Watershed Mass Balance Model and Protocol Development

Project Information

1. **Proposal Title:**

   Watershed Mass Balance Model and Protocol Development

2. **Proposal applicants:**

   Lee Shull, Montgomery Watson Harza

3. **Corresponding Contact Person:**

   Lee Shull
   Montgomery Watson Harza
   777 Campus Commons, Suite 175 Sacramento, CA 95825
   916 924-8844
   lee.r.shull@us.mwhglobal.com

4. **Project Keywords:**

   Modeling
   Water Resource Management
   Watershed Management

5. **Type of project:**

   Research

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

   No

7. **Topic Area**:

   Natural Flow Regimes

8. **Type of applicant:**

   Private for profit

9. **Location - GIS coordinates:**

   Latitude: 38.500

   Longitude: -120.900

   Datum:

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

Research Project is a[pplicable to all CalFed study areas. Development is based on using the Upper Cosumnes River Watershed (Hydrologic Unit Code 18040013)as the demonstration watershed. Watershed includes parts of SAcramento, Amador and El Dorado Counties.

10. **Location - Ecozone:**

    11.1 Cosumnes River, Code 15: Landscape

11. **Location - County:**

    Amador, El Dorado, Sacramento

12. **Location - City:**

    Does your project fall within a city jurisdiction?

    No

13. **Location - Tribal Lands:**

    Does your project fall on or adjacent to tribal lands?

    No

14. **Location - Congressional District:**

    4th

15. **Location:**

    California State Senate District Number: 1

    California Assembly District Number: 4

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

    1 year

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

       No

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

       Single Overhead Rate: 124.62 plus 15.26

       Total Requested Funds: $560,152

    b) Do you have cost share partners already identified?

No

c) Do you have potential cost share partners?

No

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

No

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

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

No

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

No

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

No

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

No

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

No

Please list suggested reviewers for your proposal. (optional)

21. **Comments:**

Environmental Compliance Checklist

Watershed Mass Balance Model and Protocol Development

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

      No
   b) Will this project require compliance with NEPA?

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

      Research activities only. No field activities are proposed

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

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

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

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

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

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

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

      None

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

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

LOCAL PERMITS AND APPROVALS

Conditional use permit

Variance

Subdivision Map Act

Grading Permit

General Plan Amendment

Specific Plan Approval

Rezone

Williamson Act Contract Cancellation

Other

STATE PERMITS AND APPROVALS

Scientific Collecting Permit

CESA Compliance: 2081

CESA Compliance: NCCP

1601/03

CWA 401 certification

Coastal Development Permit

Reclamation Board Approval

Notification of DPC or BCDC

Other

FEDERAL PERMITS AND APPROVALS

ESA Compliance Section 7 Consultation

ESA Compliance Section 10 Permit

Rivers and Harbors Act

CWA 404

Other

PERMISSION TO ACCESS PROPERTY

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

Permission to access state land.
Agency Name:

Permission to access federal land.
Agency Name:

Permission to access private land.
Landowner Name:

6. **Comments.**

Land Use Checklist

Watershed Mass Balance Model and Protocol Development

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

   No

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

   No

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

   No

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

   Research only

4. **Comments.**

Conflict of Interest Checklist

Watershed Mass Balance Model and Protocol Development

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

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

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

Applicant(s):

Lee Shull, Montgomery Watson Harza

Subcontractor(s):

Are specific subcontractors identified in this proposal? Yes

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

Lev Kavvas	UC Davis
Richard Shatz	Bookman-Edmonston
George Wessman	Wessman Industries

Helped with proposal development:

Are there persons who helped with proposal development?

