Spatial And Temporal Quantification Of Pesticide Loadings To The Sacramento River, San Joaquin River, And Bay−Delta To Guide Risk Assessment For Sensitive Species

submitted to Science Program 2006

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lead investigators:
Messer, Dean

Project Information And Executive Summary

Spatial And Temporal Quantification Of Pesticide Loadings To The Sacramento River, San Joaquin River, And Bay−Delta To Guide Risk Assessment For Sensitive Species

This is proposal #0060 for the Science Program 2006 solicitation.

Frequently asked questions and answers for this PSP are now available.

The submission deadline for this proposal has passed. Proposals may not be changed.

Instructions

Please complete the Project Information and Executive Summary Form prior to proceeding to the other forms contained on this website and required to be completed as part of your PSP application submittal. Information provided on this form will automatically support subsequent forms to be completed as part of the Science PSP submission process. Information provided on this form will appear in the Contacts and Project Staff, Task and Budget Summary, and Conflict of Interest forms.

Proposal Title: **Spatial and Temporal Quantification of Pesticide Loadings to the Sacramento River, San Joaquin River, and Bay−Delta to Guide Risk Assessment for Sensitive Species**

This field is limited to 255 characters. All proposal titles must be entered in title case. No abbreviations or acronyms will be accepted.

Applicant Information

Applicant Organization Name: **California Department of Water Resources**

Please provide the name of the organization submitting the application as follows: Davis, California University of; Fish and Game, California Department of; California Waterfowl Association, etc.

Applicant Organization Type:
State agency

eligibility

Below, please provide contact information for the representative of the applicant organization who is authorized to enter into a contractual agreement with the State of California and who has overall responsibility for the operation, management, and reporting requirements of the applicant organization. (This should be the same individual who signs the signature page.)

Salutation: **Mrs.**
First Name: **Barbara**
Last Name: **McDonnell**
Street Address: **901 P Street**
City: **Sacramento**
State or Province: **CA**
Zip Code or Mailing Code: **95814−6424**
Telephone: **916−651−9556**
E−mail Address: **bmcdonne@water.ca.gov**

Below, please provide contact information for the primary point of contact for the implementation of the proposal. This person should be the same individual who is serving as the project Lead Investigator/Project Director.

Salutation: **Dr.**
First Name: **Dean**
Last Name: **Messer**
Telephone: **(916) 651−0168**
E−mail Address: **dmesser@water.ca.gov**

Proposal Information

Total Amount Requested: $395,700

The figure represented above is provided by the total amount requested on your completed Task and Budget Summary Form. The applicant must ensure the amount indicated above is correct and equal to the total amount requested in the budget document uploaded via the Budget and Justification Form for

this project.

Select one primary and up to three secondary topic areas that best apply to this proposal:

Habitat Availability and Response to Change (Primary)

Trends and Patterns of Populations and System Response to a Changing Environment

Select up to five keywords to describe this project.
− ***agriculture***
− ***agricultural economics***
− ***agricultural engineering***
− ***agronomy***
− ***agro−ecology***
− ***benthic invertebrates***
− ***benthos***
− ***biochemistry***
− ***biological indicators***
− ***birds***
− ***channels and sloughs***
− ***climate change***
− ***conservation or agricultural easements***
− ***conservation program management***
− ***database management***
− ***ecotoxicology***
− ***economics***
− ***engineering***
− ***erosion control***
− ***environmental education***
− ***evapotranspiration***
X ***fish biology***
− delta smelt
− salmon and steelhead
− other species
− otoliths
− tagging
− ***fish management and facilities***
− ***flooded islands***
− ***floodplains and bypasses***
− ***forestry***
− ***genetics***
− ***geochemistry***
X ***geographic information systems (GIS)***
− ***geology***
− ***geomorphology***
− ***groundwater***
− ***human health***
− ***hydrodynamics***
− ***hydrology***
− ***insects***
− ***integrated pest management***
− ***integrated resource planning***
− ***invasive species / non−native species / exotic species***
− ***irrigation systems***
− ***land use laws and regulations***
− ***land use management***
− ***land use planning and policy***
− ***levees***
− ***mammals***
− ***microbiology / bacteriology***
− conceptual
− quantitative
− ***oceanography***

– ***performance measures***
– ***phytoplankton***
– ***plants***
– terrestrial
– aquatic
– wetland
– ***remote sensing / imaging***
– ***reptiles***
– ***reservoirs and lakes***
– ***restoration***
– ***riparian zone***
– ***rivers and streams***
– ***sediment***
– ***soil science***
– ***statistics***
– ***subsidence***
– ***sustainable agriculture***
– ***trophic dynamics and food webs***
– ***water operations (diversions, pumps, intakes, exports, barriers, gates, etc.)***
– ***water quality***
– other
– temperature
X contaminants
– nutrients, organic carbon, and oxygen depleting substances
– salinity
– sediment and turbidity
– ***water supply***
X ***watershed assessment***
X ***watershed management***
– ***wetlands***
– ***zooplankton***

Provide the geographic coordinates that best describe the center point of your project. (Note: If your project has more than one site, provide a center point that best captures the central location.)

Example:	Latitude:	38.575; must be between 30 and 45
	Longitude:	−121.488; must be between −120 and −130

Help for finding a geographic location.

Latitude: **38.0**
Longitude: **−122.0**

Provide the number miles radius from the center point provided above, to demonstrate the radius of the entire project.
220

Provide a description of the physical location of your project. Describe the area using information such as water bodies, river miles and road intersections.

Areas for source analysis include all agricultural and pesticide use areas of the Central Valley. Points of interest for endpoint analysis include Bay−Delta Estuary and reaches along the Sacramento and San Joaquin Rivers and their major tributaries.

Successful applicants are responsible for complying with all applicable laws and regulations for their projects, including the National Environmental Policy Action (NEPA) and the California Environmental Quality Act (CEQA). Projects funded through this PSP that tier off the CALFED Programmatic EIS/EIR must incorporate applicable mitigation strategies described in the CALFED Programmatic Record of Decision to avoid or minimize the project's adverse environmental impacts. Applicants are encouraged to review the Programmatic EIS/EIR and incorporate the applicable mitigation strategies from Appendix A of these documents for their projects.

If you anticipate your project will require compliance of this nature (ie applications for permits, other environmental documentation), provide below a list of these items, as well as the status of those applications or processes, if applicable. If you believe your project will not require these regulatory actions, please provide one or two lines of text outlining why your proposed project will not be subject to these processes. Further guidance is available in The Guide to Regulatory Compliance for Implementing CALFED Activities.

Study involves the integration of spatial and temporal databases using a Geographial Information System (GIS) analysis and numerical simulation models. There is no field component. Permit applications and environmental documentation do not apply.

Is this proposal an application for next phase funding of an ongoing project funded by CALFED Science Program?
X No. **–** Yes.

If yes, identify the ongoing project:

Project Title:
CALFED Contract Management Organization:
Amount Funded:
Date Awarded:
Lead Organization:
Project Number:

Have primary staff and/or subcontractors of the project team (those persons listed on the Contacts and Project Staff form) received funding from CALFED for a project *not* listed above?
– No. **X** Yes.

If yes, list the projects below: (only list up to the five most recent projects)

Project Title: **Phytoplankton communities in the San Francisco Estuary: monitoring and management using a submersible spectrofluorometer.**
CALFED Contract Management Organization: **CALFED Science Program**
Amount Funded: **$159,160**
Date Awarded: **September 2005**
Lead Organization: **California Department of Water Resources/ Environmental Monitoring Program**
Project Number: **SCI–05–C332**

Project Title: **Biomass and Toxicity of a Newly Established Bloom of the Cyanobacteria Microcystis Aeruginosa and its Potential Impact on Beneficial Use in the Sacramento–San Joaquin Delta.**
CALFED Contract Management Organization: **CALFED Science Program**
Amount Funded: **$500,000**
Date Awarded: **August 26, 2005**
Lead Organization: **California Department of Water Resources/ Environmental Monitoring Program**
Project Number: **SCI–05–C122**

Project Title:
CALFED Contract Management Organization:
Amount Funded:
Date Awarded:
Lead Organization:
Project Number:

Project Title:
CALFED Contract Management Organization:
Amount Funded:
Date Awarded:
Lead Organization:
Project Number:

Project Title:
CALFED Contract Management Organization:
Amount Funded:
Date Awarded:
Lead Organization:
Project Number:

Has the Lead Investigator, the applicant organization, or other primary staff or subcontractors of your project team ever submitted a proposal for this effort or a similar effort to any CALFED PSP?
– No. **X** Yes.

If yes, list the submission below: (only list up to the five most recent projects)

Project Title: **Development and Application of a Numerical Simulation Model to Evaluate and Mitigate the Transport of Pesticides from the Sacramento River Watershed into the Bay−Delta Area**
CALFED Program: **Bay−Deta Program**
Date of PSP: **Septermber 2004**

Project Title: **Exposure assessment, model development, and mitigation techniques to protect aquatic life and drinking water in the Sacramento River**
CALFED Program: **Drinking Water Quality Program**
Date of PSP: **March 2003**

Project Title:
CALFED Program:
Date of PSP:

Project Title:
CALFED Program:
Date of PSP:

Project Title:
CALFED Program:
Date of PSP:

Note: Additional information on this or prior applications submitted −− or proposals funded −− may be required of applicants.

List people you feel are qualified to serve as scientific and/or technical reviewers for this proposal and are not associated with your organization or CALFED.

Full Name	Organization	Telephone	E−Mail	Expertise
Ron Parker, Ph.D.	**U.S. Environmental Protection Agency, Office of Pesticide Programs**	**703−305−5505**	**parker.ronald@epamail.epa.gov**	
Mark Russell, Ph.D.	**DuPont Crop Protection**	**302−451−5800**	**mark.h.russell@usa.dupont.com**	
R. Donald Wauchope, Ph.D.	**U.S. Department of Agriculture (retired)**	**229−386−3892**	**don.wauchope@tifton.usda.gov**	

Provide additional comments, information, etc. here:

Funding requested for this project is $395,700. This project has interest and participation from numerous stakeholder agencies. Participation from the applicant and CVRWQCB, CDPR, USEPA, NOAA, and USGS is being donated to this project as matching funds ($112,240). This work also builds on previous modeling efforts in the Sacramento River under the Sacramento River Watershed Program. Total contract value for previous efforts is $116,500. Combined, the total value of this study is $624,440 ($395,700 + $112,240 + $116,500). Matching funds and previous funding contribute 36.6% to the total value of the project.

Executive Summary

Provide a brief but complete summary description of the proposed project; its geographic location; project objective; project type, approach to implement the proposal; expected outcomes; and adaptive management approach and relationship to the Science Program goals. The Executive Summary should be a concise, informative, stand−alone description of the proposed project and be no longer than one page in length. Please note, this information will be made public on our website shortly after the closing date of this PSP.

The objective of this project is to quantify spatially and temporally pesticide loadings to the Sacramento River, San Joaquin River, and Bay−Delta estuary to improve decision making and optimize resource spending of the Pelagic Organism Decline (POD) study, the State Water Board's Surface Water Ambient Monitoring Program (SWAMP) and Aquatic Herbicide Program, the Central Valley Water Quality Control Board's Agricultural Waiver and Total Maximum Daily Load (TMDL) programs, and agricultural Best Management Practice (BMP) projects to improve the long−term sustainability of aquatic habitats in the Bay−Delta estuary, Sacramento River, San Joaquin River and headwater tributaries. Objectives will be addressed through a combination of tools, including geographical information system (GIS), simulation

modeling, and an evaluation of existing in-stream monitoring. The project will benefit multiple system-wide and regional programs in the following areas: 1) Provide further knowledge of the fate and transport of agricultural chemicals (e.g., copper, organophosphates) and emerging pesticides (e.g., pyrethroids); 2) Match results to the location of sensitive species critical habitats; 3) Identify and rank pesticide source areas; 4) Evaluate implications of future pesticide use trends and changes in climatic conditions; 5) Aid in developing plans to improve ecosystem quality and water quality by strategic placement of BMPs and hydrologic operations; 6) Support future monitoring programs (strategic locations, sampling frequency); 7) Link results to life cycle models currently underdevelopment for striped bass and delta smelt, as well as existing models for (salmonids); and 8) Provide a data-link to support other water quality models and population models. This study will be conducted in collaboration with Central Valley Regional Water Quality Control Board (CVRWQCB); the California Department of Pesticide Regulation (CDPR); U.S. Environmental Protection Agency – Region 9 (USEPA); The National Oceanic and Atmospheric Administration (NOAA); the U.S. Geological Survey (USGS); and the University of California – Davis (UCD). This work also builds on previous modeling efforts in the Sacramento River conducted under the Sacramento River Watershed Program.

Contacts And Project Staff

This is proposal #0060 for the Science Program 2006 solicitation.

Frequently asked questions and answers for this PSP are now available.

The submission deadline for this proposal has passed. Proposals may not be changed.

INSTRUCTIONS

Use this form to provide titles, affiliations, qualifications, and descrptions of roles of the primary and secondary project staff. Include any consultants, subcontractors and/or vendors. The Lead Investigator or Project Director, as identified in the Project Information and Executive Summary Form, is required to upload a PDF version of their resume. To complete the qualification field of this form, please provide a bulleted list of relevant project/field experience and any publications/reports that support your participation in the proposed project.

Information provided on this form will automatically support subsequent forms to be completed as part of the Science Program PSP submission process. Please note tht information you enter in this form will appear in the Task and Budget Summary and Conflict of Interest forms.

Information on subcontractor services must be provided even if the specific service provider has not yet been selected. If the specific subcontractor has not been identified or selected, please list TBD (to be determined) in the last name field and the anticipated service type in the title field (example: Fish Biologist).

Please provide this information before continuing to the Tasks and Deliverables Form.

Applicant

California Department of Water Resources
Mrs. Barbara McDonnell
901 P Street
Sacramento CA 95814−6424
916−651−9556
bmcdonne@water.ca.gov

Lead Investigator/Project Director

Salutation: **Dr.**
Last Name: **Messer**
First Name: **Dean**
Title: **Chief, Bay−Delta Monitoring and Analysis Section**
Organization: **California Department of Water Resources**
Responsibilities: **Study Director**
Resume:

You have already uploaded a PDF file for this question. Review the file to verify that appears correctly.

Mailing Address: **901 P Street**
City: **Sacramento**
State: **CA**
Zip: **94236−0001**
Telephone: **(916) 651−0168**
E−Mail: **dmesser@water.ca.gov**

All Other Personnel

Salutation: **Mr.**
Last Name: **Breuer**
First Name: **Richard**
Title: **Chief of the Environmental Water Quality Monitoring**
Organization: **California Department of Water Resources**
Position:

primary staff
Responsibilities: **Technical Advisory Panel**
Qualifications:

Rich Breuer is the Chief of DWR's Environmental Water Quality and Estuarine Studies branch. He worked in the 1980's developing IPM applications, and on the rice herbicide reduction program with DPR, as well as conducting research of transport and fate of molinate. His current program continues to build on its 30 years of Delta and tributary monitoring, and research of water quality and biota. Key publications and reports include: · [DWR] California Department of Water Resources, 2004. The Municipal Water Quality Investigations Program Summary and Findings from Data Collected September 2001 through October 2003, October, 2004 · [DWR] California Department of Water Resources, 2001. State Water Project Watersheds Sanitary Survey Update Report 2001, December 2001 · [DWR] Terms and Procedures Concerning the Endangered Species Acts. Department of Water Resources, Division of Planning, Delta Planning Branch (1992) · [DWR] 1997 Compendium of Water Quality Investigations in the Sacramento River Watershed, Sacramento–San Joaquin Delta, and the San Francisco Bay Area. Department of Water Resources, Division of Local Assistance, MWQI Program (1998)

List relevant project/field experience and publications/reports.

Salutation: **Dr.**
Last Name: **Guo**
First Name: **Lei**
Title: **Associate Environmental Research Scientist**
Organization: **California Department of Pesticide Regulation**
Position:
primary staff
Responsibilities: **Technical Advisory Panel, modeling, and GIS**
Qualifications:

Lei Guo, Ph.D., is an expert in pesticide fate modeling. She has been involved in pesticides research for over 20 years and serves as a technical reviewer for numerous scientific journals, and book series. She is currently involved in monitoring and modeling nonpoint source pesticide transport in the Sacramento and San Joaquin River watersheds. · Application of GIS and SWAT simulation model to evaluate and mitigate transport of pesticides in the Central Valley of California. · Guo, L., L. Li and K. Goh. 2006. A co–kridging method to estimate precipitation coverage in the Sacramento Valley, California. J. App. Meteor. Climat. (in preparation). · Guo, L. and K. Goh. 2006. Development and application of a runoff risk index for evaluating potential pesticide loading to surface water in the Central Valley of California. Environ. Sci. Technol. (in preparation). · Guo, L., C. Nordmark, F. Spurlock , B. Johnson, L. Li, M. Lee and K. Goh. 2004. Characterizing dependence of pesticide load in surface water on precipitation and pesticide use for the Sacramento River watershed, California. Environ. Sci. Technol. 31:2331–2338.

List relevant project/field experience and publications/reports.

Salutation: **Dr.**
Last Name: **Denton**
First Name: **Debra**
Title: **Environmental Scientist**
Organization: **U.S. Environmental Protection Agency Region 9**
Position:
primary staff
Responsibilities: **Technical Advisory Panel, BMPs, inter–agency coordination**
Qualifications:

Debra Denton, Ph.D., is a recognized national expert on toxicity testing, and regional experience on pesticide TMDL and watershed monitoring issues. She has worked on water quality standards, regulatory programs including permitting and TMDLs, and pesticide monitoring for 15 years.

Example publications/reports: · Denton DL, Wrysinski J. 2005. Benefits of agricultural drainage ditches (VADD) as a best management practice Yolo County, California. Presented at the California third annual NPS pollution conference. Sacramento, CA. · Lydy MJ, Belden JB, Wheelock CE, Hammock BD, Denton, DL.

