Investigations into Toxicity of Unknown Cause in the Bay-Delta and Tributary Watersheds

Project Information

1. **Proposal Title:**

   Investigations into Toxicity of Unknown Cause in the Bay-Delta and Tributary Watersheds

2. **Proposal applicants:**

   Bruce Thompson, San Francisco Estuary Institute
   Karen Larsen, Central Valley Regional Water Quality Control Board
   Vic de Vlaming, University of California Davis
   Scott Ogle, Pacific EcoRisk
   Jeff Miller, AQUA-Science
   John Hunt, University of California Davis
   Stephen Clark, Pacific EcoRisk

3. **Corresponding Contact Person:**

   Bruce Thompson
   San Francisco Estuary Institute
   7770 Pardee Lane Oakland, CA 94621
   530 231-9539
   bruce@sfei.org

4. **Project Keywords:**

   Aquatic Toxicity
   Contaminants
   Water and Sediment Quality

5. **Type of project:**

   Research

6. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

7. **Topic Area**:

   Ecosystem Water and Sediment Quality

8. **Type of applicant:**

   Private non-profit

9. **Location - GIS coordinates:**

Latitude:

Longitude:

Datum:

Describe project location using information such as water bodies, river miles, road intersections, landmarks, and size in acres.

The study area potentially includes the entire ERP geographic scope

10. **Location - Ecozone:**

    Code 15: Landscape

11. **Location - County:**

    Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Fresno, Glenn, Madera, Marin, Mariposa, Merced, Napa, Nevada, Placer, Plumas, Sacramento, San Benito, San Francisco, San Joaquin, San Mateo, Santa Clara, Shasta, Sierra, Solano, Sonoma, Stanislaus, Sutter, Tehama, Tuolumne, Yolo, Yuba

12. **Location - City:**

    Does your project fall within a city jurisdiction?

    No

13. **Location - Tribal Lands:**

    Does your project fall on or adjacent to tribal lands?

    No

14. **Location - Congressional District:**

    California 13th

15. **Location:**

    California State Senate District Number: 9

    California Assembly District Number: 16

16. **How many years of funding are you requesting?**

    3

17. **Requested Funds:**
    a) Are your overhead rates different depending on whether funds are state or federal?

       No

If no, list single overhead rate and total requested funds:

Single Overhead Rate: 153%

Total Requested Funds: $3,026,507.44

b) Do you have cost share partners already identified?

Yes

If yes, list partners and amount contributed by each:

Sacramento River Watershed Program $65,000

USEPA Region 9 $40,000

c) Do you have potential cost share partners?

No

d) Are you specifically seeking non-federal cost share funds through this solicitation?

No

If the total non-federal cost share funds requested above does not match the total state funds requested in 17a, please explain the difference:

18. **Is this proposal for next-phase funding of an ongoing project funded by CALFED?**

No

Have you previously received funding from CALFED for other projects not listed above?

Yes

If yes, identify project number(s), title(s) and CALFED program.

ERP-99-N07	**Chronic Toxicity of Environmental Contaminants in Sacramento Splittail: A Biomarker Approach**	**ERP**
ERP-99-B06	**Assessment of the Ecological and Human Health Impacts of Mercury in the Bay-Delta Watershed**	**ERP**
ERP-98-C07	**Fathead Minnow Toxicity Study**	**ERP**

ERP-98-C08	**Algae Toxicity Study**	**ERP**
ERP-01-N22	**Rainbow Trout Toxicity Monitoring**	**ERP**
ERP-99-N08	**Assessment of Pesticide Effects on Fish & Their Food Resources in the Sacramento/San Joaquin Delta**	**ERP**

19. **Is this proposal for next-phase funding of an ongoing project funded by CVPIA?**

    No

    Have you previously received funding from CVPIA for other projects not listed above?

    No

20. **Is this proposal for next-phase funding of an ongoing project funded by an entity other than CALFED or CVPIA?**

    No

    Please list suggested reviewers for your proposal. (optional)

    Steve Bay SCCWRP 714 894 2222

    Rob Burgess EPA Narragansett 401 782 3106 burgess.robert@epamail.epa.gov

    Tom Waller University of North Texas 940 565 2982 waller@unt.edu

21. **Comments:**

Environmental Compliance Checklist

Investigations into Toxicity of Unknown Cause in the Bay-Delta and Tributary Watersheds

1. **CEQA or NEPA Compliance**
   a) Will this project require compliance with CEQA?

      No
   b) Will this project require compliance with NEPA?

      No
   c) If neither CEQA or NEPA compliance is required, please explain why compliance is not required for the actions in this proposal.

      This is a research project that will not adversely impact the environment, including protected species.

2. **If the project will require CEQA and/or NEPA compliance, identify the lead agency(ies).** *If not applicable, put "None".*

   CEQA Lead Agency:
   NEPA Lead Agency (or co-lead:)
   NEPA Co-Lead Agency (if applicable):

3. **Please check which type of CEQA/NEPA documentation is anticipated.**

   CEQA
   -Categorical Exemption
   -Negative Declaration or Mitigated Negative Declaration
   -EIR
   Xnone

   NEPA
   -Categorical Exclusion
   -Environmental Assessment/FONSI
   -EIS
   Xnone

   If you anticipate relying on either the Categorical Exemption or Categorical Exclusion for this project, please specifically identify the exemption and/or exclusion that you believe covers this project.

4. **CEQA/NEPA Process**
   a) Is the CEQA/NEPA process complete?

      None

   b) If the CEQA/NEPA document has been completed, please list document name(s):

5. **Environmental Permitting and Approvals** (*If a permit is not required, leave both Required? and Obtained? check boxes blank.*)

LOCAL PERMITS AND APPROVALS

Conditional use permit

Variance

Subdivision Map Act

Grading Permit

General Plan Amendment

Specific Plan Approval

Rezone

Williamson Act Contract Cancellation

Other

STATE PERMITS AND APPROVALS

Scientific Collecting Permit

CESA Compliance: 2081

CESA Compliance: NCCP

1601/03

CWA 401 certification

Coastal Development Permit

Reclamation Board Approval

Notification of DPC or BCDC

Other

FEDERAL PERMITS AND APPROVALS

ESA Compliance Section 7 Consultation

ESA Compliance Section 10 Permit

Rivers and Harbors Act

CWA 404

Other

PERMISSION TO ACCESS PROPERTY

Permission to access city, county or other local agency land.
Agency Name:

Permission to access state land.
Agency Name:

Permission to access federal land.
Agency Name:

Permission to access private land.
Landowner Name:

6. **Comments.**

Land Use Checklist

Investigations into Toxicity of Unknown Cause in the Bay-Delta and Tributary Watersheds

1. **Does the project involve land acquisition, either in fee or through a conservation easement?**

   No

2. **Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?**

   No

3. **Do the actions in the proposal involve physical changes in the land use?**

   No

   If you answered no to #3, explain what type of actions are involved in the proposal (i.e., research only, planning only).

   Research only

4. **Comments.**

Conflict of Interest Checklist

Investigations into Toxicity of Unknown Cause in the Bay-Delta and Tributary Watersheds

Please list below the full names and organizations of all individuals in the following categories:

- Applicants listed in the proposal who wrote the proposal, will be performing the tasks listed in the proposal or who will benefit financially if the proposal is funded.
- Subcontractors listed in the proposal who will perform some tasks listed in the proposal and will benefit financially if the proposal is funded.
- Individuals not listed in the proposal who helped with proposal development, for example by reviewing drafts, or by providing critical suggestions or ideas contained within the proposal.

The information provided on this form will be used to select appropriate and unbiased reviewers for your proposal.

Applicant(s):

Bruce Thompson, San Francisco Estuary Institute
Karen Larsen, Central Valley Regional Water Quality Control Board
Vic de Vlaming, University of California Davis
Scott Ogle, Pacific EcoRisk
Jeff Miller, AQUA-Science
John Hunt, University of California Davis
Stephen Clark, Pacific EcoRisk

Subcontractor(s):

Are specific subcontractors identified in this proposal? Yes

If yes, please list the name(s) and organization(s):

Vic de Vlaming	University of California Davis
Karen Larsen	Central Valley Regional Water Quality Control Board
Jeff Miller	AQUA-Science
Scott Ogle	Pacific EcoRisk
Stephen Clark	Pacific Eco-Risk
John Hunt	University of California Davis
None	None
None	None
None	None
None	None

Helped with proposal development:

Are there persons who helped with proposal development?

Yes

If yes, please list the name(s) and organization(s):

G. Fred Lee G. Fred Lee and Associates

Val Connor State Water Resources Control Board

Debra Denton USEPA

Comments:

Budget Summary

Investigations into Toxicity of Unknown Cause in the Bay-Delta and Tributary Watersheds

Please provide a detailed budget for each year of requested funds, indicating on the form whether the indirect costs are based on the Federal overhead rate, State overhead rate, or are independent of fund source.

Independent of Fund Source

Year 1												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1A	Project Management: SFEI	1877	53811.06	10030.38	1000	0	50000	0	0	114841.44	97683.79	212525.23
1B	Organizational and Stakeholder Coordination: CVRWQCB						50000			50000.0		50000.00
1C	Technical Editing and Advising: UCD						30000			30000.0		30000.00
2A	Toxic Sample Acquisition: UCD						30000			30000.0		30000.00
2B	Freshwater Toxicity Testing and TIEs: AQUA Science						191500			191500.0		191500.00
2C	Freshwater Toxicity Testing and TIEs: Pacific EcoRisk						81700			81700.0		81700.00
3A	Sediment Toxicity Testing and TIEs: Pacific EcoRisk						130,000.00			130000.0		130000.00
3B	Sediment Toxicity Testing and TIEs: MPSL						130,000.00			130000.0		130000.00
4A	Indigenous Species Tests: UC Davis						40,400.00			40400.0		40400.00
4B	Freshwater Bioassesment: UC Davis						59,600.00			59600.0		59600.00
4C	Benthic Community Analysis: SFEI	60	2661.60	496.12	0	0	0	0	0	3157.72	4,831.63	7989.35
		1937	56472.66	10526.50	1000.00	0.00	793200.00	0.00	0.00	861199.16	102515.42	963714.58

Year 2												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1A	Project Management: SFEI	2001	59,535.15	11,097.35	1000	0	50000	0	0	121632.5	108074.79	229707.29
1B	Organizational and Stakeholder Coordination: CVRWQCB						50,000.00			50000.0		50000.00
1C	Technical editing and advising: UC Davis						31,320.00			31320.0		31320.00
2A	Toxic Sample Acquisition: UC Davis						31,480.00			31480.0		31480.00
2B	Freshwater Toxicity Testing and TIEs: AQUA Science						199,480.00			199480.0		199480.00
2C	Freshwater Toxicity Testing and TIEs: Pacific EcoRisk						84,785.00			84785.0		84785.00
3A	Sediment Toxicity Testing and TIEs: Pacific EcoRisk						135,000.00			135000.0		135000.00
3B	Sediment Toxicity Testing and TIEs: MPSL						132,913.00			132913.0		132913.00
4A	Indigenous Species Tests: UC Davis						42,070.00			42070.0		42070.00
4B	Freshwater Bioassesment: UC Davis						62,930.00			62930.0		62930.00
4C	Benthic Community Analysis: SFEI	60	2794.80	520.95	0	0	0	0	0	3315.75	5,073.43	8389.18
		2061	62329.95	11618.30	1000.00	0.00	819978.00	0.00	0.00	894926.25	113148.22	1008074.47

Year 3												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1A	Project Management: SFEI	2061	63,917.74	11,914.27	1,000.00	5,000.00	50,000.00	0	0	131832.01	116,030.55	247862.56
1B	Organizational and Stakeholder Coordination: CVRWQCB						50,000.00			50000.0		50000.00
1C	Technical editing and advising: UC Davis						32,860.00			32860.0		32860.00
2A	Toxic Sample Acquisition: UC Davis						33,240.00			33240.0		33240.00
2B	Freshwater Toxicity Testing and TIEs: AQUA Science						207,495.00			207495.0		207495.00
2C	Freshwater Toxicity Testing and TIEs: Pacific EcoRisk						88,025.00			88025.0		88025.00
3A	Sediment Toxicity Testing and TIEs: Pacific EcoRisk						140,334.00			140334.0		140334.00
3B	Sediment Toxicity Testing and TIEs: MPSL						135,843.00			135843.0		135843.00
4A	Indigenous Species Tests: UC Davis						43,940.00			43940.0		43940.00
4B	Freshwater Bioassesment: UC Davis						66,310.00			66310.0		66310.00

4C	Benthic Community Analysis: SFEI	60	2934.60	547.01	0	0	0	0	0	3481.61	5,327.21	8808.82
		2121	66852.34	12461.28	1000.00	5000.00	848047.00	0.00	0.00	933360.62	121357.76	1054718.38

Grand Total=3026507.43

Comments.

Budget Justification

Investigations into Toxicity of Unknown Cause in the Bay-Delta and Tributary Watersheds

Direct Labor Hours. Provide estimated hours proposed for each individual.

YEAR 1 Environ. Scientist II 656 Accountant 60 Contract Manager 121 Environmental Analyst III 504 Environ. Scientist I 320 Systems Analyst 216 Senior Scientist 60 YEAR 1 TOTAL 1937 YEAR 2 Environ. Scientist II 656 Accountant 60 Contract Manager 121 Environmental Analyst III 504 Environ. Scientist I 320 Systems Analyst 216 Senior Scientist 60 Graphics Designer 60 GIS Analyst 64 YEAR 2 TOTAL 2061 YEAR 3 Environ. Scientist II 656 Accountant 60 Contract Manager 121 Environmental Analyst III 504 Environ. Scientist I 320 Systems Analyst 216 Senior Scientist 60 Graphics Designer 120 GIS Analyst 64 YEAR 3 TOTAL 2121

Salary. Provide estimated rate of compensation proposed for each individual.

