G7-1034

USDA United States Department of Agriculture | Forest Service | Pacific Southwest Research Station | P.O. Box 245 Berkeley, CA 94701-0245 (510) 559-6300 FAX (510) 559-6440

File Code: 4080

Date: JUN 29 1998

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

Dear Sir or Madam:

Enclosed for your consideration are the original and 10 copies of the grant proposal entitled "Evaluating and monitoring cumulative watershed effects," jointly prepared by Neil H. Berg, of this Research Station, and Lee MacDonald, of Colorado State University.

This proposal is submitted under the May 1998 Calfed Ecosystem Restoration Proposal Solicitation. The Station requests a total of $229,221 for the 3-year period of this study. A summary budget is attached. Of this amount, a total of $211,352 will be provided to Colorado State University under a sub-cooperative agreement issued by the Station. Institutional endorsement from the University and a separate budget for the sub-agreement are also enclosed with this letter.

As instructed in the solicitation, a budget, by task, is included in the proposal.

The required signed forms--Std.19 Nondiscrimination Compliance Statement, and Non-Collusion--are also enclosed. The Standard Clauses for Contracts with Public Entities will be completed with the agreement at the time an award is made to the Station by the State.

Please contact the principal investigators named regarding technical aspects of this proposal. Contact Roxanne Orly, in my Grants and Agreements office (510/559-6382), for inquiries of an administrative or financial nature.

Sincerely,

for HAL SALWASSER
Station Director

Enclosures

cc:
Berg
MacDonald, CSU
Eckert, CSU Sponsored Progams

Summary Budget

	Year 1	Year 2	Year 3	Total
Direct Costs				
Salaries and fringe benefits:				
Berg (2 weeks/yr)	3,800	3,990	0	7,790
Travel:	1,200	1,100	700	3,000
Equipment				
ARWG equipment	2,000			
ARC equipment	2,000	0	0	4,000
Subagreement to Colorado State Univ.	211,352	0	0	211,352
Other: ARWG Workshop participation	2,000	0	0	2,000
Total Direct Costs	222,352	5,090	700	228,142
Indirect Costs				
@ 10% modified direct costs, excluding equipment and subagreement (base = $10,790)	500	509	70	1,079
Total Project Costs	**$222,852**	**$5,599**	**$770**	**$229,221**

I-011739

Colorado State University

Sponsored Programs
Fort Collins, CO 80523-2002
(970) 491-6355
FAX: 491-6147

June 24, 1998

Roxanne Orley
Grants & Agreements
Forest & Range Experiment Station
800 Buchanan St.
Albany, CA 94710-0011

Dear Ms. Orley:

Enclosed is CSU's portion of the CALFED proposal entitled "Evaluating and Monitoring Cumulative Watershed Effects." Dr. Lee H. MacDonald is CSU's Principal Investigator and has agreed to participate in the project should an award be made.

Do not hesitate to contact us for necessary clarification or modification. Please advise us when convenient of your action regarding this proposal.

Sincerely,

Bety Eckert
Contracts and Grants Administrator

BE:cg

Enc.: 1 copy proposal

xc: L. MacDonald, Earth Resources

COLORADO STATE UNIVERSITY BUDGET

	Year 1	Year 2	Year 3	Total
Salaries:				
MacDonald	5,325	5,591	5,871	16,787
Graduate students (2)	30,000	31,500	33,075	94,575
Field assistants (2 hired locally,	10,560	14,080	14,780	39,420
$10/hr., 12 wk yr 1,	sub 45,885	51,171	53,726	159,782
16 wk yrs 2-3				
Travel:				
Field travel (per diem, lodging, mileage, airfares)	10,600	13,500	14,170	38,270
Conference presentation	0	900	1,900	2,800
Equipment:				
Two laptop computers	3,000	0	0	3,000
Other: Supplies for field	4,000	2,000	1,000	7,000
Copying, supplies	1,500	1,500	1,500	4,500
Technology transfer, training	0	2,000	3,000	5,000
	sub 5,500	5,500	5,500	16,500
Total Direct Costs	**$64,985**	**$71,071**	**$75,296**	**$211,352**
Unrecovered Indirect Costs @ 45% modified total direct costs (excluding equipment) are contributed by CSU (base = $208,352).	$27,893	$31,982	$33,883	$93,758

NONDISCRIMINATION COMPLIANCE STATEMENT

ITEM 7

COMPANY NAME

Pacific Southwest Research Station, Forest Service, U.S. Dept of Agriculture

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

CERTIFICATION

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

OFFICIAL'S NAME

DATE EXECUTED

EXECUTED IN THE COUNTY OF

PROSPECTIVE CONTRACTOR'S SIGNATURE

PROSPECTIVE CONTRACTOR'S TITLE

PROSPECTIVE CONTRACTOR'S LEGAL BUSINESS NAME

The Forest Service, as an agency of the Federal Government, complies with all Federal law and regulation regarding nondiscrimination, equal employment opportunity, and affirmative action.

Enacted. Bell JUN 29 1998

HAL SALWASSER, Station Director (date)

I-011742

I-011742

ITEM 10

Agreement No. _____

Exhibit _____

NONCOLLUSION AFFIDAVIT TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID FOR PUBLIC WORKS

STATE OF CALIFORNIA)
)ss
COUNTY OF _____)

HAL SALWASSER (name), being first duly sworn, deposes and says that he or she is Station Director (position title) of Pacific Southwest Research Station, Forest Service, U.S. Dept of Agriculture (the bidder), the party making the foregoing bid that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

DATED: _____ By _____ JUN 2 9 1998
(person signing for bidder)

Subscribed and sworn to before me on

_____

_____
(Notary Public)

(Notarial Seal)

Attachment H

COVER SHEET (PAGE 1 of 2)

May 1998 CALFED ECOSYSTEM RESTORATION PROPOSAL SOLICITATION

Proposal Title: Evaluating and monitoring cumulative watershed effects

Applicant Name: Pacific Southwest Research Station, Forest Service, USDA

Mailing Address: P.O. Box 245, Berkeley, CA 94701

Telephone: (510)559-6426

Fax: (510)559-6499

Amount of funding requested: $ 229,221 for 3 years

Indicate the Topic for which you are applying (check only one box). Note that this is an important decision: see page __ of the Proposal Solicitation Package for more information.