No

Comments:

Budget Summary

Watershed Mass Balance Model and Protocol Development

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

Independent of Fund Source

Year 1												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1	Project Management	240	4800	5982	500		23320		2508	37110.0	5663	42773.00
2	Data Requirements	80	4000	4985			15900		2090	26975.0	4116	31091.00
3	Data Collection	417	16680	20787	1000	500	31900		8715	79582.0	12144	91726.00
4	Data Evaluation & Storage	2447	85645	106731			6900		44746	244022.0	37238	281260.00
5	Identification of Data Gaps	80	3200	3988			17450		1672	26310.0	4015	30325.00
6	Community Education	120	2400	2991	1000	1000	29100		1254	37745.0	5760	43505.00
7	Reporting & Presentations	120	2400	2991	500	500	26600		1254	34245.0	5226	39471.00
		3504	119125.00	148455.00	3000.00	2000.00	151170.00	0.00	62239.00	485989.00	74162.00	560151.00

Year 2												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Year 3												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Grand Total=560151.00

Comments.

Budget Justification

Watershed Mass Balance Model and Protocol Development

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

Principal Scientist = 200 hours. Principal Engineer = 200 hours. Supervising Scientist = 824 hours. Senior Scientist = 900 hours. Staff Scientist = 900 hours. Administrative Assistant = 480 hours.

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

Principal Scientist = $60/hour. Principal Engineer = $50/hour. Supervising Scientist = $40/hour. Senior Scientist = $30/hour. Staff Scientist = $25/hour. Administrative Assistant = $20/hour.

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

Benefits: The benefits rate allocates engineering overhead pool costs to contracts using a direct labor dollar base. Overhead pool costs include payroll costs, indirect labor costs, occupancy, supplies, insurance, etc., which are related to the day-to-day operations of the business. It does not include routine in-house photocopy, telecommunications, networks, computers or postage costs, which are part of a separate Associated Project Cost pool as further detailed below. Unallowable costs, such as advertising, contributions, entertainment costs, alcoholic beverage costs, etc., are removed from the indirect cost pool in accordance with FAR Part 31.2. Overhead costs receive an allocation of G&A.

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

Travel costs to attend meetings and collect data in the study area. Primarily auto mileage.

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

Supplies for community involvement and education primarily

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

Wessman Industries - Project management, and communitiy education and involvement. $150 /hr for 560 hours. UCD - Hydrologic modelling expertise. $75/hr for 150 hours. Bookman-Edmonston - Hydrolgy expertise. $100/hr for 260 hours. Unidentified Community Relations Specialist - Data gathering and community interaction. $69/hr for 260 hours

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

No equipment purchases are anticipated for this project.

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

Team management, subcontract management, CalFed interface, monitoring project progress, preparing progress reports,etc.

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

ODCs estimated in this cost proposal included Associated Project Costs (APC), CADD and project consumables. MWA maintains a company-wide APC rate that consolidates costs for telecommunications, routine photocopies, personal computers, central MIS computer equipment, networks, and postage. The APC pool costs are allocated to contracts using a total direct labor hours base in accordance with CAS 418. The APC rate is developed by the Controllers office and is updated annually. A profit of 8% is also included in the ODC cost catagory.

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

Indirect Costs: The indirest cost factor or G&A rate allocate G&A pool costs to contracts based on a total cost input base. G&A costs represent costs incurred for the general management and administration of the Company as a whole. G&A pool costs include payroll costs of the Companys officers, marketing costs, professional liability insurance, etc. Unallowable costs such as bad debts, interest expense, entertainment costs, Federal income taxes, etc., are removed from the G&A pool in accordance with FAR Part 31.2. G&A pool costs are allocated to contracts using a total cost input base that is comprised of direct labor costs, overhead, APC (as further discussed below), subcontract costs, CAD costs and other direct charges.

