I. Executive Summary

RESTORATION OF A LARGE TIDAL MARSH: THE NAPA-SONOMA MARSH COMPLEX

California Coastal Conservancy (for Napa-Sonoma Marsh Complex Restoration Committee)

B. Project Description and Primary Ecological Objectives: This project will provide scientific support for large-scale restoration and adaptive management of the 40,000-acre Napa Sonoma Marsh Complex (Figure 1). The participants are a strong coalition of academic, private sector, and governmental scientists and managers familiar with regional wetlands functions and values. The participants have been meeting since fall 1996 to design this project. Through this project, wetlands managers and scientists will work together to meet three main objectives.

1. Produce a numerical model of the hydrology, sediment dynamics, and certain water quality variables of the Napa-Sonoma Marsh Complex to enable land managers to investigate the habitat response of various restoration scenarios. The size and complexity of the study area afford an opportunity for a balanced plan to conserve, enhance, or restore various land uses and habitats. Numerical modeling is required to forecast how land use changes and habitats relate to another, and for staged implementation of comprehensive restoration plans.

2. Produce protocols for monitoring wetlands geomorphology, water and sediment quality, fishes and other aquatic resources, waterfowl, shorebirds, and riparian birds as key aspects of wetlands health. Monitoring will be required to inform restoration designs, adaptive management of the Napa-Sonoma Marsh Complex. Standard, interagency protocols are needed to assess regional as well as local conditions, and to assure data are comparable from place to place and through time. The proposed work will yield an interagency monitoring program for wetlands in the North Bay area that could be expanded to include other regions of the Bay-Delta system.

3. Produce guidelines and recommendations for natural restoration of tidal marshes in the Napa-Sonoma Marsh Complex. These products will address critical restoration topics such as the sequence, timing, and freshwater requirements for safe desalination of salt ponds; how to minimize physical and biological stressors for tidal marshes and adjacent lands, monitoring design, and institutional arrangements for cost-effective monitoring and data management.

C. Approach, Tasks, Schedule: The overall approach is to develop technical tools for large-scale wetlands restoration and assessment through close collaboration among regional scientific experts and wetlands managers. The work plan is to build technical teams around baseline field work and then proceed with team concurrence through a series of field tests to provide appropriate numerical hydrological model(s) and monitoring protocols. Over the next 3 years, the participants will begin to implement a plan of tidal marsh restoration and monitoring in the Sonoma Marsh Complex that is sensitive to surrounding ecological and land use constraints. The following table outlines the proposed work as a set of 11 major tasks.

Year	Task	Description of Major Task
1	1	Produce a photographic base map for the study area.
1	2	Form technical teams for modeling, habitat monitoring, and ecological resource monitoring.
1	3	Compile existing information and refine objectives for management, modeling, and monitoring.
1	4	Measure areas, cross-sections, and tidal elevations for tidal and non-tidal landscapes.
1	5	Measure tidal hydrodynamics and sediment transport in tidal channels throughout the study area.
1,2	6	Measure and analyze habitat support functions for priority fishes and birds.
1,2	7	Measure and analyze water and sediment quality for salt ponds.
1,2	8	Analyze hydrodynamic and sediment transport data and develop conceptual model.
1,2,3	9	Develop monitoring protocols for priority species and habitats, plus appropriate QA/QC plans.
1,2,3	10	Develop numerical model(s) of tidal channel hydrodynamics and sediment transport, and provide the model(s) to local and regional users.
1,2,3	11	Produce reports and make recommendations based on project results.

D. Justification for Project and Funding by CALFED: The proposed project is entirely consistent with the objectives of the CALFED ERPP. The project will benefit 5 of the 7 priority habitats, 7 of the 10 priority species, and will address 7 of the 12 major stressors listed by CALFED. The study area is entirely within the "North San Francisco Bay" area of the ERPP geographic scope (Figure 1). The project participants provide partnerships among academia, non-governmental institutions, the private sector, and Federal, State, and local agencies.

The proposed project is patently desirable. The natural ecological functions of the study area have been severely altered during the last 150 years by conversion of tidal wetlands and adjacent uplands to salt ponds, hay fields, viticulture, and pasture (compare Figures 1 and 2). Plans to restore some of the natural functions of these lands are emerging through the CALFED Bay-Delta Program, the Bay Area Wetlands Ecosystem Goals Project, the US COE Napa River Salt Marsh Reconnaissance Study, and in-house plans for CDFG and US FWS properties. Integration and implementation of these plans will require the broad base of scientific and management support that this project can provide. Successful restoration will depend upon the proposed work to understand the local hydrologic and sediment transport processes that control aqueous and soil salinity within the former salt ponds, the performance of levees that protect non-tidal resources, the effectiveness of levee breaches to restore tidal marshlands, and the overall form and function of the marshlands. Adaptive management of the marshlands will depend upon the monitoring protocols that this project will provide to forecast problems in the field and measure progress. The project will provide numerous direct and indirect benefits to managers of the Napa-Sonoma marsh Complex, with significant practical applications throughout the Bay-Delta system.

E. Budget Costs and Third Party Impacts: The overall budget for this project is $1,317,502 for 3 years of effort. Based upon government salaries and existing equipment and supplies that will be dedicated to this project, the total estimated value of matching funds and in-kind services is about $1,255,00. No direct third party impacts are expected from this project.

F. **Applicant Qualifications:** The Coastal Conservancy was created by the Legislature in 1976 as a unique entity with flexible powers to work in partnership with public agencies and non-profit organizations to protect and preserve coastal resources. The Conservancy has undertaken more than 640 projects along the California coast and for San Francisco Bay. It has helped to preserve and/or enhance more than 32,700 acres in tidal and freshwater wetlands, coastal streams, watersheds, and farm lands.

G. **Monitoring and Data Evaluation:** This is a essentially a monitoring and modeling effort. Success will be measured by the degree to which tasks are performed, the model(s) adequately predict changes to the system, and data are consistently collected, interpreted, analyzed, and distributed to the interested parties

H. Local Support/Coordination with Other Programs/Compatibility with CALFED Objectives: This proposal has been reviewed and is supported in concept and technical detail by the principal investigators for the Sonoma Creek Watershed Plan, the Napa River Watershed Plan, the US COE Napa River Salt Marsh Feasibility Study, the Regional Monitoring Program for Trace Substances, and the Regional Wetlands Ecosystem Goals Project. The following organizations would be directly involved in this project: US Fish and Wildlife Service, California Department of Fish and Game, California Coastal Conservancy, US Environmental Protection Agency, US Geological Survey, US Natural Resources Conservation Service, US Army Corps of Engineers, US National Marine Fisheries Service, National Ocean Survey UC Berkeley, UC Davis, Stanford University, Napa Resource Conservation District, Southern Sonoma Resource Conservation District, Philip Williams and Associates, San Francisco Estuary Institute, and the Point Reyes Bird Observatory. The Bay Conservation and Development Commission and the San Francisco Bay Regional Water Quality Control Board have been attending meetings and providing input and regulatory guidance on proposed activities.

II. Title Page

A. **Title:** Restoration of a Large Tidal Marsh: the Napa-Sonoma Marsh Complex

B. **Applicant:** Nadine Hitchcock
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Oakland, CA 94612

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C. **Type of Organization:** State Agency

D. **Tax Identification Number:** 94-316-4968

E. **Technical and Financial Contact Person:** SAME AS ABOVE

F. **Participants/Collaborators:** The Napa-Sonoma Marsh Complex Restoration Committee consists of 11+ leading scientists and wetlands managers from academia, non-governmental organizations, the private sector, and Federal, State and local agencies. The committee has been working since fall 1996 to design this project. The committee includes representatives of agencies that hold title to lands that could be restored to tidal marsh. In addition to these participants, the project is expected to involve more than 20 scientific collaborators on 2 administrative teams and 5 technical teams, which will be formed at the beginning of this project. The project participants are listed below.