2004. Challenges in regulating pesticide mixtures. Ecology and Society. 9(6):1. · Denton DL, Fox JF, Fulk FA. 2003. Enhancing toxicity test performance by using a statistical criterion. Environ Toxicol Chem 22(10)2323–2328. · Denton DL, Wheelock CE, Murray S, Deanovic LA, Hammock BD, Hinton DE. 2003. Joint acute toxicity of esfenvalerate and diazinon to larval fathead minnows (Pimephales promelas). Environ Toxicol Chem 22(2):336–341. · Fox JF, Denton DL. 2002. Whole effluent toxicity. In Encyclopedia of Environmetrics. Eds: El–Shaarawi AH, Piegorsch WW. Volume 4, pp 2377–2381. · Denton DL, Ho K, Ireland S. Sediment toxicity testing issues and methods. 2002. In: Handbook of Ecotoxicology. 2nd edition. Ed: Hoffman DJ, Rattner BA, Burton AG, Cairns J. CRC Press. · Denton DL. 2001. Integrated toxicological and hydrological assessments of diazinon and esfenvalerate. PhD Dissertation. University of California, Davis, CA, USA. · Hughes MR, Bailer AJ, Denton DL. 2001. Material and response specific comparisons of statistical methods for estimating effective concentrations. Environ Toxicol Chem 20(6):1374–1380. · JW Newman, DL Denton, C Morisseau, CS Koger, CE Wheelock, DE Hinton, and BD Hammock. 2001. Evaluation of fish models of soluble epoxide hydrolase inhibition. Environ Health Perspectives 109:61–66. · U.S. Environmental Protection Agency. 2000. Understanding and accounting for method variability in whole effluent toxicity applications under the National Pollutant Discharge Elimination System Program. Eds: Denton DL, Fox J, Fulk FA, Greenwald K, Narvaez M, Norberg–King TJ, Phillips L. EPA/833/R–00–003. Office of Water. Washington, DC.

List relevant project/field experience and publications/reports.

Salutation: **Dr.**
Last Name: **Domalgalski**
First Name: **Joseph**
Title: **Project Chief – National Water Quality Assessment Program (NAWQA)**
Organization: **U.S. Geological Survey**
Position:
secondary staff
Responsibilities: **Technical Advisory Panel, data collection**
Qualifications:

Joseph Domagalski, Ph.D., is a research chemist and project manager with the USGS in Sacramento. Research accomplishments over the last five years have been in the areas of pesticide occurrence within the Central Valley of California and other areas, mercury and other trace metal transport and transformations in the California surface waters.

Example publications/reports: · Pesticides and Pesticide Degradation Products in Stormwater Runoff: Sacramento River Basin, California. Journal of the American Water Resources Association, 1996, vol. 32, no. 5, pp. 953–964. · Dissolved Pesticide Data for the San Joaquin River at Vernalis and the Sacramento River at Sacramento, California, 1991–94 U.S. Geological Survey Open–File Report 95–110, 27 pages. · Water Quality Assessment of the Sacramento River Basin, California––Environmental Setting and Study Design U.S. Geological Survey Water–Resources Investigations Report 97–4254. · Trace Elements and Organic Compounds in Streambed Sediment and Aquatic Biota from the Sacramento River Basin, California, October and November 1995 U.S. Geological Survey Water–Resources Investigations Report 99–4151 · Benthic Macroinvertebrate Assemblages and Their Relations with Environmental Variables in the Sacramento and San Joaquin River Drainages, California, 1993–1997. U.S. Geological Survey Water–Resources Investigations Report 00–4125, 25 p. · Shallow Ground–Water Quality Beneath Rice Areas in the Sacramento Valley, California, 1997 U.S. Geological Survey Water–Resources Investigations Report 01–4000, 33 p. · Fish Community Structure in Relation to Environmental Variables Within the Sacramento River Basin and Implications for the Greater Central Valley, California U.S. Geological Survey Open–File Report 00–247, 19 p. · Organic Carbon Trends, Loads, and Yields to the Sacramento–San Joaquin Delta, California, Water Years 1980 to 2000

List relevant project/field experience and publications/reports.

Salutation: **Dr.**
Last Name: **Hecht**
First Name: **Scott**
Title: **Ecotoxicologist**
Organization: **National Oceanic and Atmospheric Administration**
Position:
secondary staff

Responsibilities: **Technical Adivsory Panel, data collection**
Qualifications:

Scott Hecht, Ph.D. serves as technical expert on water quality issues for NOAA's Fisheries national Office of Protected Resources in the Endangered Species Division. . Provide technical review, basis, and outreach regarding NMFS' trust resources and contaminant effects. Assist national section 7 consultations related to pesticides and other contaminants. . Served as staff toxicologist for NOAA's Washington State Habitat Office. Provided technical guidance to biologists on aquatic contaminant issues (sediments–heavy metals and organics, treated wood chemicals, pesticides, endocrine disrupting chemicals, wastewater effluent, and storm water runoff) related to the Endangered Species Act. . Developed scientific basis for biological opinions on US EPA re–registration and registration of pesticides. . Coordinated contaminant related efforts with United States Fish and Wildlife Service, United States Geological Survey, EPA, state biologist, and NOAA's scientists and managers. Developed ecological risk assessment framework to assess pesticide effects to salmonids and salmonid supporting habitat. . Worked extensively with CWA, FIFRA, and essential fish habitat regulations. Technical consultant to local, state, tribal, and national entities on aquatic contaminant issues.

List relevant project/field experience and publications/reports.

Salutation: **Dr.**
Last Name: **Grismer**
First Name: **Mark**
Title: **Professor of Hydrology and Agricultural Engineering**
Organization: **University of California – Davis**
Position:
subcontractor
Responsibilities: **Technical Advisory Panel, detail review of model procedures and results**
Qualifications:

Mark Grismer, Ph.D., has 20 years of experience related to irrigated agriculture, soil–water processes, water quality and hillslope/sediment delivery. His work includes development of both physical and computer models of diazinon runoff, interflow and shallow groundwater flow from bare soils and vegetated filter strips. . Field Research – General hydrology and irrigation and drainage engineering. Extensive field research conducted related to irrigation, soil salinity and cracking, and drainage as well as general water quality issues associated with agricultural runoff. Current field research is considering erosion and riparian systems, restoration of tidal marshes via drainage channel design and construction, role of wetlands in watershed systems and use of constructed wetlands for treatment of agricultural process (e.g. winery, fruit) wastewaters. . Laboratory Research – Soil physics. Ongoing research related to measurement of soil hydraulic parameters, multi–phase transport through soils, adsorption/desorption of VOC's on clay minerals, strength of clays and general aspects of flow in porous media. . Modeling Research – Surface runoff and shallow groundwater systems. Have completed extensive modeling of the impacts of regional irrigation/drainage on soil salinity and shallow groundwater, river water quality, pesticide runoff from orchards and seepage from impoundments.

Example publication/reports: . Grismer M. E., M. A. Carr and H. L. Shepherd. 2003. Evaluation of Constructed Wetland Treatment Performance for Winery Wastewater. Water Env. Research. 75(5):412–421. . Watanabe, H. and M. E. Grismer. 2003. Numerical modeling of diazinon transport through inter–row vegetative filter strips. J. Environmental Mgmt. 69:157–168. . Grismer M. E. and Bali K. M. 2001. Reduced–Runoff Irrigation of Sudangrass Hay, Imperial Valley, California. ASCE J. Irrig. &Drain. Engr. 127(5):319–324. . Grismer, M.E. 2000. Drainage channel design and restoration of inter–tidal marshes. J. Lowland Technology 2(2):1–16. . Battany, M.C. and M.E Grismer. 2000. Rainfall runoff, infiltration and erosion in hillside vineyards: Effects of slope, cover and surface roughness. Hydrological Proc. 14:1289–1304. . Grismer, M.E. 2000. Long–Term Evapotranspiration from a Coastal Avocado/Citrus Orchard. ASCE J. Irrig. &Drain. Engr. 126(1):1–7.

List relevant project/field experience and publications/reports.

Salutation: **Dr.**
Last Name: **Zhang**
First Name: **Minghua**
Title: **Associate Adjunct Professor**

Organization: **University of California – Davis**
Position:
primary staff
Responsibilities: **Technical Advisory Panel, student oversight, detailed review of GIS procedures and results**
Qualifications:

Minghua Zhang, Ph.D. has 15 years of experience in GIS database development, wetland ecology, groundwater and surface-water quality analysis, agricultural pesticide use and its effects on environment and wildlife, GIS spatial modeling, remote sensing satellite and aerial photography applications in precision farming.

Current Projects include: . Pheromone Mating Disruption as an Alternative to Organophosphate Use in Walnuts: A Cost Analysis, State Water Resources Control Board. . New tools to promote the transition away from FQPA-targeted pesticides in California orchards, funded by US EPA Region 9 FQPA program. . Characterizing Diazinon and Chlopyrifos use in San Joaquin Watershed and mapping the high potential areas with OP surface water contamination, funded by Central Valley Regional Water Control Board. . Tracking non-residential pesticide use in urban areas of California and understanding the impacts to storm water quality, funded by California Department of Pesticide Regulation. . Detecting disease infections for precision disease management in precision farming using remote sensing

Selected publications include: . Zhang, M, Wilhoit, L, and Gieger, C. 2005. Dormant OP use trend on California almonds. Agriculture, Ecosystem and Environment. 105:41–58. . Zhang, M., Liu, X. and ZH. Qin. 2005. Combining red and near infrared bands of multuspectral remotely sensed images to detect disease stresses in two tomato fields in California, USA. International Journal of Precision Agriculture. 6:489–508. . Qin, Z., and M. Zhang. 2005. Diagnosis of rice disease stress for pest management using airborne multispectral remote sensing data. International Journal of Applied Earth Observation and Geoinformation. Vol: 7: 115–128. Campos, J. and M. Zhang. 2004. Reduced-risk pest management on winegrapes. Practical Vineyard and Winery. March–April issue: 5–19. . Zhang, M, K.S. Smallwood and E. Anderson. 2001. Relating ecosystem health to ecological integrity to assess exposure risks in Yolo county, California. In Managing Ecosystem Health. (eds. Alexander H. Harcourt), Vol 2, "Issues and Methods", Section 6 "Communities, Politics, Culture, and Tradition". . Zhang, M., A. Wadley, P. Hendley, M. Lane and S. Hayes, 1999, Approaches to refining pesticide risk assessments – the spatial estimation of potential leaching risk. Pesticide Science. 55:217–218.

List relevant project/field experience and publications/reports.

Salutation: **Mr.**
Last Name: **Williams**
First Name: **W. Martin**
Title: **Principal Water Resources Engineer**
Organization: **Waterborne Environmental, Inc.**
Position:
subcontractor
Responsibilities: **Method development, model and GIS oversight**
Qualifications:

Mr. Williams has over 25 years of experience in hydrologic and water quality investigations with special expertise in water quality modeling, risk assessment, and risk mitigation. His contributions to predictive models are supporting scientific research and regulatory decisions in the U.S., the European Union, Latin America, and the Asian Pacific. He has assisted several scientific work groups in advancing probabilistic risk assessments and simulation modeling including the Ecological Committee on FIFRA Risk Assessment Methods (ECOFRAM) and the FIFRA Environmental Model Validation Task Force (FEMVTF). Mr. Williams was the study director of the previous SRWP studies that serve as the foundation for this project. He is also the primary author of the author of rice water quality model (RICEWQ) that will be used for this study. Relevant projects/publications/reports: . Sacramento River Watershed Program (SRWP), 2006. Pesticide Loading Analysis in the Sacramento River Watershed (with S. Dasgupta and J.M. Cheplick). . Sacramento River Watershed Program (SRWP), 2004. Exposure Assessment Model for Diazinon Sources in the Sacramento River Basin's Main Drainage Canal (with N.J. Snyder). . Aquatic Ecological Risk Assessment of Atrazine — A Tiered Probabilistic Approach. 2005. SETAC Press, Pensacola, FL (with Giddings J.M., Anderson T.A., Hall L.W., Hosmer A.J., Kendall R.J., Richards R.P., and Solomon K.R.) . . Simulating Pesticide Leaching and Runoff in Rice Paddies with the RICEWQ-VADOFT Model. J. Environ. Qual. 32:2189–2199, 2003 (with Z. Miao, J.M. Cheplick, M. Trevisan, L. Padovani, M. Gennari, A. Ferrero, F. Vidotto, and E. Capri). . Probabilistic Assessment of Non-Target Plant Exposure to the

Corn Herbicide Isoxaflutole through Runoff. 23rd Annual Meeting in North America, Society of Environmental Toxicology &Chemistry, Salt Lake City, UT, November 2002 (with T. S. Ramanarayanan, R. Allen, M. G. Dobbs, J. M. Cheplick, R. F. Pugsley, and A. M. Ritter). . RICEWQ Users Manual: Version 1.60. Waterborne Environmental, Inc., Leesburg, Virginia, 1999 (with J.M. Cheplick and A.M. Ritter). . Characterizing Aquatic Ecological Risks from Pesticides using a Diquat Dibromide Case Study. I. Probabilistic Exposure Estimates, Environmental Toxicology and Chemistry, Vol. 19, No. 3, March 1996 (with A. M. Ritter, J. L. Shaw, and K. Z. Travis).

List relevant project/field experience and publications/reports.

Salutation: **Mr.**
Last Name: **Cheplick**
First Name: **J. Mark**
Title: **Principal Agricultural Engineer**
Organization: **Waterborne Environmental, Inc.**
Position:
subcontractor
Responsibilities: **Production modeling and GIS**
Qualifications:

Mr. Cheplick has over 10 years of combined experience in environmental engineering and software development while working in the consulting and governmental contracting areas. His primary expertise is in pesticide transport modeling, model system development, and the development of information management systems. He is a co-developer of the Pesticide Root Zone Model(PRZM) and the Rice Water Quality Model (RICEWQ) that will be used in this study. He has developed a number modeling platforms (including EXPRESS, PRZM in FOCUS, SWASH, PLUS, MUSCRAT, PIC, and PIRANHA) linking simulation models to soil, crop, and weather databases. These platforms have been or are currently in use for pesticide registration assessments in the U.S. and Europe.

Relevant projects/publications/reports: . Sacramento River Watershed Program (SRWP), 2006. Pesticide Loading Analysis in the Sacramento River Watershed (with S. Dasgupta and W.M. Williams). . National Exposure Analysis of Pyrethroids (Part 2); Erosion assessment using PRZM 3.12 at the watershed level. 25th Annual Meeting in North America, Society of Environmental Toxicology &Chemistry, Baltimore, MD, November 2005. . Simulating Pesticide Leaching and Runoff in Rice Paddies with the RICEWQ-VADOFT Model. J. Environ. Qual. 32:2189-2199, 2003 (with Z. Miao, J.M. Cheplick, M. Trevisan, L. Padovani, M. Gennari, A. Ferrero, F. Vidotto, and E. Capri). . PRZM_3.1, A Model for Predicting Pesticide and Nitrogen Fate in the Crop Root and Unsaturated Soil Zones: Users Manual for Release 3.0, National Exposure Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Athens, Georgia, 2003 (with R.F. Carsel, J.C. Imhoff, P.R. Hummel, and A.S. Donigian, Jr.) . Probabilistic Assessment of Non-Target Plant Exposure to the Corn Herbicide Isoxaflutole through Runoff. 23rd Annual Meeting in North America, Society of Environmental Toxicology &Chemistry, Salt Lake City, UT, November 2002 (with T. S. Ramanarayanan, R. Allen, M. G. Dobbs, J. M. Cheplick, R. F. Pugsley, and A. M. Ritter). . RICEWQ Users Manual: Version 1.60. Waterborne Environmental, Inc., Leesburg, Virginia, 1999 (with J.M. Cheplick and A.M. Ritter). . PIRANHA: Pesticide and Industrial Chemical Risk Analysis Hazard Assessment, version 2.0 user's manual, U.S. Environmental Protection Agency, 1992, (with L.A. Burns, B.W. Allen, S.L. Bird, D.R. Hartel, C.A. Kittner, F.L. Mayer, L.A. Suarez, and S.E. Wooten). . Validation Status of Pesticide Leaching and Groundwater Transport Model, U.S. Environmental Protection Agency, 1990, (with C.N. Smith, R.S. Parrish, R.F. Carsel, A.S. Donigian).

List relevant project/field experience and publications/reports.

Conflict Of Interest

This is proposal #0060 for the Science Program 2006 solicitation.

Frequently asked questions and answers for this PSP are now available.

The submission deadline for this proposal has passed. Proposals may not be changed.

Instructions

To assist Science Program staff in managing potential conflicts of interest as part of the review and selection process, we are requesting applicants to provide information on who will directly benefit if your proposal is funded. Please provide the names of individuals who fall in the following categories and are not listed in the Personnel Form:

- Persons 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; and/or
- Subcontractors listed in the proposal, who will perform tasks listed in the proposal, or will benefit financially if the proposal is funded.

Applicant
Submittor
Lead Investigator/Project Director
Primary Staff
Secondary Staff
Subcontractor

Provide the list of names and organizations of all individuals not listed in the proposal who helped with proposal development along with any comments.

Last Name	First Name	Organization	Role

Task And Budget Summary

This is proposal #0060 for the Science Program 2006 solicitation.

Frequently asked questions and answers for this PSP are now available.

The submission deadline for this proposal has passed. Proposals may not be changed.

Instructions

Use the table below to delineate the tasks needed to carry out your proposal. Tasks in this form should support the narrative description of your project in your proposal document and the informa tion provided in your detailed budget spreadsheet. Each task and subtask must have a number, title, timeline, list of personnel or subcontractors providing services, and associated budget figure.

When creating subtasks, ensure that each activity is counted only once. Please note, the initial task of your table (Task 1) must present all project management/administrative activities supporting your overall proposal.

For proposals involving multiple agencies or organizations (including subcontractors), the table must clearly state the tasks and subtasks performed by each entity.

