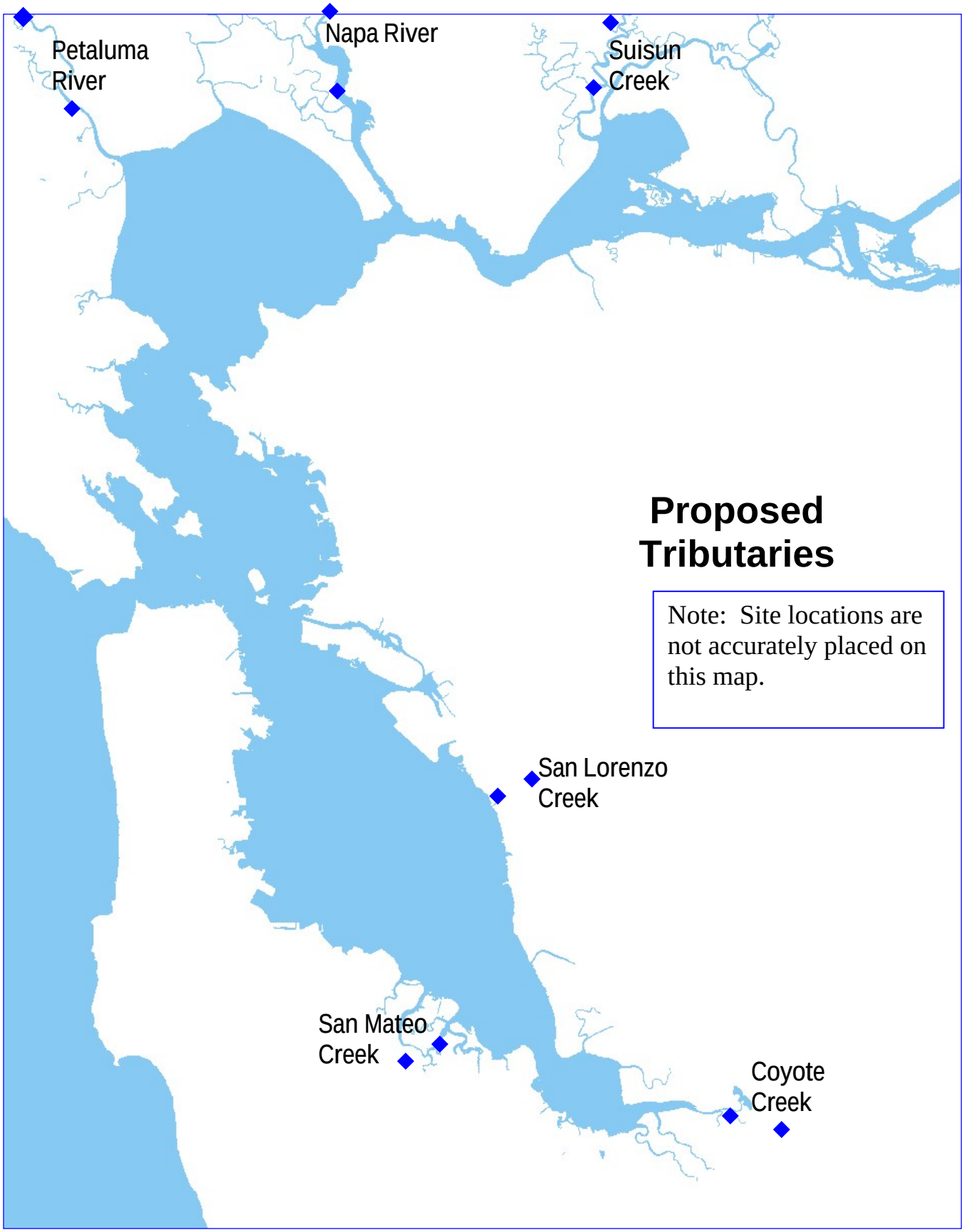
OTHER SYNTHETIC COMPOUNDS

PCB congeners (IUPAC numbers):
(Target MDLs: sediment– 1 µg/kg)
8, 18, 28, 31, 33, 44, 49, 52, 56, 60, 66, 70, 74, 87, 95, 97, 99, 101, 105, 110, 118, 128, 132, 138, 141, 149, 151, 153, 156, 158, 170, 174, 177, 180, 183, 187, 194, 195, 201, 203

Pyrethroids: (note: AXYS to participate in an intercomparison of these)
(Target MDLs: sediment – <1 µg/kg)
Cypermethrin
L-cyhalothrin
Permethrin
Bifenthrin
Deltamethrin
Piperonyl Butoxide

Polybrominated Diphenyl Ethers
(BDE-IUPAC No., Compound Name)
(Target MDLs: sediment – 1 µg/kg).