RATES ARE HOURLY SALARIES YEAR 1 Environ. Scientist II 37.80 Accountant 23.10 Contract Manager 24.26 Environmental Analyst III 19.43 Environ. Scientist I 32.03 Systems Analyst 21.53 Senior Scientist 44.36 YEAR 2 Environ. Scientist II 39.69 Accountant 24.26 Contract Manager 25.47 Environmental Analyst III 20.40 Environ. Scientist I 33.63 Systems Analyst 22.60 Senior Scientist 46.58 Graphics Designer 22.38 GIS Analyst 26.46 YEAR 3 Environ. Scientist II 41.67 Accountant 25.47 Contract Manager 26.74 Environmental Analyst III 21.42 Environ. Scientist I 35.31 Systems Analyst 23.73 Senior Scientist 48.91 Graphics Designer 23.50 GIS Analyst 27.78

Benefits. Provide the overall benefit rate applicable to each category of employee proposed in the project.

18.64%

Travel. Provide purpose and estimate costs for all non-local travel.

All travel will be local: attendance of Technical Advisory Committee, Peer Review, and stakeholder group meetings

Supplies & Expendables. Indicate separately the amounts proposed for office, laboratory, computing, and field supplies.

Supplies funds ($5000) are for printing a final report.

Services or Consultants. Identify the specific tasks for which these services would be used. Estimate amount of time required and the hourly or daily rate.

Task 1B: Organizational and Stakeholder Coordination Karen Larsen Central Valley Regional Water Quality Control Board Year 1: Labor (970 hours) - $48,500; Travel - $1,500; TOTAL - $50,000 Year 2: Labor (970 hours) - $48,500; Travel - $1,500; TOTAL - $50,000 Year 3: Labor (970 hours) - $48,500; Travel - $1,500; TOTAL - $50,000 Labor includes an ESIII at ~ 50% Travel funds for attendance of Technical Advisory Committee, Peer Review, and stakeholder group meetings Task 1C: Technical Editing and Advising Victor de Vlaming and staff University of California Davis Year 1: Labor (220 hours) - $27,500; Travel - $1,500; Supplies - $1,000; TOTAL - $30,000 Year 2: Labor (220 hours) - $28,820; Travel - $1,500; Supplies - $1,000; TOTAL - $31,320 Year 3: Labor (220 hours) - $30,360; Travel - $1,500; Supplies - $1,000; TOTAL - $32,860 Labor includes Director at ~ 10%

Travel funds for attendance of Technical Advisory Committee, Peer Review, and stakeholder group meetings Supplies funds for purchase of general office supplies and copying services. Task 2A: Toxic Sample Acquisition Victor de Vlaming and staff University of California Davis Year 1: Labor (880 hours) - $22,800; Supplies - $7,200; TOTAL - $30,000 Year 2: Labor (880 hours) - $23,680; Supplies - $7,800; TOTAL - $31,480 Year 3: Labor (880 hours) - $25,440; Supplies - $7,800; TOTAL - $33,240 Labor includes PGR II at 40%, SRA II at ~ 10% Supplies funds for general laboratory supplies (glassware, SPE columns, chemicals) and office supplies. Task 2B: Aquatic Toxicity Testing and TIEs Jeff Miller and staff AQUA-Science Year 1: Labor (1720 hours) - $124,600; Travel - $8,500; Supplies - $28,400; Services - $30,000; TOTAL - $191,500 Year 2: Labor (1720 hours) - $130,680; Travel - $9,500; Supplies - $29,300; Services - $30,000; TOTAL - $199,480 Year 3: Labor (1720 hours) - $137,595; Travel - $9,500; Supplies - $30,400; Services - $30,000; TOTAL - $207,495 Labor includes Jeff Miller at 20%, Mike Miller at 12%, Technician 1 at 14%, Technician 2 at 40% Travel funds for two people attending national conference (airfare, food, lodging), local meetings, and graphics support for presentations. Supplies include glassware, plasticware, HPLC columns, solvents, SPE columns, reagents, analytical standards, test organisms, ELISA kits, antibodies, enzymes, and equipment maintenance. Services funds are for analytical chemistry, subcontractor to be determined. Task 2C: Aquatic Toxicity Testing and TIEs Stephen Clark and staff Pacific EcoRisk Year 1: Labor (880 hours) - $52,600; Travel - $1,500; Supplies - $7,600; Services - $20,000; TOTAL - $81,700 Year 2: Labor (880 hours) - $55,230; Travel - $1,575; Supplies - $7,980; Services - $20,000; TOTAL - $84,785 Year 3: Labor (880 hours) - $57,992; Travel - $1,654; Supplies - $8,379; Services - $20,000; TOTAL - $88,025 Labor includes Stephen Clark at 14%; Staff Scientist at 24%; and Lab Technician at 10%. Travel funds for attendance of Technical Advisory Committee, Peer Review, and stakeholder group meetings Supplies include glassware, plasticware, columns, reagents, analytical standards, and test organisms. Services funds are for analytical chemistry, subcontractor to be determined. Task 3A: Sediment Toxicity Testing and TIEs Scott Ogle and staff Pacific EcoRisk Year 1: Labor (1350 hours) - $87,250; Travel - $1,500; Supplies - $11,250; Services - $30,000; TOTAL - $130,000 Year 2: Labor (1350 hours) - $91,613; Travel - $1,575; Supplies - $11,813; Services - $30,000; TOTAL - $135,000 Year 3: Labor (1350 hours) - $96,198; Travel - $1,654; Supplies - $12,482; Services - $30,000; TOTAL - $140,334 Labor includes Scott Ogle at 16%, Staff Scientist at 35%, and Lab Technician at 22%. Travel funds for attendance of Technical Advisory Committee, Peer Review, and stakeholder group meetings Supplies include glassware, plasticware, columns, reagents, analytical standards, and test organisms. Services funds are for analytical chemistry, subcontractor to be determined. Task 3B: Sediment Toxicity Testing and TIEs John Hunt and Staff Marine Pollution Studies Lab Year 1: Labor (2528 hours) - $80,000; Travel - $1,500; Supplies - $18,500; Services - $30,000; TOTAL - $130,000 Year 2: Labor (2528 hours) - $82,308; Travel - $1,550; Supplies - $19,055; Services - $30,000; TOTAL - $132,913 Year 3: Labor (2528 hours) - $84,616; Travel - $1,600; Supplies - $19,627; Services - $30,000; TOTAL - $135,843 Labor includes Senior Scientist at 27%, Technician 1 at 59%, Technician 2 at 51% Travel includes local meetings of the Technical Advisory Committee, Peer Review Committee, and planning and data synthesis among the Pis. Supplies include toxicity test organisms and general laboratory supplies to support toxicity testing and TIE work. Services funds are for analytical chemistry, subcontractor to be determined. Task 4A: Indigenous Species Tests Victor de Vlaming and staff UC Davis Year 1: Labor (1190 hours) - $34,200; Travel - $500; Supplies - $5,700; TOTAL - $40,400 Year 2: Labor (1190 hours) - $35,670; Travel - $500; Supplies - $5,900; TOTAL - $42,070 Year 3: Labor (1190 hours) - $38,140; Travel - $500; Supplies - $5,300; TOTAL - $43,940 Labor includes Director at 5%, SRA IV at 5%, PGR II at 55% Travel funds for attendance of Technical Advisory Committee, Peer Review, and stakeholder group meetings Supplies funds for general laboratory supplies (glassware, SPE columns, chemicals) and office supplies. Task 4B: Freshwater Bioassesment Victor de Vlaming and staff UC Davis Year 1: Labor (1560 hours) - $48,100; Travel - $500; Supplies - $11,000; TOTAL - $59,600 Year 2: Labor (1560 hours) - $49,980; Travel - $500; Supplies - $12,450; TOTAL - $62,930 Year 3: Labor (1560 hours) - $53,260; Travel - $1000; Supplies

- $12,050; TOTAL - $66,310 Labor includes Director at 9%, SRA II at 38%, PGR II at 38% Travel funds for attendance of Technical Advisory Committee, Peer Review, and stakeholder group meetings Supplies funds for general laboratory supplies (glassware, chemicals) and office supplies.

Equipment. Identify non-expendable personal property having a useful life of more than one (1) year and an acquisition cost of more than $5,000 per unit. If fabrication of equipment is proposed, list parts and materials required for each, and show costs separately from the other items.

SFEI will not purchase an equipment for this project.

Project Management. Describe the specific costs associated with insuring accomplishment of a specific project, such as inspection of work in progress, validation of costs, report preparation, giving presentatons, reponse to project specific questions and necessary costs directly associated with specific project oversight.

YEAR 1 Subcontracting $18,110.22 Review/Prepare Inv, Qtr Rpt $8,477.31 Track Progress (deliverables, timelines, etc.) $9,077.17 Compile/Prepare Annual Rpts. $4,538.59 Annual Report Production $1,815.43 Technical coordination and Integration $45,028.61 Peer Review coordination $59,077.17 Coordinating/Mang QA Program $30,766.33 Logistical Coordination $9,077.17 Data Mgmt/GIS/Web $26,557.21 YEAR 2 Subcontracting $19,015.09 Review/Prepare Inv, Qtr Rpt $8,901.63 Track Progress (deliverables, timelines, etc.) $9,531.03 Compile/Prepare Annual Rpts. $4,765.52 Annual Report Production $5,936.90 Technical coordination and Integration $47,228.75 Peer Review coordination $59,531.03 Coordinating/Mang QA Program $32,303.21 Logistical Coordination $9,531.03 Data Mgmt/GIS/Web $32,963.11 YEAR 3 Subcontracting $19,963.48 Review/Prepare Inv, Qtr Rpt $9,345.65 Track Progress (deliverables, timelines, etc.) $10,006.50 Compile/Prepare Annual Rpts. $5,003.25 Annual Report Production $15,466.12 Technical coordination and Integration $49,536.94 Peer Review coordination $60,006.50 Coordinating/Mang QA Program $33,916.93 Logistical Coordination $10,006.50 Data Mgmt/GIS/Web $34,610.68

Other Direct Costs. Provide any other direct costs not already covered.

There are no other direct costs.

Indirect Costs. Explain what is encompassed in the overhead rate (indirect costs). Overhead should include costs associated with general office requirements such as rent, phones, furniture, general office staff, etc., generally distributed by a predetermined percentage (or surcharge) of specific costs.

Indirect costs include rent, telephone, office supplies, office equipment, administrative staff, administrative time, and holiday, vacation, and sick time.

Executive Summary

Investigations into Toxicity of Unknown Cause in the Bay-Delta and Tributary Watersheds

Aquatic organism populations in the Delta and its tributary watersheds are in decline due to a number of factors. Over the past 20 years, water and sediment samples collected from the region produced significant mortality to aquatic organisms in laboratory toxicity tests, and a large body of information demonstrates that toxicity tests are reliable qualitative predictors of environmental impacts. Toxicity identification evaluations (TIEs) determined the chemical causes of toxicity in many samples, often implicating organophosphorus pesticides. In many cases, however, the cause of toxicity was unidentified, because TIEs were not conducted or were not successful. Identifying chemicals responsible for toxicity is a crucial step in efforts to improve ecosystem health and is the focus of the proposed project. The proposed 3-year research project will investigate the causes and ecological consequences of toxicity in the Sacramento and San Joaquin Rivers, the Sacramento-San Joaquin Delta and the Northern San Francisco Bay. The proposed study has the following objectives: 1. Develop or refine the tools for identifying cause(s) of toxicity, including refining and modifying toxicity testing procedures as well as refining or developing new TIE and analytical chemistry methods. To successfully manage contaminants, chemicals causing biological effects must be identified. 2. Improve understanding of the ecological relevance of aquatic toxicity by enhancing knowledge of the relationship between laboratory toxicity test results and impacts on aquatic biota including, but not limited to, important salmonid species and their prey communities. 3. Provide data to support remediation and restoration decisions and activities. 4. Assist under-funded monitoring programs in follow-up investigation of toxic samples to identify the cause of toxicity. Many toxicity-monitoring programs in the Sacramento and San Joaquin River watersheds and Bay-Delta system have little or no funding for follow-up investigations on toxic samples. The proposed study is designed to coordinate with these toxicity-monitoring programs. A local technical advisory committee (TAC) and an external peer review panel will direct toxicity testing and TIE work. Determinations of the chemical causes and ecological implications of toxicity will be based on multiple lines of evidence, including TIE results, resident fauna surveys, toxicity testing with indigenous species, chemical analyses, and forensic studies (e.g., examination of land use patterns, hydrology and geology). This project is designed to address CALFED ERP Goal #6, "to improve and maintain water and sediment quality and eliminate, to the extent possible, toxic impacts on organisms in the system, including humans." Information developed in this project will be used to develop management strategies for the Sacramento River Watershed Program (SRWP) and other stakeholder-based efforts, and fulfills major components of the Toxicity of Unknown Cause strategy document being developed by the SRWP.

Proposal

San Francisco Estuary Institute

Investigations into Toxicity of Unknown Cause in the Bay-Delta and Tributary Watersheds

Bruce Thompson, San Francisco Estuary Institute
Karen Larsen, Central Valley Regional Water Quality Control Board
Vic de Vlaming, University of California Davis
Scott Ogle, Pacific EcoRisk
Jeff Miller, AQUA-Science
John Hunt, University of California Davis
Stephen Clark, Pacific EcoRisk

Investigations into Toxicity of Unknown Cause in the Bay-Delta and Tributary Watersheds

A Project Description: Project Goals and Scope of Work

1 Problem Statement

Overview – The San Francisco Estuary, Delta, and Sacramento and San Joaquin Rivers provide critical habitat and migration corridors for a variety of fish, invertebrates and other organisms, including ecologically, economically and recreationally important species. Many of these species are in decline. Over the past 20 years, water and sediment samples collected from these environments have produced significant mortality to aquatic organisms in laboratory toxicity tests [1]. When combined with relevant exposure information, toxicity test results are effective predictors of environmental impacts [2,3], particularly when test results are combined with chemical, biological and bioaccumulation analyses. However, toxicity tests identify specific causes of toxicity only when they are combined with chemical analysis and toxicity identification evaluations (TIEs). TIEs are complex iterative procedures designed to characterize, identify and confirm specific chemical(s) responsible for toxicity.