Task #	Task Title	Start Month	End Month	Personnel Involved	Description	Task Budget
1	Program Administration	1	24	Messer, Dean Breuer, Richard Williams, W. Martin Cheplick, J. Mark	Activities related to contracts, day-to-day management, and coordination between technical teams.	56,300
2	Chemical Selection	1	2	Messer, Dean Breuer, Richard Guo, Lei Denton, Debra Domalgalski, Joseph Hecht, Scott Grismer, Mark Zhang, Minghua Williams, W. Martin Cheplick, J. Mark	Justify pesticides to be included in the analysis based on persistence, mobility, and volume of use.	5,400
3	Data Collection/Reduction	1	4	Messer, Dean Breuer, Richard Guo, Lei Domalgalski, Joseph Hecht, Scott Zhang, Minghua Williams, W. Martin Cheplick, J. Mark	Data layer acquisition and pre-processing for model simulations and result analysis.	65,660
4	Database/Model Processor Development	2	12	Guo, Lei	Link geocoded databases with other informational databases to develop	58,050

				Grismer, Mark Zhang, Minghua Williams, W. Martin Cheplick, J. Mark	model input parameter values and automate many thousand model runs.	
5	Validation/Sensitivity Analyysis	9	18	Grismer, Mark Zhang, Minghua Williams, W. Martin Cheplick, J. Mark	Compare relative magnitude and temporal predictions of pesticide loadings to in-stream monitoring data. Evaluate sensitivity of key input parameters on predicted loadings. Compare model predictions to University of California SWAT project.	23,900
6	Baseline, Future Trends, and Mitigation Scenarios	9	18	Messer, Dean Breuer, Richard Guo, Lei Denton, Debra Hecht, Scott Grismer, Mark Zhang, Minghua Williams, W. Martin Cheplick, J. Mark	Configure scenarios, conduct model runs, and perform quality control on model output.	41,110
7	Result Integration	9	18	Messer, Dean Breuer, Richard Guo, Lei Denton, Debra Domalgalski, Joseph Hecht, Scott Grismer, Mark Zhang, Minghua Williams, W. Martin Cheplick, J. Mark	Evaluate temporal patterns of loadings within accumulation reaches to co-occurrence with sensitive species. Provide recommendations on strategic placement of BMPs, monitoring locations, and sampling frequency.	29,750
8	Reports and Publications	6	24	Messer, Dean Breuer, Richard Guo, Lei Denton, Debra Domalgalski, Joseph Hecht, Scott Grismer, Mark Zhang, Minghua Williams, W. Martin Cheplick, J. Mark	Produce technical progress reports, draft final report, response to peer review comments, final report, and publication in scientific journal(s).	78,870
9	Technical Meetings	6	24	Messer, Dean Breuer,	Technical meetings between subcontractors and Technical Advisory Panel at key junctures to convey	19,650

				Richard Guo, Lei Denton, Debra Grismer, Mark Zhang, Minghua Williams, W. Martin Cheplick, J. Mark	results and review options. Present study at CALFED or other conferences.	
10	Qualty Assurance Program Plan	1	24	Messer, Dean Williams, W. Martin	Justify and summarize quality of databases and models that will be used. Describe quality control procedures that will be implemented.	2,220
11	Training	18	24	Messer, Dean Breuer, Richard Guo, Lei Denton, Debra Grismer, Mark Zhang, Minghua Williams, W. Martin Cheplick, J. Mark	Conduct training workshop to government agencies and other stakeholders. The workshop will contain a technical overview of the models, associated databases and GIS layers, and model linkage.	14,790

total budget=$395,700

Detailed Budget Upload And Justification

This is proposal #0060 for the Science Program 2006 solicitation.

Frequently asked questions and answers for this PSP are now available.

The submission deadline for this proposal has passed. Proposals may not be changed.

Using the budget provided via this link as a guide, please complete a budget for your proposal in the software of your choice (e.g. Excel). This document must be in a format and software that can be converted to PDF prior to uploading on the web system.

It is incumbant upon the applicant to fully explain/justify the significant costs represented in the attached budget. This information can be provided either in a text document and uploaded below, or included in your proposal text in a clearly defined budget justification section. If it is not abundantly clear to reviewers what project costs are commensurate with which efforts and benefits, the proposal may receive a poor review and denied funding.

Costs for each task described in the Task and Budget Summary Form and each staff or subcontractor described on the Contacts and Project Staff Form, must be included in your budget. The budget for Task One should represent project management activities, including but not limited to cost verification, environmental compliance, data handling, report preparation, project oversight, and public outreach. The total amount of your budget must equal the total amount represented on your Task and Budget Summary Form and the total budget amount represented on your Project Information and Executive Summary Form.

In a separate text document to be uploaded below, identify any cost share and other matching funds available to support your proposed project. If you identify cost share or matching funds, you must also describe them in the text of your proposal (see explanation of "cost share and other matching funds" in Section Two of the solicitation document).

CBDA may request additional information pertaining to the items, rates and justification of the information presented in your budget. Applications without completed budgets will not be considered for funding.

Uploading The Completed Budget Template

First, convert your completed Budget to a PDF file. Then, use the browse function to locate the PDF version of your document, select the document and click on the upload prompt below.

You have already uploaded this document. View it to verify that it appears as you expect. You may replace it by uploading another document

Uploading The Completed Budget Justification

First, convert your completed Justification text to a PDF file. Then, use the browse function to locate the PDF version of your document, select the document and click on the upload prompt below.

You have already uploaded this document. View it to verify that it appears as you expect. You may replace it by uploading another document

Uploading The Description Of Cost Share/Matching Funds

First, convert your completed Description of Cost Share/Matching Funds text file to a PDF file. Then, use the browse function to locate the PDF version of your document, select the document and click on the upload prompt below.

You have already uploaded this document. View it to verify that it appears as you expect. You may replace it by uploading another document

Schedule Of Deliverables

This is proposal #0060 for the Science Program 2006 solicitation.

Frequently asked questions and answers for this PSP are now available.

The submission deadline for this proposal has passed. Proposals may not be changed.

Use the table below to delineate the key deliverables and the time necessary to complete them (in months from the date the project's grant agreement is executed). Each Science Program 2006 PSP grant recipient must provide the required minimum deliverables for each project. The required minimum deliverables for each funded proposal are as follows:

- Semi−annual report(s)
- Final Report
- One page project summary for public audience at beginning of project
- One page project summary for public audience upon project completion
- Project closure summary report or copy of draft manuscript
- Presentation at CALFED Science Conference
- Presentations at other events at request of CALFED Science Program staff
- Copy of all published material resulting from the grant

Deliverable	Description	Delivered By: # (In Months From Project Start Date)
Project initiation summary	One page project summary for public audience at beginning of project	1
QAPP	Quality Assurrance Program Plan	1
Chemical selection report	Justification for list of chemicals to be studies (Task 2)	2
Semi−annual report #1	Technical progress on Tasks 3 and 4	6
Semi−annual report #2	Baseline results with model validation	12
Semi−annual report #3	Future condition and mitigation results	18
Final report	Documentation of methods, materials, and results	18
Training workshop	Instructional workshop for interested stakeholders on processing data for future applications	18
Project closure summary report	One page project summary for public audience upon project completion	24
Presentation #1	Presentation at CALFED Science Conference	24
Presentation #2	Presentations at other events at request of CALFED Science Program staff	24
Archive	Copy of all data products and published material resulting from the grant	24

If you are unable to provide a Schedule of Deliverables as outlined above, please provide your justification of non−compliance in the text box provided below. The Science Program reserves the right to determine a proposal non−eligible based on an applicants inability to provide the materials requested above.

Spatial and Temporal Quantification of Pesticide Loadings to the Sacramento River, San Joaquin River, and Bay-Delta to Guide Risk Assessment for Sensitive Species

1.0 Project Purpose

Problem. The current decline in pelagic species in the delta has led to investigations into the role of contaminants as the cause of decline. Currently, Pelagic Organism Decline (POD) work is focused on acute toxicity tests and examination of biomarkers as indicators of sub-lethal effects. The POD contaminants work group has identified the need to provide spatial and temporal information on the presence of contaminants to further focus biomarker and toxicity identification evaluation (TIE) studies. Current monitoring programs such as the Central Valley Water Quality Control Board's Agricultural Waiver program, the State Water Resources Control Board's Surface Water Ambient Monitoring Program (SWAMP), and the Sacramento River Watershed Monitoring program cannot provide the resources to monitor and conduct studies in a comprehensive manner to provide this answer. The large array of contaminants, along with the geographical distance, provides too great of a resource and cost challenge for these groups. This effort would provide a tool to tailor monitoring and assessment efforts under the listed programs, as well as provide POD investigators with needed information about pesticide peak loadings to assist those researchers trying to determine if contaminants were contributing to the decline of pelagic organisms in the delta.

Objectives. The objective of this project is to quantify spatially and temporally pesticide loadings to the Sacramento River, San Joaquin River, and Bay-Delta estuary to improve decision making and optimize resource spending of the POD study, the State Water Board's SWAMP and Aquatic Herbicide Program, the Central Valley Water Quality Control Board's Agricultural Waiver and Total Maximum Daily Load (TMDL) programs, and agricultural Best Management Practice (BMP) projects to improve the long-term sustainability of aquatic habitats in the Bay-Delta estuary, Sacramento River, San Joaquin River, and headwater tributaries.

Objectives will be addressed through a combination of tools, including geographical information system (GIS), simulation modeling, and an evaluation of existing in-stream monitoring. Uncertainty is inherent in any single risk assessment method. However, in combination, these tools provide risk assessors with a "weight-of-evidence" approach for regulatory decision-making. The project will benefit multiple system-wide and regional programs in the following areas:

- Provide further knowledge of the fate and transport of agricultural chemicals (e.g., copper, organophosphates) and emerging pesticides (e.g., pyrethroids) in the Sacramento River, San Joaquin River, Bay-Delta Estuary, and headwater tributaries;
- Overlay pesticide loading results with the identification and location of sensitive fish species critical habitats;
- Evaluate implications of future pesticide use trends and changes in climatic conditions and land use changes for watershed management decisions;
- Identify and rank areas of highest risk and pesticide source areas contributing to those risks;
- Aid in developing plans to improve ecosystem quality and water quality by strategic placement of BMPs and hydrologic operations;

- Support current and future monitoring programs (recommendations on strategic locations and sampling frequency);
- Link results to life cycle models currently underdevelopment for striped bass and delta smelt, as well as existing models for (salmonids); and
- Provide a data-link to support other water quality models and population models.

Hypotheses. Spatial and temporal patterns of pesticide loadings can be predicted through the use of simulation models that can account for the complex interaction of factors relevant to the fate of transport of pesticides after application. Models can be used to identify source areas, water body reaches of highest risk, optimize where and when to focus monitoring efforts, and where to target BMP research projects and mitigation measures. Models have the ability to forecast changing trends in land use, pesticide use, and climate. In addition, models can be used to evaluate the feasibility and effectiveness of mitigation measures prior to their implementation. Existing databases on pesticide use, land use, soil properties, hydrography, weather data, and chemical properties are sufficient to characterize model input parameters in the Sacramento River and San Joaquin River watersheds. Sufficient monitoring data is available to validate model predictions for the purposes of project needs.

Relevant studies. The study area consists of the Sacramento River and San Joaquin River watersheds upstream of their confluence with the Bay-Delta estuary (Figure 1). The primary importance of these systems include, the Sacramento River basin supplies more than 80% of the freshwater flows to the Sacramento-San Joaquin Delta and the San Joaquin River constitutes 22% of the irrigated acreage in California (CVRWQCB, 2002).

A number of research studies have been conducted within the study area that will help with problem formulation, identifying priority constituents for modeling, and for providing benchmark data for model validation. Detections of pesticides and other agricultural chemicals have been reported in the Bay-Delta estuary and upstream source waters (Amweg et al., 2006; Weston et al., 2004, CVRWQCB, 2006; Guo et al., 2004, Dileanis et al., 2002. The Toxicity of Unknown Cause Strategy (CVRWQCB, 2001) presents studies where locations, times, and pesticides were identified through toxicity monitoring studies that contributed to toxicity in the watershed and it also presents studies where the toxicant agents have not been identified, but pesticides may have been partially attributed due to their presence in the watershed.

As part of Irrigated Lands Waiver Program, monitoring data are also collected for characterizing water quality in agricultural drains. Regional monitoring efforts have found pyrethroid concentrations in sediment and water samples from agricultural dominated areas and urban water bodies were high enough to have contributed to toxicity to sensitive species (DWR, 2005; Amweg et al., 2006; Weston et al., 2004). Monitoring data will be useful for the identification of priority pesticides and for model validation. In addition, several demonstration projects for reducing pesticide transport are being studied in the Sacramento and San Joaquin watersheds under 319(h) grant money. Much of this work has been summarized by CVRWQCB (2003), SWRP (2002), Holmes, et al., (2000), and Giddings, et al. (2000). Model scenarios will evaluate the extent that water quality improvements might be achieved if these practices were to be implemented on a watershed scale.

The San Francisco Estuary Institute (SFEI), in collaboration with the U.S. Environmental Protection Agency (USEPA) and others (e.g., the Central Valley Regional Water Quality Board), is initiating an

effort for the San Joaquin River Region to improve current water quality monitoring and assessment. The project will produce a San Joaquin Water Quality Monitoring and Assessment Strategy that will feed into the Comprehensive Monitoring, Assessment and Research Program (CMARP) for the Central Valley, but have independent value for monitoring and assessment in the San Joaquin River region, consistent with the SWAMP and other related efforts. The strategy will identify a framework of shared objectives and activities; and identify ways to provide for improved coordination, management, and funding. In addition, it will help establish information processes and products that communicate monitoring data and assessment results to resource managers, stakeholders and the public. Additionally, the project will produce an internet-based information clearinghouse and water quality assessment fact sheets. Coordination with SFEI during this study will result in substantial benefits to both research initiatives.

The Central Valley Regional Water Quality Control Board (CVRWQCB) identified a list of 22 priority pesticides according to their potential relative risk to impact aquatic organisms in surface water in the Sacramento River watershed (CVRWQCB, 2006b). A similar risk evaluation is being prepared for the San Joaquin watershed. Chemical ranking considered volume of use and properties of mobility and persistence. The study concluded that environmental conditions, such as seasonal weather patterns, are critical in evaluating the potential overall relative risks for pesticides to impair surface water quality. This study will help confirm the relative ranking of these chemicals by representing environmental conditions and agronomic practices in a deterministic mechanistic model. The list of 22 chemicals will also be reviewed in context with chemical use in the San Joaquin River watershed to determine an appropriate list for the San Joaquin system and will be used for the study proposed herein. The CVRWQCB will serve on the Technical Advisory Panel (TAP) to facilitate coordination.

A pesticide loading analysis was conducted for the Sacramento River under the Sacramento River Watershed Program (SRWP, 2006) funded by USEPA Region 9. The study incorporated many of the models, databases, and procedures proposed herein. The study demonstrates that the approach and time frame of this proposal are feasible. Five chemicals (chlorpyrifos, diazinon, diuron, paraquat dichloride, and permethrin) were selected for analysis based on a risk index of use/toxicity, it's persistence in the environment, and the amount of chemical applied during wet season. The predicted 50th and 90th percentile mass loadings for these five pesticides in nine Sacramento Valley counties were provided to state and federal water programs. These results show those counties and watersheds that have been generating the highest loadings of these pesticides in streams and rivers in the Sacramento River watershed, therefore these areas may be candidates for more detailed analysis, monitoring and/or mitigation. It may be useful to compare these loadings to allowable TMDL projections along various river sections.

The Sacramento River Watershed Program (SRWP) also funded the development of a detailed model of the Main Drainage Canal, which serves as both model validation and an example of using models to evaluate the effectiveness of alternative mitigation strategies (SRWP, 2004). One key finding from this study was that modeling demonstrated the diazinon pesticide label changes and their effectiveness provide a 53% reduction in loadings into a 38,000-acre watershed. In addition, a comparison of modeling results to monitoring data in the lateral drains concluded that monitoring over a longer period of time but at a reduced sample frequency would have provided a better understanding of concentration magnitude and duration in that system.

The California Department of Pesticide Regulation (CDPR) is currently developing a GIS-based approach to integrate the hydrological model BASIN, and a pesticide process model, the Soil Water Assessment Tool (SWAT), to establish a conceptual model for pesticide runoff in the Sacramento Valley at a sub-watershed scale. The goal is to identify and rank pesticide source areas (sub-basins) in order to guide the choice of mitigation measures and focus areas. The project is still in a calibration stage of the project. This proposal differs in that pesticide loadings will be predicted at a finer resolution, for both the Sacramento and San Joaquin watersheds, and address irrigation return flow and spray drift -- sources that are not being included in the CDPR effort. The project proposed herein will complement the CDPR effort by providing weight-of-evidence data for their research. CDPR is included in this proposal as part of the project team in part to coordinate efforts, share data, and avoid duplication of effort and included in this proposal.

The USEPA Region 9 has funded the development of a hydrologic and hydrodynamic model of the Sacramento River using the LSPC and EFDC models (Tetra Tech, 2004a, 2004b). The model was developed to assist USEPA and the Central Valley Regional Water Quality Control Board in predicting flows in ungaged streams to support TMDL calculations. The model was designed to allow future modifications to address specific management and environmental factors, such as those proposed for this study.

The USGS is evaluating trends in concentration and use of selected pesticides relative to their application and potential toxicity to aquatic life, 1991-2005 (USGS, 2006). Objectives are to define trends in concentrations of dissolved pesticides and relate these trends to available application data for 1991 to 2005. This proposal will augment this research by predicting pesticide loads as a function of application date, environmental factors, and physicochemical properties in addition to annual volumes of pesticide use.

This proposal is relevant to other research and regulatory initiatives at the federal, state, and local level. USEPA (2002) published a "Twenty Needs Report" on how research can enhance the TMDL process. This research proposal directly addresses three of those needs:

> *Improve watershed and water quality modeling; assist States in monitoring design development; Improve information on BMPs, restorations or other management practice effectiveness, and the related processes of system recovery.*

The CVRWQCB recently adopted the water quality control plan for the Sacramento and San Joaquin River Basins, which included an orchard pesticide runoff program of surveillance and monitoring activities to determine compliance with the diazinon water quality objective. The program was initiated to determine the degree of implementation of management practices and other strategies to reduce off-site migration of diazinon, to determine whether alternatives to diazinon are causing water quality impacts, and to determine that management practices are achieving the lowest pesticide levels technically achievable (CVRWQCB, 2003; CVRWQCB, 2005).