Executive Summary

Watershed Mass Balance Model and Protocol Development

Currently no tools are available with the accuracy required to predict and monitor the effects of natural and watershed management changes. For watershed managers to estimate the impacts of various changes on river flow, a user friendly model or tool is needed. This project is the first phase of a program to develop a universal management tool. The first phase will of this research program will develop and validate a set of protocols to make accurate watershed mass balance estimations. These protocols could be used on any or all watersheds in CALFED to monitor and predict the flow productivity, defined here as the spatial and temporal distribution of combined surface and groundwater flows, of the watershed. The Upper Cosumnes River Watershed (UCRW) located in El Dorado, Sacramento and Amador counties will be used as a demonstration watershed. The overall program includes compiling, evaluating, and developing data from the UCRW, building and evaluating a model specifically for UCRW, developing the protocols necessary to apply the concept to other watersheds, and community interaction, including both giving the community information about the project and getting information from the community to assure that the product is user friendly. This phase will focus on the quantity and quality of data required for a user friendly stream flow model. Specifically, precipitation, ground water flow, surface water flow, evapotranspiration, atmospheric and hydrogeologic data would compiled and evaluated. The central element of this component is the development of data quality objectives (DQO) for evaluating these data. The DQO protocol to be developed will define the purpose of data collection, clarify what the data should represent to satisfy this purpose, and specify the performance requirements for the quality of information to be obtained from the data. The DQO protocol will evolve and be refined as a result of continuous evaluation and refinement during the course of the project. If it is determined that the quantity and quality of the existing UCRW data do not meet DQO standards, the data gaps will be identified and the cost of obtaining this data estimated and included in the next project phase.

Proposal

Montgomery Watson Harza

Watershed Mass Balance Model and Protocol Development

Lee Shull, Montgomery Watson Harza

Watershed Mass Balance Model and Protocol Development

A. Project Description: Project Goals and Scope of Work

1. Problem

The Watershed Mass Balance and Protocol Development Program aims to develop and validate a set of protocols, which will guide the development and application of essential data used in making accurate mass balance estimations. Currently, there are no tools available to assess the accuracy of physical data used to make these estimations, which are fundamental to monitoring watershed productivity and to evaluating the effects of natural and human impacts on watersheds. Productivity is defined here as the spatial and temporal distribution of combined surface and groundwater flows within and leaving watersheds. The University of California Davis Hydrologic Research Laboratory's (UCDHRL) physically-based watershed model (UCDHRL model) is being developed to derive mass balance estimations. The protocols will be developed and validated using the Upper Cosumnes River Watershed (UCRW; Hydrologic Unit Code 18040013) located in El Dorado, Sacramento, and Amador counties as the prototype and demonstration watershed. The input data to the UCDHRL model from this watershed will be collected and evaluated in accordance with these protocols. In addition, this program will compile existing data currently used for monitoring various physical parameters of watersheds (e.g., precipitation, surface water flow) and evaluate their accuracy in accordance with the subject protocols. When completed, the subject protocols and the UCDHRL model can be applied to any or all watersheds in the CALFED Bay-Delta Program resulting in enhanced monitoring and management of watershed productivity.

The basic problem being addressed with this program is the current lack of tools to predict and monitor accurately the effects of management changes and natural changes in productivity of watersheds. Obviously, the productivity of watersheds is fundamental to ecosystem restoration and health.

This proposed program has seven primary components. The first component has the objective of compiling and evaluating the accuracy of existing monitoring and physical data from the UCRW. These data fall into six major categories, namely precipitation, ground water flow, surface water flow, evapotranspiration, meteorological, and hydrological or water inventory. A central element of this component is the development of data quality objectives (DQO) for evaluating these data. The DQO protocol to be developed will define the purpose of the data collection, clarify what the data should represent to satisfy this purpose and specify the performance requirements for the quality of the information to be obtained from the data. More specifically, the protocol will define the criteria that a data collection design should satisfy, including when, where, and how to collect samples or measurements, determination of tolerable decision error rates, and the number of samples or measurements that should be collected. Existing DQO protocols (e.g., U.S. EPA Guidance on the Data Quality Objective Process,

August 2000) will be consulted and adapted. The DQO protocols will evolve and be refined as a result of continuous evaluation and refinement during the course of the project. Foe example, an initially assumed accuracy rate of +/- 15% in any of the major parameters (e.g. precipitation, surface water flow) will be evaluated and adjusted as needed. If it is determined that the quality or quantity of the existing UCRW data does not meet DQO standards, the data gaps will be identified and the cost to obtain this data will be estimated. These gaps will then be addressed in component two. If there are no gaps identified, component two will be deleted.

The second component, then, has the objective of filling any data gaps identified in each of the six categories addressed in component one. It is likely that gaps will be found in the area of groundwater flow and groundwater inventory.