"Toxicity of unknown cause" (TUC) refers to situations where toxicity was detected, but the cause was not identified. These situations occurred during studies where no TIEs were conducted, TIE results were inconclusive, or the TIE identified a toxicant but the measured concentration did not account for the magnitude of toxicity. Because TUC is a pervasive problem throughout the Sacramento and San Joaquin River watersheds and the Bay-Delta system, the CALFED Bay-Delta program enlisted a group of toxicity testing experts to develop a strategy to address TUC [4]. This strategy document summarizes historic toxicity data from monitoring programs in the Central Valley and Bay-Delta waterways, current toxicity monitoring efforts, TIE issues, and data gaps. Also included in the strategy are discussions of toxicity testing data interpretation, a conceptual model of contaminant effects in the system, and an adaptive management plan.

Toxicity Occurrence and Patterns - Tables 1 through 4 summarize, on a regional basis, the current knowledge of TUC in the Sacramento and San Joaquin River watersheds, the Delta and the Northern San Francisco Bay. In the Sacramento and San Joaquin River watersheds and the Delta several chemical causes of toxicity have been identified including organophosphorus (OP) insecticide-caused toxicity to the Cladoceran crustacean (*Ceriodaphnia dubia*) due to agricultural and urban runoff [5,6,7,8,9,10, 11,12,13]; insecticide-caused toxicity to the cladoceran due to insecticides in rice field drainage [6,14,15]; metals caused toxicity to green algae (*Selenastrum capricornutum*) in the upper Sacramento River watershed [16,17]; and diuron (an herbicide) caused toxicity to the green algae in urban and agricultural runoff [18,19]. Nonetheless, a number of studies noted water column toxicity, but the cause could not be established [6,9,10, 11,12,16,18,19,20,21,22,23,24,25,26,27,28,29]. Additionally, bulk sediment toxicity to the amphipods (*Hyalella azteca*) and sediment elutriate toxicity to cladocera requires further investigation [27,30,31]. In most cases causality was not identified due to narrow study objectives, limited follow-up or inadequate TIE methods (Tables 1-3).

Studies in the Northern San Francisco Bay demonstrated both water column and sediment toxicity (Table 4). Toxicity to mysid shrimp (*Mysidopsis bahia*) was noted in runoff from the Napa River and Grizzley Bay, and intermittently in water samples collected from Pacheco Slough [32]. The Northern San Francisco Bay studies suggest the toxicity in several samples collected during episodic monitoring between 1996 and 1998 was caused by the OP insecticides diazinon and chlorpyrifos. However, all of the toxic samples collected in the 1998-1999 monitoring, and most of the toxic 1999-2000 samples, contained diazinon and chlorpyrifos concentrations below toxic thresholds, suggesting that they were contributing to toxicity in an additive fashion with other unidentified toxicants, or that other constituents were responsible. Bulk sediment toxicity to amphipods and sediment elutriate toxicity to mussel larvae was noted in samples collected from the Napa River and Grizzley Bay primarily during winter [33,34,35,36]. Sediment toxicity has been observed in samples from Castro Cove, Peyton Slough and the San Pablo and Suisun Bays [37]. In many cases, the cause of the toxicity was suspected, but not confirmed through TIEs.

TIE Techniques and Limitations - Many observations of TUC can be linked to standard TIE method limitations. In 1988, USEPA published TIE procedures consisting of three phases designed to identify the chemical(s) responsible for acute toxicity in freshwater samples through characterization, identification and confirmation steps [38,39,40]. TIE procedures were updated to refine the original techniques [41,42,43], identify chronic toxicity [44], and provide procedures for estuarine and marine matrices [45]. TIE procedures have been applied to identify the causes of toxicity in municipal and industrial effluents. However, TIE procedures have been inconsistent in identifying toxicants in surface waters, storm water runoff, bulk sediments and pore waters. Potential reasons for the lack of successful TIEs with these matrices are summarized in Table 5.

The lack of TIE profiles (i.e., chemical fingerprints) for most major use pesticides and other organic and inorganic contaminants is a deficiency that limits the ability of TIE procedures to distinguish chemical causes of toxicity. Development of TIE profiles will require analytical procedures with the sensitivity to detect environmental contaminants at biologically significant concentrations. Procedures are needed to reduce ambient sample matrix interferences. Development of these procedures will require analytical chemists experienced in the analysis of environmental chemicals in a variety of matrices. Access to state-of-the-art analytical equipment will be essential because solutions to the analytical difficulties associated with TIE methods will incorporate improved chemical separation techniques and analytical procedures. Furthermore, identification of previously unidentified toxicants will require an understanding of contaminant interactions. For example, unexpected toxic interactions among OP insecticides, herbicides and metals recently have been reported [46,47,48].

Sediments serve as sinks and sources of contaminants. Understanding the causes of sediment toxicity will require application of TIE techniques, many of which are in early stages of development. While water and sediment are in physical contact and continually exchange contaminants, causes, distribution and temporal patterns of toxicity may vary substantially between the two media. Acute toxicity in the water column frequently manifests over short time periods associated with rain events, thus resulting in pulses of water-soluble contaminants. Sediment toxicity is more persistent, and has been linked to

mixtures of metals and hydrophobic compounds distributed by sediment re-suspension and deposition. This recycling of sediments transports a larger mass of contaminants than does water inflow, and operates on time scales that include contaminants deposited decades ago.

Study Goals/Objectives

1. Develop or refine the tools for identifying cause(s) of toxicity, including refining and modifying toxicity testing procedures as well as refining or developing new TIE and analytical chemistry methods. To successfully manage contaminants, chemicals causing biological effects must be identified.
2. Improve understanding of the ecological relevance of aquatic toxicity by enhancing knowledge of the relationship between laboratory toxicity test results and impacts on aquatic biota including, but not limited to, important salmonid species and their prey communities.
3. Provide data to support remediation and restoration decisions and activities.
4. Assist under-funded monitoring programs in follow-up investigation of toxic samples to identify the cause of toxicity. Many toxicity-monitoring programs in the Sacramento and San Joaquin River watersheds and Bay-Delta system have little or no funding for follow-up investigations on toxic samples. The proposed study is designed to coordinate with these toxicity-monitoring programs.

2 Justification

Conceptual Model - Figure 1 summarizes the conceptual model of ecosystem impacts and the framework for addressing toxicity issues. Toxicity, as assessed employing laboratory or *in situ* toxicity testing methods, may translate to direct and indirect instream species impacts. To reduce or eliminate these impacts on aquatic ecosystem biota, toxicants must be identified.

Adaptive Management - All aspects of this project incorporate adaptive management. The proposed project is framed from information gathered and lessons learned during previous studies. The strategy outlined in Larsen *et al* [4], the basis for the proposed project, was designed to adapt as data are gathered. Additionally, the proposed research project fits into the Ecosystem Restoration Program's adaptive management process (Draft Stage 1 Implementation Plan pg. 8) as illustrated in Figure 2.

3 Approach

Figure 3 outlines the approach to achieve the project objectives. To adaptively manage the proposed project, two panels will be convened to provide expert technical guidance and independent scientific review. A technical advisory committee (TAC) will be formed consisting of project proponents, participants in the Sacramento River Watershed Program (SRWP) Toxicity Focus Group and representatives of related public agencies (i.e., USGS, USEPA, the Department of Fish and Game, the California State Water Resources Control Board [CSWRCB] and the Central Valley and San Francisco Regional Water Boards). After providing guidance on initial study design, the TAC will make 'real time' decisions regarding study processes. This group will review project results and related information as they become available, and modify future tasks accordingly.

The TAC will select an external, independent peer-review committee, with composition subject to approval by CALFED. The committee will consist of five to seven members representing relevant areas of expertise. The peer-review committee will meet at least annually to hear formal presentations of project results, review TAC decisions, and suggest modifications to planned work. This group may assist with interpretive reports. Members will respond to e mail or telephone requests for advice that cannot be resolved by the TAC.

The proposed study design includes two parallel lines of investigations. The first is TIE and analytical chemistry method refinement or development. This will add to the suite of tools that assist in identifying causes of toxicity.

The second line of investigation is evaluation of and response to toxicity detections. Follow-up actions depend on the magnitude of toxicity. When high magnitude toxicity (defined as greater than 50% mortality within 48 hours) occurs, re-testing the original sample, re-sampling the site (to estimate duration of toxicity) and preliminary TIE efforts can be initiated without TAC authorization. The assumption is that high magnitude toxicity warrants further study. If this investigation is inconclusive, the TAC will determine subsequent steps. In cases of moderate toxicity (including chronic mortality and severe sub-lethal responses), re-testing the original sample can be initiated without TAC authorization; however, the TAC will approve all other actions. Follow-up investigation of chronic toxicity will depend on duration, frequency and geographic extent (e.g., frequent cladoceran reproductive impairment throughout the Sacramento River watershed during runoff events warrants investigation while isolated events of reproductive impairment may not).

Quality assurance will be a component of every aspect of the proposed project. A Quality Assurance Project Plan (QAPP) will be developed based on methods employed in regional and national monitoring programs for toxicity testing and chemical analyses [49,50]. The QAPP will be prepared by the project participants, and approved by the TAC and CALFED prior to commencement of work. Each field team and analysis laboratory will employ standard and accepted QA practices. Quality control measures will include blanks, standards, reference materials, control and reference site samples, and ancillary parameter measurements (e.g. dissolved oxygen, ammonia, sulfide) where appropriate. Quality control data submitted to the San Francisco Estuary Institute (SFEI) will be evaluated in relation to QAPP criteria. Data sets out of compliance with established criteria will be submitted for reanalysis or retesting where appropriate. Where remedies are not available, data failing the QAPP criteria will be excluded from the final analyses. QA results will be included in the final report and a summary will be maintained in metadata and data files.

Several lines of investigation will accompany the efforts outlined above to accumulate a 'weight of evidence'. Determining the chemical(s) responsible for toxicity requires using all available information. Work will occur (at the discretion of the TAC) simultaneously in the following areas:

TIEs – These include utilizing standard methods, advanced TIEs and possibly employing new methods developed during the project.

Determine the spatial and temporal variability/distribution/extent of toxicity - Investigations into temporal and spatial patterns of toxicity and associated hydrologic conditions will be included. For example, fixed-date monitoring schedules, while logistically more convenient, may result in characterization of a study site as non-toxic when in fact targeted, event-based sampling based on hydrologic conditions may produce a different conclusion.

Chemical releases and transport (types and locations) – Investigators will examine land use in the watershed to identify potential contaminants. For example, with agricultural land use, cropping and pesticide/fertilizer application patterns, soil types, irrigation patterns, slope and other aspects of geography will be examined. The assistance of county agricultural commissioners, the Department of Pesticide Regulation, farm advisors, pesticide applicators and growers will be sought.

Factors other than contaminants will be considered. Salts, minerals, physical factors (high total suspended solids) and biological factors (pathogens) may contribute to toxicity. Apparent toxicity may be due to a deficiency of a physiologically required element (e.g., poor test organism performance in soft water).

Consider species sensitivity - Toxicological literature will be reviewed to determine the relative toxicity of potential contaminants, including consideration of toxicant additivity and synergism. In addition, employing alternative testing procedures (e.g., different matrices or test species, etc.) may provide additional evidence as to the cause of toxicity.

Chemical analysis – Toxic samples will be analyzed at analytical chemistry laboratories. Frequently, samples contain chemicals that cannot be identified or at concentrations below the reporting or detection limits. This project will require procedure refinement and modification so that lower detection limits are achieved and a wider range of chemicals identified.

Ecological relevance – Habitat and biological assemblage assessment will be employed to determine whether toxicity observed in the laboratory translates to instream impacts. These will be linked with Central Valley Regional Water Quality Control Board (CVRWQCB) and SRWP OP Focus Group studies of assemblages in agriculturally and effluent dominated waterbodies. Toxicity testing with species indigenous to the system watersheds will be conducted. Ecological relevance of sediment toxicity test results will be evaluated by examining species composition and abundances of benthic macro fauna at toxic sites, and by comparison to sediment quality guidelines for sediment contamination concentrations.

Forensic investigations –Current TIE procedures are not always adequate to identify the cause of aquatic life toxicity in waters or sediments. However, without identifying the cause of the toxicity, it is possible to determine its origin and thereby affect control programs. Forensic studies involve a combination of toxicity testing, TIE and chemical analysis results to determine the source of toxic constituents.

Proposed Scope of Work – SFEI will be the lead project proponent and manager. The budget for each task is outlined in Table 7. Below are task summaries. In addition, SFEI and all subcontractors will participate as members of the TAC.

Task 1. Project Management and Administration

1A. General Project Management. SFEI will be responsible for the project administration, tracking and all subcontracting. This includes tracking expenditures, deliverables and timelines. In addition, SFEI will be responsible for coordinating the peer review team, preparation and implementation of the quality assurance and study plans, logistical coordination among investigators, data handling and storage, and report publication.

1B. Organizational and Stakeholder Coordination and Strategy Revision. CVRWQCB staff will be responsible for coordinating the TAC, leading the TAC meetings, producing meeting minutes and revising the strategy document [4] as new information is gathered. CVRWQCB staff will liaison between stakeholder groups (i.e., SRWP Monitoring and Toxics Subcommittee) and the TUC project TAC to relay results to those groups. CVRWQCB staff will assist in coordination with existing monitoring programs in order to acquire toxic samples (see Task 2A).

1C. Technical Editing and Advising. The UC Davis Aquatic Toxicology Laboratory (UCD ATL) will be responsible for technical oversight, assisting with logistical coordination, and serve as technical editor and advisor for annual and final reports.

Task 2. Toxic Water Column Sample Acquisition, Toxicity Testing & TIEs

2A. Toxic Water Column Sample Acquisition. Much of the proposed research relies on obtaining toxic water column and sediment samples. An initial task is to select and implement the following three methods to maximize the probability of obtaining such samples. 1) The project will be coordinated with other monitoring programs (e.g., SRWP, US Geological Survey, Regional Water Quality Control Boards, RMP, NPDES permit dischargers, etc.) that do not include funding for TIEs. Additionally, arrangements will be made to obtain toxic samples on which other laboratories were unable to complete successful TIEs. 2) The TAC will select locations in the Sacramento River, San Joaquin River and Bay-Delta watersheds where TUC has been reported. Project field crews will collect samples from these sites. 3) The TAC will select locations and times where water column or sediment toxicity is expected. These sampling locations and times will be selected based on criteria (e.g., land uses, chemical uses, hydrology, geology, sensitive species habitats, etc.) developed by the TAC. Project field crews will collect samples from these sites.