BDE 17	[2,2',4-triBDE]
BDE 28	[2,4,4'-triBDE]
BDE 47	[2,2',4,4'-tetraBDE]
BDE 66	[2,3',4,4'-tetraBDE]
BDE 82	[2,2',3,3',4-pentaBDE]
BDE 85	[2,2',3,4,4'-pentaBDE]
BDE 99	[2,2',4,4'5-pentaBDE]
BDE 100	[2,2',4,4',6-pentaBDE]
BDE 128	[2,2',3,3',4,4'-hexaBDE]
BDE 138	[2,2',3,4,4',5'-hexaBDE]
BDE 153	[2,2',4,4',5,5'-hexaBDE]
BDE 154	[2,2',4,4',5,6'-hexaBDE]
BDE 183	[2,2',3,4,4',5',6-heptaBDE]
BDE 190	[2,3,3',4,4',5,6-heptaBDE]
Octa-BDE	
Nona-BDE	
BDE 209	[2,2',3,3',4,4',5,5',6,6'-decaBDE]


Petaluma River
Napa River
Suisun Creek
Proposed Tributaries
Note: Site locations are not accurately placed on this map.
San Lorenzo Creek
San Mateo Creek
Coyote Creek

Appendix A:

RELATED STUDIES:

PRISM 041355520: Investigations of Sources and Effects of Pyrethroid Pesticides in Watersheds of the San Francisco Estuary.
The purpose of this project is to evaluate pyrethroids in sediments and their potential impact on benthic organisms.

There are three tasks to this project:

1) Conduct a field study during the spring season to determine if sediments entering the San Francisco Estuary from local tributaries are toxic to three ecologically relevant benthic amphipods. Characterize the contaminant levels in the collected sediments including trace metals, PAHs, PCBs, OP pesticides, and diazinon replacement pesticides (specifically pyrethroids), and if the samples are toxic, perform Toxicity Identification Evaluations (TIEs) to identify causes.
2) Develop dose-response information (LC50s) for standard EPA sediment toxicity testing species, and ecologically relevant species to the Estuary, for three pyrethroids (cypermethrin, permethrin, and bifenthrin). The species to be evaluated include the amphipods *Eohaustorius estuarius* and *Ampelisca abdita*. (The rationale for targeted pesticides and species is provided in item 5 below.)
3) Develop and validate TIE procedures for sediment toxicity tests targeting toxicity caused by pyrethroids. The TIE methods used will be similar to those proposed in PRISM proposal #0032 "Tools for Surface Water Monitoring", however, that project emphasizes pesticides in water. Both groups will collaborate through ongoing discussions about methods development and validation for both water and sediment samples.

PRISM 041345520: Development of New Chemical Methods for the Diazinon Replacements: Pyrethroids (including Deltamethrin), Carbamates, Imidacloprid, and Piperonyl Butoxide.

There are three tasks in this project:

1) Evaluation and development of high performance liquid chromatography/mass spectrometry-mass spectrometry (LC/MS-MS) and high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS) methods for measurement of the target pesticides,
2) Analysis of environmental samples (water and sediment) by LC/MS-MS and HRGC/HRMS. (Field sampling will be coordinated with the RMP's Episodic Toxicity Monitoring Study and PRISM Project 041355520)
3) Comparison between LC/MS-MS and HRGC/HRMS methods for both lab and environmental (ambient) samples for some of these pesticides.

RMP Episodic Toxicity Monitoring Program: Ambient water toxicity monitoring of storm-water runoff events (Oct – May). Results from this monitoring effort over the past several years has shown that water entering the Estuary during storm events is usually not toxic to mysid shrimp or fish larvae and that pulses of pesticides moving downstream (which are difficult to sample) are toxic to some resident organisms for periods up to several days. Additionally, changing pesticide usage upstream call for adaptive monitoring strategies. We plan to use the 2004 funds to explore the hypothesis that sediments coming into the Estuary through episodic, wet season transport may be contributing to the observed

persistent sediment toxicity in several regions of the Estuary, and to redesign the toxicity monitoring effort.

Excerpt from the most recent RMP Episodic Toxicity Monitoring-Annual Report:
"Aquatic toxicity monitoring programs must be aware of changes in activities (e.g., pesticide use) in the watersheds being studied, and must adapt the monitoring tools (e.g., sampling design, toxicity tests, and chemical analyses) to reflect those changes. For example, knowing that diazinon and chlorpyrifos had been linked to ambient water toxicity in upstream waters, and that OP pesticides can remain dissolved in the water, are very toxic to crustaceans, and are relatively non-toxic to fish, we believe that the currently used approach of ambient water sampling and toxicity testing with *A. bahia* is an appropriate monitoring approach. However, the fate and effects of the pyrethroid pesticides are different than the OP pesticides. This suggests that transitions in pesticide use (or use of other chemicals) in the Estuary watershed may need to be reflected in changes in the way we monitor for ambient toxicity. The current water sampling approaches, currently recommended suite of chemical analytes, and toxicity testing with *Ceriodaphnia* and mysids may not be the optimal approach for assessment of the effects of "new" contaminants, such as the pyrethroids, on the San Francisco Estuary aquatic ecosystems." (PERL, RMP Technical Report: Ambient Water Toxicity In The San Francisco Estuary, 2002)