Committee Role	Name	Affiliation	Sub-contractor
Implementation	Paul Jones	US EPA	NO
	Nadine Hitchcock	CA Coastal Conservancy	NO
	Larry Wyckoff	CA DFG	NO
Science Coordination	Joshua N. Collins, Ph.D.	San Francisco Estuary Institute (SFEI)	YES
Modeling Team Leadership	Vincent Neary, Ph.D.	Philip Williams and Associates	YES
	Geoffrey Schladow, Ph.D.	UC Davis	YES
	Jon Burau	Stanford University	YES
Hydro-geomorphology Team Leadership	David Schoellhamer, Ph.D.	US GS	YES
	Geoffrey Schladow, Ph.D.	UC Davis	YES
	Robert Zlomke	Napa RCD	YES
	Paul Sheffer	S. Sonoma RCD	YES
Fish Resources Team Leadership			
Avian Resources Team Leadership	Nadav Nur, Ph.D.	Point Reyes Bird Observatory	YES
GIS Team Leadership	Zoltan Der	San Francisco Estuary Institute (SFEI)	YES

G. **RFP Project Group Type(s):** Services

III. Project Description

A. Project Description and Approach: This project will provide scientific support for the large-scale restoration and adaptive management of the 40,000-acre Napa Sonoma Marsh Complex (Figure 1). The overall approach is to develop technical tools for large-scale wetlands restoration planning, and adaptive management through close collaboration among regional scientific experts and wetlands managers. The work plan is to build technical teams around baseline field work and then proceed with team concurrence through a series of field tests and demonstrations to produce hydrological model(s) and monitoring protocols.

The relative abundance of the major habitat types that comprise the study area are shown in the table below.

CALFED Priority Habitats (from the ERPP)	Napa-Sonoma Marsh Complex Habitat Type (from interagency Habitat Typology of Regional Wetlands Ecosystem Goals Project)	Amount (acres) ca 1800	Amount (acres) ca 1997
Saline emergent wetland	Tidal Marsh	38,650	9,147
Instream aquatic, Shaded river aquatic, Midchannel shoal	Major Tidal Channels	3,899	775
Seasonal wetland and aquatic	Diked Farmed Baylands	0	19,715
	Diked Grazed Baylands	0	1,558
	Salt Ponds	0	7,554
	Diked Marsh (managed for natural resources)	0	2,127

The existing tidal marshlands mainly consist of narrow patches of low (young) marsh along the outboard margins of levees constructed during historical, large-scale tidal marsh reclamation. The tidal channels consist of remnant reaches of fifth-order mainstem channels of the historical channel networks of saline and brackish tidal marshlands. Diked farmed and diked grazed baylands represent agricultural uses of reclaimed lands that are distinguished from each other by their amount of topographic relief and the associated water management practices. In general, diked farmed baylands have lesser topographic relief but better drainage. the Diked managed marsh includes private duck clubs and public marshlands managed for natural resources. Salt ponds represent the recently discontinued commercial use of reclaimed marshlands for salt production. Salt ponds include low salinity intake ponds, higher salinity evaporation ponds, and very high salinity bittern ponds. Carefully controlled desalination of the high salinity ponds is a pre-requisite to their restoration as tidal marsh. Much of the diked baylands have subsided below mean sea level.

B. Location and/or Geographic Boundaries of the Project: The Napa-Sonoma Marsh Complex includes portions of Solano County, Napa County, and Sonoma County, and extends from the tidal reaches of the Napa River in the East; to Searsville Point bordering Tolay Creek in the West; to the northern shoreline of San Pablo Bay to the South; and to the historical extent of the tides among the watersheds of Tolay Creek, Sonoma Creek, Huichica Creek, Carneros Creek, and the Napa River in the North (Figure 1).

C. Expected Benefits: The proposed project will benefit 5 of the 7 priority habitats, 7 of the 10 priority species, and will address 7 of the 12 major stressors identified by CALFED. The project will initiate an interagency approach to large-scale wetlands alternatives analysis, conceptual design, and quantitative assessment that could be applied to other estuarine areas of the Bay-Delta system, such as the Hamilton Air Force Field Project, Petaluma Reclamation Marsh Project, Ora Loma Marsh Project, Baumberg Project, Bair Island Project, Montezuma Marsh Project, Project Island, and other Delta wetlands restoration projects.

The following tables show the expected benefits of the proposed work in relationship to the major stressors (identified by letter and bold font in the CALFED ERPP), the component stressors (as underlined in the ERPP), and the priority habitats and species (these are italicized in the third table below, which shows project benefits in relation to major stressors).

	Priority Habitats
✔	*Tidal perennial aquatic habitat (freshwater)*
✔	*Seasonal wetland and aquatic habitat*
✔	*Instream aquatic habitat*
✔	*Shaded riverine aquatic habitat*
✔	*Saline emergent wetlands habitat (tidal)*
✔	*Midchannel islands and shoal habitat*
	N. Delta agricultural wetlands and grasslands

	Priority Species
	San Joaquin E. Delta fall-run chinook salmon
	Late-fall run chinook salmon
	Spring-run chinook salmon
✔	*Winter-run chinook salmon*
✔	*Delta smelt*
✔	*Longfin smelt*
✔	*Splittail*
✔	*Steelhead trout*
✔	*Green Sturgeon*
✔	*Striped bass and Migratory Birds*
✔	*State or Federal listed species including Clapper Rail and Salt Marsh Harvest Mouse*

The direct ecological benefits to priority habitats and priority species within the Napa-Sonoma Marsh Complex can have secondary benefits to agriculture, recreation, education, research, flood management, and commerce. The secondary benefits to agriculture would include improved tidal circulation of irrigation water and the forecasting of hydrological stresses on levees. The secondary benefits to recreation could include improved navigation among the marshlands, local improvements in fishing and waterfowl hunting, and enhanced opportunities for passive recreation. The secondary benefits to education and research would stem from the basic science and the large empirical data sets on habitats and wildlife that this project will provide. Flood hazards could be reduced locally due to the expanded marsh floodplain and scouring of the aggraded tidal reaches of adjacent rivers and streams. Local commerce and industry could realize secondary benefits due to a reduced need for dredging in the main navigational channels of Sonoma Creek and the Napa River.

Major Stressor	Associated Benefits
Alteration of Flows	Restoration of tidal action to selected salt ponds and/or diked baylands will reverse hydrograph alterations caused by reclamation and will promote scour of existing channels to remove shoals as migration barriers to *all local priority fish species*. Model-based planning will identify needs for control structures to prevent fish entrainment. At least 10 miles of major tidal channels could be restored, including *tidal perennial aquatic, instream aquatic, saline emergent tidal,* and possibly *midchannel habitats.*
Marshland Changes	Restoration of tidal action and tidal marshland will locally eliminate hydrological and physical isolation of the marshplain, and in these areas will fully restore the fine sediment replenishment that is essential for natural tidal marsh evolution and maintenance. Restoration of tidal marshlands will benefit *all of the local priority species*. At least 5,000 acres of publicly-owned diked baylands will be restored to tidal action.
Channel Form Changes	Restoration of tidal action to selected salt ponds and/or diked baylands will reverse chronic channel aggradation due to fine sediments as an alteration of channel form for *all local priority fish species* and some *priority species of migratory birds* (i.e., diving and dabbling waterfowl). Restoration of tidal marshland will locally eliminate isolation of sidechannels and tributaries by promoting the formation of dendritic channel networks typical of saline or brackish tidal marshlands as *tidal perennial aquatic, instream aquatic, saline emergent tidal,* and possibly *midchannel habitats* for *all local priority species*. Approximately 2,500 linear feet of channel will be restored for every 10 acres of tidal marshland.
Undesirable Species Interactions	Monitoring protocols will help detect introductions of undesirable species and competition from introduced plants, and to track responses to management efforts. Monitoring benefits are expected for *all local priority species and habitats.*