The CVRWQCB's Watershed Management Initiative (WMI) highlights that a priority for the region is to develop an integrated approach for addressing nonpoint source pollution in agriculturally dominated water bodies such as the Sacramento Valley to include evaluation of management practices, and monitoring protocols to assess beneficial use impacts (CVRWQCB, 2001). Establishing the baseline

water quality of the river system upstream of Sacramento will be important in assessing the relative contribution from the various land uses within the entire Sacramento River watershed. It is identified in the CALFED Record of Decision (ROD) that State agencies will implement and coordinate a comprehensive source water protection program for the Delta and its tributaries. "This program will include identification and implementation of appropriate pollutant source control measures, focused regulatory and/or incentive programs targeting pollutants of concern, development of a monitoring and assessment program, and infrastructure improvements to separate drinking water intakes from irremediable sources of pollutants" (CALFED, 2000).

The CVRWQCB adopted the Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Agricultural Waiver). To comply with the Waiver, Coalition Groups will develop a monitoring program to assess the sources and impacts of waste in discharges from irrigated lands, and where necessary, to track progress in reducing the amount of waste discharged that affects the quality of the waters of the state and its beneficial uses. The purpose of the monitoring program is to monitor the discharge of wastes in irrigation return flows and storm water. The monitoring plans are designed to achieve the following objectives as a condition of the Waiver:

- Assess the impacts of waste discharges from irrigated lands to surface water;
- Determine the degree of implementation of management practices to reduce discharge of specific wastes that impact water quality;
- Determine the effectiveness of management practices and strategies to reduce discharges of wastes that impact water quality; and
- Determine concentration and load of waste in these discharges to surface waters.

This project will also address several data gaps outlined by the Sacramento River Watershed Program (SRWP). These data gaps include: (1) the need for a comprehensive watershed pesticide monitoring and assessment program, (2) the need to evaluate the alternative pesticides (pyrethroids) for runoff potential, and (3) the need to evaluate the effectiveness of various BMP within the watershed to reduce diazinon runoff to meet the diazinon load allocations and the required TMDLs.

2.0 Background and Conceptual Models

Detections of pesticides and other agricultural chemicals have been reported in the Bay-Delta estuary and upstream source waters (Amweg et al., 2006; Weston et al., 2004; CVRWQCB, 2006a; Guo et al., 2004; Dileanis et al., 2002). The exposure of these chemicals to aquatic organisms is highly variable and dependent on the complex interaction of factors related to the use of the chemical, the timing of their use relative to rainfall and irrigation events, agronomic practices, and the mobility and persistence of the individual chemicals. Available monitoring data provides an indication of concentration magnitude in certain locations and at certain snap shots in time. However, monitoring data are not comprehensive enough for risk assessment purposes and cannot be used for future condition assessments. Programs charged with dealing with pesticides and water quality (including Agricultural Waiver, Aquatic Herbicide Program, SWAMP, POD, TMDL, and BMP initiatives) have limited knowledge of source areas, temporal patterns of exposure, and the co-occurrence with sensitive organisms for program implementation.

Pesticide transport to non-target water bodies can occur from spray drift, irrigation return flow, atmospheric deposition, and precipitation induced runoff and erosion. Chemical fate is highly dependent on the complex interaction of factors related to the use of a pesticide (e.g., formulation, application rates, and method of application); meteorological conditions and water management practices during and after its use; and the characteristics of individual application sites (e.g., crop/plant characteristics, properties, soil properties, and the proximity to water). The spatial and temporal patterns of loadings at individual application sites can be predicted through the use of continuous simulation models that can account for the complex interaction of factors in a mass balance context that address chemical mobility and persistence.

3.0 Approach and Scope of Work

Methods and materials. Spatial and temporal patterns of pesticide loadings in both the Sacramento and San Joaquin watersheds will be predicted using field-scale simulation models (pollutant source models) including the Pesticide Root Zone Model (PRZM), the rice water quality model (RICEWQ), and the spray drift model, AgDRIFT®. The models have been accepted for regulatory use in the U.S. and Europe and have the ability to address chemical mass balance on a spatial and temporal scale. Processes represented include: the distribution of pesticide residues during application on foliage, soil, and spray drift; adsorption to soil; uptake by plants; leaching through soil; and degradation in foliage, soil, and by different breakdown mechanisms (microbial degradation, photolysis, hydrolysis, and volatilization). Degradation processes include transformation of parent compound to degradation products. A short synopsis of the recommended models follows:

- PRZM (Suárez, 2005) is the standard model used for ecological and drinking-water risk assessments for pesticides by the U.S. Environmental Protection Agency's Office of Pesticide Programs (USEPA, 2004). The model has undergone an extensive validation effort against numerous field-scale runoff and leaching studies conducted for pesticides in the United States (Jones and Russell 2001). The model has been integrated into watershed assessments in the U.S. (Parker et al., in press) and pesticide risk assessment procedures in Europe (FOCUS, 2005; FOCUS, 2004). Pesticide loading assessments in the Sacramento River watershed have also been conducted (SRWP, 2006; SRWP, 2004).

- RICEWQ (Williams et al., 1999) simulates pesticide mass balance and water management practices in rice paddy environments. The model has been endorsed by the European community (Delmas et al., 2001) and has been validated with a number of field and watershed applications (Capri and Miao, 2002; Cheplick et al., 2002; Miao et al., 2003a; Miao et al., 2003b; Warren et al., 2004).

- AgDRIFT® is a predictive tool for calculating off-site deposition of pesticides applied by aerial, ground, and orchard airblast spraying means, and for evaluating the potential of buffer zones to protect sensitive aquatic and terrestrial habitats from undesired exposures (Teske et al. 2001). The model was developed and tested by a number of regulatory stakeholders that include the U.S. Department of Agriculture, USEPA, and a coalition of pesticide registrants.

The Pesticide Use Reporting (PUR) database (CDPR, 2006) will be used to identify when and where pesticide applications have occurred, at what rate, and to what crop. PUR records are related to specific square-mile sections, based on the Public Land Survey System (PLSS). A Geographical Information

System (GIS) will be used to identify other relevant factors that determine the magnitude and timing of pesticide transport to adjacent water bodies for each PLSS section, including spatially related soils, generalized proximity to water, and weather patterns. Data that feed into the GIS will be combined with other informational databases on crop factors, soil properties, land use, meteorological data, and geomorphology to determine detailed input files. Model output will consist of a daily time-series prediction of pesticide loadings from runoff, erosion, irrigation return flow, and drift sources for each PUR record. Loadings from urban and residential uses will also be addressed, but at a lower level of accuracy because these pesticide use records are not available at the same level of resolution. Loadings will expressed seasonally and cumulatively along the major tributaries and main stems of the Sacramento and San Joaquin rivers. Results will be analyzed relative to spatial and temporal co-occurrence of critical species and sensitive life cycles. Figure 2 shows a schematic of the models and data linkage to be used for the project.

Four sets of model simulations will be conducted.

- The first set combines the specific year of weather data with PUR application to compare spatial and temporal patterns of pesticide loadings to concentrations observed in monitoring data. These simulations will be used to validate the ability of the model to simulate the relative magnitude and timing of exposure from monitoring data.

- The second set simulates two or three recent years of PUR applications with 20-30 years of weather data to predict pesticide loadings in a probabilistic context under a range of low, moderate, and high runoff events.

- The third set simulates anticipated changes in pesticide use for the same 20-30 years of weather data to predict the future trends in pesticide loadings on aquatic ecosystems.

- The fourth set will be used to evaluate the feasibility of alternate management practices in minimizing impacts to those same aquatic ecosystems.

This study builds on previous research efforts conducted in the Sacramento River basin (SRWP, 2004; SWRP 2006). The 2006 study provides the "proof-of-concept" for this project. The objective of that study was to estimate pesticide loadings to the Sacramento River and its tributaries in terms of spatial and temporal probability of occurrence. The study was performed for the Sacramento River Watershed Program funded by USEPA Region 9. Five chemicals (chlorpyrifos, diazinon, diuron, paraquat dichloride, and permethrin) were selected for analysis from a list of 22 chemicals identified by the Central Valley Regional Water Quality Control Board (CVRWQCB, 2006b). The five chemicals were selected based on volume of use, toxicity, persistence in the environment, and the amount of chemical applied during the wet season. A Geographical Information System (GIS) was used to construct approximately 43,000 model simulations representing unique combinations of soil, land use, and chemical use within the study area. Simulations were conducted using the USEPA's Pesticide Root Zone Model (PRZM) (Suárez, 2005). Information about chemical use was obtained from the Pesticide Use Reporting (PUR) database (CDPR, 2006). Environmental fate properties of the five chemicals were obtained from the USDA-ARS Pesticide Property database (USDA, 2003). Detailed land use data for the pesticide application sites in the 23 counties were also obtained from the PUR database. The land uses were associated with seven major categories for modeling: corn, fruit, grain, grape, grass, nut, and

vegetable. Soil parameters were identified from the State Soil Geographic (STATSGO) database (USDA, 2004). Cropping dates (emergence, maturation, and harvest) and other crop parameters (interception storage, maximum coverage, active root depth, aerial coverage, maximum canopy height) were derived from USEPA's Office of Pesticide Program's standard modeling scenarios (USEPA, 2004). Simulations were conducted for 30-years of historical weather to evaluate runoff loadings under a range of potential low, moderate, and high rainfall events. The weather data were obtained from USEPA's Center for Exposure Assessment Modeling (CEAM) for five meteorological stations within and around the watershed.

Simulations were conducted at the township-range-section level, which is the reporting level of the PUR database and has a resolution of 1 square mile. Edge-of-field predictions of pesticide runoff were aggregated (scaled-up) to the township scale (36 square miles) for visual presentation and to the county scale for tabular presentation. Model predictions were represented in terms of temporal probability of occurrence by calculating 50th and 90th percentile annual mass loadings.

This proposal builds on that work for this current study by including additional pesticides (including uses on rice), refining areas of uncertainty from the previous analysis, and expanding the scope to include the San Joaquin River and Bay-Delta estuary. CVRWQCB is currently preparing a parallel relative pesticide risk report for the San Joaquin and Delta waterways. Coordination between projects will occur through the involvement of CVRWQCB on the TAP. Areas of refinement from the previous study will include: incorporation of predictions of irrigation return flow into the simulations; increase of the density of weather stations for greater spatial resolution; utilization of the SSURGO database (USDA, 2006) to obtain a more accurate estimate of soil properties for applications in each PLSS section; additional years of PUR records to address year-to-year variability in pesticide application (e.g., crop rotation), incorporation of urban and residential uses; and incorporation of an assessment of potential spray drift.

A geostatistical approach will be used to estimate pesticide loadings from urban and residential uses. Detailed land use records from DWR (CDWR, 2006) will be used to improve estimates of where urban and residential applications have occurred. It will be assumed that applications will occur at typical rates and dates in urban and residential settings for model simulations.

Spray drift loadings will be estimated based on field proximity to water. Fields having the potential to have received the pesticide application in the township-range-section documented by the PUR database will be identified from the DWR detailed land use database and the high resolution version of the National Hydrography Dataset (http://nhd.usgs.gov/index.html) using GIS analysis. Spray drift loads will be assessed based on generalized distances of those fields to water (e.g., 0-25' zone, 25-50' zone, etc). Figure 3 provides an example of DWR detailed land use data for walnuts at the township-range-section level and its proximity to high resolution NHD data. Buffers of 25, 50, and 75 feet are also shown for each water body.

For this study, we will also present cumulative loadings along river reaches and into the Bay-Delta estuary using the NHDplus hydrography data set that has recently been released for California (http://www.horizon-systems.com/NHDPlus/). The data set includes significant quality control and improvements in database and network navigation.

Temporal patterns of loading within accumulation reaches will be evaluated in context of temporal co-occurrence of critical life stages for sensitive species. Pesticide loads will be summed seasonally for each chemical and expressed in terms of frequency of occurrence (90^{th} percentile and 50^{th} percentile corresponding to 10-year and 2-year return periods) or other endpoints as dictated by the TAP. Daily predictions for each PUR section (1 mi^2) will be retained so that the output is available for future studies and applications (e.g., to provide loadings into receiving water models, ecosystem population models, and other program-specific assessments).

Project tasks. Eleven tasks have been identified as described below. Costs are provided in the Task and Budget Summary and the accompanying Detailed Budget.

1. Project Administration. Activities relate to day-to-day management and coordination between technical teams.

2. Chemical Selection. Priority chemicals for simulation will be selected based on use volume, chemical properties indicating persistence and mobility, toxicity, and historical detections near or exceeding the State's water quality objectives or TMDL target levels. The TAP will provide input into this process. Once selected, the Pesticide Use Report (PUR) database will be used to guide model applications and crops.

3. Data Collection/Reduction. This task involves the collection and pre-processing of relevant spatial and temporal data on soil properties, pesticide use, weather, land use, and ecology into formats that can be used for other tasks. Five parallel activities are included in this effort:

    a) Critical Habitat – development of GIS data layers for critical species habitats that will later be used in evaluating model results and their potential impacts. Data from the federal and state agencies, including the U.S. Fish and Wildlife Services (USFWS) and National Oceanic and Atmospheric Administration (NOAA) fisheries, (http://www.dfg.ca.gov/whdab/html/cnddb_info.html), and/or other appropriate data sources as determined through contacts with local experts and agencies, will be acquired to define the locations of critical habitats as well as the times of year that species are estimated to be present in those water bodies, especially during sensitive life cycles.

    b) Water Quality Monitoring – development of a geocoded database that summarizes the location, sampling periods, and results of pesticide monitoring efforts in both watersheds. The data will be used to validate the relative magnitude and duration of model predictions during Task 5 and to assess the adequacy of existing monitoring programs in characterizing exposure concentration from pesticide sources in the Sacramento and San Joaquin watersheds during Task 7. Agencies involved in assessing monitoring efforts, including CDPR, USGS, CVRWQCB, State Water Resources Control Board, and SFEI will be contacted to minimize redundancy and duplication of efforts for this task.

    c) Soil Data – USDA's soil survey geographical database (SSURGO), currently available for the majority of California, will be processed on a county-by-county basis to obtain relevant soil properties (Curve Number, organic matter, texture, slope, etc.) for model simulations. The STATSGO database will be used for remaining areas. This is a significant data processing

activity because of the large geographical area of study. SSURGO is preferred for this study because it identifies the location of soils on a soil series level. STATSGO is at a coarser detail and introduces uncertainty in the assessment.

d) Weather Data – Daily weather data (precipitation, temperature, solar radiation, and pan evaporation) will be obtained from the National Weather Service for use in model simulations. Data will be collected for a dozens of meteorological stations to address weather variability in the study area. Missing weather data will be filled in from appropriate adjacent stations to provide for a complete network. The weather data are used to set boundary conditions in PRZM and RICEWQ for calculating runoff, soil moisture, evapotranspiration, and the need for irrigation.

e) Proximity to Water – The proximity of pesticide application sites to water will be assessed using GIS processing to provide load estimates due to spray drift. DWR's high-resolution land use database will be used to identify locations within each township-range-section where each PUR application may have occurred. The shortest distance to water for each of these locations will be calculated and the average distance from all locations in the section will be used for drift calculations. Drift will be based on the method of application identified in the PUR (aerial vs. ground). Calculations will be performed for every PLSS section in a 3-year recent history.

4. Database Linkage/Model Processor Development. This task includes the modification of existing processors that have been developed to automate the production of thousands of model simulations with PRZM and RICEWQ. The processors link the geocoded databases prepared in Task 3 with other input parameter databases to define specific model input parameter values to each unique combination of soil, weather, crop, and pesticide application.

5. Validation / Sensitivity Analysis. a) Simulations and development of a sensitivity matrix of parameters for the Pollutant Source Assessment Model that may include crop, environmental fate, and soil parameters, including parameters of greatest uncertainty. Sensitivity will be reviewed at the point of loading and key location(s) along the river network. b) Validation will be performed through comparison of model results to the relative magnitude and duration of observed in-stream water quality data. Validation will be conducted primarily through visual techniques. Travel time analysis of USGS stream flow stations may be used to refined temporal predictions. c) Evaluate predictions in context with SWAT modeling being conducted by University of California – Davis.

6. Baseline, Future Trends, and Mitigation Scenarios. Model scenarios will address 20-30 years of historical meteorology to assess chemical loadings and concentrations in a probabilistic framework (i.e., high, moderate, and low rainfall conditions), under existing pesticide use and agronomic practices, and under other alternate "what-if" scenarios. Scenarios can be designed to represent projected changes in climate, land use, and agronomic practices in the watershed and updated as needed in the future to address evolving pesticide uses and additional management scenarios. Mitigation scenarios can be designed to predict pesticide reductions likely to occur under the implementation of BMPs and other mitigation measures. Specific scenarios will be identified by the TAP.

7. Result Integration. Temporal patterns of loading within accumulation reaches will be evaluated in context of temporal co-occurrence of critical life stages for sensitive species. Results will be used to prioritize areas of risk, identify source loadings for potential mitigation, and to assess the adequacy of existing monitoring programs in characterizing exposure concentration from pesticide sources in the Sacramento and San Joaquin watersheds. Recommendations will be provided on strategic placement of BMPs, monitoring locations, and sampling frequency.

8. Reports and Publications. To include technical progress reports, draft final report, response to peer review comments, final report, and publication in scientific journal(s) (e.g., SETAC).

9. Technical Meetings. Under this task it is assumed that two meetings will occur between subcontractors and the TAP at key stages of the project: 1) project initiation and 2) review of baseline results. The second meeting will also be used to define the future condition and mitigation scenarios.

10. Quality Assurance Project Plan (QAPP). Although this study does not involve sample collection or analysis, a QAPP will be developed for quality control, documentation, and to ensure results are reproducible. The plan will justify and summarize the quality of databases and models used for the project. A description of the quality control procedures to be implemented will also be provided. In addition, a budget item has been included for developing study-specific QAPP procedures.

11. Training. A training workshop will be provided to interested parties and stakeholder agency staff. The workshop will contain a technical overview of the models, associated databases and GIS layers, and model linkage.