Appendix B:
DESCRIPTION OF QUALITY ASSURANCE/QUALITY CONTROL, AND REPORTING EXPECTATIONS

Quality Assurance and Quality Control

This study will employ similar laboratory methodologies as the RMP, which is a performance-based program. Laboratories will use current RMP laboratory methods unless new methods are discussed, warranted, and approved by the project manager (or designee). Laboratories will review the 1999 Quality Assurance Project Plan (QAPP) of the RMP available on the web at http://www.sfei.org/rmp/reports/1999_QAPP/99_QAPP.html.

All scientific activities undertaken by laboratories must adhere to quality assurance and quality control (QA/QC) procedures as developed in the QAPP. This will include requirements for documenting chain of custody for samples, proper sample storage and holding times, data validation methods, and analysis of quality control samples, laboratory blanks and spikes, laboratory replicates, and standard reference materials (when available). Laboratories will be required to provide concise and complete reports of analyses of quality control samples to verify that Data Quality Objectives (DQOs) are being met. If DQOs are not being met, re-analysis of samples may be necessary.

DQO's for the pyrethroids will be developed over the coarse of this study and laboratory staff will collaborate with SFEI in developing those objectives.

Reporting of Results

Analytical results, including associated quality control samples, will be provided to SFEI **no later than 120 days after sample receipt.**

Laboratory personnel will verify, screen, validate, and prepare all data, including QA/QC results, in accordance with the RMP'S QAPP and will provide (upon request) detailed QA/QC documentation that can be referred to for an explanation of any factors affecting data quality or interpretation. Any detailed QA/QC data not submitted as part of the reporting package (see below) should be maintained in the laboratory's database for future reference.

Laboratories will provide electronic copies of the cover letter and tabulated analytical data (including associated QA/QC information outlined below) in the SWAMP database format or a format agreed upon with the RMP's Project/Data Manager or designee.

Each electronic data report package will consist of the following components:

1. A **cover letter** (electronic copy) transmitting the data report package. The following topics will be addressed in the narrative:
    a. Identify Samples: Include the contract number, study, sample dates, matrix, and total number of field samples being submitted. Note if any of the contracted number of samples were not analyzed for any reason. Include a list of the type of QA samples included in the report package.
    b. Clarify linkage between field samples and QA: Provide a list of which QA samples are associated with each set of field samples. Be sure to say if the QA samples are associated by batch or cruise
    c. Summarize Methods used: Provide a short summary of the procedures and instrumentation used, including:
        i. pre-prep., extraction, and quantification methods (reference EPA methods where applicable). Include electronic copies of your SOPs with your data submission package.

ii. Type and frequency of QA samples run (e.g. blank, duplicate, matrix spike, SRMs). Include: (1) concentrations used for spiked samples or equivalent, and (2) concentration range used for generating instrument calibration curves. (Note: You may choose to reference the location of this information in the expanded report.)
iii. Sample size extracted and what units you are reporting the data in.
iv. Indicate if the data have been recovery corrected and if the MDLs were adjusted for sample size extracted. Also indicate if the data are reported in wet or dry weight.
v. PROVIDE DATA THAT HAVE NOT BEEN BLANK CORRECTED and clearly identify all blank samples that would be used to blank correct each sample batch. State that the data were not blank corrected in the cover letter and list those parameters that should be blank corrected prior to data usage.
vi. A list of qualifier definitions.

d. Report on the QA/QC: Do the results meet the data quality objectives (DQOs) outlined in Tables 3 and 4 of the 1999 QAPP? Provide a brief summary table of precision, accuracy, and blank sample concentrations and explain any analytical problems and/or corrective actions taken. Examples of items to include are:
i. An explanation of any analyte accuracy and recovery calculations that were outside DQOs outlined in the QAPP.
ii. Any contamination of the blanks.
iii. Any analyte concentrations that were outside calibrated range.
iv. Lost/broken samples.