- ☐ Fish Passage Assessment
- ☐ Fish Passage Improvements
- ☐ Floodplain and Habitat Restoration
- ☐ Gravel Restoration
- ☐ Fish Harvest
- ☐ Species Life History Studies
- ☑ Watershed Planning/Implementation
- ☐ Education
- ☐ *Fish Screen Evaluations - Alternatives and Biological Priorities*

Indicate the geographic area of your proposal (check only one box):

- ☐ Sacramento River Mainstem
- ☐ Sacramento Tributary: _____
- ☐ Delta
- ☐ East Side Delta Tributary: _____
- ☐ Suisun Marsh and Bay
- ☐ San Joaquin Tributary: _____
- ☐ San Joaquin River Mainstem
- ☐ Other: _____
- ☑ Landscape (entire Bay-Delta watershed)
- ☐ North Bay: _____

Indicate the primary species which the proposal addresses (check no more than two boxes):

- ☐ San Joaquin and East-side Delta tributaries fall-run chinook salmon
- ☐ Winter-run chinook salmon
- ☐ Spring-run chinook salmon
- ☐ Late-fall run chinook salmon
- ☑ Fall-run chinook salmon
- ☐ Delta smelt
- ☐ Longfin smelt
- ☐ Splittail
- ☑ Steelhead trout
- ☐ Green sturgeon
- ☐ Striped bass
- ☐ Migratory birds

COVER SHEET (PAGE 2 of 2)

May 1998 CALFED ECOSYSTEM RESTORATION PROPOSAL SOLICITATION

Indicate the type of applicant (check only one box):

☐	State agency	☑	Federal agency
☐	Public/Non-profit joint venture	☐	Non-profit
☐	Local government/district	☐	Private party
☐	University	☐	Other: _____

Indicate the type of project (check only one box):

☐	Planning	☑	Implementation
☐	Monitoring	☐	Education
☐	Research		

By signing below, the applicant declares the following:

(1) the truthfulness of all representations in their proposal;

(2) the individual signing the form is entitled to submit the application on behalf of the applicant (if applicant is an entity or organization); and

(3) the person submitting the application has read and understood the conflict of interest and confidentiality discussion in the PSP (Section II.K) and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent as provided in the Section.

(Signature of Applicant)
NEIL BERG
Principal Investigator

for HAL SALWASSER
Station Director

JUN 29 1998

II. EXECUTIVE SUMMARY

Project Title: Evaluating and Monitoring Cumulative Watershed Effects
Applicant Name: Pacific Southwest Research Station, USDA Forest Service

Project Description and Primary Biological/Ecological Objectives: The project will develop science-based procedures to predict and monitor changes in water quality and stream channels resulting from the combined effects of forest fuels treatments, roads, timber harvest, rural settlements and other activities. More accurate procedures applicable at multiple geographic scales are needed by local watershed groups and resource agencies for planning and management purposes. Efforts will focus on sediment and water flows, as these are significant controls on aquatic habitat quality. Although the results should be applicable to much of the Sierra Nevada, field work will focus on the American and Consumnes River basins. Results will therefore relate most directly to fall-run salmon and steelhead. Besides the American River Watershed Group (ARWG) and the Consumnes River Task Force (CRTF), we will collaborate with local educational institutions (e.g., American River College) in volunteer monitoring programs. Close collaboration with State and federal agencies will help ensure that the data and methodologies developed through this project will strengthen the planning, monitoring and evaluation capabilities of the USDA Forest Service and the California Department of Forestry and Fire Protection at both the project and watershed scales.

Approach/Tasks/Schedule: The project is structured into nine interrelated tasks: (1) Develop a generic framework for assessing cumulative watershed effects (CWEs) (1999), (2) Select sites and develop land use histories (1999-2000), (3) Field measurements of sediment production and delivery rates (1999-2001), (4) Develop empirical models to predict the production and delivery of sediment to the stream network (2000-2001), (5) Predict the delivery of sediment through the stream network (sediment routing) (2000-2001), (6) Predict changes in peak flows, low flows, and annual water yield (2000-2001), (7) Assess and refine procedures to monitor stream channel condition, and quantify the influence of local controls, such as gradient and drainage area (1999-2001), (8) Test the relationship between stream channel characteristics and predicted changes in runoff and sediment yields (2001), (9) Disseminate the results, procedures, and models (2001).

Justification for Project and Funding by CALFED: Fires, roads, forest harvest and other activities alter runoff and erosion rates at the local scale. These in turn generate cumulative impacts at the watershed level that can adversely affect sensitive aquatic species. Changes in runoff, sediment loads and large woody debris are important constraints on resource managers in the Sierra Nevada (Menning et al. 1996), as they can directly or indirectly affect water quality, channel morphology and aquatic habitat (e.g., Salo and Cundy 1987). Current methods to predict and assess CWEs treat watersheds as lumped entities and do not account for the location of activities relative to the stream network (Reid 1993; MacDonald 1998). There also are few data that directly link the type, magnitude and timing of land management activities to changes in channel condition or aquatic ecosystems in the Sierra Nevada (McGurk and Fong 1995), or that can be used to help develop Total Maximum Daily Loads. Watercourses draining westward from the Sierra support important resident and anadromous fisheries (e.g., fall run salmon and steelhead), and are primary sources of water and sediment to the entire Bay-Delta system. A growing consensus of scientists agree that fine sediment moves through the foothill reservoirs to impact conditions below the dams.

Numerous activities affect sediment inputs, runoff and downstream sedimentary CWEs. High fuel loads are an increasing concern in the Sierra (p. 65-66, ERPP vol. 1), and a variety of practices

are being prescribed across the landscape to reduce the risk of catastrophic wildfires. The effects of these practices must be evaluated in conjunction with the changes in runoff and sediment loads due to roads (p. 66-67, ERPP vol. 1), forest harvest, rural settlements, natural events, and other activities. The longer-term goal of improving water quality and watershed health by reducing the potential for large damaging fires may cause shorter-term increases in runoff and sediment loads. Techniques to better predict and monitor these changes are urgently needed to improve watershed planning and management, and to better relate upland activities to water quality impacts.