Population Management	Monitoring protocols will greatly enhance the management of local populations of *all priority species* by providing information on habitat support and the distribution and dispersal of species that is comparable through space and over time. Tidal marsh restoration will decrease habitat fragmentation and predation pressures.
Water Quality	Restoration of tidal action to selected salt ponds and/or diked baylands will increase filtration by the wetlands to reduce levels of contaminants in tidal water and increase the flux of carbon and nutrients essential to estuarine health. The model-based planning will enable managers to prevent detrimental downstream effects of increased salinity due to desalination of abandoned salt ponds. The increase in tidal prism due to tidal marsh restoration could decrease mobilization of contaminants due to dredging by increasing natural channel maintenance. These actions will benefit *all local priority species* in *tidal perennial aquatic, instream aquatic, saline emergent tidal,* and possibly *midchannel habitats.*
Land Use	The model-based planning will enable managers to develop balanced plans for the various habitats and land uses of the Napa-Sonoma Marsh Complex, including grazing and oat hay farming. Improved management of diked baylands will mainly benefit *migratory birds* of *seasonal wetlands and aquatic habitat..*

D. Background and Biological/Technical Justification: During the last 130 years, reclamation of tidal marshlands for agriculture and salt production has caused chronic aggradation and narrowing of adjacent sloughs, creeks, and rivers. Sonoma Creek no longer supports commercial shipping. The Napa River must be dredged to maintain shallow-draft boat traffic. The tidal reaches of Tolay Creek, Huichica Creek, and Carneros Creek have all but disappeared. Subsidence of the diked lands has greatly increased costs for their irrigation and drainage. Since commercial salt production has ceased, salts have continue to accumulate in every abandoned salt pond, causing a steady decline in their ecological value, and increasing the technical and regulatory complexity of desalination and wetlands restoration.

The strong consensus among estuarine scientists is that the conservation, enhancement, or restoration of intertidal habitats will first require practical understanding of the local tides, their movement and volume, chemical nature, and the sediment they carry. The recommended approach to tidal restoration therefore begins with an empirical investigation of the functional relation between channel form and hydrologic performance.

Due to the large size of the study area, alternative scenarios for wetlands restoration present themselves. Alternative landscape arrangements can be explored to minimize the negative impacts of local conversion from one habitat to another. This is an essential aspect of regulatory compliance that can only be addressed at the landscape scale. Because of the physical size and complexity of these alternatives, their analysis and selection requires a modeling approach.

It is also recognized that the critical forms and functions of the tidal channels depend upon inputs of sediment and water from adjacent estuarine bays and local watersheds. The proposed work therefore includes integration of the marshland model(s) with other models being developed by the USGS, USCOE, and local RCD's for bays, wetlands, and watersheds.

The assessment of restored lands will depend upon a regular flow of information from the field about the condition of habitats and fish and wildlife. To meet the information needs, standard protocols will be developed to monitor priority habitats and species. The resulting monitoring program will provide information to guide the restoration process, including the design of individual restoration projects as well as their integration within the larger Napa Sonoma Marsh Complex. Monitoring will also assist in evaluating project performance, forecasting problems, and identifying and changes needed to make the project more effective.

The expected benefits of the project follow directly from the existing body of science for estuarine wetlands in this region, the prominent contributions to this body of knowledge by the principal investigators and collaborators of this project, and the direct involvement of the primary agencies responsible for wetlands protection. The project benefits are expected to endure because they will result from habitat restoration plans that are entirely consistent with natural habitat controls, and because the lands that are targeted for restoration are already publicly owned. As a result of this project, all necessary permits will be obtained for tidal marsh restoration within the Napa-Sonoma Marsh Complex.

E. Proposed Scope of Work: The approximate sequencing of the 11 major tasks is evident in the tables of major tasks and milestones in sections IC and IVB. Administrative work, such as contract management, is dispersed among these major tasks.

Description of Major Tasks

Task 1: Produce a photographic base map for the study area. All participants will receive digital and paper copies of the project area base map constructed in ArcInfo using new 1:2400 scale Infra Red and natural color aerial photography provided by the US NOS and geo-rectified using Digital Orthogonal Quarterly Quadrangles provided by the US GS. The participants will also receive a map overlay of historical conditions and a documentation report that include meta-data for all features and coverages.

Task 2: Form technical teams for modeling and ecological monitoring. Members of the Napa-Sonoma Marsh Complex Restoration Committee who are technical team leaders will be responsible for assembling technical teams from the regional pool of expertise in hydrologic modeling, wetlands habitat assessment, fish and bird monitoring, and Geographic Information Systems (GIS). The technical teams will be established to advise the implementation team on technical matters and to provide the broad base of scientific support needed to implement the restoration plans. The technical teams will help select or describe field methodologies, and they will help interpret study results. The technical teams will respond to information requests from the project implementation team.

Task 3: Compile existing information and refine objectives for management, modeling, and monitoring. Representatives of the wetlands protection agencies who serve on the implementation team will work with participating scientists to construct linkages between wetlands science and management. For example, there will be a need to relate the scope and output of modeling and monitoring to clearly defined management objectives of the Napa-Sonoma Marsh Complex, as they emerge through the ERPP, the Regional Wetlands Ecosystem Goals Project, the revised US FWS Tidal Marsh Ecosystem Recovery Plan, the US COE Napa Salt Marsh Feasibility Study, and the Basin Plan of the San Francisco Bay Regional Water Quality Control Board.

Task 4: Measure areas, cross-sections, and tidal elevations for tidal and non-tidal landscapes. The hydrologic modeling will require measurement of cross-section for approximately 112 tidal slough locations and estimates of tidal elevation for the salt ponds within the Napa-Sonoma Marsh Complex. Twelve of the cross-sections will serve as reference stations requiring first-order leveling to tidal datums, such as Mean High Water. Tidal reckoning will require direct tidal observation in the study area by instrument and technician with reference to corresponding tides at the US NOS control station at Alameda, by the standard methods and procedures of the US NOS. All cross-sections and tidal benchmarks will be monumented for re-occupation as needed to show any significant effects of tidal marsh restoration on channel cross-sectional form. Survey accuracy will be specified according to modeling requirements. The maximum error of tidal reckoning, cross-sectional surveys, and other elevation surveys due to statistical samples of the tides and due to survey closure is expected to be less than 0.1 feet. A lesser amount of error is expected for leveling among cross-sectional stations. Planimetric measures will be conducted in the GIS with horizontal control of at least 15 feet. If necessary, horizontal control will be improved using Geographic Positions Systems (GPS). Suitable GPS is available through the project participants.

Task 5: Measure tidal hydrodynamics and sediment transport in tidal channels throughout the study area. This work will build upon an existing cooperative program of the US GS and UC Davis that has been measuring tidal currents, salinity, and suspended sediment in the Napa River (see Figures 3 and 4). Additional and comparable measurements will be made at 16 fixed locations within the Napa-Sonoma Marsh Complex during the full range of seasonal conditions (Figure 5). The 16 fixed stations have been selected based upon the anticipated requirements for empirical data to calibrate the numerical model(s). Spot profiles of temperature,

conductivity, pH, dissolved oxygen, chlorophyll-*a*, and suspended sediment within the salt ponds and adjacent sloughs will be taken to provide a direct link between hydrologic modeling and salt pond desalination plans. To further elucidate the processes that control salinity and tidal circulation in the Napa-Sonoma Marsh Complex, a dye tracer study will be conducted. Dispersal of Rhodamine-WT dye (non-toxic) within the slough system will be monitored fluorometrically as a mimic of high-saline salt pond discharge. The same instrumentation used to develop the baseline data for the 16 fixed stations will be repositioned to describe the tidal flows, salinity, and sediment distribution occurring during the dye tracer study.