The third component has the objective of incorporating an atmospheric model into the UCDHRL model. The atmospheric model is necessary to accommodate spatially and temporally-distributed atmospheric parameters such as wind velocity, precipitation, and temperature, for estimating evapotranspiration from watersheds where existing ground data are sparse or none existent. Evapotranspiration is an important component in interpolating precipitation data, and estimating productivity. The scale at which the atmospheric model provides data to the UCDHRL model will be evaluated quantitatively in order to determine the atmospheric data resolution required to produce the desired accuracy in watershed productivity.

The fourth component will incorporate the results from the first three components and the UCDHRL model into a model of the UCRW. This specific model will then be evaluated for accuracy. If the desired accuracy is not achieved because of data quality or quantity, the data gaps will be identified and the cost of filling these gaps estimated.

The fifth component, then, has the objective of filling these additional data gaps.

The sixth component will incorporate the additional data and make any modifications required to the model and the protocols to make them user friendly for local watershed managers.

The seventh component has an educational objective, which includes both providing information to the community about the project and receiving information from the community to ensure that the program outcome is “user friendly” and directly beneficial to the local watershed management program.

The specific objective of this project is to complete component one and do the corresponding part of component seven. Specifically, DQO’s will be developed for each of the six major categories of data needed for the UCDHRL model, including the atmospheric model. The six major categories of data will then be

compiled, evaluated and stored in GIS format. Any data gaps will then be identified and the cost to generate the data will be estimated.

A second objective of this project will be to start the information exchange with the local community. The major vehicle for this exchange will be the Cosumnes River Task Force, although interaction with the local RCD's, governmental agencies, private landowners and Native American Tribes will be included. At least four meetings with the local community will be held and quarterly written information will be made available. This portion of the community education program will be focused on (i) both disseminating and receiving information related to understanding the UCRW, (ii) compiling UCRW data, (iii) creating and testing the DQO protocols, (iv) evaluating the UCRW data and identifying data gaps in the UCRW database, (v) describing and illustrating the watershed processes and their interrelationships, and (vi) defining the interrelationships between natural functions and human actions within the UCRW. The expected outcome is improved UCRW management decisions. The education program will also facilitate interaction at the individual and small group levels, which complies with an important objective of the CALFED Program. Specific educational tools to be employed are: (i) quarterly newsletters sent to all landowners and local agencies in conjunction with the CRTF newsletter, and (ii) quarterly workshops held at various locations within the UCRW.

This general program approach has been done elsewhere. The UC Davis Hydrologic Research Laboratory (UCDHRL) has undertaken watershed modeling projects in California – the Scott Valley watershed, Calaveras watershed, Ward Creek watershed in the Lake Tahoe Basin and Camp Creek, North Fork and lower Cosumnes River subbasins in the Cosumnes River Basin – as well as internationally – Shiobara Dam watershed in Japan. These projects have been supported by funds from the USEPA/NSF Watersheds Program, the UC Water Resources Center, the National Institute for Global Environmental Change (NIGEC), the UC Davis EPA Center for Ecological Health Research, the US Army Corps of Engineers, the US Fish and Wildlife Service, and, recently, by CALFED through the UC Davis Center for Watershed Science. The Government of Japan funded the international project.

The physically-based watershed model is the result of approximately one decade of research and development into hydrologic processes at the watershed scale (Kavvas and Govindaraju, 1992; Tayfur and Kavvas, 1994; Chen et al. 1994a,b; Horne and Kavvas, 1997; Dogrul et al.1998)

However, this specific approach, which will model a complete hydrogeologic unit with sufficient accuracy to predict and monitor management and natural changes, has not been done.

The specific objectives of this project have not been previously accomplished. Several projects have been done to accumulate some of the data. However, all of the data has not been complied in one location and the quality and adequacy of the data has not been evaluated.

The specific hypotheses of this study are:

- The data in the six major categories can be compiled from existing sources.
- This data can be evaluated based on established DQO methodology.
- Data gaps can be identified
- Mutually beneficial information exchange can occur with the local community.

2. Justification

The basic approach used in this proposed program has been used to evaluate changes to major systems in many fields. Its application to water management in California will be equally productive. However the application is dependent on the availability of accurate input data.