Budget Costs and Third Party Impacts: Budget Costs: $229,221 total requested for 3 years. Matching funds exceed $239,000, primarily as salaries and reduced overhead rates. There will also be significant in-kind contributions in terms of facilities, equipment and infrastructure.

Third Party Impacts: Third party impacts anticipated from this project include monetary inflows to the local economy through the hiring of field assistants (estimated at $39,400) and local expenditures (food and lodging, estimated at $41,000). Much of the equipment for monitoring and field measurements will remain with local organizations (estimated value $4,000). $2,000 is allocated to local groups for travel expenses to regional watershed workshops. The project will not manipulate any resources or otherwise cause adverse impacts to environmental or economic resources.

Applicant Qualifications: Signature of the cover letter to this proposal by the Director of the Pacific Southwest Research Station (USDA Forest Service) is an institutional commitment to complete the work described in this proposal.

The two principal investigators are Ph.D. scientists with extensive training and background in the topics addressed. Each has years of field experience in the Sierra Nevada, and they have each published numerous peer-reviewed scientific articles on subjects directly relevant to the proposed project. The co-investigators have received over $1,700,000 in external funding, and this support has led to a wide variety of conference papers, guidance manuals, journal articles and other products.

Monitoring and Data Evaluation: A major objective of the project is to develop improved guidelines for monitoring the effects of different management activities on stream channel condition. Field measurements will be made at sites established as part of watershed projects in El Dorado and Placer Counties (e.g., El Dorado Watershed Improvement 2000 and Coordinated American River Watershed Health Improvement and Monitoring Project). We will offer training in monitoring techniques to watershed groups as well as regulatory and management agencies. Data collection and analysis procedures will be clearly documented, and data collected through this project will be available either through the World Wide Web or on request. Final reports and other formal products will be peer-reviewed before dissemination.

Local Support/Coordination with other Programs/Compatibility with CALFED Objectives: Letters of support from the ARWG and the American River College and two state agencies are included in this submission. These document the need of these and other groups for improved, scientifically-sound predictive tools and monitoring procedures. Such tools are essential for successful and cost-effective watershed planning, management and evaluation. The project will develop procedures and tools that should be applicable to much of the Sierra Nevada, and by analogy to other areas. The project will closely coordinate with existing fuels reduction and monitoring projects led by the ARWG and the National Forest System. Classes from the American River College and area high schools will learn scientific methods including upland and instream monitoring techniques.

III. TITLE PAGE

Title of Project: Evaluating and Monitoring Cumulative Watershed Effects

Principle Investigators:

- Neil H. Berg (Pacific Southwest Research Station, USDA Forest Service, 800 Buchanan St., West Bldg., Albany, CA 94710-0011. 510/559-6426 (fax: -6499), nberg/psw@fs.fed.us
- Lee MacDonald (Earth Resources Department, Colorado State University, Ft. Collins, CO 80523-1482. 970/491-6109 (fax: -6307), leemac@cnr.colostate.edu

Type of Organization and Tax Status: Federal government agency and State academic institution; both "non-profit"

Tax Identification Number: Not applicable

Participants/Collaborators:

- American River Watershed Group
- American River College
- Consumnes River Task Force
- Other USDA Forest Service organizations (e.g., Eldorado and Tahoe National Forests)
- Various California State agencies (e.g., Department of Forestry and Fire Protection, Division of Mines and Geology, Water Resources Control Board)
- University of California, Berkeley

I-011748

IV. PROJECT DESCRIPTION

A. Project Description and Approach

Local community groups and resource management agencies require scientifically-based procedures to predict and monitor downstream changes in sediment yield and runoff, and the resultant impacts on aquatic resources. The goal of this project is to develop, test, and disseminate procedures for use in developing an improved, "second-generation" procedure for predicting and detecting off-site cumulative watershed effects (CWEs). The work will be conducted in the American and Consumnes River basins, and the land uses of primary concern are roads, large-scale fuels reduction treatments, timber harvest and small-scale urban development (McGurk et al. 1996; McGurk and Davis 1996). Although CWEs are wide-ranging and can include impacts to water temperature, channel structure and other watershed attributes, the underlying assumption is that sediment is a primary concern in the Sierra Nevada. Because sediment transport, channel erosion and aquatic resources are highly sensitive to changes in flow, the project will also develop procedures for predicting watershed-scale changes in peak flows, low flows, and annual water yields. The approach and procedures developed under this project should be directly applicable to other parts of the Sierra Nevada, and may serve as a prototype for analogous efforts in other geographic regions. This project will provide additional procedures and techniques for an expanded "toolbox" aimed at assessing CWEs; it is not intended, however, to solve all CWE issues.

A consortium of USDA Forest Service personnel, federal and university researchers, and local community groups will conduct the project. It will be closely coordinated with the watershed health project initiated by the American River Watershed Group (ARWG). This structure will ensure that the work is relevant, practical and scientifically-based. The funds requested from CALFED will trigger more than a 1:1 match from the sponsoring organizations; this leveraging, together with the interagency collaboration, will maximize the benefits from the project. The project is designed to enhance the full exchange of data, information, and knowledge between project personnel and the primary target groups (community groups, regulatory agencies and land management agencies).

B. Proposed Scope of Work

The complex nature of the problem means that the following tasks are closely interrelated, and the end result is likely to be of considerably greater value than the sum of the parts. Nevertheless, the overall project and budget have been broken into nine specific tasks:

1. Develop a generic conceptual framework for assessing cumulative effects. CWEs result from a series of direct and indirect effects extending across a wide range of temporal and spatial scales. Complex interactions with site conditions and natural processes mean that the framework for assessing CWEs is not straightforward. We will draw on existing knowledge and case law to develop a generic, conceptual framework for conducting a CWE analysis, with particular emphasis on identifying the scope, scale, and level of effort for the analysis. This framework will then be disseminated and tested by local watershed groups, the USDA Forest Service and other management agencies, and refined as needed to incorporate the results of the field testing.