Task 6: Measure and analyze habitat support functions for priority fishes and birds. The development of monitoring protocols for priority bird species, plus species listed as endangered or threatened, will require measurements of their abundance, distribution, and habitat use (i.e., roosting, foraging, and/or nesting) in the major habitat types characteristic of the Napa-Sonoma Marsh Complex. Based upon the ERPP and the Regional Wetlands Ecosystem Goals Project, the major habitat types are tidal marsh, salt ponds, diked grazed bayland, diked farmed bayland, managed marsh, and intertidal mudflat. Bird censuses will be conducted seasonally among these habitats using methods particular to each major habitat type and each major guild of birds, as recommended by the technical team. Data from the study area will be integrated with comparable data from other projects and reference sites in the North Bay area. Team leaders will contribute comparable data that are currently being collected in the North Bay area for separate but related projects. Protocol development for tidal marsh fishes will build upon the work of the CDFG and UC Davis to describe the seasonal distribution and abundance of different age classes of priority fishes for intertidal flats and among tidal channels of first- through fifth-order. The technical team for fishes will work closely with fisheries biologists from the Interagency Ecological Program (IEP) to build monitoring protocols that will be used throughout the Bay-Delta system.

Task 7: Measure and analyze water and sediment quality in salt ponds. The successful conversion of abandoned salt ponds to tidal marshes will require careful control of the biological stresses of pond effluent on receiving waters and existing tidal marsh. The required amount of control will follow from clear statements of management objectives (i.e., what is the desired level of control; see the description of task 3 above), the desired residual pond salinity (i.e., what is the desired plant community composition, and what are the corresponding soil salinities), and the existing amount of salts within the ponds (i.e., how much salt has to be removed). Measurements of existing pond conditions are therefore essential for planning tidal marsh restoration. To get these measurements, random samples of at least 5 sample units of sediment and water salinity, Ph, conductivity, and biological oxygen demand (BOD) will be taken monthly from each salt pond. It is expected that monthly measurements will be required to show the effects of rainfall and evaporation on sediment and water quality within the ponds. After the first year of baseline data collection, the sampling program will be adjusted if necessary to maximize its efficiency.

Task 8: Analyze hydrodynamic and sediment transport data and develop conceptual model(s). Principal component and time series analysis will be performed on the hydrodynamic and sediment transport data to quantify the patterns of tidal flow and sediment transport through space and over time (see Figures 3 and 4). This is actually an ongoing task that parallels data collection (see description of task 5 above), such that the baseline hydrologic sampling can be adjusted as necessary to optimally support the modeling effort. The modeling team will provide frequent reports to the other technical teams on the results of the hydrodynamic and sediment transport studies. As a result of these interactions among teams, one or more conceptual models will be developed to show the likely relationships among levee breaches, time-of-year, salt pond water and sediment quality, salinity of salt pond discharge, adjacent ecological impacts, and management objectives. A key topic will be the need for 1-D (1 dimensional), 2-D, or 3-D models for the Napa River, Sonoma Creek, tidal sloughs, and salt ponds. To the extent appropriate, the conceptual model(s) will reflect how the Napa-Sonoma Marsh Complex, adjacent watersheds, and adjacent estuarine bays function together as one hydrological system.

Task 9: Develop monitoring protocols for priority species and habitats. Standard protocols will be produced for monitoring wetlands hydrology, geomorphology, priority fishes, and priority birds in the Napa-Sonoma Marsh Complex. These protocols will reflect the results of the field work that will be conducted through this project, and the consensus opinions of the technical teams. It is the intent of all the participants in this project to develop habitat models and monitoring protocols that can be used to monitor tidal marshlands and seasonal wetlands anywhere within the Bay-Delta system. The technical teams for birds and fishes will recruit technical reviews and comments from the Interagency Ecological Program (IEP) and from other parts of the regional community of professional avian and fisheries ecologists.

Task 10: Develop numerical model(s) of tidal channel hydrodynamics and sediment transport, and provide model(s) to local and regional users. Based upon the empirical studies of tidal hydrology and sediment transport, the modeling team will select and/or develop one or more numerical models to predict the effects of salt pond levee breeches on tidal marsh restoration, the form of adjacent tidal channels, their aqueous salinity, and the related ecological effects within the Napa-Sonoma Marsh Complex. It is likely that an adaptation of an existing, peer-reviewed model will be used. The model(s) will be selected based on their ability to represent the conceptual model, and for their ability to interface with other models already being used for adjacent watersheds and estuarine bays. Once a satisfactory model is calibrated and validated, then it will be transferred as a planning tool to local and regional wetlands protection agencies. It is expected that model output will be linked to the GIS for visualization and spatial analysis. Technical requirements to receive the model will be described as the model is built. Science transfer will proceed at various levels, depending upon the users' needs and capabilities.

Task 11: Produce reports and make recommendations based on project results. There will be regular reports from the technical teams that will be integrated by SFEI into quarterly reports to the Napa-Sonoma Marsh Complex Restoration Committee. The project applicant will, in turn, use these reports as the basis of progress reports to CALFED. The final report for the project will be produced by the implementation team with review by the Committee. The final report will include project documentation, descriptions of the conceptual and numerical models, and site-specific plans for tidal marsh restoration and adaptive management. It is anticipated that the final report will be the basis for an interagency wetlands monitoring program that can serve the needs of most of the wetlands interests throughout the Bay-Delta system. With this in mind, the implementation team intends to meet frequently with wetlands interests to provide progress reports and to receive comments on how to maximize the benefits of this project.

F. Monitoring and Data Evaluation: This is essentially a modeling and monitoring program. The model(s) will be evaluated based upon predictive performance as evidenced by empirical calibration and validation. All aspects of monitoring, from the selection or development of methodologies to data management and evaluation, will be accomplished with advise and review by the technical teams. The San Francisco Estuary Institute (SFEI) will provide monitoring coordination between this project and the Regional Monitoring Program for Trace Substances, the in-bay hydrodynamics studies and sediment transport studies of the US GS, the Grasslands Bypass Project, the Regional Wetlands Ecosystem Goals Project, the emerging Regional Wetlands Management Plan of the San Francisco Estuary Project, and the proposed watershed assessments for Sonoma Creek, Petaluma River, and Napa River.

G. Implementability: This project will provide scientific information to aid restoration design and impact assessment for projects throughout the Bay-Delta system. With specific regard to the Napa-Sonoma Marsh Complex, the project will provide the information and planning necessary to receive all permits for the conversion of salt ponds into tidal marshes. The targeted lands are owned by the CDFG; no land acquisition or easements are anticipated. Other than the needed scientific information that this project will provide, no major obstacles to implement restoration are apparent at this time. The resulting restoration will be sensitive to climatic and hydrologic change because natural habitat controls will be emphasized in restoration design.

IV. Costs and Schedule to Implement Proposed Project

A. Budget Costs: The total budget for this project is $1,317,502 over 3 years. Based upon government salaries, cost-sharing programs, and existing equipment and materials that will be dedicated to this project, the total value of matching funds and in-kind services is about $1,255,000.

The proposed project consists of 11 inter-related major tasks and reporting over 3 years. The cost of contract administration is distributed among these tasks. If CALFED funding must be incremental, then the increments should be based upon tasks, not years. For example, baseline studies (tasks 1-8), protocol development (task 9) and numerical modeling (task 10) represent logical increments of the proposed work. Partial funding for numerical modeling might be available through the feasibility study phase of the US COE Napa River Salt Marsh Restoration Project Study. But this is an uncertain contingency at this time.