This project is a research project. The objective of this project, as well as this program has not been achieved before. Many of the components that are required to meet the objective have been done and are clearly feasible. The unique feature of this program is the achieving of the necessary accuracy, putting all the components together and determining the economic feasibility of obtaining adequate data. The unique feature of this project is compiling all the available data, determining its quality and identifying any data gaps.

This programmatic approach when implemented will obviously facilitate the adaptive management approach. Specifically, it will enter into the "Establishing Ecosystem Goals/Objectives", "Assess, Evaluate, Adapt", and "Revise Goals/Objectives" steps (See Figure 1, page 8, Draft Stage 1 Implementation Plan).

The data, the mass balance model and the protocols developed in the project will be of value at the local level for better decision-making. The data that would be developed or compiled, and evaluated for this project include precipitation, surface water flow, ground water flow, water inventory within the UCRW watershed, evapotranspiration rates for local groundcover, water management practices, land use, topographic data, special data, geologic data, hydrogeologic data, and soils data. These data will all be incorporated into the GIS database prior to use in any analyses or modeling runs. This activity has not heretofore been performed for the UCRW. The created database, which will consist of evaluated data, will greatly assist local decision makers in several ways (*e.g.*, generating an awareness of available data, identifying data gaps, prioritizing data needs). Further, the quality of the decisions will be enhanced when the quality of the data is known. For example, the data and their quality is an important part of any local decisions associated with water management change. Assessing the effect of either adding or removing a storage pool on the overall productivity of a watershed, and estimating the impact of such an action if taken, is another example.

The DQO protocols for compiling data and for using these data in mass balance modeling will also be valuable at the local level as a result of participation of stakeholders in further development of data. Local stakeholders can provide valuable information as to the actual value of any proposed data-gathering effort. This will include participation in determining how to cost effectively obtain further data.

3. Approach

Initially, the data quality objectives (DQO) for evaluating the compiled data will be developed. The DQO protocol to be developed will define the purpose of data collection, clarify what the data should represent to satisfy this purpose, and specify the performance requirements for the quality of information to be obtained from the data. More specifically, the protocol will define the criteria that a data collection design should satisfy, including when, where, and how to collect samples or measurements, determination of tolerable decision error rates, and the number of samples or measurements that should be collected. Existing DQO protocols (*e.g.*, U.S. EPA *Guidance on the Data Quality Objectives Process*, August 2000) will be consulted and adapted. The DQO protocols will evolve and be refined as a result of continuous evaluation and refinement during the course of the project. For example, an initially assumed accuracy rate of +/- 15% in any of the major parameters (e.g. precipitation, surface water flow) will be evaluated and adjusted as needed.

Secondly, the existing data will be complied from all known sources, including the appropriate federal, state, and local agencies. These agencies include the local RCDs, the state Department of Water Resources, the state and regional Water Resources Control Boards, the state and federal forest services, the U. S. Bureau of Reclamation, the United States Geological Survey, and the National Resources Conservation Service, United States Department of Agriculture, and the United States National Oceanic and Atmospheric Administration. In addition, private sources will be solicited. The data collected will be incorporated into a Geographic Information System (GIS) (ArcView®) database.

Third, the complied data will be evaluated using the DQO's. Any data gaps will be identified and the cost of developing the necessary data will be estimated.

In parallel with these three steps, the community outreach will be pursued. The community education program, which will be implemented at the outset, will be focused on (i) both disseminating and receiving information related to understanding the UCRW, (ii) compiling UCRW data, (iii) creating and testing the DQO protocols, (iv) evaluating the UCRW data and identifying data gaps in the UCRW database, (v) describing and illustrating the watershed processes and their interrelationships, and (vi) defining the interrelationships between natural functions and human actions within the UCRW. The expected outcome is improved UCRW management decisions. The education program will also facilitate interaction at the individual and small group levels, which complies with an important objective of the CALFED Program. Specific educational tools to be employed are: (i) a quarterly newsletters sent to all landowners and local agencies in conjunction with the CRTF newsletter, and (ii) quarterly workshops held at various locations within the UCRW.