2. Tabulated electronic results in SWAMP database format unless another format is agreed upon with the project manager. Tabulated data will include the following information for each sample (when applicable):
a. Sample identification: Unique sample-ID (provided on the COC and available electronically upon request - contact SFEI's Project/Data Manager), site code, site name, collection date, analysis date/s, sample type (field sample or QA/QC), matrix (water, sediment, tissue (include species))
b. Analytical methods: pre-prep., extraction, and quantification methods (codes should reference to SOPs submitted with the data submission package).
c. Analytical results: Parameter name, result, unit, and method detection limit (MDL) for all target parameters (see Table 1 for naming convention and reporting units). When applicable, state whether the results are reported in wet or dry weight, and submit the appropriate QA/QC data qualifiers with the results.
d. Required additional data include:
i. % solids
ii. Control results (for toxicity tests)
iii. Field and lab replicate results
iv. Quality assurance information for each analytical chemistry batch:
1. SRM results, absolute concentrations measured, certified value, and % recovery relative to certified value.
2. Matrix spike results (or similar samples): include target amount spiked for each analyte, actual recovery concentrations, and calculated % recovery.
3. Method blank sample results in units equivalent to field sample results (e.g. if the field samples are reported as ng/g, method blanks are given in the same units). Clearly identify those samples recommended for blank correcting the results.
4. Field and lab replicate results.

Waste Disposal
After receipt of samples, laboratories will be responsible for proper storage of samples during the project, and disposal of samples after the project is complete. To the extent that any samples collected, or other materials used, are considered hazardous waste, laboratories will be responsible for disposing of these materials in accordance with all applicable Federal, State and/or Local laws.

Archiving
Whenever possible, laboratories will retain sufficient amounts of sample or sample extract to allow for future re-analysis. Samples or extracts will be archived using appropriate storage techniques. Sample materials will not be discarded until all work described in this contract has been submitted to SFEI, validated, verified and SFEI has paid the final invoice.

TABLE 3. TASK BREAKDOWN BETWEEN THE COORDINATED STUDIES:

1) EPTOX – RMP Episodic Toxicity Monitoring Program 2004/05
2) PRISM – Investigations of Sources and Effects of Pyrethroid Pesticides in Watersheds of the San Francisco Bay Estuary (subtask 3.1)

Each tributary will be sampled in two locations for two sampling events (November-2004 and April-2005). The six up-stream sites will have a full chemistry analyses. **Only downstream sites that are shown to be toxic to amphipods will have a full chemistry analyses (estimated at 3 down-stream sites per sampling event).** All samples will be analyzed for grainsize and TOC.

	SubContractor	November Sampling	April Sampling		Total
		No. Samples Paid for By EPTOX	No. Samples Paid for By EPTOX	No. Samples Paid for By PRISM	Samples for Combined Study
1.0 Logistics and Sampling	**AMS/SFEI**	12	6	6	24
1.1 Sediment Chemistry					
Trace Elements	**BRL**				
TEs (Al, Ag, Cd, Cu, Fe, Pb, Mn, Ni, Zn)		9	3	6	18
TEs (As)		9	9	0	18
TEs (Se)		9	9	0	18
%solids		9	3	6	18
Sediment Quality and Mercury	**UCSCDET**				
Total Organic Carbon		12	6	6	24
Total Nitrogen		12	12	0	24
% solids		9	3	6	18
Grain Size %clay (sedigraph)		12	6	6	24
Grain Size %silt (sedigraph)		12	6	6	24
Grain Size %sand (digestion, sieve)		12	12	0	24
Grain Size %gravel (digestion, sieve)		12	12	0	24
Total Mercury		9	9	0	18
Methyl Mercury		9	9	0	18
Organics	**CDFG-WPCL**				
PAHs		9	3	6	18
PCBs & PESTs (original RMP analyte list)		9	3	6	18
New analytes - PBDEs		9	9	0	18
New analytes - Pyrethroids		9	3	6	18
Sed TIE (chemistry)		0	0	2	2
1.2 Sediment Toxicity					
Toxicity & chemistry	**UCD-GCML**				
Sed Tox (H. azteca 10d)		6	0	6	12
Sed Tox (E. estuarius 10d)		6	6	0	12
ELISA Clorpyrifos & Diazinon		12	6	6	24
Sed TIE (amphipod toxicity)		0	0	2	2
Sed TIE sample collection		0	0	2	2

REFERENCES

ASTM. (1992). Designation E 1367: Standard guide for conducting 10-day static sediment toxicity tests with marine and estuarine amphipods. Volume 11.04. American Society for Testing and Materials, Philadelphia, PA.

Field Operations Manual: Regional Monitoring Program for Trace Substances (2001) David, N., D. Bell, J. Gold, San Francisco Estuary Institute, Oakland, CA (www.sfei.org)

Quality Assurance Project Plan for the Regional Monitoring Program for Trace Substances (1999) Lowe, S.; R. Hoenicke; J. Davis. San Francisco Estuary Institute, Oakland, CA (www.sfei.org)

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U.S. Environmental Protection Agency. 2000. Methods for measuring the toxicity and bioaccumulation of sediment-associated contaminants with freshwater invertebrates. Office of Research and Development. EPA 600-R-99-096, Washinton, DC, USA