The participants in the Napa-Sonoma Marsh Complex Restoration Committee have been assembled through multi-agency efforts to provide the desired technical products and review for this project. It is expected that the applicant agency, the California Coastal Conservancy, will sole-source to the Committee members to accomplish the work designed by the Committee. Any sub-contracting through any of the participants will follow from Committee concurrence, and will be accomplished according to state contracting procedures.

Task	Year	Direct Labor Hours	Direct Salary and Benefits	Overhead Labor	Service Contracts	Material and Acquisition Contracts	Miscel. and Other Direct Costs	Total Cost
	1	556	20,000	10,495		20,400	2,000	52,895
1	2	126	5,264	2,725				7,989
	3	126	5,264	2,725				7,989
	1	362	15,892	10,320			250	26,462
2	2	262	9,957	7,481			250	17,688
	3	232	9,242	7,454			100	16,796
	1	306	12,693	5,668				18,361
3	2	102	4,044	1,947				5,991
	3	102	4,044	1,947				5,991
	1	2157	34,600	3,460	22,400	4,000	6,000	70,460
4	2							
	3	240	5,200	520				5,720
	1	1450	28,497	30,640		21,300	15,536	95,973
5	2	1507	31,264	31,872		11,500	21,538	96,174
	3	360	7,796	720		11,200	9,888	29,604
	1	2050	36,000	8,790		1,000	7,490	53,280
6	2	2000	35,000	8,500		500	5,500	49,500
	3	1500	25,000	5,600		500	3,588	34,688
	1					21,483		21,483
7	2					2,000		2,000
	3					2,000		2,000
	1	718	13,356	6,254		750	229	20,589
8	2	1455	29,531	16,100		750	752	47,133
	3	1535	34,479	20,519		750	958	56,706
	1	1200	23,000	6,340	2,000	500	5,500	37,340
9	2	1500	27,500	7,150		500	5,500	40,650
	3	1550	28,500	7,440		500	6,000	42,440
	1	1574	44,023	24,656		750	2,000	71,429
10	2	2142	51,880	21,967		750	2,000	76,597
	3	2650	63,823	29,105		750	2,000	95,678
	1	918	33,007	14,748			5,750	53,502
11	2	1148	37,729	16,003			6,870	60,602
	3	1725	57,625	27,917			8,250	93,792

B. Schedule Milestones: Assuming that CALFED funding begins in November 1997, and given the existing schedule for field work and mapping that has already begun through other projects, then the following schedule of major milestones is reasonable.

Task	Major Milestone	Date	
		Start	Finish
1	Acquire and register aerial photography.	11-97	11-97
1	Transfer basemap to participants.	12-97	1-98
2	Form technical teams and set team work schedules.	11-97	12-97
3	Compile existing local information on priority habitats and species.	12-97	2-98
3	Refine objectives for management and monitoring.	12-97	2-98
4	Establish tidal benchmarks.	2-98	4-98
4	Measure cross-sections relative to tidal datums.	4-98	6-98
4	Characterize diked baylands topography relative to tidal datums.	4-98	6-98
5	Measure hydrodynamics and sediment transport for high flow conditions.	11-97	2-98
8	Measure hydrodynamics and sediment transport for low-flow conditions.	8-98	11-98
6	Measure habitat support functions for priority bird species.	3-98	3-00
6	Measure habitat support functions for priority fish species.	4-98	4-00
7	Characterize salt pond water and sediment quality.	2-98	2-00
8	Analyze hydrodymanic and sediment transport data.	11-97	11-99
8	Develop conceptual model of salt pond breech effects on tidal hydrodynamics, sediment transport, and tidal salinity.	11-97	11-98
9	Develop monitoring protocols for tidal marsh habitat.	6-98	10-98
9	Develop monitoring protocols for priority bird species.	3-99	9-00
9	Develop monitoring protocols for priority fish species.	4-99	9-00
10	Select/develop numerical model(s) for hydrodynamics and sediment transport.	8-98	6-99
10	Calibrate and validate numerical model(s) for hydrodynamics and sediment transport.	6-99	6-00
10	Transfer numerical model(s) for hydrodynamics and sediment transport to local and regional users.	6-00	9-00
11	Produce progress reports among technical teams and to CALFED	11-97	11-00
11	Produce completion report and recommendations.	9-00	11-00

C. Third Party Impacts: There will be no direct third party impacts from this proposed project.

V. Applicant Qualifications: The Coastal Conservancy was created by the Legislature in 1976 as a unique entity with flexible powers to work in partnership with public agencies and non-profit organizations to protect and preserve coastal resources. With an annual budget of $8 million, the Conservancy has undertaken more than 640 projects along the coast and for San Francisco Bay. It has helped to preserve more than 32,700 acres in wetlands, wildlife habitat, dunes, and farmland; and it has enhanced tidal and freshwater wetlands, coastal streams, and watersheds. The Conservancy has a full-time staff of 43, including legal assistants, contract specialists, and a grants coordinator.

Planned Organization of Staff and Other Resources:

This project will be conducted by the Napa-Sonoma Marsh Complex Restoration Committee. The committee consists of scientists and managers from academia, wetlands protection agencies, the private sector, and non-governmental organizations who have been meeting since fall 1996 to develop this project. Staffing for this project will consist of administrative and technical teams that report to the committee, with committee members serving as team leaders. Funding for project participants will be allocated by the project applicant, who will be ultimately responsible for products and deliverables to CALFED. The implementation team will work closely with the project applicant to help provide inter-agency coordination and support. The science coordinator

(SFEI) will work with the technical team leaders to coordinate tasking and the transfer of science and technology among the technical teams. The science coordinator will also plan and conduct inter-team meetings and will provide quarterly progress reports to the Napa-Sonoma Marsh Complex Restoration Committee.

Biosketches and Project Responsibilities:

Technical team leaders have been recruited except for the Fish Team. Candidate leaders for the fish team have conferred with SFEI on cost estimates for fish monitoring protocols, but selection of a fish team leader depends upon acceptance of this proposal.

Nadine Hitchcock will co-lead the implementation team and she will serve as the technical and financial contact person for the applicant agency. She is an environmental planner with over 12 years experience as a project manager with the Coastal Conservancy, and 5 previous years experience with the Coast Commission. She has managed several large-scale projects involving multiple agencies and nonprofit organizations to acquire lands, preserve agriculture, and plan restoration of wetlands and other habitats. She is the contract manager for the Conservancy's hydrologic and biologic retainer contract, and she is project manager for the US COE Napa Salt marsh Restoration Feasibility Study, the Lower Napa River Enhancement and Public Access Plan, and the Napa River Reach II Enhancement Plan.

Paul Jones will co-lead the implementation team. He will help provide inter-agency coordination of wetlands projects and programs in the study area. He is a wetlands scientist and planner with Region 9 of the U. S. Environmental Protection Agency. He has been a part of EPA wetland staff in permits, enforcement, or planning for over 7 years. He is co-author of the Regional Monitoring Strategy, an appendix to the Comprehensive Conservation and Management Plan, for the San Francisco Estuary Project. He received a Master's degree in Ecology and Systematics and a BS in marine sciences from San Francisco State University. As the EPA North Bay coordinator for the past 2 years for EPA, he has worked on a variety of wetland regulatory and planning issues in the Napa-Sonoma area.

Joshua N. Collins, Ph.D., will be the science coordinator among the technical teams. He is an environmental scientists with the San Francisco Estuary Institute, where he leads the programs in wetlands and watersheds. He is the science coordinator for the Bay Area Wetlands Ecosystem Goals Project, and lead author of the Bay Area Watersheds Science Plan. His scientific publications include refereed papers and reports on the evolution and natural maintenance of tidal marshlands, the ecology of perennial and seasonal palustrine wetlands, mosquito control, and environmental planning.