4. Feasibility

The data handling tasks have two parts: (i) compiling the subject data, and (ii) evaluating the UCRW data. Compiling the existing UCRW monitoring data related to precipitation, ground water flow, surface water flow, evapotranspiration, atmospheric parameters, and hydrogeology or water inventory in the UCRW is a technically feasible undertaking. As explained in other parts of this proposal, relationships with local watershed stakeholders will be proactively developed. Through these relationships, the data will be compiled.

Evaluating these data is also technically feasible, but requires some developmental work prior to performing the evaluation. Because there are no existing protocols for evaluating the accuracy, usability, or adequacy of the existing data [*i.e.*, no Data Quality Objectives (DQO protocols) protocol], a DQO protocol will be developed that defines this evaluation process. The DQO protocol will define the purpose of data collection, clarify what the data should represent to satisfy this purpose, and specify the performance requirements for the quality of information to be obtained from the data. More specifically, the protocol will define the criteria that a data collection design should satisfy, including when, where, and how to collect samples or measurements, determination of tolerable decision error rates, and the number of samples or measurements that should be collected. Existing DQO protocols, such as U.S. EPA's recently published *Guidance on the Data Quality Objectives Process* (August 2000) will be consulted and adapted to the data associated precipitation, ground water flow, surface water flow, evapotranspiration, and hydrogeology or water inventory. The DQO protocols will evolve and be refined as a result of continuous evaluation and refinement during the course of the project. If it is determined that the quantity and quality of the existing UCRW data do not meet DQO standards, data gaps will be identified and addressed in component two. The DQO protocol also includes an investigation into the use of atmospheric models, such as IRSHAM (Kavvas et al., 1998a) or MM5 (Grell et al., 1994) to generate spatially- and temporally-distributed atmospheric parameter values associated with wind, radiation, temperature, and precipitation for use in the physically-based UCDHRL watershed model (UCDHRL model). The influence of atmospheric model resolution will be evaluated quantitatively by investigating the differences between supplying the atmospheric data at 4 km, 2 km or 1 km resolution to the UCDHRL model. The DQO protocols will also be developed to address modeling parameters needed to satisfactorily estimate the impact of basin changes. The developed DQO protocol will be general enough for application to any watershed within the Bay-Delta system. A goal of the proposed project is to provide CALFED with a means of quantifying long-term watershed monitoring requirements.

The compilation of existing data and storing it in GIS format is clearly feasible.

Evaluating this data based on the DQO's and identifying data gaps has been done in many scientific fields and is clearly feasible.

The overall program of watershed mass balance model and protocol development is technically feasible based on sited experience. However, obtaining sufficient data to achieve desire accuracy may be cost prohibitive for the entire CALFED Bay-Delta Program. This project will give very good indication of this fiscal feasibility.

5. Performance Measures

The primary performance measure for this project will be the progress made in comparision to the planned time and expenditure schedule. At the start of the project detailed budgets, schedules, and task descriptions will be developed. The progress will be tracked monthly relative to these plans.

6. Data Handling and Storage

The data collected will be incorporated into a Geographic Information System (GIS) (ArcView®) database.

7. Expected Products/Outcomes

The expected products are:

1. DQO Report
2. A CD(s) with all the compiled data.
3. A Data Gap Report
4. Quarterly newsletters sent to all landowners and local agencies.
5. Quarterly workshops held at various locations within the UCRW.
6. Quarterly progress reports
7. Monthly invoices

8. Work Schedule

The following is the preliminary schedule:

1. DQO Report – Month 2
2. Compilation of Data – Month 2 – 8
3. Data CD(s) – Month 9
4. Data Gap Report – Month 9
5. Quarterly newsletters – Months 3, 6, 9, & 12
6. Quarterly workshops - Months 3, 6, 9, & 12
7. Quarterly progress reports - Months 3, 6, 9, & 12
8. Monthly Invoices – Months 1 – 12

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

1. ERP, Science Program and CVPIA Priorities

The following priorities are addressed:

1. MR- 2
    a. Work with local interests
    b. Compare effectiveness of different practices
2. MR-3
    a. Education programs
    b. Bay-Delta Tributaries Fact Sheets
3. MR-4
    a. Climate and hydrologic variability
4. MR-5
    a. Dissolved Oxygen and Oxygen Depleting Substances
    b. Mercury
    c. Pesticides
    d. Selenium
    e. Other Pollutants
    f. Fine Sediment
5. DR-1
    a. East Delta habitat corridor
6. DR-2
    a. Floodplain management plans and actions

7. DR-8
    a. Studies to better understand climate variability

2. Relationship to Other Ecosystem Restoration Projects

When this program is successfully implemented it will positively affect all ecosystem restoration projects that depend on water quantity or quality. It will give a method to predict and monitor the effect of various management strategies and natural events.

3. Requests for Next-Phase Funding

Not applicable

4. Previous Recipients of CALFED Program or CVPIA funding

5. System-Wide Ecosystem Benefits

When implemented system-wide, this methodology will benefit all efforts to improve the ecosystem by improving water quantity or quality.

6. Additional Information for Proposals Containing Land Acquisition

Not applicable

C. Qualifications

MWH

MWH is a large environmental consulting firm that provides high quality consulting services to clients seeking to cost-effectively manage their environmental related issues. Services provided support clients in compliance with federal and state environmental statutes, liability management, project management, database management, and Geographic Information Systems (GIS).

MWH has assembled an impressive team of scientists, engineers, computer specialists, geostaticians, and communications and government professionals who have the necessary expertise and experience in watershed management. These professionals are primarily senior environmental professionals, with fifteen or more years of consulting experience, in environmental-related disciplines of the consulting industry. Most of these professionals spent a substantial amount of their professional careers in large consulting firms and, as such, have broad experience implementing a wide-range of environmental and water resource programs.

MWH specializes in value-added service that enhances clients' ability to manage complex environmental and resource management programs. The firm's data management strategies employ techniques based on decision analysis, rigorous spatial data processing, up-to-date regulatory analyses and comprehensive probabilistic cost-benefit analysis to create innovative solutions. NewFields specialists employ state-of-the-art data visualization, exploration, presentation and evaluation methods and innovative management systems to (i) maximize effective use of data already collected, (ii) solve their clients' technical and regulatory problems and (iii) to meet project management objectives. NewFields maintains current software and hardware computer systems to manage large complex databases and provides GIS services for clients. NewFields, with $8.5M revenue in 2000, maintains modern business accounting and financial systems for a project consulting practice. Individual cost accounting and reporting is maintained on the hundreds of projects completed each year at NewFields.

UCDHRL

The UC Davis Hydrologic Research Laboratory (UCDHRL) has undertaken watershed modeling projects in California – the Scott Valley watershed, Calaveras watershed, Ward Creek watershed in the Lake Tahoe Basin and Camp Creek, North Fork and lower Cosumnes River subbasins in the Cosumnes River Basin – as well as internationally – Shiobara Dam watershed in Japan. These projects have been supported by funds from the USEPA/NSF Watersheds Program, the UC Water Resources Center, the National Institute for Global Environmental Change (NIGEC), the UC Davis EPA Center for Ecological Health Research, the US Army Corps of Engineers, the US Fish and Wildlife Service, and, recently, by CALFED through the UC Davis Center for Watershed Science. The international project was funded by the Government of Japan.

The physically-based watershed model is the result of approximately one decade of research and development into hydrologic processes at the watershed scale (Kavvas and Govindaraju, 1992; Tayfur and Kavvas, 1994; Chen et al. 1994a,b; Horne and Kavvas, 1997; Dogrul et al.1998). The project team will consist of a development engineer who has been associated with the model development from its inception as well as two post-graduate research engineers who have contributed to the development and application of the model. The UCDHRL is also experienced in working on CALFED related projects having contributed to the UC Davis Center for Watershed Science Cosumnes River project, which is providing funding for the development of the initial Upper Cosumnes River watershed model.

The UCDHRL also has experience with field data collection having set up a field site in the Ward Creek watershed and maintained the site for data collection related to model verification of the Ward Creek project for two years. These qualifications provide a sound basis for the successful completion of the proposed project.