- PRODUCT: A generic, conceptual process for scoping and assessing CWEs.

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2. Site selection and development of land use histories. We will focus on the low- to mid-elevation zones in the Sierra Nevada where most future management activities are likely to occur. Because of the difficulty of validating CWE models at larger scales and the need to understand the controlling processes, our primary study watersheds will range from approximately 1-100 mi^2 in area (i.e., up to "super-watersheds" as defined by the California Department of Forestry and Fire Protection). Study watersheds and subwatersheds will be selected in a nested design according to the availability of existing land use histories and site characteristics in a GIS format, as well as the type and amount of instream monitoring data. We will identify watersheds that represent a wide range of management activities (i.e., relatively pristine to heavily managed). Compilation and checking of the site characteristics, land use histories, and monitoring data will be largely done by USFS personnel as in-kind contributions to the project. Preliminary discussions suggest that areas within both the Tahoe and Eldorado National Forests meet these criteria. We will work with members of the ARWG, the Consumnes River Task Force, NRCS, RCDs and others to collect data on private lands and to maximize the use of concurrent monitoring efforts.

- PRODUCTS: GIS-based site characteristics and land use histories for selected watersheds.

3. Field assessment of sediment production and delivery. The GIS database will be the basis for stratifying the landscape into discrete classes for estimating sediment production, delivery to the channel network, and particle-size distributions of the delivered sediment. As a first approximation, sediment production from roads will be estimated from existing data or models (e.g., Cline et al. 1981; Elliot et al. 1993; Anderson and MacDonald et al. 1998), as road erosion processes are relatively well-documented (e.g., Megahan 1984). Sediment fences will be constructed immediately below selected road discharge locations to assess the reliability of these estimates. Sediment captured by these fences will be periodically weighed and subsampled for particle-size distribution. Similarly, sediment delivery to the stream network will be estimated by a combination of data from other studies (e.g., Megahan et al. 1991) and by tracking and sampling sediment plumes from a stratified sample of road discharge locations. Amounts of sediment generated from gullies will be estimated from direct measurement of the "missing" material.

A second focus will be on sediment generated from areas subjected to timber harvest, fuels reduction and fires (both prescribed and wild). If these areas appear to be major sources of sediment, we will capture the sediment from selected sites using sediment fences. The data from burned sites will be used in part to calibrate and test predicted post-fire erosion rates following the GIS-based models of hydrophobicity risk and soil erodibility (MacDonald et al. in press).

Mass movement frequency in different landscape units will be assessed from air photos and existing inventories. Stratified sampling will be used to select sites for detailed measurements of the material displaced, particle-size distribution and estimated delivery to the stream channel.

- PRODUCTS: Quantitative estimates of sediment production stratified by source, landscape unit, and particle-size class.

4. Predict the amount, distribution, and delivery of sediment. The land use data, data from the field assessments of erosion and sediment and data on the frequency of mass movements will provide the basis for predicting sediment production across the sampled land types. For each combination of site characteristics and management activity we will use either a regression-based model or a sample

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mean to predict the amount of sediment being produced, the proportion of sediment by size classes, and the likely delivery to the stream network. We will estimate the amount of inchannel erosion in representative stream reaches from existing monitoring data and our own instream measurements.

- PRODUCTS: Field data on inchannel erosion rates, and procedures for predicting the production and delivery of sediment to channels.

5. Predict the delivery of sediment through the stream network (sediment routing). Accurate prediction of downstream CWEs is highly dependent on the routing of sediment through the stream channel (Reid 1993; Bunte and MacDonald 1998). Key controls on sediment routing include the particle-size distribution of the introduced sediment, the gradient of each segment in the channel network and runoff. The volume and distribution of runoff can be estimated from watershed area and climatic zone, while gradients can be estimated from the GIS database and particle-size distributions drawn from our field data. To route sediment downstream, we will use a deterministic approach based on the average annual travel distances compiled by Bunte and MacDonald (1998) for different particle sizes and stream types. We will also investigate the use of sediment transport equations and a stochastic component, particularly for transport-limited streams.

- PRODUCT: Procedure for routing sediment downstream as a function of particle size and stream characteristics in a GIS framework.

6. Predict changes in peak flows, low flows, and annual water yield. Our assumption is that increased sediment loads are of greater concern than changes in runoff. This hypothesis will be assessed by quantifying changes in channel characteristics as determined during the first field season (task 7). Because of the high level of interest in changes in discharge we will also estimate the cumulative changes in peak flows, low flows, and annual water yields by stratifying the landscape by vegetation type and climatic regime, and using land use history information to estimate changes in flow. The estimated flow changes will be based on the changes in, and recovery of, flow duration curves calculated from 31 paired watershed experiments (Austin, in preparation), Stednick's (1997) updating of Bosch and Hewlett's (1982) review of changes in annual water yields and data on the effects of urbanization on runoff (e.g., Hollis 1975; Dunne and Leopold 1978; Booth 1991). The calculated changes in flow will simply be delivered through the stream network with an appropriate dilution factor for areas unaffected by management, as hydraulic routing models are too data intensive to apply on a watershed scale and changes in timing are not easily predicted. If the predicted changes in high flows are greater than 5-10%, sediment transport equations will be used to estimate the likely impact on sediment transport rates and downstream sediment delivery.

- PRODUCTS: Procedure for predicting the likely changes in flow, and spatially-explicit predictions of changes in flow in the study watersheds.

7. Assess and refine procedures to monitor stream channel condition and quantify influence of local controls. The type and magnitude of changes in carefully selected stream channel indicators can indicate whether excess sediment or changes in flow is of primary concern (Nunally 1985; Montgomery and Buffington 1997). Recent studies also suggest that when buffer strips and other best management practices are used, "local controls" (e.g., gradient, drainage area, hydrologic regime, and the amount of large woody debris) may have a greater effect on channel characteristics than management activities (MacDonald et al. 1997).