2B. Conduct Ambient Water Toxicity Testing and TIEs. In coordination with UCD and Pacific EcoRisk (PER), AQUA-Science will conduct toxicity testing on samples collected at sites identified by the TAC. The TAC will review toxicity information on water samples acquired as described in Task 2A. Based on the characteristics (magnitude, duration, frequency, etc.) of the toxicity, the TAC will determine follow-up actions including re-testing, re-sampling, or conducting TIEs to identify the toxicant(s) (Figure 3). The TIE process will be facilitated by development of TIE profiles (e.g. chemical fingerprints) for priority chemical toxicants identified by the TAC. TIE profiles for priority chemicals include a description of any special sampling and storage procedures, the extent of interaction with standard TIE reagents, elution profiles from solid phase extraction and HPLC columns, recoveries in the various TIE processes, along with analytical procedures and chemical spectra for use in TIE confirmation and cause identification. Based on results of standard TIE procedures, the TAC may recommend

advanced TIE procedures including antibody-mediated chemical-specific TIE procedures [51], chemical-specific enzymatic procedures [52], or use of advanced instrumentation including high-resolution mass spectroscopy, NMR and HPLC/MS to identify and confirm toxicants. TIE work will include analytical chemistry conducted by contract laboratories.

Task 2C. Water Column Toxicity Testing and TIEs. In coordination with UCD and AQUA-Science, PER investigators will conduct toxicity testing on samples collected from sites identified by the TAC. The TAC will review toxicity information on all water samples acquired or identified as described in Task 2A. Follow-up and TIE testing will include those outlined in Task 2B.

Task 3. Conduct Ambient Sediment Toxicity Testing and TIEs

Task 3A. Sediment Toxicity Testing and TIEs. In coordination with the Marine Pollution Studies Laboratory (MPSL), PER will conduct sediment toxicity tests and TIEs on samples determined by the TAC. The sediment toxicity tests will be conducted using standard USEPA freshwater test organisms (bulk sediment with *Hyalella azteca* or larval *Chironomus tentans* [53] and elutriates with *Ceriodaphnia dubia* [54]) and standard estuarine test organisms (bulk sediment with *Eohaustorius estuarius* [55] or elutriate with both bivalve [*Mytilus* sp.] embryos [56] and *Americamysis bahia* [57]). Upon observation of toxicity, follow-up activities to identify the cause(s) of toxicity shall follow the TUC Strategy Flowchart (Figure 3).

Phase I TIEs initially will be restricted to procedures that identify toxicity due to non-polar organic constituents, cationic metals, and pyrethroid and OP insecticides. Phase I procedures will be performed on bulk sediment, sediment porewater, or sediment elutriate, as deemed appropriate by the TAC. Based on the results of the Phase I TIEs, selected samples will be subjected to advanced TIEs. TIE work will include analytical chemistry conducted by contract laboratories.

3B. Sediment Toxicity Testing and TIEs. In coordination with PER, MPSL will conduct sediment toxicity testing and TIEs as described in Task 3A. Candidate toxicants identified by the TIEs will be confirmed using advanced instrumentation including high-resolution mass spectroscopy, ICP/MS, NMR, GC/MS/MS, or HPLC/MS/MS.

Task 4. Ecological Relevance Evaluation

4A. Freshwater Bioassessments. The UCD ATL will conduct benthic macroinvertebrate bioassessments at 12 sites determined by the TAC. Each site will be assessed twice per year (spring and early fall).

4B. Indigenous Species Toxicity Testing. As a component of predicting the ecological relevance of water column toxicity with a weight of evidence approach, the UCD ATL will conduct indigenous species toxicity testing on 30 samples collected at sites selected by the TAC. Indigenous species tests will employ *Chironomus tentans, Gammarus daiberi,* and *Simocephalus vetelus* developed by the UCD ATL under a previously funded CALFED project (ERP-99-N08).

4C. Ecological Relevance of Sediment Toxicity. SFEI will evaluate ecological relevance of sediment toxicity test results by examining the species composition and abundances of benthic macro fauna collected from toxic sites, and by comparison to sediment quality

guidelines for sediment contamination concentrations. The relative abundances of contaminant sensitive or tolerant benthic taxa will be used to assess possible ecosystem impacts [58,59]. Together with sediment contamination data, a weight of evidence approach will be used to evaluate sediment condition. For example, if the sediments are toxic, have high contamination, and benthic composition of reduced or tolerant taxa, the toxicity tests will be considered validated. However, abiotic factors (e.g. flows, salinity, sediment-type) can influence the benthos. Therefore, selected abiotic variables will be measured along with benthic sampling. Monthly monitoring by the Department of Water Resources will provide benthic data that may be useful in this assessment.

4 Feasibility

The proposed project is feasible as indicated by the record of successful investigations completed by the project proponents, both individually and in cooperative projects. The investigators offering this proposal have extensive experience conducting the types of analyses proposed. The participating laboratories (AQUA-Science, UCD ATL, MPSL, and PER) have cooperated with the participating agencies (State and Regional Boards, USEPA) in numerous projects involving monitoring surveys, toxicity assessments, and TIE research. Additionally, the development of new TIE methods builds upon continuing efforts undertaken by the proponents over the past 10 years.

5 Performance Measures

Project Activities - Performance measures in this category are numbers of subcontracts executed, TAC meetings held, peer review meetings held, toxicity tests that meet test acceptability criteria and TIEs conducted. A measure of particular importance will be the number of TIEs that account for all of the sample toxicity and identify the cause(s).

Project Outputs – Performance measures in this category are deliverables associated with each task: meeting minutes, the QAPP and study plan, new toxicity testing and TIE methods developed, revised strategy document, guidance document on an approach for investigating TUC, presentations, annual data reports, and the final project report.

Project Outcomes – Performance measures in this category are a more thorough understanding of causes and significance of toxicity, as well as linking water column or sediment toxicity to bioassessment-determined impacts on aquatic ecosystem biota. Scientists and managers can use this information to improve design of toxicity monitoring programs, as well as make informed watershed management decisions. In addition, this project will provide data to support restoration and remediation actions and decisions (see objective #3), as well as enhance coordination among monitoring programs (see objective #4).

Environmental Indicators – Performance measures in this category include generation of data that will assist managers in developing implementation plans for watershed toxicity reduction. While implementation of management measures is outside the scope of this three-year project, data generated will support such actions.

6 Data Handling & Storage

SFEI will be responsible for data management and storage procedures. Data management will utilize procedures developed for the Regional Monitoring Program for

Trace Substances, whose data SFEI has been managing for seven years. Additionally, SFEI has handled data and reporting for the Grasslands Bypass Program since 1996. Data will be transferred to SFEI in Microsoft Excel spreadsheets by the field and laboratory investigators, and compiled into an Oracle database. To minimize data formatting by SFEI, templates and data reporting guidelines will be provided to participating laboratories. Data will be reviewed to ensure that they meet the requirements outlined in the QAPP and are consistent with the required format. The database will be in Microsoft Access for ease of data manipulation and retrieval, and transferred to Oracle for storage upon data validation. Results will be compiled in a cross-tabular format for QA review and reporting, and the final database will be available on SFEI's web site for retrieval.

7 Expected Products/Outcomes

Products expected from the proposed study include the strategy document, methods for new or modified toxicity testing and TIE procedures, quarterly and annual data reports and a final project report, and presentations at the National or NorCal Society of Environmental Toxicology and Chemistry (SETAC) meeting(s).

8 Work Schedule

Some of the proposed work requires coordination with monitoring programs. Thus, the work schedule must be flexible to maximize the numbers of toxic samples processed. All timelines are subject to revision by the TAC. An estimated timeline for project milestones is outlined in Table 6.

B Applicability to CALFED ERP and Science Program Goals and Implementation Plan and CVPIA Priorities

1 ERP, Science Program and CVPIA Priorities

ERP Goals

Goal 1 – At Risk Species and Goal 3 – Harvestable Species: This project focuses on contaminant impacts that may have indirect or direct effects on salmonid species (i.e., effects on prey species and direct rainbow trout toxicity assessment). Many of the species proposed to be employed in toxicity tests under this project serve as surrogates for salmonid food species. In addition, this project includes community assessment of benthic organisms, which also represent food for threatened salmonids.

Goal 4 – Habitats: Although habitats usually are defined as some combination of physical and biotic features, the chemical habitat is important and should not be ignored. The proposed study considers the chemical integrity of critical salmonid habitats (among others) including areas currently being restored and rehabilitated by CALFED agencies.

Goal 6 – Sediment and Water Quality: The goal "to improve and maintain water and sediment quality… and eliminate, to the extent possible, toxic impacts on organisms in the system, including humans" is the major focus of this project. This project proposes to identify and quantify toxic impacts, using this information to develop management strategies in a stakeholder-based program, the SRWP. A strategy to address TUC already is under development.

Science Program Priorities

The proposed project will add to the body of knowledge necessary to understand the role of contaminants in the Bay-Delta ecosystem.

2 Relationship to Other Ecosystem Restoration Projects

The CALFED Ecosystem Restoration Program has funded projects to address: 1) ecosystem water quality including new approaches to identifying toxicity when it occurs (biomarkers in splittail; ERP-99-N07), 2) development of methods for estimating toxicity to species indigenous to Bay-Delta system (ERP-99-N08), 3) an assessment of contaminant effects on smelt (ERP-97-N09), and 4) monitoring contaminant effects on rainbow trout (ERP-01-N22). The proposed project contributes to three ongoing studies by developing strategies to identify causes of toxicity.

In addition to the above-mentioned projects, this project will be coordinated with another proposal being submitted by the US Army Corps of Engineers and UC Berkeley for this round of ERP funding. One of the co-investigators (Dr. Donald Weston) has worked with the proponents of this project throughout the development of the strategy to address TUC and this proposal. Dr. Weston is proposing to use cDNA microarrays as an approach for identifying causes of toxicity. Their approach identifies the toxicant based on the unique gene transcription pattern elicited in exposed organisms. This work is an alternative, complementary approach to the development of TIE procedures proposed herein.

3 Requests for Next-Phase Funding

This proposal is not a request for next-phase funding. It builds on several earlier CALFED funded projects (see section 4 below).

4 Previous Recipients of CALFED Program or CVPIA Funding

SFEI: *ERP-99-N07 Chronic Toxicity of Environmental Contaminants in Sacramento Splittail: A Biomarker Approach* – The project is in its second year. SFEI's component is field sampling and analytical chemistry. The first year of field sampling has been completed. *ERP-99-B06 Assessment of the Ecological and Human Health Impacts of Mercury in the Bay-Delta Watershed* – The project is in its third year. Two years of sampling and chemical analysis have been completed and a final report is in preparation.

CVRWQCB: *ERP-98-C07 Fathead Minnow Toxicity Study* – One year of toxicity monitoring has been completed. Investigators currently are identifying ecological relevance of pathogen infection. *ERP-98-C08 Algae Toxicity Study* – One year of toxicity monitoring has been completed. Investigators currently are refining TIE methods. *ERP-01-N22 Rainbow Trout Toxicity Monitoring* – The CVRWQCB's recipient agreement with CALFED is being negotiated.

UCD: *ERP-99-N08 Assessment of Pesticide Effects on Fish & Their Food Resources in the Sacramento/San Joaquin Delta* - Indigenous species toxicity testing procedures have been developed for: rainbow trout (larval stage), Sacramento splittail (larval stage), the cladoceran species *Simocephalus vetelus*, the midge species *Chironomus riparius* (larval stage) and *C. tentans*, and the amphipod species *Gammarus daiberi*. Methods remain

under development for: the copepod species *Eurytemora vernalis*, amphipods of the genus *Corophium* and the rotifer species *Brachionus calyciflorus*.

5 System-Wide Ecosystem Benefits

The Estuary and Delta provide critical habitat for diverse organisms that support birds, mammals, and early life stages of commercially important marine and anadromous fish. Significant mortality of water column, benthic and epibenthic organisms has been observed in laboratory toxicity tests of Estuary/Delta water and sediments conducted by numerous programs over the past 20 years [1,37]. This toxicity likely impacted and continues to adversely affect aquatic ecosystem biota [1]. Because a variety of factors affect estuarine communities, few attempts have been directed at establishing links between toxicity and effects on biotic communities. Establishing such links is a component of the proposed project.

Causes of toxicity have been suggested through correlation analyses [35], and identification of responsible chemical classes has been accomplished in watersheds, inflows and Delta waterways [1], as well as in highly contaminated Estuary sediments [37]. Effective source control is more probable when specific chemicals causing adverse biological effects are identified. A major focus of the proposed project is identification of causes of toxicity that have been elusive.

By documenting toxicity, identifying temporal and spatial patterns, identifying chemical causes, and determining the sensitivity of resident organisms to causative agents, the proposed project will provide a weight of evidence for predicting contaminant impacts on aquatic biota. Partnering these studies with ecological surveys and bioassessments will allow evaluation of the linkages among the measured parameters.

6 Additional Information for Proposals Containing Land Acquisition

This proposal does not include land acquisition.

C Qualifications

Figure 4 summarizes the relationship among the management, peer review, and technical aspects of the proposed project.

San Francisco Estuary Institute (SFEI): SFEI is a 501(c)(3) non-profit organization created in 1994. The creation of SFEI was prompted by the Comprehensive Conservation and Management Plan (CCMP) for the San Francisco Estuary, adopted by the Governor of California and the USEPA in 1993. SFEI's Mission is to foster development of the scientific understanding needed to protect and enhance the San Francisco Estuary through research, monitoring, and communication.

SFEI is a scientific organization, restricted from advocacy or policy-setting. The Institute's Board of Directors includes key individuals from both public agencies and private organizations with substantial interest in the management of the San Francisco Bay-Delta Estuary. A Committee of Science Advisors provides guidance to the Board and Staff on the need, application and interpretation of scientific information that the Institute's programs provide. SFEI conducts four major programs: Contaminant Monitoring and Research, Wetlands, Watersheds, and Biological Invasions. Two other

Institute components, Historical Ecology and Information Technology, including the EcoAtlas Information System, augment and support the major programs.