Project deliverables. Work products include: one-page project summary for public audience at the beginning of the project; one-page project summary for public audience upon project completion; progress reports at key stages of completion; semi-annual and final reports (including peer review of final report); project closure summary report; presentation at CALFED science conferences; presentation at other events at the request of the CALFED Science Program staff; and a copy of all published material resulting from the grant. A time-series database of model predictions will be provided that can be used for future studies, including other water quality models, ecosystem population models, or other analyses by as the Central Valley Regional Water Quality Control Board staff, State Water Resources Control Board, Resource Conservation Districts, CDPR, USDA, and other entities.

The final report will document methods, materials, and results including: input parameter values, sources and rationale; sensitivity analysis, calibration, and validation; maps and tables illustrating the relative mass loadings of priority pesticides at key locations in the watershed system relative to critical habitats; and identification of areas of model uncertainty.

4.0 Feasibility

The potential for project success is high given that a pilot study has already been conducted as proof-of-concept (SWRP, 2004; SWRP, 2006). The 2006 study was conducted in a 5-month period. The current work, allowing for contingencies, can be completed in an 18-month period. This study does not require

the development or completion of external models or databases. The study is not contingent on permits, weather, or the establishment of biological communities.

The scope has been limited to produce a well defined deliverable. We have not added additional phases or stages that require additional investigation and controversial negotiation between stakeholders (e.g., linkage to receiving water models or population models). Rather the deliverables would provide an immediate utility in the understanding of the spatial and temporal variability in pesticide loadings as well as the building blocks to a variety of future programs.

The project team has sufficient depth and experience that it can continue in the event of the loss of project scientists. The study team includes authors of both PRZM and RICEWQ models. The models themselves have been widely used in the scientific community. Furthermore, the model development and outcome assessments will be reviewed the TAP, to be comprised of experts from USGS, NOAA, University of California-Davis (UCD), CDPR, CVRWQCB, the State Water Resources Control Board, Department of Water Resources (DWR), and USEPA.

Decisions will be made by the TAP to ensure that cross-agency needs and considered and addressed. Involvement will occur at the initiation of the project to coordinate data collection and avoid duplication of efforts with other activities that either have occurred or are in progress. Interaction with the TAP will be continuous and iterative. The TAP will receive progress reports and other interim communication and redirect efforts as necessary to maximize the success of this study.

5.0 Relevance to the CALFED Science Program

The results of the modeling as proposed will provide an understanding of the hydrologic delivery of pesticides to water bodies in the Sacramento and San Joaquin watersheds, as well as address listed priorities for the CALFED Science Program:

Topic 3: Trends and Patterns of Populations and System Response to a Changing Environment

As climatic changes brings changes in hydrology and runoff, the development of pesticide transport and fate models will be needed to calculate the change in loading to the rivers. Irrigation practices will change based on changing hydrology. Development of this model will provide a tool to transfer changes in land use and hydrology through climate change to changes in contaminant loading. Matching the output to lifecycle modeling and habitat mapping will provide an assessment told for potential risks to sensitive species.

Questions addressed as part of Proposed Project Implementation

- How will climatic changes influence or change pesticide loadings?
- How will these changes in loading impact sensitive species?
- How will changes in management of irrigation water due to climate change affect loading of pesticides and impacts to sensitive species?

Topic 4: Habitat Availability and Response to Change

The future will bring changes in land use in the watershed of the Delta. Agricultural practices will continue to evolve from social, economic, and environmental pressures. The continuing conversion of agricultural lands to urban will bring temporal and geographical shifts in water use and runoff. Pesticide use will also shift for urban applications. An example is the recent outbreak of West Nile virus has required urban applications of pyrethroids to control mosquitoes. Seasonality of loading will shift as storm water runoff becomes a larger component of pesticide transport. The completion of the proposed project will meet the following CALFED objectives:

1. The development and use of spatially-explicit models and databases to analyze and map the potential effects of anticipated stressors on existing habitats;

2. The development and use of population models to evaluate effects of changes in habitat on demographic characteristics of key species such as fecundity, growth, survival, etc.

It is proposed to link the results of the pesticide loading model with results of the life cycle models currently under development for striped bass and delta smelt, as well as existing models (salmonids). This will provide toxicologists with a focused set of contaminants to study in terms of toxicology testing. In addition, biomarker work done under the current POD effort will be enhanced by the knowledge of the pesticides identified in the loading results. This will allow the estimation of population level effects on these species.

Future changes in agricultural practices; such as wide-scale BMPs to reduce offsite movement of pesticides will be captured by running the model adjusted for the effects of the BMPs on off-site movement. Increases in urban loading from land use shifts will be calculated. The current effort to better track total use of pesticides in the urban setting through sale of pesticides to home owners, as well as commercial pest control companies will provide a better estimate of the true application of urban pesticides. This in turn will allow for a more refined modeling of the loading from this source.

The SRWP identified a range of challenges for agriculture in the Sacramento River watershed including contaminant stressors, issues with water quantity, transfers and exports, agricultural land conversion to urban landscape, erosion and sedimentation, and climate change issues (SWRP 2005). The Central Valley is undergoing growth rates of which the Sacramento Metropolitan Area is expected to nearly double in size in the next fifty years. The estimate for Sacramento Metropolitan area is that nearly 450,000 acres of currently agricultural lands will be retired from agriculture and converted to urban landscape. Also of concern is global warming indicating temperature increase and precipitation decrease. In particular, this project can generate hypothetical scenarios for varying meteorological conditions to demonstrate those watershed changes in order to inform managers for watershed management and decision-making. Also, as land is converted from agricultural to urban density and those changes in pesticide uses can be generated for comparison on the watershed scale.

This proposal contributes to research needs identified by Hinton (1998) in a review paper of multiple stressors in the Sacramento River watershed. Hinton concluded that studies and approaches are needed in the Sacramento River watershed to understand and more closely mimic the exposure to multiple

stressors and understand when exposures are co-occurring with critical life stages of fish will either be directly toxic or adversely affect the availability of food.

This project will also address several data gaps outlined by the Sacramento River Watershed Program (SRWP). These data gaps include: (1) the need for a comprehensive watershed pesticide monitoring and assessment program, (2) the need to evaluate the alternative pesticides (pyrethroids) for runoff potential, and (3) the need to evaluate the effectiveness of various BMP within the watershed to reduce pesticide runoff to meet the load allocations and the required TMDLs.

In addition the project will quantify loadings of agricultural uses of copper. Copper is a ubiquitous surface water pollutant that causes a range of adverse acute, chronic, and sublethal effects in fish as well as to aquatic invertebrates and algae (Hansen et al., 1999; Baldwin et al., 2003; Sandahl et al., 2004). These effects are relevant to threatened and endangered salmonids in California's Central Valley considering copper's use as a fungicide. For example, copper sulfate pentahydrate is used extensively on rice to control tadpole shrimp. From 1991 to 1996 the use of this active ingredient increased almost threefold to 2,987,034 pounds applied. Of the approximately 3 million pounds that were applied in 1996, 91.4% was applied to rice (CDPR, 1999). Copper sulfate pentahydrate use has continued to increase with 3,675,045 lbs applied in 2004 (CDPR, 2004). It can be applied by both aerial and ground application methods. Due to the sensitivity of salmonid sensory systems, the ecological significance of their impairment, and the documented presence of elevated concentrations of dissolved copper in salmonid habitats, it is critical to determine exposure concentrations and durations that adversely affect salmonids.

6.0 Qualifications

Project Staffing. This project will be administered by the California Department of Water Resources (DWR) under the direction of Dr. Dean Messer. DWR roles include: 1) management of contracts and subcontracts; 2) work as an advocate to promote resource support for SWAMP, SRWP, and the Agricultural Waiver program to assist in guiding monitoring and assessment efforts; 3) transfer the data to those researchers conducting risk assessment of sensitive species as part of the POD effort; and 4) coordinate the application of the results by connecting with those researchers that possess or are developing lifecycle models for sensitive species.

This proposal was prepared in consultation with stakeholders involved in both the regional and local efforts and builds off of previous research in the watershed. Project collaborators include the Central Valley Regional Water Quality Control Board (CVRWQCB); the California Department of Pesticide Regulation (CDPR); Environmental Protection Agency – Region 9 (USEPA); The National Oceanic and Atmospheric Administration (NOAA), the U.S. Geological Survey (USGS); the University of California – Davis (UCD). As part of the Technical Advisory Panel (TAP), representatives from each organization will be involved in overall project direction and work on specific components of the study. The study team was selected based on relevant expertise in technical areas and end-user needs.

Currently, DWR does not have the modeling staff and expertise to create and expand the watershed and fate modeling tools described in the proposal. Additionally, current monitoring programs for the Environmental Water Quality and Estuarine Studies (EWQES) branch do not extend up into the upper

reaches of the river systems. Therefore, the majority of the grant money will be sent to those subcontractors listed below.

Contractors selected for this study are uniquely qualified to perform this work based on their intimate knowledge of the procedures and to be used for this study. Waterborne Environmental, Inc. (WEI) is the primary contractor for this study. WEI is an environmental consulting company specializing in pesticides and water quality. They are the developers of the rice water quality RICEWQ (Williams et al., 1999) and authored many of the features in the PRZM model (Suárez, 2005; FOCUS, 2004). They have conducted other validation and production modeling studies of both PRZM and RICEWQ (SRWP, 2004; SRWP, 2006; Snyder and Williams, in press; Warren et al., 2004; Miao et al., 2003a; Miao et al., 2003b; Cheplick et al., 2002; Jones and Russell, 2001). The Spatial Technologies Group at Waterborne Environmental Inc., is an ESRI Certified Consultant and Certified Programmer for ArcView and ArcInfo GIS software. WEI conducted the pilot study for the Sacramento River that serves as the foundation of this study (SRWP, 2006). The infrastructure and processing algorithms from that study that link relevant databases will be used for the current study. WEI also conducted the validation study of PRZM in the Sacramento River basin that included an evaluation of alternate mitigation practices (SRWP, 2004).

University of California – Davis (UCD) is an additional contractor for this study. In addition to functioning as technical advisors, graduate students will assist in data collection, data processing, classification of aquatic habitats, model validation, and presentation of results.

Key staff. Key staff is identified below. Project roles are provided on the Personnel form.

- DWR: Dean Messer, Ph.D., is the Chief of the DWR's Bay-Delta Monitoring and Analysis Section. He has over 20 years of experience in the areas of water quality, hydrology, environmental and biological assessment, and monitoring program development. Dr. Messer is responsible for ensuring that all stages of a water right decision (data collection, reduction, analysis, and reporting mandate) issued to the Department by the State Water Resources Control Board is satisfied and to conduct special studies in response to monitoring findings. Dr. Messer will serve as study director for the project and provide 180 hours of in-kind labor for the project.

- DWR: Rich Breuer is the Chief of DWR's Environmental Water Quality and Estuarine Studies branch. He worked in the 1980's developing IPM applications, and on the rice herbicide reduction program with CDPR, as well as conducting research of transport and fate of molinate. His current program continues to build on its 30 years of Delta and tributary monitoring, and research of water quality and biota. In-kind labor provided by Mr. Breuer will be 100 hours.

- CDPR: Lei Guo, Ph.D., is an expert in pesticide fate modeling. She has been involved in pesticides research for over 20 years and serves as a technical reviewer for numerous scientific journals, and book series. Dr. Guo is donating in-kind time to assist in modeling and GIS. In-kind labor provided by Dr. Guo will be 360 hours. She will also be serving on the TAP.

- USEPA: Debra Denton, Ph.D., is a recognized national expert on toxicity testing, and regional experience on pesticide TMDL and watershed monitoring issues. She has worked on water quality standards, regulatory programs including permitting and TMDLs, and pesticide monitoring for 15

years. Dr. Denton is donating in-kind time to serve on the TAP as well as provide technical assistance for data synthesis, and watershed coordination with stakeholders and end users of the model outputs. In-kind labor provided by Dr. Denton will be 160 hours.

- USGS: Joseph Domagalski, Ph.D., is a research chemist and project manager with the USGS in Sacramento. Much of his career has centered on pesticide issues in the Sacramento and San Joaquin Valleys and he has written numerous reports and journal articles dealing with agricultural non-point source pollution. Dr. Domagalski is project chief of the National Water Quality Assessment Program (NAWQA) in the Sacramento River Basin and is currently the leader of NAWQA's Agricultural Contaminant Transport studies in the San Joaquin Valley. Dr. Domagalski is donating in-kind time (80 hours total) to serve on the TAP for this project.

- NOAA Fisheries: Scott Hecht, Ph.D., is a national expert on pesticides and their effects on threatened and endangered salmonids. He has extensive experience with ecological risk assessment, salmonid ecology, and ecotoxicology. Dr. Hecht has worked with several environmental regulations including the CWA, FIFRA, NEPA, and ESA. He has worked in the field of ecotoxicology for the past 8 years. He will provide technical assistance for salmonid ecology including habitat use and other ESA related issues (e.g., designated critical habitat). Dr. Hecht is providing in-kind time (80 hours total) to serve on the TAP for this project.

- UCD: Mark Grismer, Ph.D., has 20 years of experience related to irrigated agriculture, soil-water processes, water quality, and hillslope/sediment delivery. His work includes development of both physical and computer models of diazinon runoff, interflow and shallow groundwater flow from bare soils and vegetated filter strips. Dr. Grismer is a subcontractor for this project serving on the TAP and providing detailed review of model procedures and results.

- UCD: Minghua Zhang, Ph.D. is an associate adjunct professor and a senior research scientist for the California Department of Pesticide Regulation. She has 15 years of experience in the areas of pesticide application and environmental effects, groundwater and surface-water quality analysis, and GIS database development and spatial modeling. Current work includes characterizing diazinon and chlopyrifos use in the San Joaquin Watershed, tracking non-residential pesticide use in urban areas and working on new tools to promote the transition away from the Food Quality Protection Act-targeted pesticides in California orchards. Dr. Zhang is a subcontractor for this project serving on the TAP and providing detailed review of GIS procedures and results. In-kind labor provided by Dr. Zhang will be 200 hours.

- WEI: W. Martin Williams, P.E., will serve as the Principal Engineer for modeling and GIS activities at WEI. Mr. Williams has over 25 years of experience in hydrologic and water quality investigations with special expertise in pesticide water quality modeling, risk assessment, and risk mitigation. He served as an expert scientist on USEPA's Ecological Committee of FIFRA Risk Assessment Methods (ECOFRAM, 1999) and the Atrazine Ecological Probabilistic Risk Assessment Panel (Giddings et al, 2005). Mr. Williams was the study director of the previous SRWP studies that serve as the foundation for this project (SRWP, 2006, 2004). He is also the primary author of the author of rice water quality model (RICEWQ) that will be used for this study.

- WEI: Mark Cheplick will be the Principal Investigator of modeling efforts. He has 20 years of experience in chemical fate and transport modeling, and geographical information system (GIS) analysis. He is an author of the Pesticide Root Zone Model (PRZM) that is being used for this study and has linked the model with informational database for production modeling for a variety of applications. Mr. Cheplick developed the technology behind the SRWP pilot study that serves as the foundation of this study.

Matching Funds. Funding requested for this project is $395,700. Participation from the applicant and CVRWQCB, CDPR, USEPA, NOAA, and USGS is being donated to this project as matching funds for a total of $112,240. This work also builds on previous modeling efforts in the Sacramento River under the Sacramento River Watershed Program. Total contract value for previous efforts is $116,500. Combined, the total value of this study is $624,440 ($395,700 + $112,240 + $116,500). Matching funds and previous funding contribute 36.6% to the total value of the project.

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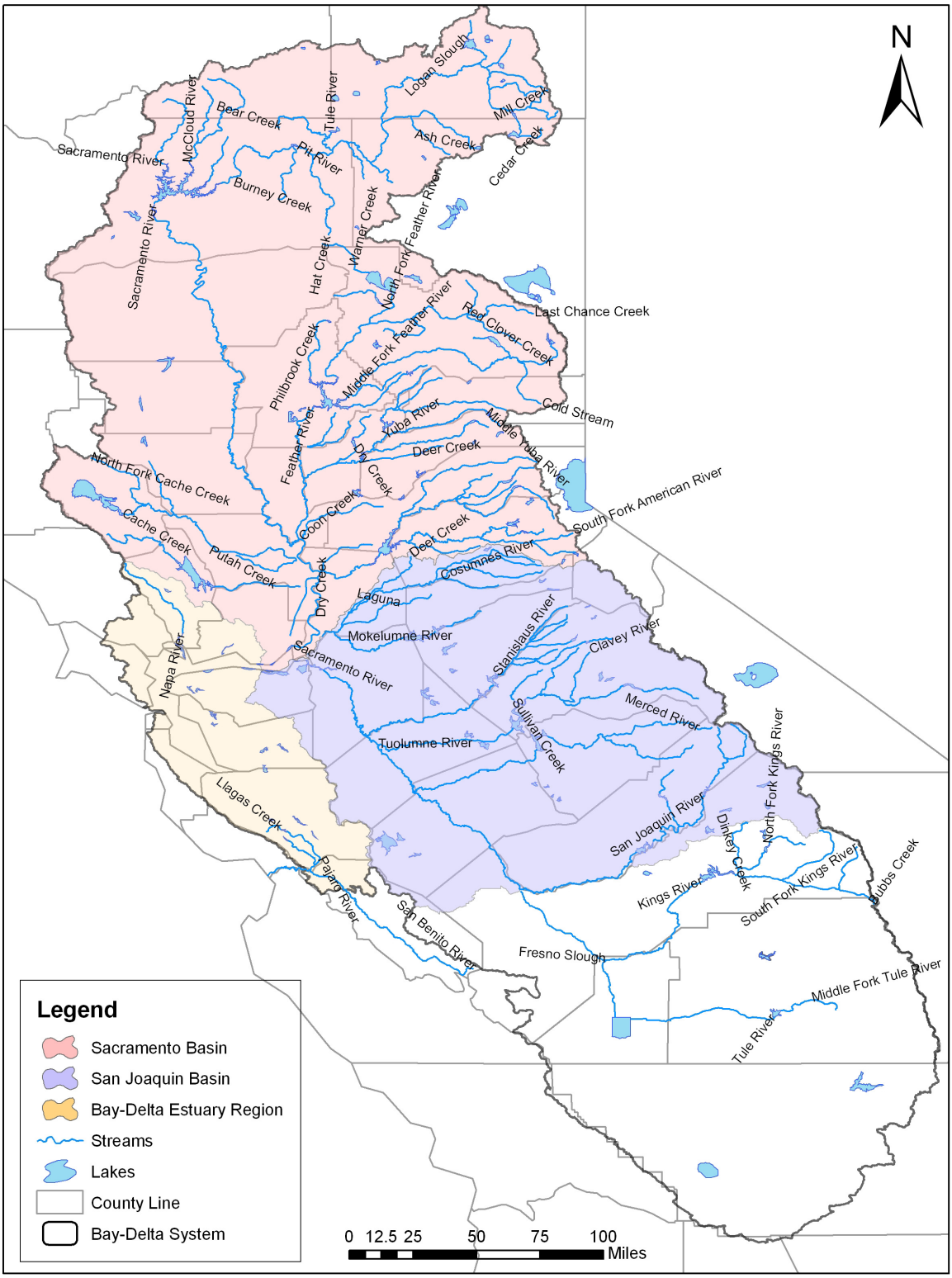

Figure 1. Study area.