David Schoellhamer, Ph.D., will co-lead the hydro-geomorphology team. He is a research hydrologist with the US Geological Survey. His recent publications center on sediment transport studies in San Francisco Bay in cooperation with the San Francisco Regional Water Quality Control Board, US Army Corps of Engineers, Regional Monitoring Program for Trace Substances, and the Interagency Ecological Program. Many publications and technical presentations have resulted from this work.

Vincent Neary, Ph.D., will co-lead the modeling team. He is hydraulic engineer with Philip Williams & Associates specializing in numerical and physical modeling of flow and sediment processes in rivers and estuaries, and he has a theoretical background in unsteady flow modeling, sediment transport dynamics, and open channel hydraulics. His recent work has focused on floodplain and tidal marsh restoration of the Napa River.

Geoffrey Schladow, Ph.D., will co-lead the modeling and hydro-geomorphology teams. He is an Associate Professor of Water Resources and Environmental Engineering at UC Davis. He has extensive experience in modeling and measuring flow and water quality in salt- and temperature-stratified hydrological systems. His recent research includes measurement and modeling in the Napa River, Sacramento River, Clear Lake, Whiskeytown Reservoir, Lake Tahoe and the Salton Sea.

Jon Burau will co-lead the modeling team with special regard for integration with numerical models of estuarine rivers and bays. He is completing his doctorate in estuarine hydrodynamics at Stanford University. He has been instrumental in the construction of applied computer models for the Bay-Delta system in cooperation with the California Department of Water Resources, California Water Resources Control Board, and U.S. Bureau of Reclamation. He was a principal investigator for the Entrapment Zone Studies for the Inter-agency Ecological Program (IEP).

Nadav Nur, Ph.D., will co-lead the avian resources team. He is population ecologist for the Point Reyes Bird Observatory (PRBO), and an Adjunct Professor of Biology at San Francisco State University. His scientific publications include a monograph on statistical analysis and design for avian population monitoring, and a variety of governmental reports on avian habitat and populations in the Bay-Delta system. The PRBO is a primary source of regional avian field science for terrestrial as well as aquatic birds.

Larry Wyckoff will co-lead the hydro-geomorphic team, with regard to physical characterization of the salt ponds. He is an Associate Wildlife Biologist for the Napa-Sonoma Marshes Wildlife Area with Region 3 of the CA Dept. Of Fish and Game. He has been with the CDFG for 10 years. Mr. Wyckoff will be assisted by Tom Huffman who is a Fish and Wildlife Assistant for the Napa-Sonoma Marshes Wildlife Area of the CDFG. The team will be further assisted during years 1 and 2 by 4 Scientific Aides.

Zoltan Der is an environmental researcher with the San Francisco Estuary Institute, where he supervises GIS operations. He has five years experience in digital cartography and GIS tools and applications, including geo-rectification of aerial photography. He is well versed in a variety of GIS software, including MapInfo, ArcInfo, and component modules for vector- and rastor-based imaging and mappings.

Robert Zlomke will co-lead the hydro-geomorphology team for Napa River tidal slough cross sections and elevations. He will also work with the Modeling Team for integration with numerical modeling of the Napa River Watershed. He is a modeling and GIS specialist with the Napa County Resource Conservation District. As the technical coordinator for the Napa River Survey, he has trained volunteer surveyors and he has developed computer applications for data entry and formatting. Working with Vince Neary, he developed the Phase 1 Napa Model using Mike 11 software.

Paul Sheffer will co-lead the hydro-geomorphology team for Sonoma Creek tidal slough cross sections and tidal elevations. He is a soil conservationist (retired) with the Marin County and Southern Sonoma County Resource Conservation Districts. He has 30 years experience with agricultural land management and field science in the North Bay area.

VI. Compliance with Standard Terms and Conditions: The terms and conditions of the ERPP are agreeable to the project applicant and the project participants. Please see the attached forms.

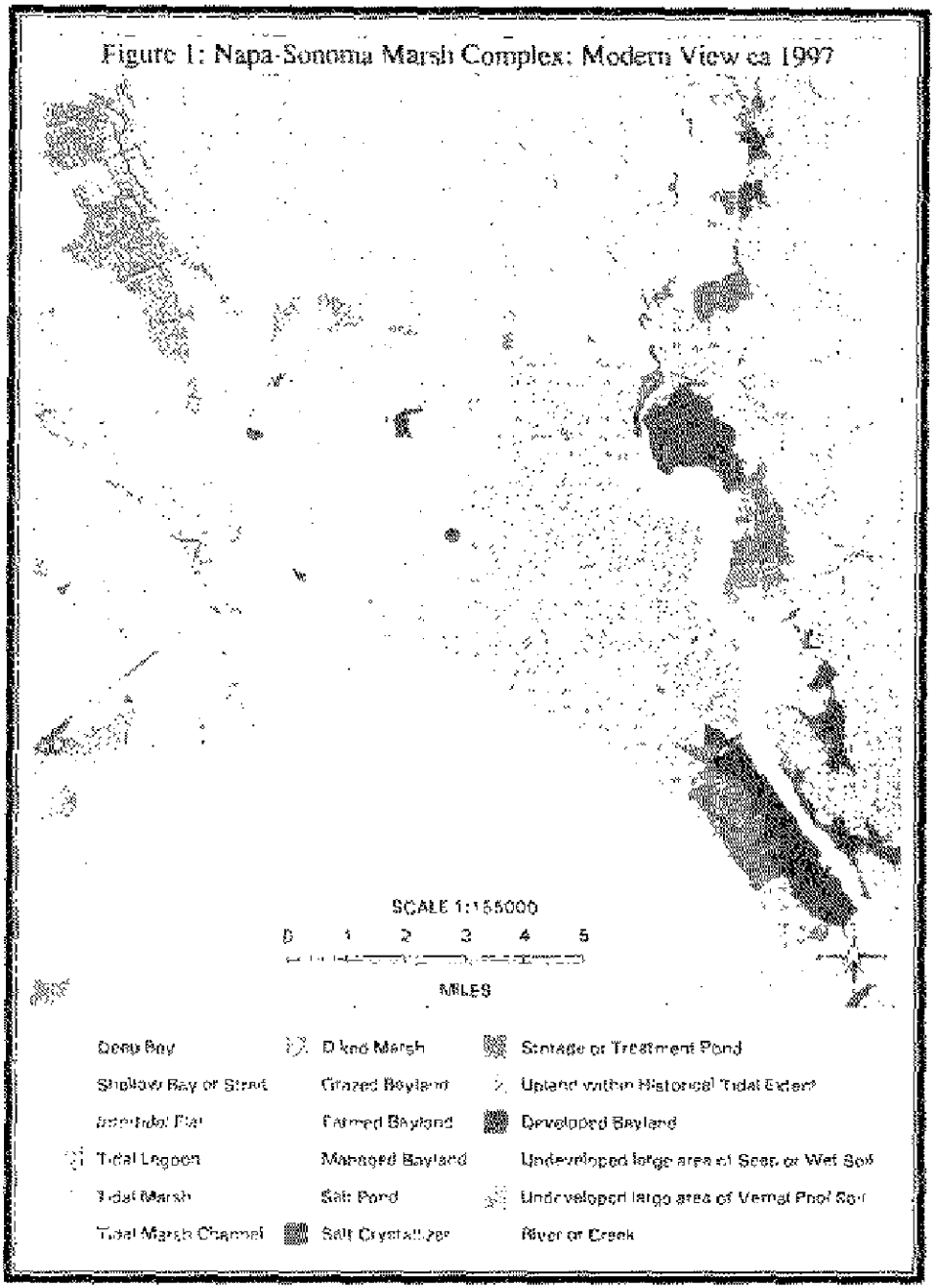


Figure 1: Napa-Sonoma Marsh Complex: Modern View ca 1997
SCALE 1:155000
0 1 2 3 4 5
MILES
Deep Bay
Shallow Bay or Strait
Intertidal Flat
Tidal Lagoon
Tidal Marsh
Tidal Marsh Channel
Diked Marsh
Grazed Baylend
Farmed Baylend
Managed Baylend
Salt Pond
Salt Crystallizer
Storage or Treatment Pond
Upland within Historical Tidal Extent
Developed Baylend
Undeveloped large area of Seas or Wet Soil
Undeveloped large area of Vernal Pool Soil
River or Creek