For the past nine years, SFEI has managed and administered the Regional Monitoring Program for Trace Substances (RMP), which was begun in 1993 in response to an order of the San Francisco Bay Regional Water Quality Control Board. Currently over 80 federal, state, and local agencies and private companies support the RMP at a level of about $3 million per year. SFEI also conducts program level quality assurance, data management, and reporting for the RMP and its participants. A RMP Steering Committee and SFEI's Board of Directors oversee these activities. A comparable role of management and administration is proposed for the TUC project.

Bruce E. Thompson, Ph.D., Senior Scientist, SFEI Interim Executive Director: Dr. Thompson received his M.A. from the Moss Landing Marine Laboratory, and his Ph.D. in biological sciences from the University of Southern California in 1982. He is currently serving as the Interim Executive Director of the Institute, but is expecting to return soon to his more familiar role as the Senior Scientist where he directs the Contaminant Monitoring and Research Program and is the Chief Scientist for the San Francisco Estuary RMP for Trace Substances. His research has included field and laboratory studies of the ecology of benthic communities and species off southern California and the San Francisco Bay-Delta, how they are affected by contamination, and sediment toxicity. He is a Co-Investigator on the EPA funded CISNet San Pablo Bay Program in collaboration with UC Davis, and is currently working on the EPA EMAP and NOAA sediment assessments in San Francisco Bay and the West Coast. He is a member of the NOAA SF Airport Science Review Panel, and has served on the Science Advisory Board for the State's Bay Protection and Toxic Cleanup Program and the Surface Water Ambient Monitoring Program, the Technical Advisory Panel for the CALFED Delta Dredge Material Re-use Project, was a member of the National Benthic Experts Panel convened by the Washington Department of Ecology in Seattle, and as a Sediment Toxicity Essay Expert Reviewer for NOAA. Dr. Thompson has published numerous peer-reviewed journal articles, a book chapter, and technical reports on his research, which include studies of sediment toxicity from southern California and San Francisco Bay.

Victor L. de Vlaming, Ph.D., UCD ATL: Victor has held tenured faculty teaching/research positions at Marquette University and the University of California, Davis, was a consultant to the California Board of Forestry, and served as a data review scientist at the California Department of Food and Agriculture. From l986 to May 2001, Victor was an environmental scientist with the CSWRCB. In May 2001 he accepted a position as director of the UCD ATL. Victor has authored or co-authored over 140 original research papers, book chapters, and review articles. He has been an invited speaker at several international symposia. He has served on the editorial boards of several international journals. Victor was a member of the first board of directors for the NorCal SETAC. He is an invited member on the national SETAC Expert Advisory Panel on Performance, Evaluation, and Interpretation of Toxicity Testing Data. Victor has served as a training instructor for national SETAC, USEPA, and the CSWRCB. His primary duties at the CSWRCB included design, implementation, management, and data interpretation of surface water monitoring projects throughout California. In his position at the UCD ATL Victor designs and directs investigations into aquatic ecosystem health.

Ms. Karen L. Larsen, Environmental Scientist, CVRWQCB: Karen Larsen received a Bachelor's of Science degree in Biological Sciences from the University of California, Davis. She served as Quality Assurance Officer and Data Manager at the UCD ATL for 5 years. As staff at the UCD ATL, Ms. Larsen mastered techniques in ambient water toxicity testing including USEPA's three-species chronic toxicity test protocols as well as TIE methods. Ms. Larsen also has extensive experience in Enzyme Linked Immunosorbant Assay (ELISA) techniques. Ms. Larsen currently works as an Environmental Scientist for the CVRWQCB in the Sacramento River Watershed Unit where she serves as technical support in the field of aquatic toxicity. This includes management of three CALFED funded toxicity studies: the Fathead Minnow and Algae Toxicity Studies and Rainbow Trout Toxicity Monitoring Study.

Jeffrey L. Miller, Ph.D., DABT, AQUA-Science: Dr. Jeff Miller is President of AQUA-Science, an environmental toxicology consulting and testing company in Davis, CA. He has over 20 years of experience directing large-scale laboratory and field projects involving acute and chronic toxicity tests with over 14 freshwater, estuarine and marine species for NPDES dischargers, private clients including major steel, oil and pesticide companies, and for CSWRCB, USEPA and USFWS. Dr. Miller has developed many innovative TIE approaches including chemical toxicity fingerprinting, antibody-mediated TIE procedures and application of TIE methods to West Coast aquatic species. He is a member of SETAC's TIE Expert Panel, serves as an instructor for USEPA on effluent TIE methods, and has developed and taught advanced TIE workshops at local and national scientific meetings. Dr. Miller has published numerous peer-review papers and case studies on identification of causes of toxicity in ambient waters and effluents.

R. Scott Ogle, Ph.D., Pacific EcoRisk: For almost 17 years, Dr. Scott Ogle has been directing or participating in research in the areas of aquatic ecotoxicology and environmental chemistry. Dr. Ogle's major area of research includes evaluation of the fate and effects of metals, pesticides, and petroleum and petroleum products in aquatic ecosystems 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 development of new testing procedures. Much of Dr. Ogle's recent work has focused on evaluation of contaminated freshwater, estuarine, and marine sediments, and he and his lab staff have established a reputation as being one of the best sediment and aquatic testing lab in California. Dr. Ogle's sediment investigations incorporate the latest developments in study design, sample collection, toxicity and bioaccumulation testing, and interpretation of data. These sediment evaluations also incorporate the latest regulatory recommendations and are consistent with established guidelines.

Stephen Clark, Ph.D., Pacific EcoRisk: Stephen L. Clark has been directing and participating in research and testing for over ten years in the areas of aquatic ecotoxicology and environmental chemistry. Mr. Clark's emphasis for his Ph.D. dissertation research was on the effects of contaminants on aquatic organism at the cellular/biochemical level (e.g., biomarkers). Stephen has also been actively involved in the development of sediment toxicity testing approaches, including sediment-water interface testing, as well as the development of TIE methods for algae. Stephen's professional and academic research has included extensive experience with a suite of

established EPA and ASTM aquatic and sediment toxicity tests, including freshwater, estuarine and marine organisms, with applications to regulatory testing, research and monitoring studies. As the Laboratory Director at PER, Stephen manages daily operations of the PER laboratory, directs field sampling efforts, and is the project director for the SRWP monitoring program. Stephen is also expert in regulatory aspects of aquatic ecotoxicology, and has contributed in the preparation and implementation of Management or Monitoring Plans for San Francisco Bay, the Pacific Coast, Monterey Bay, and the Sacramento River Watershed. Stephen serves as a Board member for NorCal SETAC and has taught several scientific short courses on environmental education.

John W. Hunt, M.S., MPSL, UC Davis: John received his Master of Science degree in Marine Science from the Moss Landing Marine Laboratories in 1987. He has been conducting research in applied toxicology at the Marine Pollution Studies Laboratory at Granite Canyon for 15 years, and has designed and coordinated grant-funded projects in the areas of toxicity test development, sediment quality assessment, toxicity identification, and watershed investigations of biological impacts from contaminated runoff. He has authored or co-authored four of the seven toxicity testing protocols included in the EPA West Coast Toxicity Testing Manual, has been an invited instructor for the Society of Environmental Toxicology and Chemistry course on toxicity testing methods, and is a member of SETAC's expert panel on TIE. He has participated in large multi-investigator assessment programs such as NOAA NS&T, EPA EMAP, and the CSWRCB's BPTCP and SWAMP programs. Through these and other activities he has authored or co-authored more than 35 articles in peer-reviewed scientific journals. He currently serves on the Board of Directors of the SETAC Northern California Chapter.

D Cost

1 Budget

The detailed labor and materials budget for each year is included in the web forms. Table 7 outlines the task budget on a unit cost basis.

2 Cost-Sharing

The SRWP has agreed to contribute $20,000 to fund coordination of the Toxicity Focus Group (the majority of investigators participate in this group), which will oversee and provide feedback to the investigators on this project. In addition, the SRWP Monitoring Subcommittee has agreed to provide technical expertise through regular updates (estimated at approximately $15,000/year). Furthermore, the SRWP Monitoring program will coordinate with this proposed project to supply investigators with toxic samples (estimated at $30,000/year). The SRWP OP Focus Group also will coordinate their 319(h), Proposition 13 and CALFED funded OP and bioassessment monitoring with the proposed project (over $1 million).

USEPA Region 9 has agreed to contribute $40,000 for toxicity monitoring of the San Joaquin River at Vernalis. Chronic toxicity tests will be conducted over time to determine the magnitude and frequency of toxicity at Vernalis. This work will include TIE testing as well. The TUC project TAC will consult with EPA's experts (Dr. Mount and Dr. Burgess) from ORD Duluth and Narragansett labs.

Additionally, USEPA has agreed to coordinate sediment TIE development with the proposed project. The EPA Office of Research and Development, Duluth will be conducting both acute and chronic sediment toxicity tests and possibly TIEs employing *Hyalella* and *Chironomus* on samples from several California sites including both urban and agricultural inputs. The TUC project TAC will consult with EPA's experts (Dr Mount and Ms Norberg-King). This support is offered as in-kind support.

The CVRWQCB San Joaquin River Watershed Unit has agreed to supply toxic samples acquired during their water and sediment toxicity monitoring under the Surface Water Ambient Monitoring Program (estimated toxicity monitoring budget of $75,000/year). Also, the CVRWQCB Sacramento River Watershed Unit will coordinate their biological and habitat assessment monitoring with that conducted under the TUC project (estimated at $200,000). In addition, the CVRWQCB NPDES units have agreed to update project investigators whenever toxicity is detected in receiving waters as part of permit required toxicity monitoring programs.

E Local Involvement

The group initially convened to develop a strategy for addressing TUC was the SRWP Toxicity Focus Group. One of the cornerstones of the SRWP is to promote the activities and missions of local watershed conservancies by providing them with technical assistance, such as monitoring and assessment. SRWP participants recognize that it is at the local level that land use changes occur. Projects similar to the proposed study should be coordinated with these local efforts because watershed restoration activities such as contaminant control strategies are most effective when they are informed by an understanding of current conditions. In addition, the proposed project will coordinate with local entities conducting toxicity monitoring throughout the study area including NPDES dischargers, cities and counties.

F Compliance with Standard Terms and Conditions

SFEI will be the primary contracting entity with CALFED. The standard terms and conditions are acceptable to SFEI.

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Figure 1. Conceptual model of ecosystem impacts and framework for addressing toxicity issues.

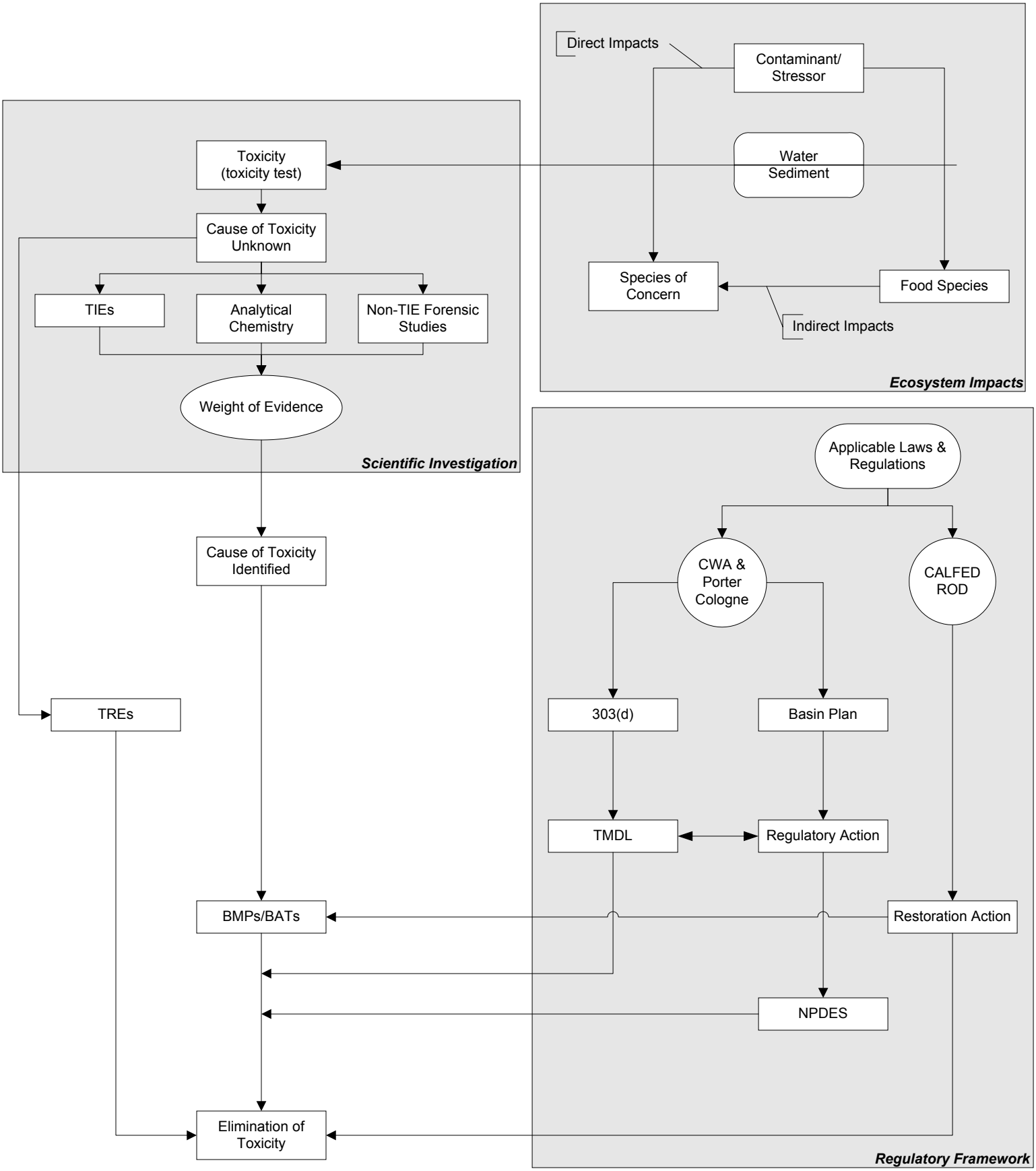
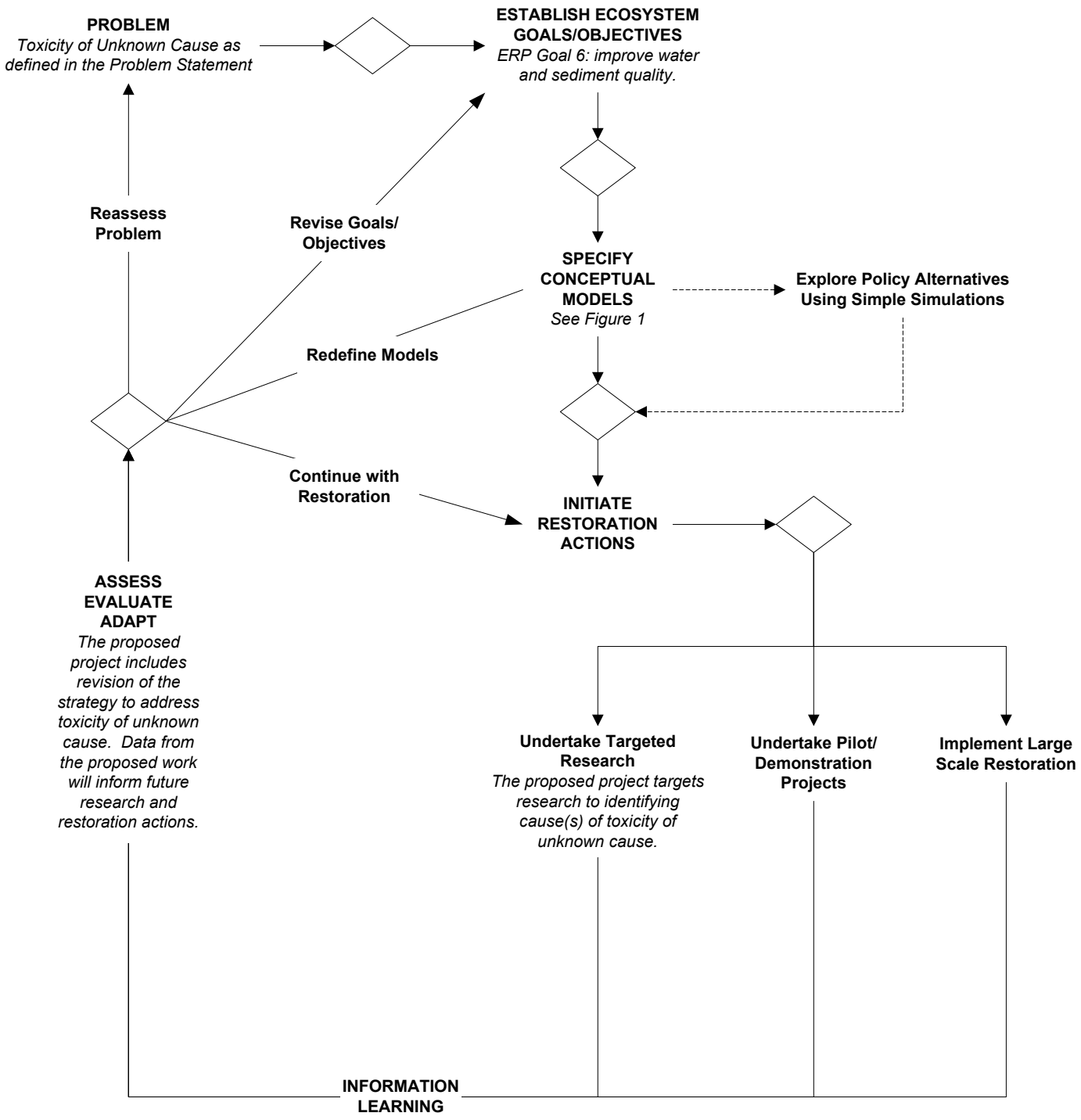