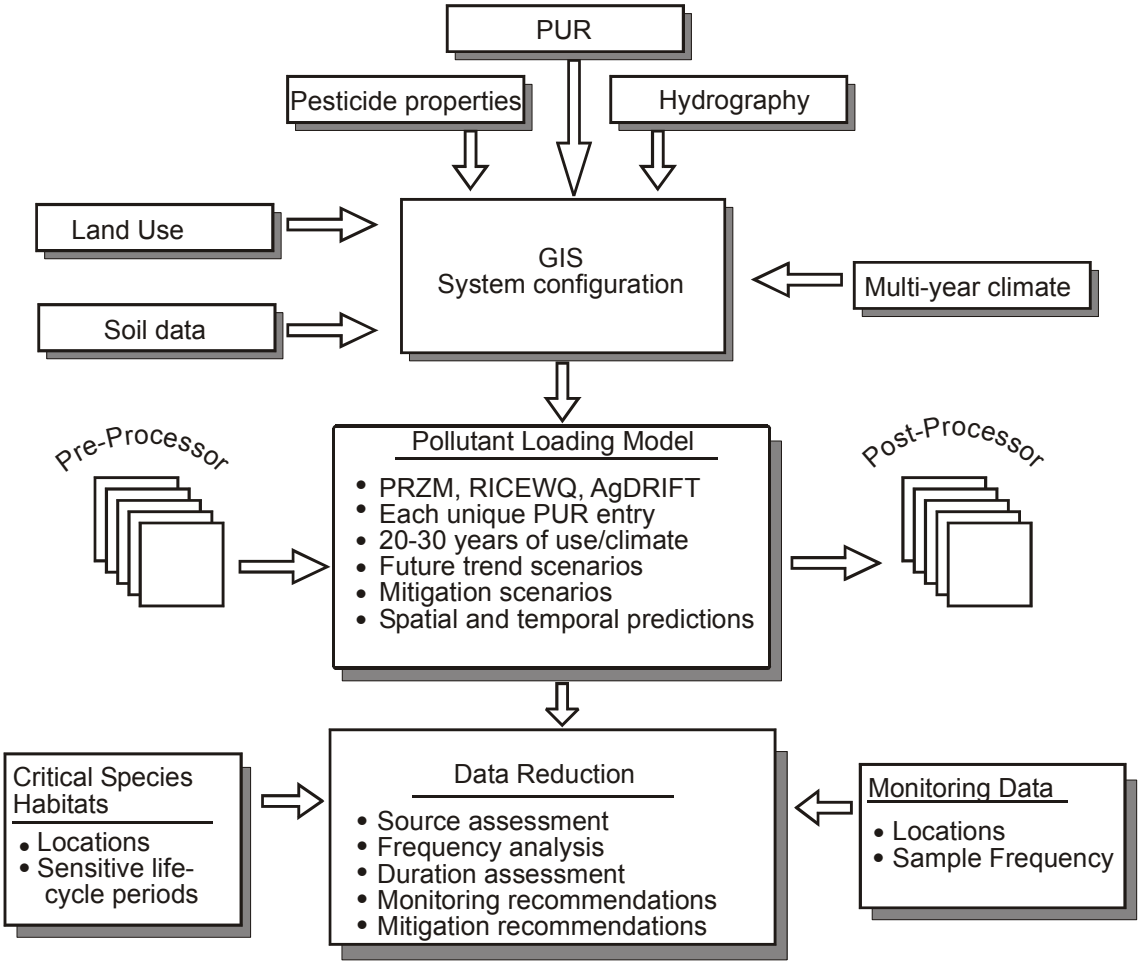

Figure 2. Models and data linkage schematic

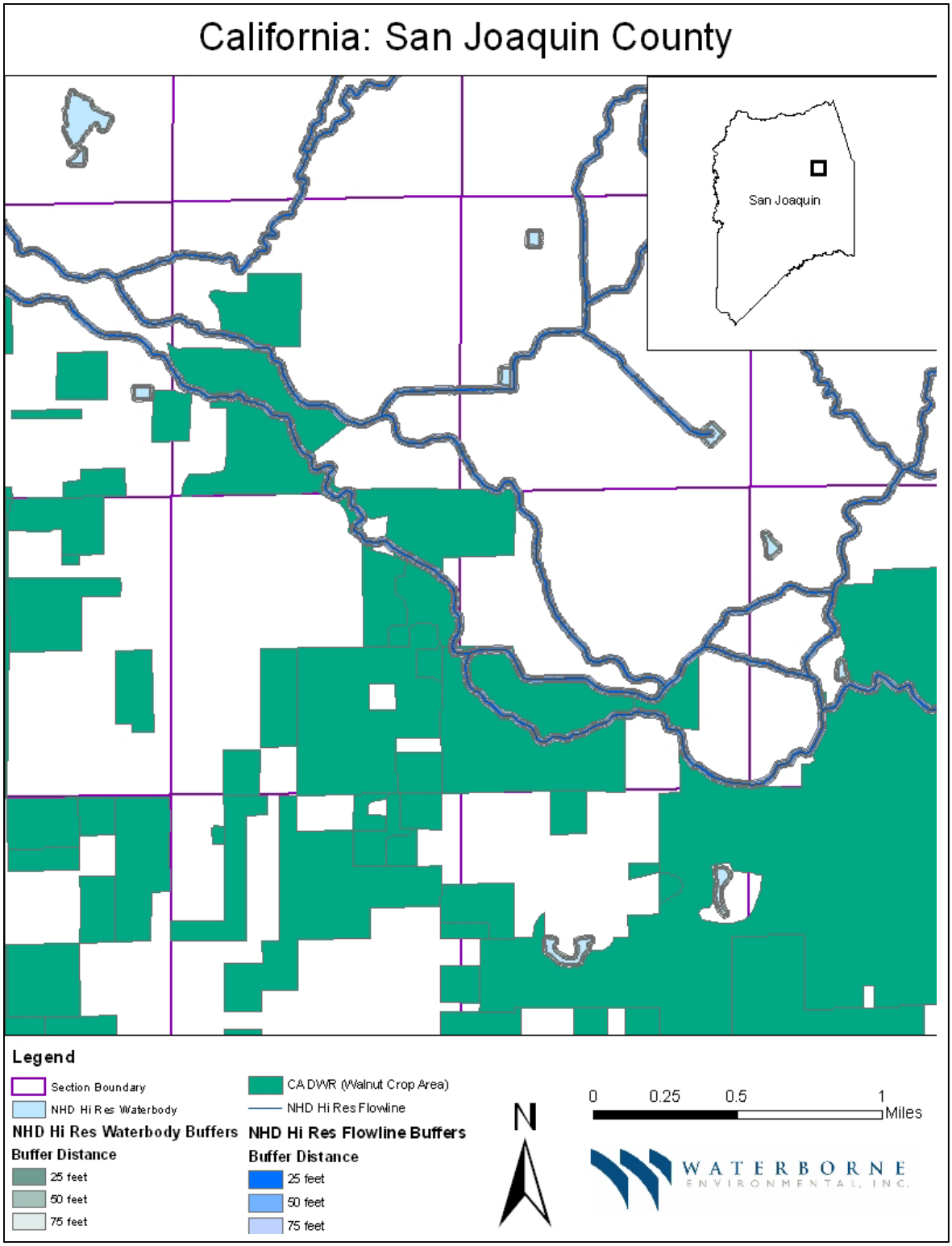

Figure 3. Example of DWR land use data at the township-range-section level for walnuts in San Joaquin County and its proximity to NHD high resolution data.

DEAN F. MESSER, Ph.D.

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WORK EXPERIENCE

CALIFORNIA DEPARTMENT OF WATER RESOURCES, Sacramento, California

Senior Environmental Scientist. 2004 – Present

Chief, Bay Delta Monitoring and Analysis Section

As Chief of the Bay-Delta Monitoring and Analysis Section in the Environmental Water Quality and Estuarine Studies Branch of the Division of Environmental Services, I am responsible for ensuring that the data collection, reduction, analysis, management, and reporting mandate of a water right decision issued to the Department by the State Water Resources Control Board is fulfilled, and that special studies are conducted in response to monitoring findings and the needs of management.

LARRY WALKER ASSOCIATES, INC., Davis, California

Senior Scientist. 1997-2004

Larry Walker Associates is an environmental management firm specializing in water quality issues. Services provided include water quality assessment assistance to wastewater and stormwater agencies, regulatory policy analysis, monitoring program development, watershed management administration, performance of watershed level research and assistance with strategic planning and administration.

Example projects performed with Larry Walker Associates include:

- Management and oversight of a consultant & university based team undertaking a water-borne pathogen detection/source identification project.
- Management of several stormwater Best Management Practice (BMP) monitoring and effectiveness studies throughout California.
- Participated in environmental impact research related to wastewater treatment plant expansions and stormwater management systems for several California cities.
- Developed TMDLs, bioassessment monitoring plans and wetland restoration plans.
- Developed stormwater BMP handbooks, stormwater runoff management plans and water quality monitoring guidance manuals.

UNIVERSITY OF CALIFORNIA, DAVIS

Lecturer. Department of Hydrologic Science 1995-1997

Responsible for developing and teaching courses in hydrologic and environmental resource science and performing research on water quality.

Post-Doctoral Research Associate. Center for Ecological Health Research 1994-1996

Developed, in conjunction with local, state and federal agencies, a comprehensive database of water quality data from rivers throughout California.

Research Associate – Project Manager. Department of Land, Air and Water Resources 1988-1994

Developed and supervised field sampling, laboratory analysis, data analysis, report preparation, and managed personnel for large scale, multi-year research projects examining water quality in California.

Example Projects:

- Examined the effects of clear-cut logging practices upon stream water quality in northern coastal California, (performed in conjunction with the California Department of Forestry).
- Examined water quality parameters and biological communities of agriculture drain-water evaporation ponds as part of a larger study examining selenium toxicity in California's San Joaquin Valley (performed in conjunction with the State Water Quality Control Board).

CALIFORNIA STATE UNIVERSITY, FULLERTON

Pre-doctoral Research Associate

Assistant Project Manager – Task Coordinator. Department of Biological Sciences 1986-1988

Supervised and coordinated research activities of several investigators from various disciplines, supervised laboratory and field technicians, directed data analysis and report preparation for large-scale environmental research project.

Example Projects:

- Examined water quality and sewage effluent in the Santa Ana River in southern California (performed in conjunction with the Regional Water Quality Control Board).
- Examined the distribution, abundance and mitigation of endangered species in southern California (performed in conjunction with the Department of Fish and Game).

PURDUE UNIVERSITY

Research Assistant – Assistant Project Manager. Department of Entomology 1984-1986

Co-supervised sample collection, laboratory analysis and report preparation for a large scale, multi-year entomological research project in three Midwestern states.

OTHER RELATED WORK EXPERIENCE

ENVIRONMENTAL RESEARCH ASSOCIATES (environmental consulting firm) Davis, CA 1993-1997

Consultant (at will)

Served as a technical consultant and researcher on several environmental assessment projects in the western United States.

Example Project:

- Consulted to the Klamath Indian Tribe in analyzing historical dynamics and concentrations of nutrients in Klamath Lake, Oregon.

LEADERSHIP AND ORGANIZATIONAL DEVELOPMENT

RIPARIAN IMPROVEMENT ORGANIZATION, Davis, CA (non-profit environmental organization)

Vice President 1997-1999

UNIVERSITY OF CALIFORNIA

Public Service Research Program, Undergraduate Research Committee 1996
Public Service Research and Dissemination Program, Bioregion Committee 1995
Provost's Advisory Committee on Information Technology 1994
Graduate Group Admission Committee (Co-Chair) 1994

TAHOE-BAIKAL INSTITUTE, South Lake Tahoe, CA (non-profit educational organization)

Program Coordination Committee 1993-1996
Admissions Committee (Co-Chair) 1993-1996

GRANTS AND RESEARCH DEVELOPMENT

UNIVERSITY OF CALIFORNIA

Public Service Research Program Grant Committee 1995-1996
Presidents Undergraduate Research Fellowship Committee 1995
Graduate Group Grants and Fellowships Committee (Co-Chair) 1994

GRANTS, FELLOWSHIPS AND AWARDS

Graduate Group Travel Award 1994; Chancellor's Teaching Fellowship 1993; Jastro-Shields Graduate Scholarship 1993; Natural Reserve System Research Grant 1993; Outstanding Graduate Student Teaching Award 1992, 1993; Hewlett Foundation Grant 1992; Sigma Xi Research Award 1991; Gamma Sigma Delta Honor Society, Outstanding Graduate Student Award 1986; Dean's Honor Roll 1981-1984.

EDUCATION

Ph.D., Ecology, University of California 1995

M.S., Entomology, Purdue University 1986

B.A., Biology, California State University, Fullerton 1984

RECENT AND RELEVANT PUBLICATIONS

Metzger, M. E., D. F. Messer, C. L. Beitia, C.M Myers and V. L. Kramer. 2002. The Dark Side of Stormwater Runoff Management: Disease Vectors Associated with BMPs. Stormwater 3(2): 24-39.

Kluh, S., M. E. Metzger, D. F. Messer, J. E. Hazelrigg and M. B. Madon. 2002. Stormwater, BMPs and Vectors: The Impact of New BMP Construction on Local Public Health Agencies. Stormwater 3(2): 40-46.

Messer, D.F. 1995. The Influence of Riparian Vegetation on Stream Macroinvertebrate Community Structure in an Old-Growth Forest. PhD. Dissertation. Davis, CA: University of California; 102 pp.

Messer, D. F.; C. L. Donaldson, M. S. Parker and A. W. Knight. 1994. Effects of clear-cut logging practices on benthic communities of the North Fork Caspar Creek Watershed, Jackson State Demonstration Forest: Interim Report, Spring 1987 to Spring 1992. Land, Air, and Water Resources Paper No. 100024. Davis, CA: University of California; 28 pp.

Messer, D. F. and A. W. Knight. 1990. Methods for sampling the biological communities of agricultural drainage evaporation ponds: including literature review of sampling techniques. Land, Air and Water Resources Paper No. 10016. Davis, CA: University of California; 58 pp.

Total Project Budget Summary by Task and by Fiscal Year

Proposal Number: 0060

Applicant Name: CDWR

Proposal Name: Spatial and Temporal Quantification of Pesticide Loadings to the Sacramento River, San Joaquin River, and Bay-Delta

Note: This budget summary **automatically links** to the costs and totals on the **"Budget Detail"** worksheet.
DO NOT CHANGE FORMULAS OR ENTER NUMBERS INTO ANY CELLS EXCEPT THE SHADED CELLS for "Cost Share" and "Other Matching Funds"

BUDGET SUMMARY	Total Amount for Year 1	Total Amount for Year 2	Total Amount for Year 3	Total Amount for All Years
Total Costs for Task One	$ 34,250.00	$ 22,050.00	$ -	$ 56,300.00
Total Costs for Task Two	$ 5,400.00	$ -	$ -	$ 5,400.00
Total Costs for Task Three	$ 65,660.00	$ -	$ -	$ 65,660.00
Total Costs for Task Four	$ 58,050.00	$ -	$ -	$ 58,050.00
Total Costs for Task Five	$ 23,900.00	$ -	$ -	$ 23,900.00
Total Costs for Task Six	$ 20,555.00	$ 20,555.00	$ -	$ 41,110.00
Total Costs for Task Seven	$ 14,875.00	$ 14,875.00	$ -	$ 29,750.00
Total Costs for Task Eight	$ 23,661.00	$ 55,209.00	$ -	$ 78,870.00
Total Costs for Task Nine	$ 9,825.00	$ 9,825.00	$ -	$ 19,650.00
Total Costs for Task Ten	$ 2,220.00	$ -	$ -	$ 2,220.00
Total Costs for Task Eleven	$ -	$ 14,790.00	$ -	$ 14,790.00
Total Costs for Task Twelve	$ -	$ -	$ -	$ -
Total Costs for Task Thirteen	$ -	$ -	$ -	$ -
Total Costs for Task Fourteen	$ -	$ -	$ -	$ -
Total Costs for Task Fifteen	$ -	$ -	$ -	$ -
Total Costs for Project Tasks	$ 258,396.00	$ 137,304.00	$ -	$ 395,700.00
1/Cost Share	$ 56,120.00	$ 56,120.00	$ -	$ 112,240.00
2/ Other Matching Funds	$ 116,500.00	$ -	$ -	$ 116,500.00

1/ *Cost share funds* are specifically dedicated to your project and can include private and other State and Federal grants. Any funds listed in this line must be further described in the text of your proposal (see Chapter 3, Section D, of the PSP document)

2/ *Other matching funds* include other funds invested consistent with your project in your project area for which the ERP grant applicant is not eligible. Any funds listed in this line must be further described in the text of your proposal (see Chapter 3, Section D, of the PSP document)

BUDGET FOR TASK ONE (Administrative)	TOTAL AMOUNT TASK 1 All Years	Year 1			Year 2			Year 3		
		Amount per hour	Number of Hours	Total Amount for Year 1	Amount per hour	Number of Hours	Total Amount for Year 2	Amount per hour	Number of Hours	Total Amount for Year 3
Personnel										
Brianne Noble	$ 31,500.00	$ 63.00	250	$ 15,750.00	$ 63.00	250	$ 15,750.00	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
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	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
Personnel Subtotal	**$ 31,500.00**			**$ 15,750.00**			**$ 15,750.00**			**$ -**
1/ Benefits as percent of salary	40%			$6,300.00			$6,300.00			$0.00
Personnel Total (salary + benefits)	**$44,100.00**			**$22,050.00**			**$22,050.00**			**$0.00**
Other Costs	**Total All Years**			**Total Year 1**			**Total Year 2**			**Total Year 3**
Operating Expenses: (ex: seed, plant materials, irrigation supplies, software, office supplies, etc)	$ -						$ -			$ -
2/ Travel and Per Diem	$ -			$ -			$ -			$ -
3/ Equipment	$ -			$ -			$ -			$ -
4/ Sub-Contractor - Waterborne Environmental, Inc. (WEI)	$ 12,200.00			$ 12,200.00			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
Other Costs Subtotal	**$ 12,200.00**			**$ 12,200.00**			**$ -**			**$ -**
5/ Overhead Percentage (Applied to Personnel & Other Costs)				$ -			$ -			$ -
Total Costs for Task One	**$ 56,300.00**			**$ 34,250.00**			**$ 22,050.00**			**$ -**

1/ Indicate your rate, and change formula in column immediately to the right of this cell

2/ Travel expenses and per diem must be at rates specified by the Department of Personnel Administration. The contractor is required to maintain travel receipts and records for auditing purposes. No travel out of the state of California shall be reimbursed unless prior written authorization is obtained from the State.