I-003057

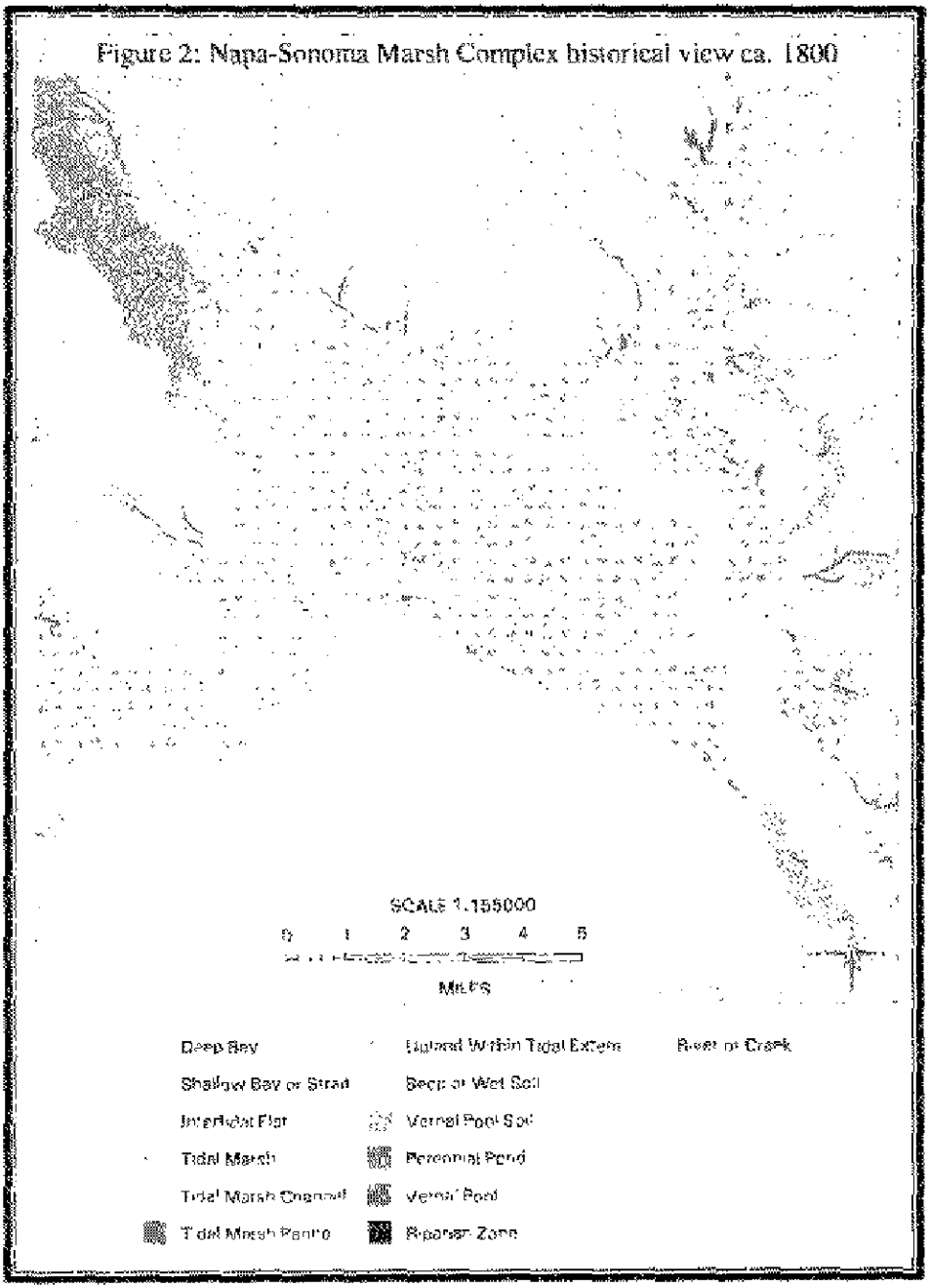


Figure 2: Napa-Sonoma Marsh Complex historical view ca. 1800
SCALE 1:155000
0 1 2 3 4 5
MILES
Deep Bay
Shallow Bay or Strait
Intertidal Flat
Tidal Marsh
Tidal Marsh Channel
Tidal Marsh Ponds
Upland Within Tidal Extent
Bed or Wet Soil
Vernal Pool Soil
Perennial Pond
Vernal Pond
Riparian Zone
River or Creek

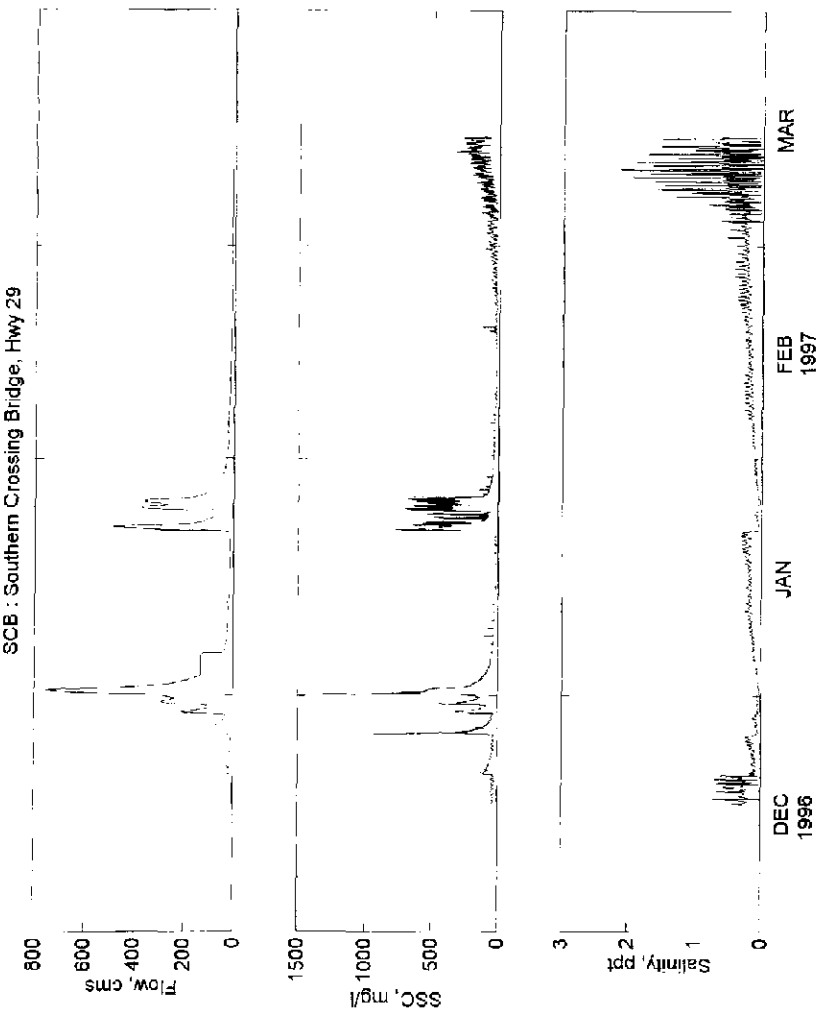


Figure 3: Flow, suspended solids concentration (SSC), and salinity data from an upstream tidal reach of the Napa River.