Figure 2. Fit of proposed project into ERP adaptive management process (flowchart summary).



Note: Bold text taken from ERP Adaptive Management Process (Draft Stage 1 Implementation Plan pg. 8). Italics identify how the proposed project fits the ERP adaptive management model.

Figure 3. Approach to achieving the proposed study objectives (flowchart summary).

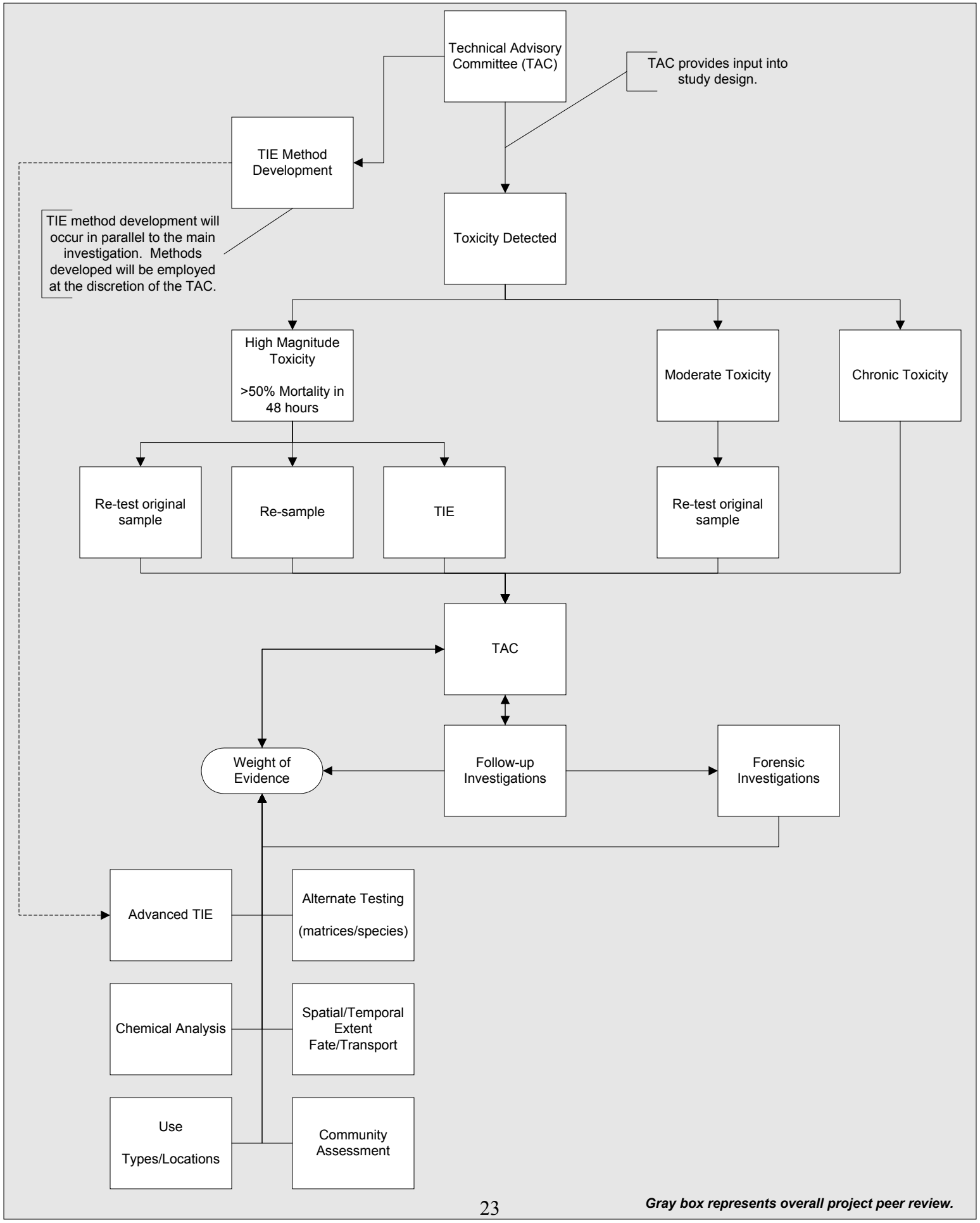
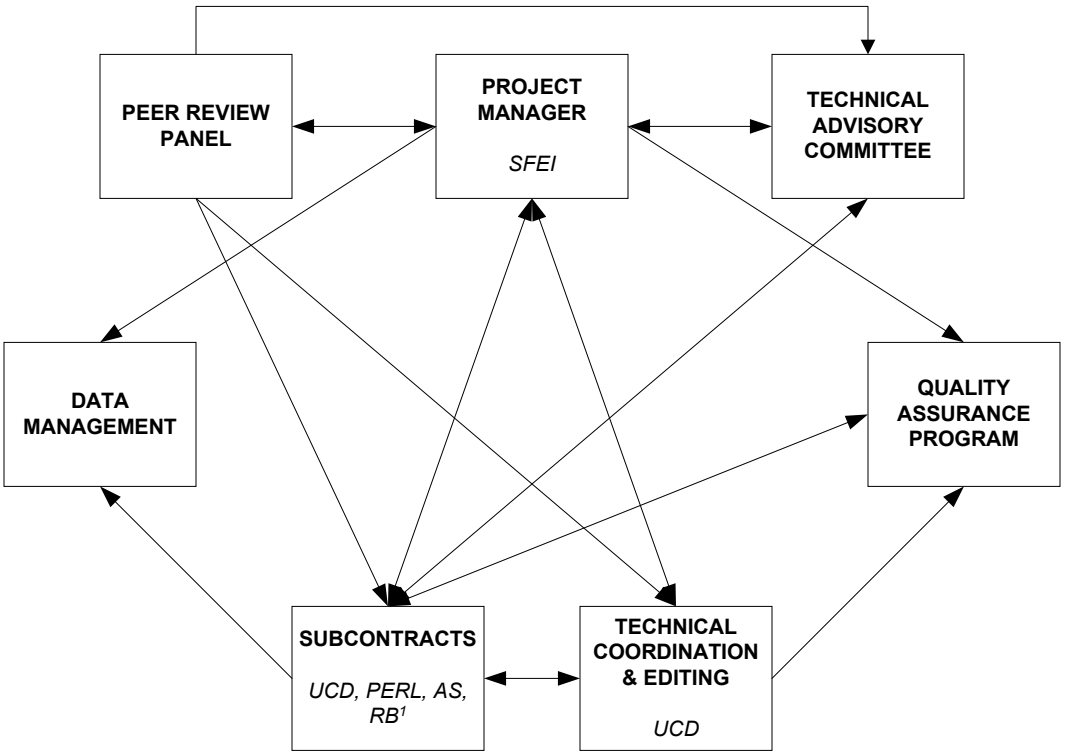


Figure 4. Project management and organization (summary diagram).



1 UCD = UC Davis (includes Aquatic Toxicology Lab & Marine Pollution Studies Lab); PERL = Pacific EcoRisk Laboratory; AS = AQUA *Science*; RB = Regional Board.

Table 1. Summary of TUC incidents in the Sacramento River watershed.

Matrix	Ref. No.	Description of TUC	Magnitude of Toxicity	Reason Cause is Unknown
Water Column	[16]	Widespread, intermittent *P. promelas* toxicity	Mainly less than 100% mortality in 20% of samples collected	No follow-up TIEs
		Intermittent *S. capricornutum* toxicity except in ag. drains	Impairment in 50% of samples collected from American & Feather Rivers	No follow-up TIEs
	[24]	*S. capricornutum* toxicity in urban drainages during runoff events	Up to 80% reduction in algal growth	TIE identified toxicants, but concentration did not account for magnitude
	[21]	*P. promelas* toxicity detected in Strong Ranch Slough during runoff events	Less than 100% mortality observed	TIEs attempted – toxicity not persistent
	[18]	Widespread, intermittent *P. promelas*	Always less than 100% mortality	TIEs attempted – toxicity not persistent
		Widespread *C. dubia* reproductive impairment	Up to 75% reduction in reproduction in most samples collected during high flows	No follow-up TIEs
		S. capricornutum toxicity in Arcade Creek	Up to 50% reduction in cell number in 50% of samples collected	TIE identified toxicants, but concentration did not account for magnitude
	[25]	*O. mykiss* toxicity in Sacramento urban drainages during runoff events	Up to 100% mortality in all samples collected during first flush rain event	No follow-up TIEs
	[19]	Widespread, intermittent *P. promelas* toxicity	Less than 100% mortality in 13% of samples collected	TIEs attempted – toxicity not persistent
		Widespread *C. dubia* reproductive impairment	Up to 50% reduction in reproduction in over 50% of samples collected during high flows	No follow-up TIEs
	[20]	Widespread, intermittent *P. promelas* toxicity	Less than 100% mortality in 10% of the samples collected	TIEs inconclusive
		Widespread, intermittent *C. dubia* reproductive impairment	Up to 60% reduction in reproduction in 10% of samples collected	No follow-up TIEs
	[22]	Widespread, intermittent *P. promelas* toxicity in Cache Cr. at Rumsey Br. and in Putah Creek during runoff events	Up to 40% mortality in 40% of the samples collected from Cache Creek at Rumsey; up to 100% mortality in samples collected from Putah Creek during runoff events.	TIEs conducted. All TIEs were inconclusive.
		Widespread, intermittent *C. dubia* reproductive impairment in Cache Creek.	Up to 90% reduction in reproduction in 14% of the samples collected.	TIEs attempted in some cases. All TIEs were inconclusive.
	[23]	Widespread, intermittent *C. dubia* reproductive impairment	Up to 50% reduction in reproduction in 15% of samples collected	TIE attempted – toxicity not persistent
Sediment	[30]	Bulk sediment toxicity to *H. azteca* & elutriate water toxicity to *C. dubia*, *O. mykiss* & *P. promelas*	Average of 58% *H. azteca* mortality, 100% *C. dubia* mortality & 90% *O. mykiss* mortality	Metals suspected, but no confirmation TIEs conducted.
	[31]	Bulk sediment toxicity to *H. azteca* and sediment elutriate toxicity to *C. dubia*	50% of samples tested were toxic to *H. azteca* with normalized % mortality from 22-71%; 50% of samples tested were toxic to *C. dubia* with 100% mortality in one sample and 50% reduction in reproduction	No follow-up TIEs; no available chemistry data

Note: Widespread toxicity refers to the entire watershed rather than specific sites.

Table 2. Summary of TUC incidents in the San Joaquin River watershed.