3/ Please provide a list and cost of major equipment ($5,000 or more) to be purchased, and complete "Equipment Detail" Worksheet

4/ Please list each subcontractor and amounts (if subcontractor not selected yet, use function like "ditch construction subcontractor")

5/ Indicate rate in column immediately to the right of this cell; and provide a description of what expenses are covered by overhead. If overhead is > 15% must provide justification

Detailed Budget Breakdown by Task and by Fiscal Year

		Year 1			Year 2			Year 3		
BUDGET FOR TASK TWO	**TOTAL AMOUNT TASK 2 All Years**	**Amount per hour**	**Number of Hours**	**Total Amount for Year 1**	**Amount per hour**	**Number of Hours**	**Total Amount for Year 2**	**Amount per hour**	**Number of Hours**	**Total Amount for Year 3**
Personnel										
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
Personnel Subtotal	**$ -**			**$ -**			**$ -**			**$ -**
[1/] Benefits as percent of salary				$0.00			$0.00			$0.00
Personnel Total (salary + benefits)	**$0.00**			**$0.00**			**$0.00**			**$0.00**
Other Costs	**Total All Years**			**Total Year 1**			**Total Year 2**			**Total Year 3**
Operating Expenses: (ex: seed, plant materials, irrigation supplies, software, office supplies, etc)	$ -			$ -			$ -			$ -
2/ Travel and Per Diem	$ -			$ -			$ -			$ -
3/ Equipment	$ -			$ -			$ -			$ -
4/ Sub-Contractor - WEI	$ 5,400.00			$ 5,400.00			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
Other Costs Subtotal	**$ 5,400.00**			**$ 5,400.00**			**$ -**			**$ -**
[5/]Overhead Percentage (Applied to Personnel & Other Costs)				$ -			$ -			$ -
Total Costs for Task Two	**$ 5,400.00**			**$ 5,400.00**			**$ -**			**$ -**

1/ Indicate your rate, and change formula in column immediately to the right of this cell

2/ Travel expenses and per diem must be at rates specified by the Department of Personnel Administration. The contractor is required to maintain travel receipts and records for auditing purposes. No travel out of the state of California shall be reimbursed unless prior written authorization is obtained from the State.

3/ Please provide a list and cost of major equipment ($5,000 or more) to be purchased, and complete "Equipment Detail" Worksheet

4/ Please list each subcontractor and amounts (if subcontractor not selected yet, use function like "ditch construction subcontractor")

5/ Indicate rate in column immediately to the right of this cell; and provide a description of what expenses are covered by overhead. If overhead is > 15% must provide justification

Detailed Budget Breakdown by Task and by Fiscal Year

		Year 1			Year 2			Year 3		
BUDGET FOR TASK THREE	**TOTAL AMOUNT TASK 3 All Years**	**Amount per hour**	**Number of Hours**	**Total Amount for Year 1**	**Amount per hour**	**Number of Hours**	**Total Amount for Year 2**	**Amount per hour**	**Number of Hours**	**Total Amount for Year 3**
Personnel										
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
Personnel Subtotal	**$ -**			**$ -**			**$ -**			**$ -**
1/ Benefits as percent of salary				$0.00			$0.00			$0.00
Personnel Total (salary + benefits)	**$0.00**			**$0.00**			**$0.00**			**$0.00**
Other Costs	**Total All Years**			**Total Year 1**			**Total Year 2**			**Total Year 3**
Operating Expenses: (ex: seed, plant materials, irrigation supplies, software, office supplies, etc)	$ -			$ -			$ -			$ -
2/ Travel and Per Diem	$ -			$ -			$ -			$ -
3/ Equipment	$ -			$ -			$ -			$ -
4/ Sub-Contractor - WEI	$ 47,850.00			$ 47,850.00			$ -			$ -
4/ Sub-Contractor - University of California - Davis (UCD)	$ 17,810.00			$ 17,810.00			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
Other Costs Subtotal	**$ 65,660.00**			**$ 65,660.00**			**$ -**			**$ -**
5/ Overhead Percentage (Applied to Personnel & Other Costs)				$ -			$ -			$ -
Total Costs for Task Three	**$ 65,660.00**			**$ 65,660.00**			**$ -**			**$ -**

1/ Indicate your rate, and change formula in column immediately to the right of this cell

2/ Travel expenses and per diem must be at rates specified by the Department of Personnel Administration. The contractor is required to maintain travel receipts and records for auditing purposes. No travel out of the state of California shall be reimbursed unless prior written authorization is obtained from the State.

3/ Please provide a list and cost of major equipment ($5,000 or more) to be purchased, and complete "Equipment Detail" Worksheet

4/ Please list each subcontractor and amounts (if subcontractor not selected yet, use function like "ditch construction subcontractor")

5/ Indicate rate in column immediately to the right of this cell; and provide a description of what expenses are covered by overhead. If overhead is > 15% must provide justification

Detailed Budget Breakdown by Task and by Fiscal Year

BUDGET FOR TASK FOUR	TOTAL AMOUNT TASK 4 All Years	Year 1 Amount per hour	Year 1 Number of Hours	Year 1 Total Amount for Year 1	Year 2 Amount per hour	Year 2 Number of Hours	Year 2 Total Amount for Year 2	Year 3 Amount per hour	Year 3 Number of Hours	Year 3 Total Amount for Year 3
Personnel										
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
Personnel Subtotal	**$ -**			**$ -**			**$ -**			**$ -**
1/ Benefits as percent of salary				$0.00			$0.00			$0.00
Personnel Total (salary + benefits)	**$0.00**			**$0.00**			**$0.00**			**$0.00**
Other Costs	**Total All Years**			**Total Year 1**			**Total Year 2**			**Total Year 3**
Operating Expenses: (ex: seed, plant materials, irrigation supplies, software, office supplies, etc)	$ -			$ -			$ -			$ -
2/ Travel and Per Diem	$ -			$ -			$ -			$ -
3/ Equipment	$ -			$ -			$ -			$ -
4/ Sub-Contractor - WEI	$ 58,050.00			$ 58,050.00			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
Other Costs Subtotal	**$ 58,050.00**			**$ 58,050.00**			**$ -**			**$ -**
5/ Overhead Percentage (Applied to Personnel & Other Costs)				$ -			$ -			$ -
Total Costs for Task Four	**$ 58,050.00**			**$ 58,050.00**			**$ -**			**$ -**

1/ Indicate your rate, and change formula in column immediately to the right of this cell

2/ Travel expenses and per diem must be at rates specified by the Department of Personnel Administration. The contractor is required to maintain travel receipts and records for auditing purposes. No travel out of the state of California shall be reimbursed unless prior written authorization is obtained from the State.

3/ Please provide a list and cost of major equipment ($5,000 or more) to be purchased, and complete "Equipment Detail" Worksheet

4/ Please list each subcontractor and amounts (if subcontractor not selected yet, use function like "ditch construction subcontractor")

5/ Indicate rate in column immediately to the right of this cell; and provide a description of what expenses are covered by overhead. If overhead is > 15% must provide justification

Detailed Budget Breakdown by Task and by Fiscal Year

BUDGET FOR TASK FIVE	TOTAL AMOUNT TASK 5 All Years	Year 1 Amount per hour	Year 1 Number of Hours	Year 1 Total Amount for Year 1	Year 2 Amount per hour	Year 2 Number of Hours	Year 2 Total Amount for Year 2	Year 3 Amount per hour	Year 3 Number of Hours	Year 3 Total Amount for Year 3
Personnel										
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
Personnel Subtotal	**$ -**			**$ -**			**$ -**			**$ -**
1/ Benefits as percent of salary				$0.00			$0.00			$0.00
Personnel Total (salary + benefits)	**$0.00**			**$0.00**			**$0.00**			**$0.00**
Other Costs	**Total All Years**			**Total Year 1**			**Total Year 2**			**Total Year 3**
Operating Expenses: (ex: seed, plant materials, irrigation supplies, software, office supplies, etc)	$ -			$ -			$ -			$ -
2/ Travel and Per Diem	$ -			$ -			$ -			$ -
3/ Equipment	$ -			$ -			$ -			$ -
4/ Sub-Contractor - WEI	$ 15,660.00			$ 15,660.00			$ -			$ -
4/ Sub-Contractor - UCD	$ 8,240.00			$ 8,240.00			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
Other Costs Subtotal	**$ 23,900.00**			**$ 23,900.00**			**$ -**			**$ -**
5/ Overhead Percentage (Applied to Personnel & Other Costs)				$ -			$ -			$ -
Total Costs for Task Five	**$ 23,900.00**			**$ 23,900.00**			**$ -**			**$ -**

1/ Indicate your rate, and change formula in column immediately to the right of this cell

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3/ Please provide a list and cost of major equipment ($5,000 or more) to be purchased, and complete "Equipment Detail" Worksheet

4/ Please list each subcontractor and amounts (if subcontractor not selected yet, use function like "ditch construction subcontractor")

5/ Indicate rate in column immediately to the right of this cell; and provide a description of what expenses are covered by overhead. If overhead is > 15% must provide justification

BUDGET FOR TASK SIX	TOTAL AMOUNT TASK 6 All Years	Year 1 Amount per hour	Year 1 Number of Hours	Year 1 Total Amount for Year 1	Year 2 Amount per hour	Year 2 Number of Hours	Year 2 Total Amount for Year 2	Year 3 Amount per hour	Year 3 Number of Hours	Year 3 Total Amount for Year 3
Personnel										
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
Personnel Subtotal	**$ -**			**$ -**			**$ -**			**$ -**
1/ Benefits as percent of salary				$0.00			$0.00			$0.00
Personnel Total (salary + benefits)	**$0.00**			**$0.00**			**$0.00**			**$0.00**
Other Costs	**Total All Years**			**Total Year 1**			**Total Year 2**			**Total Year 3**
Operating Expenses: (ex: seed, plant materials, irrigation supplies, software, office supplies, etc)	$ -			$ -			$ -			$ -
2/ Travel and Per Diem	$ -			$ -			$ -			$ -
3/ Equipment	$ -			$ -			$ -			$ -
4/ Sub-Contractor - WEI	$ 30,910.00			$ 15,455.00			$ 15,455.00			$ -
4/ Sub-Contractor - UCD	$ 10,200.00			$ 5,100.00			$ 5,100.00			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
Other Costs Subtotal	**$ 41,110.00**			**$ 20,555.00**			**$ 20,555.00**			**$ -**
5/ Overhead Percentage (Applied to Personnel & Other Costs)				$ -			$ -			$ -
Total Costs for Task Six	**$ 41,110.00**			**$ 20,555.00**			**$ 20,555.00**			**$ -**

1/ Indicate your rate, and change formula in column immediately to the right of this cell

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3/ Please provide a list and cost of major equipment ($5,000 or more) to be purchased, and complete "Equipment Detail" Worksheet

4/ Please list each subcontractor and amounts (if subcontractor not selected yet, use function like "ditch construction subcontractor")

5/ Indicate rate in column immediately to the right of this cell; and provide a description of what expenses are covered by overhead. If overhead is > 15% must provide justification

Detailed Budget Breakdown by Task and by Fiscal Year

BUDGET FOR TASK SEVEN	TOTAL AMOUNT TASK 7 All Years	Year 1 Amount per hour	Year 1 Number of Hours	Year 1 Total Amount for Year 1	Year 2 Amount per hour	Year 2 Number of Hours	Year 2 Total Amount for Year 2	Year 3 Amount per hour	Year 3 Number of Hours	Year 3 Total Amount for Year 3
Personnel										
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
Personnel Subtotal	**$ -**			**$ -**			**$ -**			**$ -**
1/ Benefits as percent of salary				$0.00			$0.00			$0.00
Personnel Total (salary + benefits)	**$0.00**			**$0.00**			**$0.00**			**$0.00**
Other Costs	**Total All Years**			**Total Year 1**			**Total Year 2**			**Total Year 3**
Operating Expenses: (ex: seed, plant materials, irrigation supplies, software, office supplies, etc)	$ -			$ -			$ -			$ -
2/ Travel and Per Diem	$ -			$ -			$ -			$ -
3/ Equipment	$ -			$ -			$ -			$ -
4/ Sub-Contractor - WEI	$ 18,210.00			$ 9,105.00			$ 9,105.00			$ -
4/ Sub-Contractor - UCD	$ 11,540.00			$ 5,770.00			$ 5,770.00			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
Other Costs Subtotal	**$ 29,750.00**			**$ 14,875.00**			**$ 14,875.00**			**$ -**
5/ Overhead Percentage (Applied to Personnel & Other Costs)				$ -			$ -			$ -
Total Costs for Task Seven	**$ 29,750.00**			**$ 14,875.00**			**$ 14,875.00**			**$ -**

1/ Indicate your rate, and change formula in column immediately to the right of this cell

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3/ Please provide a list and cost of major equipment ($5,000 or more) to be purchased, and complete "Equipment Detail" Worksheet

4/ Please list each subcontractor and amounts (if subcontractor not selected yet, use function like "ditch construction subcontractor")

5/ Indicate rate in column immediately to the right of this cell; and provide a description of what expenses are covered by overhead. If overhead is > 15% must provide justification

Detailed Budget Breakdown by Task and by Fiscal Year

BUDGET FOR TASK EIGHT	TOTAL AMOUNT TASK 8 All Years	Year 1 Amount per hour	Year 1 Number of Hours	Year 1 Total Amount for Year 1	Year 2 Amount per hour	Year 2 Number of Hours	Year 2 Total Amount for Year 2	Year 3 Amount per hour	Year 3 Number of Hours	Year 3 Total Amount for Year 3
Personnel										
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
Personnel Subtotal	**$ -**			**$ -**			**$ -**			**$ -**
1/ Benefits as percent of salary				$0.00			$0.00			$0.00
Personnel Total (salary + benefits)	**$0.00**			**$0.00**			**$0.00**			**$0.00**
Other Costs	**Total All Years**			**Total Year 1**			**Total Year 2**			**Total Year 3**
Operating Expenses: (ex: seed, plant materials, irrigation supplies, software, office supplies, etc)	$ -			$ -			$ -			$ -
2/ Travel and Per Diem	$ -			$ -			$ -			$ -
3/ Equipment	$ -			$ -			$ -			$ -
4/ Sub-Contractor - WEI	$ 68,680.00			$ 20,604.00			$ 48,076.00			$ -
4/ Sub-Contractor - UCD	$ 10,190.00			$ 3,057.00			$ 7,133.00			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
Other Costs Subtotal	**$ 78,870.00**			**$ 23,661.00**			**$ 55,209.00**			**$ -**
5/ Overhead Percentage (Applied to Personnel & Other Costs)				$ -			$ -			$ -
Total Costs for Task Eight	**$ 78,870.00**			**$ 23,661.00**			**$ 55,209.00**			**$ -**

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4/ Please list each subcontractor and amounts (if subcontractor not selected yet, use function like "ditch construction subcontractor")

5/ Indicate rate in column immediately to the right of this cell; and provide a description of what expenses are covered by overhead. If overhead is > 15% must provide justification

Detailed Budget Breakdown by Task and by Fiscal Year

BUDGET FOR TASK NINE	TOTAL AMOUNT TASK 9 All Years	Year 1 Amount per hour	Year 1 Number of Hours	Year 1 Total Amount for Year 1	Year 2 Amount per hour	Year 2 Number of Hours	Year 2 Total Amount for Year 2	Year 3 Amount per hour	Year 3 Number of Hours	Year 3 Total Amount for Year 3
Personnel										
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
Personnel Subtotal	**$ -**			**$ -**			**$ -**			**$ -**
1/ Benefits as percent of salary				$0.00			$0.00			$0.00
Personnel Total (salary + benefits)	**$0.00**			**$0.00**			**$0.00**			**$0.00**
Other Costs	**Total All Years**			**Total Year 1**			**Total Year 2**			**Total Year 3**
Operating Expenses: (ex: seed, plant materials, irrigation supplies, software, office supplies, etc)	$ -			$ -			$ -			$ -
2/ Travel and Per Diem	$ -			$ -			$ -			$ -
3/ Equipment	$ -			$ -			$ -			$ -
4/ Sub-Contractor - WEI	$ 15,740.00			$ 7,870.00			$ 7,870.00			$ -
4/ Sub-Contractor - UCD	$ 3,910.00			$ 1,955.00			$ 1,955.00			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
Other Costs Subtotal	**$ 19,650.00**			**$ 9,825.00**			**$ 9,825.00**			**$ -**
5/ Overhead Percentage (Applied to Personnel & Other Costs)				$ -			$ -			$ -
Total Costs for Task Nine	**$ 19,650.00**			**$ 9,825.00**			**$ 9,825.00**			**$ -**

1/ Indicate your rate, and change formula in column immediately to the right of this cell

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4/ Please list each subcontractor and amounts (if subcontractor not selected yet, use function like "ditch construction subcontractor")

5/ Indicate rate in column immediately to the right of this cell; and provide a description of what expenses are covered by overhead. If overhead is > 15% must provide justification

Detailed Budget Breakdown by Task and by Fiscal Year

BUDGET FOR TASK TEN	TOTAL AMOUNT TASK 10 All Years	Year 1			Year 2			Year 3		
		Amount per hour	Number of Hours	Total Amount for Year 1	Amount per hour	Number of Hours	Total Amount for Year 2	Amount per hour	Number of Hours	Total Amount for Year 3
Personnel										
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
Personnel Subtotal	**$ -**			**$ -**			**$ -**			**$ -**
1/ Benefits as percent of salary				$0.00			$0.00			$0.00
Personnel Total (salary + benefits)	**$0.00**			**$0.00**			**$0.00**			**$0.00**
Other Costs	**Total All Years**			**Total Year 1**			**Total Year 2**			**Total Year 3**
Operating Expenses: (ex: seed, plant materials, irrigation supplies, software, office supplies, etc)	$ -						$ -			$ -
2/ Travel and Per Diem	$ -			$ -			$ -			$ -
3/ Equipment	$ -			$ -			$ -			$ -
4/ Sub-Contractor - WEI	$ 2,220.00			$ 2,220.00			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
Other Costs Subtotal	**$ 2,220.00**			**$ 2,220.00**			**$ -**			**$ -**
5/ Overhead Percentage (Applied to Personnel & Other Costs)				$ -			$ -			$ -
Total Costs for Task Ten	**$ 2,220.00**			**$ 2,220.00**			**$ -**			**$ -**

1/ Indicate your rate, and change formula in column immediately to the right of this cell

2/ Travel expenses and per diem must be at rates specified by the Department of Personnel Administration. The contractor is required to maintain travel receipts and records for auditing purposes. No travel out of the state of California shall be reimbursed unless prior written authorization is obtained from the State.