Given this background, we will first place existing water quality and channel monitoring data into the GIS. These data will be reviewed for trends, variability from different sources (e.g., over time, between observers, between stream types), and the likely cause(s) of the observed condition and trends. From this review we will identify the need for particular types of stream channel data by location and stream type. A focussed data collection effort will be initiated on a collaborative basis among the participating organizations. Regression and other analyses will be used to assess the strength of the relationships between selected local controls and measured channel characteristics, as this is critical to evaluating differences between streams and to the design of comparative monitoring projects. Monitoring data from minimally-disturbed basins will be used to define the range of natural variability under reference conditions.

- PRODUCTS: Improved monitoring guidelines and better understanding of the controls on, and causes of, channel morphology.

8. Test the relationship between stream channel characteristics and predicted changes in runoff and sediment yields. This critical task can only be done after the other tasks have been largely completed. Our hypothesis is that the predicted site-specific changes in sediment or runoff from our second-generation model will be more closely related to the observed channel characteristics than the predictions from current CWE models. To maximize the power and reliability of the relationships between predicted CWEs and channel characteristics, we will first remove the effect of the local controls as quantified in task 7 (Helsel and Hirsch 1992). We will examine and test the relationships between measured channel characteristics and as many indices or predictors of management effects as possible. For example, other studies have shown significant correlations between stream channel condition and the number of road crossings (Eaglin and Hubert 1993; Rinne and Neary 1996; Schnackenberg and MacDonald, in press).

- PRODUCTS: Rigorous evaluation of different models and indices for predicting CWEs. Identification of the channel characteristics most sensitive to management activities.

9. Enhance the capability of local watershed groups and disseminate the results. The collaboration and involvement with local watershed groups and educational institutions will facilitate the exchange of experience and knowledge and foster the teaching of science and the scientific method. This exchange will also be formalized through training sessions on the process for evaluating CWEs, the use of different models, and a variety of monitoring issues. Most of the field equipment acquired by the project will be retained by the local watershed groups and collaborating agencies (e.g., American River College), which will further strengthen the capability of these organizations to play an active role in watershed management and restoration. Dissemination of the work products to regulatory and management agencies will proceed through regular consultations, progress reports and workshops and training courses on an as-needed basis. Each of these interactions will also help ensure that the project yields practical, readily-usable products.

- PRODUCTS: Technology transfer through workshops, training sessions, and publications.

C. Location and/or Geographic Boundaries of the Project

Field data collection will be focussed in the lower- to mid-elevation zones of the American and Consumnes River basins, as these basins are subject to active fuels treatment programs, intensive roading, growing rural settlements, and other management activities. However, because the project is

I-011752

procedure- and process-oriented, the results should be more widely applicable. The use of the American and Consumnes River watersheds should also facilitate comparisons in sediment delivery and flow dynamics between the last major undammed, west-flowing drainage (the Consumnes River) and an adjacent dammed basin (the American River).

D. Products and Benefits

The procedures, models and data on sediment and flow dynamics will provide local watershed groups and state and federal agencies with badly-needed information to improve watershed planning and land management decisions. In addition to developing the structure and initial formulation of a second-generation CWE model, we will produce generic guidance on addressing cumulative effects, a series of technical products, and a strengthening of local land management and watershed organizations. From a technical perspective, it would be irresponsible to promise that the proposed project will provide the definitive model for predicting all types of CWEs throughout the Sierra Nevada. At a minimum, however, the proposed activities will: (1) develop a conceptual framework and a practical procedure for addressing and modeling multi-scale sediment CWEs; (2) further our understanding of how land use activities alter rates of erosion, runoff, and sediment delivery; (3) identify the controls on, and likely causes of, channel characteristics and channel change; and (4) help refine and focus future monitoring efforts. Monitoring equipment acquired for the project will be retained by local watershed groups and educational institutions, and this will again serve to strengthen their capability to play an active role in watershed management and restoration.

E. Background and Ecological/Biological/Technical Justification

The combined impact of multiple human activities in space and over time can lead to significant on- and off-site cumulative effects (Reid 1993; Megahan et al. 1992; Berg et al. 1996). Both the National Environmental Policy Act and the California Environmental Quality Act require an explicit assessment of the possible cumulative effects from certain proposed actions (Thatcher 1990; Costick 1996). The 1998 Clean Water Action Plan mandates the development of "Unified Watershed Assessments", which by definition are cumulative in time and space.

A major management concern in most upstream areas is the anthropogenic increase in fine sediment loads, as this has a direct, adverse effect on both fish habitat (Waters 1995) and water quality. A 1996 national survey indicated that sediment "pollution" was responsible for nearly one-third of the more than 18,000 waterbodies identified as impaired. For these impaired waterbodies it will be necessary to estimate the contribution of different sediment sources and the assimilative capacity of the impaired water body (i.e., Total Maximum Daily Loads or TMDLs). For effective management it is essential to predict, with a reasonable degree of accuracy, the likely changes in runoff and sediment delivery at a range of watershed scales. In the absence of such predictive tools, management activities may continue until degradation is obvious, by which time it is too late to adjust management activities. Alternatively, management activities may be unfairly precluded due to unfounded fears over possible CWEs. A reasonable predictive capability and sensitive, cost-effective monitoring techniques are essential for implementing watershed-scale regulations such as TMDLs, evaluating and improving best management practices, and maximizing the cost-effectiveness of any restoration efforts. The need for improved predictive and monitoring

capabilities is particularly urgent given the proposed fuel reduction programs, growing rural settlements, and existing road networks.