I-003059

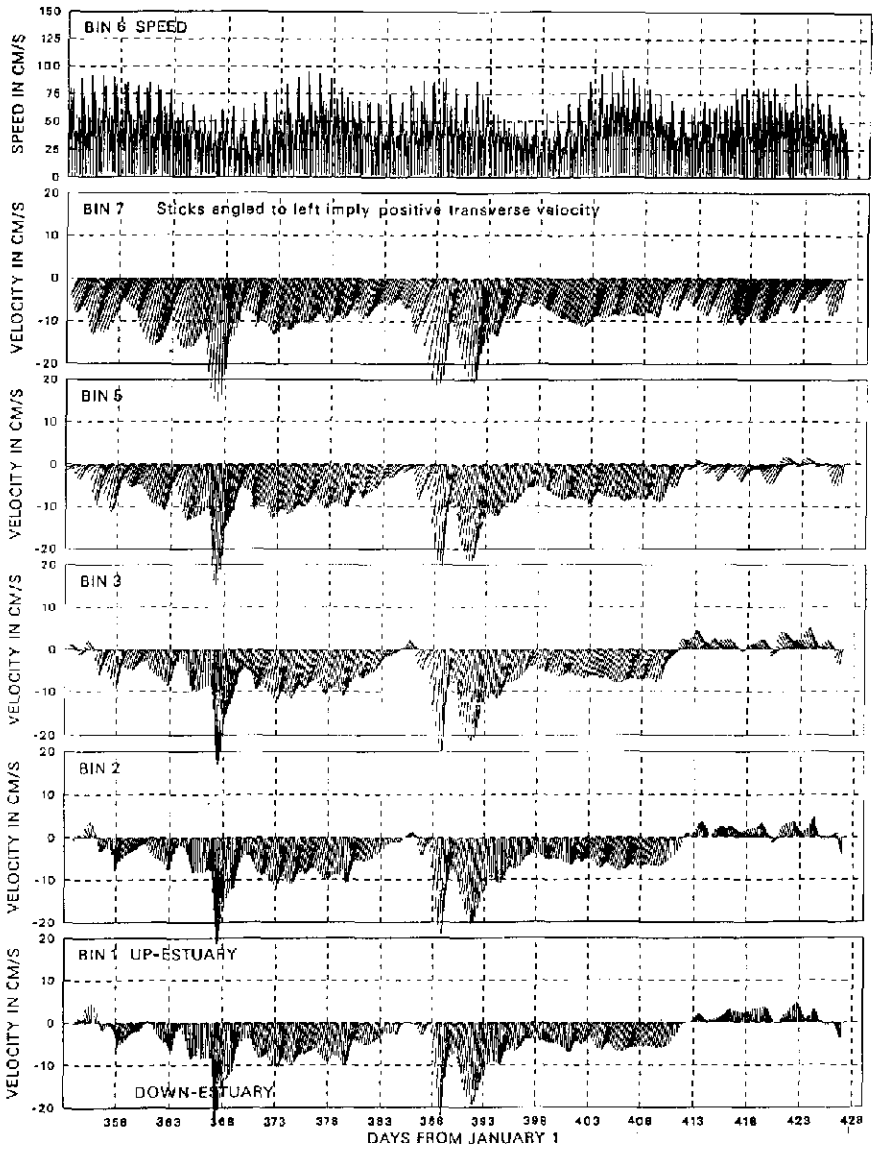
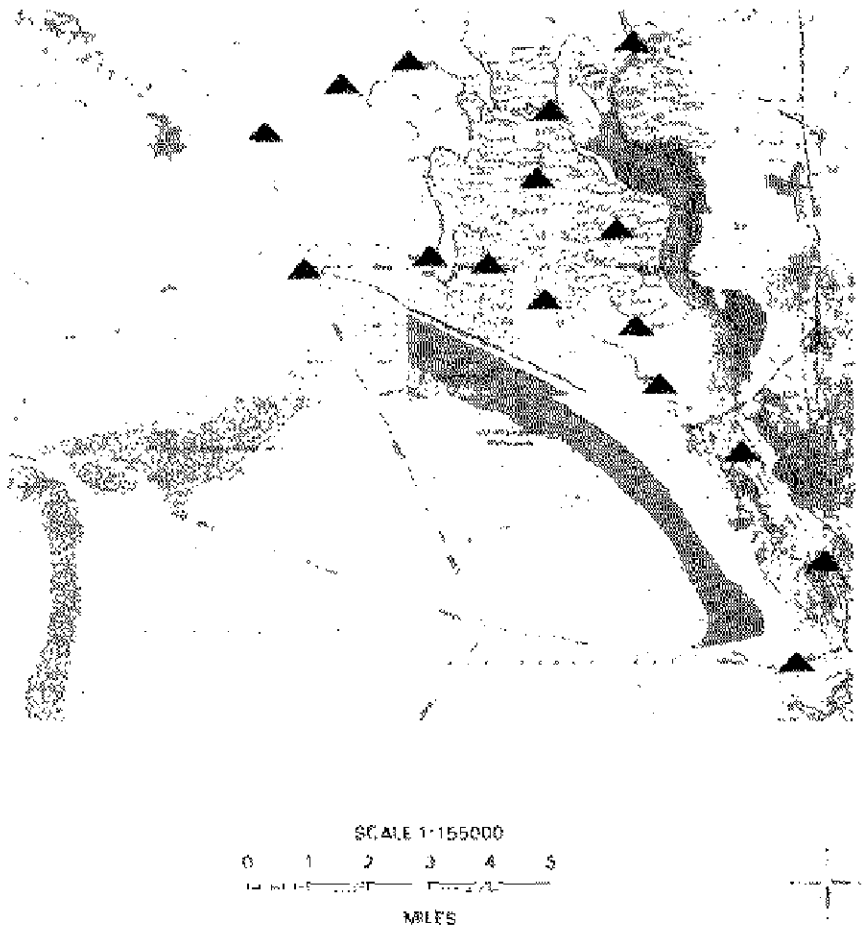


Figure 4: Residual velocity data from a downstream tidal reach of the Napa River (15 Dec 1996 - 3 March 1997)

Figure 5: 16 fixed hydrological stations



Coastal Conservancy

DATE: July 25, 1997

TO: CalFed Bay-Delta Program

FROM: Marcia Grimm
Senior Staff Counsel

RE: Coastal Conservancy Compliance with Contractual Terms and Conditions

I have reviewed relevant provisions of the CalFed Bay-Delta Program's 1997 Category III Request for Proposals for Ecosystem Restoration Projects and Programs with respect to applications submitted by the State Coastal Conservancy, a California state agency. The Coastal Conservancy is agreeable to, and able to comply with, terms and conditions included in Attachment D of the Request for Proposal except as follows: (1) the Conservancy would revise or exclude Paragraph 9 in the "Attachment D Terms and Conditions", requiring it to indemnify, defend and save harmless the State because the Conservancy is itself an agency of the State. (2) The Conservancy would exclude Paragraph 10 in the "Attachment D Terms and Conditions", because agents and employees of the Conservancy are, in fact, officers and employees or agents of the State of California.

The provisions included under "Standard Clauses - Contracts with Public Entities" and "Standard Clauses - Interagency Agreements" are acceptable to the Coastal Conservancy, and we are able to comply with all of their provisions.

1330 Broadway, 11th Floor
Oakland, California 94612-2530
510-286-1015 Fax: 510-286-0470

I-003062