Bookman – Edmonston, a division on Navigant Consulting, Inc.

Bookman-Edmonston Engineering (B-E), a division of Navigant Consulting, Inc. (NCI), has provided innovative solutions for managing and augmenting water supplies in the West since 1959. B-E is recognized as one of the foremost water resources engineering firms in the United States. We have comprehensive experience in all aspects and levels of water resources engineering from basic concept development to the planning, design and construction supervision of major conveyance and distribution works.

B-E has assisted CALFED and the California Department of Water Resources to evaluate and select water resource management options. As part of the team preparing CALFED Environmental Impact Statements/Environmental Impact Reports (EIR/EIS), B-E analyzed the beneficial and adverse environmental impacts of alternative levee rehabilitation, habitat restoration, water quality, and water storage and conveyance programs on the physical flood management systems in the Delta and Sacramento and San Joaquin Valleys. B-E also participated in Technical Advisory Group meetings, visits to the offstream storage site, and prepared comments to the California Department of Water Resources. On different project B-E teamed with another firm, to assist the California Department of Water Resources to develop finite-element groundwater models for several basins in the state. The project, which consists of model construction, development, and calibration, is funded by CALFED' s Integrated Storage Investigation (ISI) effort. Recently, NCI was retained by CALFED to prepare the power economics framework and analysis for the upcoming Bay-Delta EIR/EIS. The analysis identifies power generation and pumping requirement impacts to the State Water Project and the Central Valley Project resulting from various alternatives for arriving at a long-term solution to water supply and quality concerns in the Bay-Delta region of California.

B-E was retained by the Authority for Environmental Analysis of Water Transfers in association with the Bay-Delta Transfers Committee to prepare the Delta Water Transfer Handbook--Guidelines for Temporary and Long-Term Transfers Through the Delta. The handbook outlines the procedures necessary to successfully implement water transfers through the Sacramento-San Joaquin Delta in California. Development of the handbook included scoping meetings with and review of drafts by pertinent agencies including the State Water Resources Control Board, U.S. Bureau of Reclamation, California Department of Water Resources, California Department of Fish and Game, U.S. Fish and Wildlife Service, and National Marine Fisheries Service.

The B-E project team will be led by Mr. Richard Shatz who has over 18 years of experience in groundwater evaluations. He has prepared water balances for the Coldwater, Acton, and Gillibrand hydrologic subareas, along with Ward Valley. He has estimated available the water crop for development using soil moisture balances for areas along the Santa Clara River. He designed and constructed one of the most sophisticated monitoring systems in the coastal area that included a daily water balance that uses irrigation, precipitation, evapotranspiration to calculate how much and where water percolates into the ground. He monitored and reported the results for the last 14 years. His experience also includes development and implementation of a Watershed Monitoring Program for the Lower Santa Margarita River.

B-E offers its staff and resources from offices in Sacramento, Glendale, and Bakersfield, California, and in Phoenix, Arizona.

Wessman Industries, Inc.

Wessman Industries, Inc. is a small consulting firm performing services in management and engineering. George L. Wessman will be the project manager for this project. He has extensive experience in managing highly technical programs varying in value from $10,000 to $100, 000,000 and in length from a few months to ten years. Over the past three years he has gained considerable insight into developing watershed mass balance models and protocols.

He has extensive experience in interacting with the public on projects in several different fields.

D. Cost

1. Budget

See submittal forms.

2. Cost-Sharing

No cost sharing is anticipated.

E. Local Involvement

The development of the envisioned program has been coordinated with the Cosumnes River Task Force, the Mokelumne/Cosumnes Alliance, the local Resource Conservation Districts (RCDs), the state Department of Water Resources, the state and regional Water Resources Control Boards, the state and federal forest services, the U. S. Bureau of Reclamation, the United States Geological Survey, the National Resources Conservation Service, United States Department of Agriculture, and the United States National Oceanic and Atmospheric Administration.

F. Compliance with Standard Terms and Conditions

MWH will comply with the standard terms and conditions

G. Literature Cited

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