The problem is that most procedures for assessing CWEs are "simple, incomplete, theoretically unsound, unvalidated, . . . and heavily used" (Reid 1993, p. 35). The primary model used to assess CWEs on public lands in the Sierra Nevada, the Equivalent Roaded Area (ERA) procedure, was developed in the early 1980s. A key limitation of this approach is its treatment of watersheds as lumped entities, while numerous studies emphasize the spatial variability in key processes and the fact that the location of management activities does matter (e.g., Hewlett 1961; Menning et al. 1996). Perhaps more importantly, the basic coefficients in the ERA model were based on estimated changes in runoff, and it is inappropriate to use the same procedure to estimate allowable changes in erosion or sediment yields. Recent studies have begun to address some of the key limitations of the ERA approach (e.g., McGurk and Fong 1995; Costick 1996; Menning et al. 1996), but they have not resolved the underlying limitations of the procedure. Recent advances in the availability of GIS, our understanding and quantification of watershed behavior, and computing power, indicate that the time is ripe to develop much more realistic, but still practical, procedures for predicting CWEs and developing TMDLs.

F. Monitoring and Data Evaluation

A major objective of the project is to evaluate monitoring techniques and develop guidelines for assessing cumulative watershed effects. We will collaborate with staff from the Proposition 204-funded Coordinated American River Watershed Health Improvement and Monitoring Project and El Dorado Watershed Improvement 2000. A variety of standard quality assurance and quality control procedures will be used to assess the quality of data collected in this project and by collaborating institutions. We will provide training in monitoring techniques to watershed groups and provide guidelines or protocols for continued monitoring. Formal products, including data analyses, will be peer reviewed before dissemination.

G. Implementability

The Pacific Southwest Research Station (USDA Forest Service) complies with all federal regulations under NEPA, the National Forest Management Act, etc. Work proposed on California State and private lands will be done in compliance with all State of California regulations. Through the American River Watershed Group, the Consumnes River Task Force and their diverse members, we will actively partner with private land owners, especially with respect to obtaining land use histories and making measurements in channels and at fuels reduction treatment sites, timber harvests and roads. PSW Research Station will seek all required permits and/or easements as needed, coordinate with National Forest supervisors, and obtain Use Permits for activities on Forest Service lands.

The proposed activities are non-manipulative in nature. The design of the project provides for collection of small (e.g., a few pounds) of sediment. We believe that sediment gathering and other activities at the project sites will have no significant impacts under CEQA and NEPA and therefore that these activities are "categorically excluded".

V. COSTS AND SCHEDULE TO IMPLEMENT PROPOSED PROJECT

A. Budget Costs

The USDA Forest Service and Colorado State University will provide substantial in-kind and cost-sharing contributions. The Forest Service will cover virtually all the salary and other expenses relating to the participation of Dr. Neil Berg, co-principal investigator, and Mr. John Chatoian, regional liaison to the Eldorado and Tahoe National Forests. Similarly, the Eldorado and Tahoe National Forests will provide data, professional support, and some field support at no cost to the project. An existing EPA-Forest Service project will cover part of Dr. Lee MacDonald's contribution to this project, and an estimated 1 ½ months per year of Dr. MacDonald's salary will be provided by CSU as an inkind contribution. More specifically, CSU will reduce its overhead rate from the normal 45% to 0%, and this represents a direct contribution of approximately $81,000. CSU will also provide computer workstations and much of the other infrastructure necessary to carry out this project. The ARWG has received a Proposition 204 grant to improve and monitor watershed health, and some of the activities being conducted under that project will contribute to the project proposed here. In particular, the monitoring components in both projects should lead to a synergistic exchange of information and strengthening of the ARWG.

Total funding requested from CALFED for this project is $229,221(Table 1), with $211,352 of this amount sub-contracted to CSU. Over $86,000 will return to the local economy (see Section VC). The miscellaneous and other direct costs in Table 1 are for transportation and per diem by university and Forest Service employees ($43,100) and purchase of equipment and supplies ($25,000, with $4,000 of this for equipment for the ARWG and American River College).

Over $239,000 is anticipated to be provided as matching funds by the USDA Forest Service and CSU, primarily as staff time for the co-principal investigators (25 weeks) and supporting professionals and field assistants (90 weeks), and a reduction in the standard overhead rate.

B. Project Schedule and Milestone (Table 2)

The project will run from 1 January 1999 to 31 December 2001. In the first year we will complete task 1, make substantial progress on task 2, and initiate work on tasks 3 and 7. Besides quarterly progress reports, a preliminary report on this work will be submitted by 31 March 2000.

We anticipate that the second field season will focus on task 3, with a reduced emphasis on task 7. The relative emphasis on roads, harvest units, burned areas, and mass movements will depend upon the first-year field observations, discussions with local experts, and aerial photo analyses. A preliminary written report on erosion sources and sediment delivery to the stream channel will be submitted on 31 March 2001. Key results from the instream monitoring and erosion assessment will be presented at a scientific conference, such as the Fall Meeting of the American Geophysical Union or the biannual conference of the Watershed Management Council.

Collaborators from the USFS, the ARWG and hopefully the CRTF will continue upslope and instream monitoring efforts in order to increase the amount of data available for analysis and model validation, and to better assess the variability between sites and basins within the Sierra Nevada.

The combination of instream and hillslope data will allow us to develop the initial framework and algorithms for our CWE model(s).

Work in the third and final year will focus on tasks 4, 5, 6, 8 and 9. Field work during this year will be directed towards the most critical gaps needed to predict erosion rates and sediment transport on a landscape scale. A full report on the work will be submitted in writing by 31 December 2001. We would also expect to run one or more training courses on our approach, disseminate the results at a scientific meeting, and write up the results into several peer-reviewed articles.

C. Third Party Impacts

Third party impacts anticipated from this project include monetary inflows to the local economy through the hiring of field assistants (estimated at $39,400) and the payment of travel expenses (gasoline, lodging and per diem) (estimated at $41,000). Equipment purchased through the project that can be used for future monitoring and data collection will remain with local organizations (estimated value of $4,000). An additional $2,000 is allocated to local groups for travel expenses to participate in regional watershed workshops. The project will not manipulate any resources or otherwise cause adverse impacts to environmental or economic resources that could require mitigating actions.

VI. APPLICANT QUALIFICATIONS

The project will be led by staff from the USDA Forest Service and Colorado State University. A variety of local organizations and California state institutions will be collaborating partners.