Matrix	Ref. No.	Description of TUC	Magnitude of Toxicity	Reason Cause is Unknown
Water Column	[6]	Widespread, intermittent *S. capricornutum* impairment	Up to 90% reduction in chlorophyll a production in 5% of the samples collected	No follow-up TIEs
	[9]	*C. dubia* reproductive impairment in ag. drains	Up to 60% reduction in reproduction over 5-mo. period	No follow-up TIEs
	[27]	*P. promelas* toxicity in San Luis Drain, Salt Slough & Mud Slough	Up to 60% mortality between October '98 and March '99	No follow-up TIEs
	[26-29]	*S. capricornutum* impairment in San Luis Drain, Mud Slough & Salt Slough	Up to 75% reduction in cell number in 50% of the samples collected between 1996 & 2000	No follow-up TIEs
Sediment	[31]	Bulk sediment toxicity to *H. azteca* and sediment elutriate toxicity to *C. dubia*	67% of samples tested were toxic to *H. azteca*, with normalized 35% mortality; 67% of samples tested were toxic to *C. dubia* with 80% mortality in one sample and 40% reduction in reproduction in the other	No follow-up TIEs; no available chemistry data

Table 3. Summary of TUC incidents in the Sacramento-San Joaquin Delta.

Matrix	Ref. No.	Instances of TUC	Magnitude of Toxicity	Reason Cause is Unknown
Water Column	[10-12]	Intermittent *S. capricornutum* impairment in Old R. at Tracy, Paradise Cut, Delta Mendota Canal & Victoria Is. Drain as well as urban drainages	Up to 50% reduction in cell number in 50% of the samples collected	TIEs inconclusive or toxicant concentration did not account for magnitude of toxicity observed.
		M. bahia toxicity in samples collected from Mallard Island	Significant mortality in 14% of the samples collected; >50% mortality in 11% of samples collected	Analytical chemistry detected diazinon & chlorpyrifos at concentrations too low to explain magnitude of toxicity; No follow-up TIEs
Sediment	[31]	Bulk sediment toxicity to *H. azteca* and sediment elutriate toxicity to *C. dubia*	100% of samples tested to toxic to *H. azteca*, with normalized mortality from 10-55%; 100% of samples tested were toxic to *C. dubia* with 68-100% reduction in reproduction	No follow-up TIEs; no available chemistry data

Table 4. Summary of TUC incidents in the Northern San Francisco Bay.

Matrix	Ref. No.	Instances of TUC	Magnitude of Toxicity	Reason Cause is Unknown
Water Column		Chronic toxicity to estuarine mysid (*Mysidopsis bahia)* in samples collected from Pacheco Slough during storm events	5 of 13 samples (1997-1998) 3 of 11 samples (1998-1999) 3 of 12 samples (1999-2000)	No TIEs performed No TIEs performed No TIEs performed, one sample with chlorpyrifos above LC_{50}.
	[32]	Chronic toxicity to estuarine mysid (*Mysidopsis bahia)* in samples collected from Napa River during storm events	2 of 10 samples (1998-1999) with 100% mortality in 48 hrs and in 24 hrs upon re-test 2 of 11 samples (1999-2000)	No TIEs performed No TIEs performed; one sample with diazinon or chlorpyrifos above the LC_{50}
		Chronic toxicity to estuarine fish (*Menidia beryllina*) during non-stormwater study of Napa River	3 samples toxic (complete mortality), with two samples causing complete mortality within 48 hours 2 samples (8/00 and 9/00) resulting in complete mortality	No TIEs performed Limited TIE suggests toxicity associated with suspended particulates, presumably contaminants associates with particulates
Sediment	[33-35]	Grizzley Bay RMP site solid-phase sediment toxic to amphipods	Toxic in 7 of 15 RMP surveys since 1993: 5 of 7 winter; 2 of 8 summer (1999 and 2000).	Solid-phase TIEs conducted. Solid-phase more toxic than porewater. No indication of toxicity due to non-polar organics. Toxicity removed by weak-acid leaching, possibly implicating metals. Multivariate correlations with Cu, Ag, and Chlordanes.
	[35, 36]	Grizzley Bay RMP site sediment elutriate toxic to bivalves	Toxic in 14 of 15 RMP surveys since 1993.	TIEs conducted in sediment elutriate and overlying water. Chemistry and TIE indicate toxicity most likely due to copper in combination with other metals.
	[35]	Napa River RMP site solid-phase sediment toxic to amphipods	Toxic in 7 of 15 RMP surveys since 1993: 5 of 7 winter; 2 of 8 summer (1999 and 2000).	No TIEs conducted. Multivariate correlations with Pb, Ag, Cd, and Chlordanes.
		Napa River RMP site sediment elutriate toxic to bivalves	Toxic in 8 of 15 RMP surveys since 1993	No TIEs conducted. No significant multivariate correlations.
	[37]	Peyton Slough BPTCP site solid-phase sediment toxic to amphipods; porewater and overlying water toxic to sea urchin larvae.	Toxic to amphipods at 4 of 4 sites along gradient. Toxic to sea urchins in 3 of 4 tests.	TIE conducted on porewater. Toxicity to urchins due to Cu and Zn. Possible NH_3 toxicity to amphipods.
		Castro Cove BPTCP site solid-phase sediment toxic to amphipods	Toxic in 2 BPTCP surveys and multiple previous surveys.	No TIEs conducted. Site highly contaminated with PAHs.

Matrix	Ref. No.	Instances of TUC	Magnitude of Toxicity	Reason Cause is Unknown
		Of 28 sites in BPTCP toxicity screening surveys in Suisun and San Pablo Bays, 2 sites (Vallejo and Suisun Bay Reserve Fleet) were toxic to amphipods.	Moderate toxicity: 73% and 71% survival.	No TIEs conducted.
		Of 28 sites in BPTCP toxicity screening surveys in Suisun and San Pablo Bays, 14 sites (50%) had porewater toxic to bivalves.	Varied from moderate to complete.	No TIEs conducted. H_2S and NH_3 above toxicity thresholds in some cases.

Table 5. Deficiencies of TIE procedures for identification of ambient toxicity caused by unknown constituents.

Category	*Herbicides*	*OP Insecticides*	*Pyrethroid Insecticides*
TIE Procedures	No published Phase I or II TIE profiles for major-use herbicides	Phase I and II TIE profiles published for only a few OPs e.g. diazinon, chlorpyrifos and carbaryl	No published Phase I and II TIE procedures for major use pyrethroids
Analytical Methods	Multiple analytical procedures needed to analyze different chemical classes of herbicides	Difficult to quantify in samples with matrix interferences	Inadequate sensitivity of analytical procedures
Other Considerations	TIE reagents not compatible with algal toxicity test method	Toxic interactions with metals and herbicides in ambient samples are poorly understood	Sampling and handling procedures not optimized for recovery TIE procedures difficult to apply to bulk sediment
	Multiple toxicants present in a sample make toxicant identification difficult and expensive.		

Table 6. Summary of the estimated project timeline.

Component Project	Timeline
Project Management	Entire Project Period
Subcontracts	Within 6 mo. of recipient agreement execution
QAPP	Within 3 months of subcontract execution
Study Plan	Within 3 months of subcontract execution
Coordinate TAC	Entire Project Period
Coordinate Peer Review	Entire Project Period
Revise Strategy Document	Yearly
Annual Report	Yearly
Final Project Report	End of Project Period
Acquire Toxic Samples	Upon Subcontract Execution and QAPP development
Water Column Toxicity Testing & TIEs	Upon Subcontract Execution and QAPP development
Sediment Toxicity Testing & TIEs	Upon Subcontract Execution and QAPP development
Ecological Relevance	Upon Subcontract Execution and QAPP development

Table 7. Estimated year 1 budget on a unit cost basis for the TUC project.

	Task	Contractor	Units	# of Units	Unit Cost 2	Travel	Serv/Consult.	Total Cost
Task 1. Project Management								
1A	1. Subcontracting	SFEI	hours[1]	205	$ 88.29			$ 18,099.65
	2. Review/Prepare Invoices & Quarterly Reports	SFEI	hours[1]	96	$ 88.25			$ 8,472.36
	3. Track Progress (i.e., deliverables, timelines, etc.)	SFEI	hours[1]	80	$ 113.40			$ 9,071.88
	4. Compile/Prepare Annual Reports	SFEI	hours[1]	40	$ 113.40			$ 4,535.94
	5. Annual Report Production	SFEI	hours[1]	16	$ 113.40			$ 1,814.38
	6. Technical Coordination and Integration	SFEI	hours[1]	528	$ 83.34	$ 1,000.00		$ 45,002.92
	7. Peer Review Coordination	SFEI	hours[1]	80	$ 113.40		$ 50,000.00	$ 59,071.88
	8. Coordinating/Managing QA Program	SFEI	hours[1]	320	$ 96.09			$ 30,748.38
	9. Logistical Coordination	SFEI	hours[1]	80	$ 113.40			$ 9,071.88
	10. Data Mgmt./GIS/Web	SFEI	hours[1]	432	$ 61.44			$ 26,541.72
1B	1. Coordinate TAC	CVRWQCB	hours[1]	700	$ 50.00	$ 1,500.00		$ 36,500.00
	2. Revise strategy document	CVRWQCB	hours[1]	170	$ 50.00			$ 8,500.00
	3. Liaison to stakeholders	CVRWQCB	hours[1]	100	$ 50.00			$ 5,000.00
1C	1C. Technical Editing & Advising	UCD	hours[1]	228	$ 125.00	$ 1,500.00		$ 30,000.00
							TASK TOTAL =	**$ 292,430.99**
Task 2. Aquatic Toxicity Testing & TIEs								
2A	1. Coordinate acquisition of "other's" toxic samples	UCD	hours[1]	125	$ 24.00			$ 3,000.00
	2. Acquire pre-selected routine samples	UCD	samples	60	$ 225.00			$ 13,500.00
	3. Acquire pre-selected event-based samples	UCD	samples	60	$ 225.00			$ 13,500.00
2B	1. Sampling Design & Coord.	AS	hours[1]	40	$ 80.00			$ 3,200.00
	2. Chronic Toxicity Testing (cerio or fathead)	AS	tests	50	$ 650.00			$ 32,950.00
	3. Acute Phase I TIEs	AS	TIEs	20	$ 1,500.00		$ 10,000.00	$ 40,250.00
	4. Advanced TIEs	AS	TIEs	10	$ 4,000.00		$ 10,000.00	$ 49,200.00
	5. TIE Profiles	AS	profiles	5	$ 5,000.00		$ 10,000.00	$ 36,850.00
	6. ELISA, antibody procedures, HPLC fractionation	AS	samples	147	$ 75.00			$ 11,050.00
	7. Reporting & TAC participation	AS	hours[1]	100	$ 95.00	$ 8,500.00		$ 18,000.00
2C	1. Sampling Design & Coord.	PERL	hours[1]	40	$ 85.00	$ 1,500.00		$ 4,900.00
	2. Chronic *Ceriodaphnia* test	PERL	tests	37	$ 650.00			$ 24,400.00
	3a. Acute Phase I TIEs	PERL	TIEs	9	$ 1,500.00		$ 10,000.00	$ 23,000.00
	3b. Advanced TIEs	PERL	TIEs	4	$ 4,000.00		$ 10,000.00	$ 26,000.00
	4. Reporting	PERL	hours[1]	40	$ 85.00			$ 3,400.00
							TASK TOTAL =	**$ 303,200.00**
Task 3. Sediment Toxicity Testing & TIEs								
3A	1. Sampling Design & Coord.	PERL	hours[1]	50	$ 125.00	$ 1,500.00		$ 7,750.00
	2a. 10-d *Hyallela* bulk sediment test	PERL	tests	24	$ 850.00			$ 20,400.00
	2b. Chronic *Ceriodaphnia* elutriate test	PERL	tests	24	$ 650.00			$ 15,600.00
	3a. Phase I TIEs	PERL	TIEs	6	$ 4,000.00		$ 10,000.00	$ 34,000.00
	3b. Advanced TIEs	PERL	TIEs	4	$ 3,500.00		$ 10,000.00	$ 24,000.00
	3c. New TIE methods	PERL	TIEs	3	$ 4,000.00		$ 10,000.00	$ 22,000.00
	4. Reporting	PERL	hours[1]	50	$ 125.00			$ 6,250.00
3B	1. Sampling Design & Coord.	MPSL	hours[1]	60	$ 45.00	$ 1,500.00		$ 4,200.00
	2a. *Hyalella* bulk sediment test	MPSL	tests	12	$ 860.00			$ 10,210.00
	2b. *Ceriodaphnia* elutriate test	MPSL	tests	12	$ 650.00			$ 7,800.00
	3a. *Eohaustorius* bulk sediment test	MPSL	tests	15	$ 800.00			$ 12,000.00
	3b. *Mytilus* elutriate toxicity test	MPSL	tests	15	$ 650.00			$ 9,750.00
	4. Phase I TIEs	MPSL	TIEs	5	$ 4,000.00		$ 10,000.00	$ 30,020.00
	5. Advanced TIEs	MPSL	TIEs	4	$ 3,500.00		$ 10,000.00	$ 24,000.00
	6. New TIE methods	MPSL	TIEs	3	$ 4,000.00		$ 10,000.00	$ 22,000.00
	7. Reporting	MPSL	hours[1]	85	$ 117.88			$ 10,020.00
							TASK TOTAL =	**$ 260,000.00**
Task 4. Ecological Relevance Evaluation								
4A	Indigenous species tests (3 species/sample)	UCD	tests	40	$ 997.50	$ 500.00		$ 40,400.00
4B	1. Bioassessment	UCD	sites	24	$ 1,937.50	$ 500.00		$ 47,000.00
	2. Site Reconnaisance	UCD	hours[1]	91	$ 33.00			$ 3,000.00
	3. Reporting	UCD	hours[1]	160	$ 60.00			$ 9,600.00
4C	Benthic Community Analysis	SFEI	hours[1]	60	$ 133.08			$ 7,984.69
							TASK TOTAL =	**$ 107,984.69**
							TOTAL YEAR 1 BUDGET	**$ 963,615.68**

1. Hourly rates represent an average of all classifications working on the task.
2. The unit cost estimates includes supplies.