3/ Please provide a list and cost of major equipment ($5,000 or more) to be purchased, and complete "Equipment Detail" Worksheet

4/ Please list each subcontractor and amounts (if subcontractor not selected yet, use function like "ditch construction subcontractor")

5/ Indicate rate in column immediately to the right of this cell; and provide a description of what expenses are covered by overhead. If overhead is > 15% must provide justification

Detailed Budget Breakdown by Task and by Fiscal Year

BUDGET FOR TASK ELEVEN	TOTAL AMOUNT TASK 11 All Years	Year 1 Amount per hour	Year 1 Number of Hours	Year 1 Total Amount for Year 1	Year 2 Amount per hour	Year 2 Number of Hours	Year 2 Total Amount for Year 2	Year 3 Amount per hour	Year 3 Number of Hours	Year 3 Total Amount for Year 3
Personnel										
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
	$ -	$ -		$ -	$ -		$ -	$ -		$ -
Personnel Subtotal	**$ -**			**$ -**			**$ -**			**$ -**
[1/] Benefits as percent of salary				$0.00			$0.00			$0.00
Personnel Total (salary + benefits)	**$0.00**			**$0.00**			**$0.00**			**$0.00**
Other Costs	**Total All Years**			**Total Year 1**			**Total Year 2**			**Total Year 3**
Operating Expenses: (ex: seed, plant materials, irrigation supplies, software, office supplies, etc)	$ -			$ -						$ -
2/ Travel and Per Diem	$ -			$ -						$ -
3/ Equipment	$ -			$ -			$ -			$ -
4/ Sub-Contractor - WEI	$ 12,940.00			$ -			$ 12,940.00			$ -
4/ Sub-Contractor - UCD	$ 1,850.00			$ -			$ 1,850.00			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
4/ Sub-Contractor	$ -			$ -			$ -			$ -
Other Costs Subtotal	**$ 14,790.00**			**$ -**			**$ 14,790.00**			**$ -**
[5/]Overhead Percentage (Applied to Personnel & Other Costs)				$ -			$ -			$ -
Total Costs for Task Eleven	**$ 14,790.00**			**$ -**			**$ 14,790.00**			**$ -**

1/ Indicate your rate, and change formula in column immediately to the right of this cell

2/ Travel expenses and per diem must be at rates specified by the Department of Personnel Administration. The contractor is required to maintain travel receipts and records for auditing purposes. No travel out of the state of California shall be reimbursed unless prior written authorization is obtained from the State.

3/ Please provide a list and cost of major equipment ($5,000 or more) to be purchased, and complete "Equipment Detail" Worksheet

4/ Please list each subcontractor and amounts (if subcontractor not selected yet, use function like "ditch construction subcontractor")

5/ Indicate rate in column immediately to the right of this cell; and provide a description of what expenses are covered by overhead. If overhead is > 15% must provide justification

Spatial and Temporal Quantification of Pesticide Loadings to the Sacramento River, San Joaquin River, and Bay-Delta to Guide Risk Assessment for Sensitive Species

Subcontractor Cost Justification

- Labor costs are detailed in the attached table.

- General direct costs for telephone, postage, shipping, and copies are assumed to be 3 percent of labor costs.

- Data costs under Task 3 include $400 for weather data and $300 for critical species/ecosystem data. The weather data covers National Climatic Data Center in CD format with additional online downloads as needed (http://lwf.ncdc.noaa.gov/oa/ncdc.html). The critical species data is based on data access license to Nature Serve (http://www.natureserve.org). Other significant data required for this project have been obtained or are available free by download. It is assumed that minor data needs, identified during the course of the study is covered by the general direct cost budget identified above.

- Equipment costs ($3,300 under Task 7) covers computer hardware and software required by the University of California – Davis for data processing and GIS analysis of study results.

- Travels costs include two trips for two people to attend technical meetings with the Technical Advisory Panel (TAP) at critical stages of the project (Task 9) and one trip for two people at project closure for training and technology transfer (Task 11). The trips will also be coordinated to include training and working meetings between Waterborne Environmental, Inc., and University of California – Davis. Travel assumptions are provided below:

    - Airfare = $500 (assumed based on current rates are $300-$600 with advanced booking)
    - Per diem= $103 lodging + $59 meals and incidental expenses (MIE) = $162 maximum. 1st and last day is $44.25 (75% of meals) (based on U.S. General Services Administration
    - Domestic Per Diem Rates for Sacramento www.gsa.gov/perdiem Last Reviewed 8/30/2006)
    - Ground transportation/parking = Assume $200 per trip.

List of Tasks

Task 1. Program Administration
Task 2. Chemical Selection
Task 3. Data collection/reduction
    a. Critical habitats
    b. Monitoring
    c. Soil data
    d. Weather data
    e. Proximity to water
Task 4. Database linkage/model processor development
Task 5. Validation / sensitivity analysis
Task 6. Baseline, future trends, and mitigation scenarios
Task 7. Result integration
Task 8. Reports
    a. Progress reports
    b. Final report
    c. Publications
Task 9. Technical meetings
Task 10. Quality Assurance Program Plan
Task 11. Training

SUBCONTRACTOR COSTS

Spatial and Temporal Quantification of Pesticide Loadings to the Sacramento River, San Joaquin River, and Bay-Delta to Guide Risk Assessment for Sensitive Species

Waterborne Environmental, Inc.	Hourly	Task 1	Task 2	Task 3					Task 4	Task 5	Task 6	Task 7
A. Human Resources (HR)	Rate			a	b	c	d	e				
WEI - Principal Engineer	$140	64	4	2	2	1	1	1	4	4	16	8
WEI - Principal Investigator	120	24	4	0	8	4	4	4	300	8	80	24
WEI - Senior Engineer	110	0	0	0	0	0	4	0	8	48	8	48
WEI - GIS Specialist	90	0	0	0	0	80	0	240	8	0	0	0
WEI -Staff Engineer / Scientist	70	0	60	8	32	88	64	0	260	120	240	120
Total hours		88	68	10	42	173	73	245	580	180	344	200
HR dollars		$11,840	$5,240	$840	$3,480	$13,980	$5,540	$22,220	$56,360	$15,200	$29,520	$17,680
B. Direct Expenses (DE)												
Telephone/copies/shipping (3%)		$360	160	30	100	420	170	670	1,690	460	890	530
Data and equipment		$0	0	0	0	0	400	0	0	0	500	0
Travel/subsistence		0	0	0	0	0	0	0	0	0	0	0
Total DE		$360	160	30	100	420	570	670	1,690	460	1,390	530
TOTAL BY TASK		$12,200	$5,400	$47,850					$58,050	$15,660	$30,910	$18,210

University of California - Davis	Hourly	Task 1	Task 2	Task 3					Task 4	Task 5	Task 6	Task 7
A. Human Resources (HR)	Rate			a	b	c	d	e				
UCD- Mark Grismer	$175	0	0	0	0	0	0	0	0	0	8	0
UCD - Graduate student	25	0	0	200	320	0	160	0	0	320	340	320
Total hours		0	0	200	320	0	160	0	0	320	348	320
HR dollars		$0	$0	$5,000	$8,000	$0	$4,000	$0	$0	$8,000	$9,900	$8,000
B. Direct Expenses (DE)												
Telephone/copies/shipping (3%)		$0	0	150	240	0	120	0	0	240	300	240
Data and equipment		$0	0	300	0	0	0	0	0	0	0	3,300
Travel/subsistence		0	0	0	0	0	0	0	0	0	0	0
Total DE		$0	0	450	240	0	120	0	0	240	300	3,540
TOTAL BY TASK		$0	$0	$17,810					$0	$8,240	$10,200	$11,540

GRAND TOTAL	$12,200	$5,400	$65,660	$58,050	$23,900	$41,110	$29,750

SUBCONTRACTOR COSTS

Spatial and Temporal Quantification of Pesticide Loadings to the Sacramento River, San Joaquin River, and Bay-Delta to Guide Risk Assessment for Sensitive Species

Waterborne Environmental, Inc.	Hourly	Task 8			Task 9	Task 10	Task 11	Totals
A. Human Resources (HR)	Rate	a	b	c				
WEI - Principal Engineer	$140	40	40	16	24	4	0	231
WEI - Principal Investigator	120	72	60	80	40	4	40	756
WEI - Senior Engineer	110	0	0	0	0	0	0	116
WEI - GIS Specialist	90	40	12	8	0	0	0	388
WEI -Staff Engineer / Scientist	70	120	120	80	40	16	80	1,448
Total hours		272	232	184	104	24	120	2,939
HR dollars		$26,240	$22,280	$18,160	$10,960	$2,160	$10,400	$272,100
B. Direct Expenses (DE)								
Telephone/copies/shipping (3%)		790	670	540	330	60	310	$8,180
Data and equipment		0	0	0	0	0	0	$900
Travel/subsistence		0	0	0	4,450	0	2,230	$6,680
Total DE		790	670	540	4,780	60	2,540	$15,760
TOTAL BY TASK			$68,680		$15,740	$2,220	$12,940	$287,860

University of California - Davis	Hourly	Task 8			Task 9	Task 10	Task 11	Totals
A. Human Resources (HR)	Rate	a	b	c				
UCD- Mark Grismer	$175	12	12	4	16	0	8	60
UCD - Graduate student	25	80	80	40	40	0	16	1,916
Total hours		92	92	44	56	0	24	1,976
HR dollars		$4,100	$4,100	$1,700	$3,800	$0	$1,800	$58,400
B. Direct Expenses (DE)								
Telephone/copies/shipping (3%)		120	120	50	110	0	50	$1,740
Data and equipment		0	0	0	0	0	0	$3,600
Travel/subsistence		0	0	0	0	0	0	$0
Total DE		120	120	50	110	0	50	$5,340
TOTAL BY TASK			$10,190		$3,910	$0	$1,850	$63,740

GRAND TOTAL		$78,870			$19,650	$2,220	$14,790	$351,600

Spatial and Temporal Quantification of Pesticide Loadings to the Sacramento River, San Joaquin River, and Bay-Delta to Guide Risk Assessment for Sensitive Species

Cost Share / Matching Funds

The following government organizations and institutions are providing in-kind services for this project:

California Department of Water Resources (DWR)
Rich Breuer - Chief of DWR's Environmental Water Quality and Estuarine Studies branch
In-kind Time: 50 hours per year, 100 hours total
Rate: $88 per hour
Total Cost: $8,800

Dean Messer, Ph.D. - Chief of the DWR's Bay-Delta Monitoring and Analysis Section.
In-kind Time: 90 hours per year, 180 hours total
Rate: $88 per hour
Total Cost: $15,840

U.S. Environmental Protection Agency (USEPA)
Debra Denton, Ph.D. – Environmental Scientist USEPA Region 9
In-kind Time: 80 hours per year, 160 hours total
Rate: $90 per hour
Total Cost: $14,400

California Department of Pesticide Regulation (CDPR)
Lei Guo, Ph.D. - Associate Environmental Research Scientist
In-kind Time: 180 hours per year, 360 hours total
Rate: $100 per hour
Total Cost: $36,000

U.S. Geological Survey (USGS)
Joseph Domagalski, Ph.D. - Research chemist and project manager
In-kind Time: 40 hours per year, 80 hours total
Rate: $150 per hour
Total Cost: $12,000

University of California - Davis
Minghua Zhang, Ph.D. - Associate adjunct professor and senior research scientist for the California Department of Pesticide Regulation
In-kind Time: 100 hours per year, 200 hours total
Rate: $90 per hour
Total Cost: $18,000

National Oceanic Atmospheric Administration (NOAA Fisheries)
Scott Hecht, Ph.D. – Ecotoxicologist
In-kind Time: 40 hours per year, 80 hours total
Rate: $90 per hour
Total Cost: $7,200

Total in-kind labor = $112,240.

Previous Funding

- Exposure Assessment Model for Diazinon Sources in the Sacramento and Feather Rivers. Conducted under the Sacramento River Toxic Pollutant Control Program (SRTPCP) under a grant funded by the U.S. Environmental Protection Agency (USEPA) Region 9 to the Sacramento Regional County Sanitation District (SRCSD). SRCSD Contract No.92449. Contract amount $40,000. Year 2001.

- Exposure Assessment Model for Diazinon Sources in the Sacramento River Basin's Main Drainage Canal. Conducted under the Sacramento River Toxic Pollutant Control Program (SRTPCP) under a grant funded by the U.S. Environmental Protection Agency (USEPA) Region 9 to the Sacramento Regional County Sanitation District (SRCSD). SRCSD Contract No.92981. Contract amount $37,500. Year 2004.

- Pesticide Loading Analysis in the Sacramento River Watershed. Conducted under the Sacramento River Toxic Pollutant Control Program (SRTPCP) under a grant funded by the U.S. Environmental Protection Agency (USEPA) Region 9 to the Sacramento Regional County Sanitation District (SRCSD). SRCSD Contract No.92981. Contract amount $23,000. Year 2005.

- Pesticide Loading Analysis in the Sacramento River Watershed. Additional funding to include dry-season irrigation return flow. Conducted under the Sacramento River Toxic Pollutant Control Program (SRTPCP) under a grant funded by the U.S. Environmental Protection Agency (USEPA) Region 9 to the Sacramento Regional County Sanitation District (SRCSD). Funding approved $16,000. Year 2006.

Total previous funding = $116,500.

Signature

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Signature

The applicant for this proposal must submit this form by printing it, signing below, and faxing it to +1 877-408-9310. Send exactly one form per transmission.

Failure to sign and submit this form will result in the application not being considered for funding. The individual submitting this proposal will receive e-mail confirmation as soon as this signature page has been processed.

The individual signing below declares that:

- all representations in this proposal are truthful;
- the individual signing the form is authorized to submit the application on behalf of the applicant (if applicant is an entity or organization);
- the applicant has read and understood the conflict of interest and confidentiality discussion under the Confidentiality and Conflict of Interest Section in the main body of the PSP and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent provided in this PSP; and
- the applicant has read and understood all attachments of this PSP.

proposal title: ~~Alternate Uses of Exotic Species Outside of Delta~~ Spatial and Temporal Quantification of Pesticide loadings to the Sacramento River, the San Joaquin River and Bay Delta to guide Risk Assessment for Sensitive species

proposal number: 2006.01-~~0001~~ 0060

applicant organization: ~~Fast and Friendly Benthologists of the Sierra~~ California Department of Water Resources

applicant contact: ~~Ms. Danielle Wilson~~ Ms Barbara McDonnell, Division Chief

applicant signature Barbara J McDonnell

date Aug 31, 2006

Help is available: help@solicitation.calwater.ca.gov, +1 877 408-9310

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Department of Pesticide Regulation

Mary-Ann Warmerdam
Director

Arnold Schwarzenegger
Governor

August 30, 2006

CALFED Science Program
650 Capitol Mall, 5th Floor
Sacramento, CA 95814

To Whom It May Concern:

The Department of Pesticide Regulation supports the California Department of Water Resources' research proposal, entitled *Spatial and temporal quantification of pesticide loadings to the Sacramento River, San Joaquin River, and the Bay-Delta to guide risk assessment for sensitive species*, submitted in response to the CALFED Science Program's recent proposal solicitation package. The investigators aim to improve decision-making and optimize resource spending for several State programs involving pesticide monitoring through use of pesticide modeling with GIS, which can then be used to better explain and predict pesticide loading in the watersheds under various scenarios.

The Department of Pesticide Regulation was invited to collaborate on this project in an advisory capacity. I am pleased to dedicate staff resources to this important effort. My branch has staff scientists accomplished in developing and refining models that address pesticide contamination and movement in environmental media, including surface water.

Thank you for your consideration. If you need additional information regarding our participation in this project, please contact me.

Sincerely,

John S. Sanders

John S. Sanders, Ph.D.
Chief, Environmental Monitoring Branch
(916) 324-4100