Primary Investigators: The project will be led, coordinated, and overseen by two principal investigators who are Ph.D. scientists with considerable experience in the study area. They have both published peer-reviewed scientific articles on a variety of topics relevant to the proposed project. To date the co-investigators have been responsible for obtaining and administering over $1,700,000 in external funding from a variety of institutions (e.g., US Bureau of Reclamation, Pacific Gas and Electric Company, Sierra Nevada Ecosystem Project, USDA Fish and Wildlife Service, US EPA, California Air Resources Board).

The project director and coordinator is Dr. Neil Berg. Dr. Berg has been a hydrologist with the USDA Forest Service for over 20 years, primarily as a project leader for hydrologic, fish habitat, and cumulative effects research in California. He currently is overseeing a national, collaborative effort by the Forest Service and US EPA to develop improved methods for assessing cumulative watershed effects on forested lands. Dr. Berg has authored over fifty scientific publications, including a study on sedimentation in the Camp Creek watershed of the Eldorado National Forest. Most of his other publications are directly relevant to this study, as they cover cumulative effects, snow hydrology, water yield, and fish habitat issues in the Sierra Nevada. Dr. Berg will manage and administer the project and will assist Dr. Lee MacDonald in the technical oversight.

Professor Lee MacDonald at Colorado State University will take primary responsibility for directing the field research and model development. Dr. MacDonald was a Forest Service hydrologist in California for nearly four years while working on his Ph.D. During this time he published a number of papers related to forest hydrology and forest management in the Sierra Nevada. Dr. MacDonald is well known for his EPA publication on monitoring the effects of forest management on streams (MacDonald et al., 1991) and his continuing research has resulted in numerous publications and conference presentations on monitoring, cumulative effects, road erosion, and the effects of forest harvest on peak and low flows. He teaches one of only two university courses in the country on cumulative effects and watershed analysis, and he has led or been an invited speaker at more than 40 workshops or training courses. This project will bring together and draw on both his past research and his current, more conceptual work on cumulative effects.

Mr. John Chatoian is the Regional Geologist for the Pacific Southwest Region of the USDA Forest Service, and is responsible for the regional efforts to assess CWEs. Mr. Chatoian will serve as the primary liaison between the project and the National Forests in the Pacific Southwest Region and he will assist in developing and testing the generic framework for assessing cumulative effects (task 1). During his 17-year involvement in CWE issues, Mr. Chatoian developed, implemented and oversaw the CWE methodology for the USDA Forest Service Pacific Southwest Region. He has collaborated on CWE projects, including an interagency effort in the Mokelumne River basin in the early 1990's. Mr. Chatoian has also trained federal and state government staff and industry representatives on CWE scoping and assessment issues and techniques.

Staff members of the Eldorado and Tahoe National Forests will have critical supporting responsibilities including the coordination of local GIS activities. Temporary staff hired specifically for this project will include two Ph.D. students at CSU and two locally-hired field assistants.

Established organizational infrastructures of the Pacific Southwest Research Station, Colorado State University, and the Eldorado and Tahoe National Forests will provide ongoing fiscal, clerical, procurement, and computer support.

Collaborating Groups: We will collaborate closely with the El Dorado County Watershed Improvement 2000 project and the Coordinated American River Watershed Health Improvement and Monitoring Project. The groups sponsoring these projects have diverse memberships, including Resource Conservation Districts. Through collaboration with the American River Watershed Group and the Consumnes River Task Force we will actively interact with local communities and organizations. This collaboration will take the form of coordinating field measurements, sharing data, and other informal exchanges of information and experience. We also expect to collaborate in an exchange of data and monitoring procedures with the Deer Creek sediment assessment project in the northern Sierra Nevada. In the third year of the project, we hope to co-sponsor workshops with these groups on designing monitoring projects and monitoring procedures.

As part of the project, classes from the American River College and area high schools will learn about upland and instream monitoring techniques. Students will collect and analyze data as class projects and will learn applied science and become better informed citizens. The process of

collecting real-world data is essential to the study of hydrology and related fields (MacDonald 1993). Equipment purchased for the project (e.g., geo-positioning system, laser level) will ultimately become property of the College.

The Geology and Geophysics Department, University of California, Berkeley will loan equipment to the project for field measurements.

Various California State agencies (e.g., Department of Forestry and Fire Protection, Division of Mines and Geology, Water Resources Control Board) and federal agencies (e.g., USDA Forest Service) will be invited to participate in different aspects of the project and thereby help ensure that the results are incorporated into agency practice.

There are no known or anticipated potential conflicts of interest for the principal investigators or any of the other project participants.

VII. COMPLIANCE WITH STANDARD TERMS AND CONDITIONS

"Public Entity", "Non-Discrimination Compliance", and "Non Collusion" forms are attached as requested for proposals by a federal agency for a "Services/Consulting/Preconstruction/ Research" project.

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Table 1. Requested CALFED funding (based upon 3-year total expenses, with FS=Forest Service, CSU=Colorado State University, and LH=locally-hired)

Project Task	**Direct Labor (Staff Weeks)**	**Direct Salary & Benefits**	**Overhead**	**Miscellaneous & other Direct Costs**	**Total Cost**
Assessment process	CSU-15	5257		1000	6257
Site selection/ land use histories	FS-1 CSU-30	1948 10513	195	1500	14156
Field assessment	FS-2 CSU-95 LH-60	3895 33292 39420	688	47670	124964
Predict sediment	FS-0.5 CSU-35	974 12265	98	1050	14387
Route sediment	CSU-35	12265		1050	13315
Predict flows	CSU-35	12265		1000	13265
Monitoring	CSU-40	14018		7971	21989
Validate methods	FS-0.5 CSU-20	974 7009	98	1550	9631
Tech. transfer	CSU-15	5257		6000	11257
TOTAL		159351	1079	68121	229221

I-011762

Table 2. Schedule of Proposed Activities (CE = cumulative effects; Number of dashes per quarter indicate relative intensity of effort).