Note: The budget for the tasks conducted by UCD was calculated according to a 10% overhead charge. The 10% rate will be charged if funding is from State sources; however, if funding is from Federal sources, then the overhead rate increases to 48%. This increased overhead rate would decrease the amount of work UCD could conduct by 1/4 (assuming their total budget stays the same).

Table 7 (continued). Estimated year 2 budget on a unit cost basis for the TUC project.

	Task	Contractor	Units	# of Units	Unit Cost 2	Travel	Serv/Consult.	Total Cost
Task 1. Project Management								
1A	1. Subcontracting	SFEI	hours[1]	205	$ 92.70			$ 19,003.99
	2. Review/Prepare Invoices & Quarterly Reports	SFEI	hours[1]	96	$ 92.67			$ 8,896.44
	3. Track Progress (i.e., deliverables, timelines, etc.)	SFEI	hours[1]	80	$ 119.07			$ 9,525.47
	4. Compile/Prepare Annual Reports	SFEI	hours[1]	40	$ 119.07			$ 4,762.74
	5. Annual Report Production	SFEI	hours[1]	76	$ 78.07			$ 5,933.44
	6. Technical Coordination and Integration	SFEI	hours[1]	528	$ 87.50	$ 1,000.00		$ 47,201.77
	7. Peer Review Coordination	SFEI	hours[1]	80	$ 119.07		$ 50,000.00	$ 59,525.47
	8. Coordinating/Managing QA Program	SFEI	hours[1]	320	$ 100.89			$ 32,284.36
	9. Logistical Coordination	SFEI	hours[1]	80	$ 119.07			$ 9,525.47
	10. Data Mgmt./GIS/Web	SFEI	hours[1]	432	$ 76.26			$ 32,943.87
1B	1. Coordinate TAC	CVRWQCB	hours[1]	700	$ 50.00	$ 1,500.00		$ 36,500.00
	2. Revise strategy document	CVRWQCB	hours[1]	170	$ 50.00			$ 8,500.00
	3. Liaison to stakeholders	CVRWQCB	hours[1]	100	$ 50.00			$ 5,000.00
1C	1C. Technical Editing & Advising	UCD	hours[1]	220	$ 131.00	$ 1,500.00		$ 31,320.00
							TASK TOTAL =	**$ 310,923.02**
Task 2. Aquatic Toxicity Testing & TIEs								
2A	1. Coordinate acquisition of "other's" toxic samples	UCD	hours[1]	120	$ 26.00			$ 3,120.00
	2. Acquire pre-selected routine samples	UCD	samples	60	$ 236.33			$ 14,180.00
	3. Acquire pre-selected event-based samples	UCD	samples	60	$ 236.33			$ 14,180.00
2B	1. Sampling Design & Coord.	AS	hours[1]	40	$ 86.25			$ 3,450.00
	2. Chronic Toxicity Testing (cerio or fathead)	AS	tests	50	$ 726.00			$ 36,300.00
	3. Acute Phase I TIEs	AS	TIEs	20	$ 1,675.00		$ 10,000.00	$ 43,500.00
	4. Advanced TIEs	AS	TIEs	9	$ 4,291.11		$ 10,000.00	$ 48,620.00
	5. TIE Profiles	AS	profiles	5	$ 5,342.00		$ 10,000.00	$ 36,710.00
	6. ELISA, antibody procedures, HPLC fractionation	AS	samples	140	$ 77.93			$ 10,910.00
	7. Reporting & TAC participation	AS	hours[1]	100	$ 104.90	$ 9,500.00		$ 19,990.00
2C	1. Sampling Design & Coord.	PERL	hours[1]	40	$ 89.25	$ 1,575.00		$ 5,145.00
	2. Chronic *Ceriodaphnia* test	PERL	tests	37	$ 692.43			$ 25,620.00
	3a. Acute Phase I TIEs	PERL	TIEs	9	$ 1,547.78		$ 10,000.00	$ 23,930.00
	3b. Advanced TIEs	PERL	TIEs	4	$ 4,130.00		$ 10,000.00	$ 26,520.00
	4. Reporting	PERL	hours[1]	40	$ 89.25			$ 3,570.00
							TASK TOTAL =	**$ 315,745.01**
Task 3. Sediment Toxicity Testing & TIEs								
3A	1. Sampling Design & Coord.	PERL	hours[1]	50	$ 131.25	$ 1,575.00		$ 8,137.50
	2a. 10-d *Hyallela* bulk sediment test	PERL	tests	24	$ 892.50			$ 21,420.00
	2b. Chronic *Ceriodaphnia* elutriate test	PERL	tests	24	$ 682.50			$ 16,380.00
	3a. Phase I TIEs	PERL	TIEs	6	$ 4,200.00		$ 10,000.00	$ 35,200.00
	3b. Advanced TIEs	PERL	TIEs	4	$ 3,675.00		$ 10,000.00	$ 24,700.00
	3c. New TIE methods	PERL	TIEs	3	$ 4,200.00		$ 10,000.00	$ 22,600.00
	4. Reporting	PERL	hours[1]	50	$ 131.25			$ 6,562.50
3B	1. Sampling Design & Coord.	MPSL	hours[1]	60	$ 46.33	$ 1,550.00		$ 4,330.00
	2a. *Hyalella* bulk sediment test	MPSL	tests	12	$ 855.19			$ 10,262.22
	2b. *Ceriodaphnia* elutriate test	MPSL	tests	12	$ 660.00			$ 7,920.00
	3a. *Eohaustorius* bulk sediment test	MPSL	tests	15	$ 855.19			$ 12,827.78
	3b. *Mytilus* elutriate toxicity test	MPSL	tests	15	$ 660.00			$ 9,900.00
	4. Phase I TIEs	MPSL	TIEs	5	$ 4,100.00		$ 10,000.00	$ 30,500.00
	5. Advanced TIEs	MPSL	TIEs	4	$ 3,639.00		$ 10,000.00	$ 24,556.00
	6. New TIE methods	MPSL	TIEs	3	$ 4,100.00		$ 10,000.00	$ 22,300.00
	7. Reporting	MPSL	hours[1]	212	$ 48.67			$ 10,317.00
							TASK TOTAL =	**$ 267,913.00**
Task 4. Ecological Relevance Evaluation								
4A	Indigenous species tests (3 species/sample)	UCD	tests	40	$ 1,039.25	$ 500.00		$ 42,070.00
4B	1. Bioassessment	UCD	sites	24	$ 2,181.25	$ 500.00		$ 52,850.00
	2. Site Reconnaisance	UCD	hours[1]	0	$ 33.00			$ -
	3. Reporting	UCD	hours[1]	160	$ 63.00			$ 10,080.00
4C	Benthic Community Analysis	SFEI	hours[1]	60	$ 139.74			$ 8,384.29
							TASK TOTAL =	**$ 113,384.29**
							TOTAL YEAR 2 BUDGET	**$ 1,007,965.31**

1. Hourly rates represent an average of all classifications working on the task.
2. The unit cost estimates includes supplies.

Note: The budget for the tasks conducted by UCD was calculated according to a 10% overhead charge. The 10% rate will be charged if funding is from State sources; however, if funding is from Federal sources, then the overhead rate increases to 48%. This increased overhead rate would decrease the amount of work UCD could conduct by 1/4 (assuming their total budget stays the same).

Table 7 (continued). Estimated year 3 budget on a unit cost basis for the TUC project.

	Task	Contractor	Units	# of Units	Unit Cost 2	Travel	Serv/Consult.	Total Cost
Task 1. Project Management								
1A	1. Subcontracting	SFEI	hours[1]	205	$ 97.33			$ 19,951.83
	2. Review/Prepare Invoices & Quarterly Reports	SFEI	hours[1]	96	$ 97.29			$ 9,340.19
	3. Track Progress (i.e., deliverables, timelines, etc.)	SFEI	hours[1]	80	$ 125.01			$ 10,000.66
	4. Compile/Prepare Annual Reports	SFEI	hours[1]	40	$ 125.01			$ 5,000.33
	5. Annual Report Production	SFEI	hours[1]	76	$ 203.42			$ 15,460.02
	6. Technical Coordination and Integration	SFEI	hours[1]	528	$ 91.87	$ 1,000.00		$ 49,508.62
	7. Peer Review Coordination	SFEI	hours[1]	80	$ 125.01		$ 50,000.00	$ 60,000.66
	8. Coordinating/Managing QA Program	SFEI	hours[1]	320	$ 105.93			$ 33,897.14
	9. Logistical Coordination	SFEI	hours[1]	80	$ 125.01			$ 10,000.66
	10. Data Mgmt./GIS/Web	SFEI	hours[1]	432	$ 80.07			$ 34,590.49
1B	1. Coordinate TAC	CVRWQCB	hours[1]	700	$ 50.00	$ 1,500.00		$ 36,500.00
	2. Revise strategy document	CVRWQCB	hours[1]	170	$ 50.00			$ 8,500.00
	3. Liaison to stakeholders	CVRWQCB	hours[1]	100	$ 50.00			$ 5,000.00
1C	1C. Technical Editing & Advising	UCD	hours[1]	220	$ 138.00	$ 1,500.00		$ 32,860.00
							TASK TOTAL =	**$ 330,610.60**
Task 2. Aquatic Toxicity Testing & TIEs								
2A	1. Coordinate acquisition of "other's" toxic samples	UCD	hours[1]	120	$ 28.00			$ 3,360.00
	2. Acquire pre-selected routine samples	UCD	samples	60	$ 249.00			$ 14,940.00
	3. Acquire pre-selected event-based samples	UCD	samples	60	$ 249.00			$ 14,940.00
2B	1. Sampling Design & Coord.	AS	hours[1]	40	$ 91.50			$ 3,660.00
	2. Chronic Toxicity Testing (cerio or fathead)	AS	tests	50	$ 765.80			$ 38,290.00
	3. Acute Phase I TIEs	AS	TIEs	20	$ 1,766.50		$ 10,000.00	$ 45,330.00
	4. Advanced TIEs	AS	TIEs	9	$ 4,467.78		$ 10,000.00	$ 50,210.00
	5. TIE Profiles	AS	profiles	5	$ 5,453.00		$ 10,000.00	$ 37,265.00
	6. ELISA, antibody procedures, HPLC fractionation	AS	samples	140	$ 88.07			$ 12,330.00
	7. Reporting & TAC participation	AS	hours[1]	100	$ 109.10	$ 9,500.00		$ 20,410.00
2C	1. Sampling Design & Coord.	PERL	hours[1]	40	$ 93.70	$ 1,654.00		$ 5,402.00
	2. Chronic *Ceriodaphnia* test	PERL	tests	37	$ 727.08			$ 26,902.00
	3a. Acute Phase I TIEs	PERL	TIEs	9	$ 1,625.17		$ 10,000.00	$ 24,626.50
	3b. Advanced TIEs	PERL	TIEs	4	$ 4,336.63		$ 10,000.00	$ 27,346.50
	4. Reporting	PERL	hours[1]	40	$ 93.70			$ 3,748.00
							TASK TOTAL =	**$ 328,760.00**
Task 3. Sediment Toxicity Testing & TIEs								
3A	1. Sampling Design & Coord.	PERL	hours[1]	50	$ 137.82	$ 1,654.00		$ 8,545.00
	2a. 10-d *Hyallela* bulk sediment test	PERL	tests	24	$ 941.42			$ 22,594.00
	2b. Chronic *Ceriodaphnia* elutriate test	PERL	tests	24	$ 720.00			$ 17,280.00
	3a. Phase I TIEs	PERL	TIEs	6	$ 4,410.00		$ 10,000.00	$ 36,460.00
	3b. Advanced TIEs	PERL	TIEs	4	$ 3,833.75		$ 10,000.00	$ 25,335.00
	3c. New TIE methods	PERL	TIEs	3	$ 4,410.00		$ 10,000.00	$ 23,230.00
	4. Reporting	PERL	hours[1]	50	$ 137.80			$ 6,890.00
3B	1. Sampling Design & Coord.	MPSL	hours[1]	60	$ 47.67	$ 1,600.00		$ 4,460.00
	2a. *Hyalella* bulk sediment test	MPSL	tests	12	$ 855.19			$ 10,262.22
	2b. *Ceriodaphnia* elutriate test	MPSL	tests	12	$ 702.96			$ 8,435.56
	3a. *Eohaustorius* bulk sediment test	MPSL	tests	15	$ 855.19			$ 12,827.78
	3b. *Mytilus* elutriate toxicity test	MPSL	tests	15	$ 702.96			$ 10,544.45
	4. Phase I TIEs	MPSL	TIEs	5	$ 4,237.38		$ 10,000.00	$ 31,186.88
	5. Advanced TIEs	MPSL	TIEs	4	$ 3,700.00		$ 10,000.00	$ 24,800.00
	6. New TIE methods	MPSL	TIEs	3	$ 4,237.38		$ 10,000.00	$ 22,712.13
	7. Reporting	MPSL	hours[1]	212	$ 50.07			$ 10,614.00
							TASK TOTAL =	**$ 276,177.00**
Task 4. Ecological Relevance Evaluation								
4A	Indigenous species tests (3 species/sample)	UCD	tests	40	$ 1,086.00	$ 500.00		$ 43,940.00
4B	1. Bioassessment	UCD	sites	24	$ 2,281.25	$ 1,000.00		$ 55,750.00
	2. Site Reconnaisance	UCD	hours[1]	0	$ 33.00			$ -
	3. Reporting	UCD	hours[1]	160	$ 66.00			$ 10,560.00
4C	Benthic Community Analysis	SFEI	hours[1]	60	$ 146.73			$ 8,803.68
							TASK TOTAL =	**$ 119,053.68**
							TOTAL YEAR 3 BUDGET	**$ 1,054,601.28**

TOTAL PROJECT BUDGET $ 3,026,182.27

1. Hourly rates represent an average of all classifications working on the task.
2. The unit cost estimates includes supplies.

Note: The budget for the tasks conducted by UCD was calculated according to a 10% overhead charge. The 10% rate will be charged if funding is from State sources; however, if funding is from Federal sources, then the overhead rate increases to 48%. This increased overhead rate would decrease the amount of work UCD could conduct by 1/4 (assuming their total budget stays the same).