Task	1999 Quarter				2000 Quarter				2001 Quarter			
	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th
1 CE assessment process	---	---	---									
2a Site selection	- -	---				- -			- -			
2b Land use histories		- -	---	---	- -	-			-			
3 Field measurements		- -	---	-		---	---	- -	- -	- -		
4 Hillslope sediment						-	- -	- -	---	- -		
5 Sediment routing					-	- -	- -	---	- -	-		
6 Flow prediction					-	- -	- -	---	---	-		
7 Monitoring procedures			- -	---	---	- -	- -	-	-	-		
8 Validate procedures									-	---	---	-
9 Dissemination/ training						-		-	-	-	---	---

I-011763

Placer County Resource Conservation District
251 Auburn Ravine Rd., Suite 201 - Auburn, CA 95603-3719 - Phone (916) 885-3046 / FAX (916) 823-5504

June 23, 1998

Mr. Neil Berg
Pacific Southwest Research Station
USDA Forest Service
P.O. Box 245
Berkeley, CA 94701

Dear Mr. Berg:

The District, on behalf of the American River Watershed Group, wishes to express our support for your proposal "Evaluating and Monitoring Cumulative Watershed Effects".

If selected for funding, your proposal will complement our existing funded watershed programs and proposed Integrated Watershed Plan and Stewardship Strategy. A predictive model that is sensitive to vegetative management will assist in our long-term desire to develop a voluntary TMDL strategy.

Thank you for your interest in working with the American River Watershed Group.

Cordially,

Richard C. Gresham,
Manager

ARC

Quality Learning That Transforms and Enriches People's Lives

June 29, 1998

CALFED Bay-Delta Program Office
1416 9th St., Suite 1155
Sacramento, CA 95814

To whom it may concern:

The American River College fully supports the proposal for a sediment evaluation and monitoring project submitted by the Pacific Southwest Research Station. This project would expand an ongoing relationship between the College and the El Dorado National Forest in which students have learned scientific procedures as part of a stream monitoring project.

Among other things, we'd like to integrate student GIS projects with the watershed work discussed in the grant proposal. The college is always looking for ways to incorporate "real life" applications to the curriculum and this proposal offers several means of doing just that. The proposal also allocates monies to the purchase of monitoring equipment for use by the college. This type of equipment is hard for us to come by and its acquisition would provide us with truly long-term benefits. The equipment could be shared with other educational institutions to expand its usefulness.

In summary, I enthusiastically endorse the proposal which is a "win-win" relationship for each party and urge you to fund it.

Sincerely,

Colleen Owings
Dean, Science/Allied Health

American River College
4700 College Oak Drive
Sacramento, CA 95841
Phone: (916) 484-8011
www.arc.losrios.cc.ca.us

I-011765

STATE OF CALIFORNIA — THE RESOURCES AGENCY PETE WILSON, Governor

DEPARTMENT OF FORESTRY AND FIRE PROTECTION
P.O. Box 944246
SACRAMENTO, CA 94244-2460
(916) 227-2651 FAX (916) 227-2672

FP 11

June 29, 1998

Mr. Lester A. Snow
CALFED Bay-Delta Program Office
1416 Ninth Street, Suite 1155
Sacramento, California 95814

Dear Mr. Snow:

The California Department of Forestry and Fire Protection supports the CALFED Category III grant proposal, submitted by the USDA Forest Service Pacific Southwest Research Station, entitled "Evaluating and Monitoring Cumulative Watershed Effects."

Water quality impacts of fuel reduction treatments and forest management activities need to be better understood. These impacts must be placed in the context of other sources of water quality impacts, such as the potential of large catastrophic fires, rural residential development, and extensive road networks. The short-term consequences of land management activities must be better understood by land managers to ensure that the long-term benefits of reducing the probability of catastrophic fires are achieved. The proposed project will provide valuable information on erosion and sedimentation for both on-site and off-site effects of land management.

The Department is also interested in procedures that the project will develop for evaluating cumulative watershed effects. As we collectively move toward increased emphasis on planning at the landscape level, and demands on natural resources continue to increase, better tools will be needed to predict the effects of multiple management actions on water quality and flows. Significant questions regarding these issues frequently arise in forest management planning.

The proposed project would complement ongoing watershed planning projects in El Dorado and Placer Counties, such as the Proposition 204 funded projects and the proposed Category III funded watershed planning focused on the American River. Although fieldwork will focus on the central Sierra Nevada, the applicability of the project is region-wide. In addition, the project will enhance public awareness through environmental education and community participation in water quality monitoring.

CDF strongly supports funding this project and believes its benefits will reach far beyond the boundaries of the American and Cosumnes River watersheds.

Sincerely,

Richard A. Wilson
Director

RH:pc

STATE OF CALIFORNIA-THE RESOURCES AGENCY PETE WILSON, Governor

DEPARTMENT OF CONSERVATION
DIVISION OF MINES AND GEOLOGY
135 RIDGWAY AVENUE
P.O. BOX 670
SANTA ROSA, CA 95402-0670
(707) 576-2959

June 29, 1998

Neil Berg
USDA Forest Service
PSW Research Station
800 Buchannan St., West Bldg
Albany, CA 94710-0011

Dear Neil,

Thank you for providing me the opportunity to review the proposal being submitted by you and Lee MacDonald to refine the methodology for landscape-scale assessments of potential cumulative watershed effects (CWEs). As observed by Leslie Reid, The problem is that most procedures for assessing CWEs are "simple, incomplete, theoretically unsound, unvalidated, . . . and heavily used".

The science-based research approach for evaluating the cumulative effects to streams and rivers in areas where landuse activities have occurred that you and Lee are proposing will greatly aid in placing specific timber harvesting proposals in a reasonable context. A revised CWE model may also help in developing science-based remediation. The GIS monitoring of impacts and effects that you propose will provide the base for our long-term understanding of watershed systems. The approach you are taking for refining the CWE methodology is integral to the common goal of understanding watersheds so that landuse and environmental protection can accommodate each other.

Sincerely,

Thomas E. Spittler
Senior Engineering Geologist

cc: Trinda Bedrossian