Project Information

2005 Proposal Number: 0062

Proposal Title: **Sustaining Private Seasonal Wetland Habitat Value and Function Under Ag Waiver Mandated Salt Management**

Applicant Organization Name: **University of California, Merced**

Total Amount Requested: $**1,492,107**

ERP Region: San Joaquin Region

Short Description

This project seeks to implement real−time water quality management on two duck clubs in the Grasslands Water District.

Executive Summary

This proposal is a continuation of two previously funded concept studies – the first started under the CALFED Ecosystem Restoration Program with the Grassland Water District (Contract No. ERP−00−B05) and the second with the Fish and Wildlife Service in the federal San Luis National Wildlife Refuge (DWR−DWP Contract No. 4600001642). These projects laid the theoretical ground work for the application of real−time water quality management to seasonal wetlands, developed a network of real−time water quality monitoring stations, enhanced the capability of remote sensing technologies for moist soil plant recognition and for the assessment of the long−term impact of salinity management actions. A recently funded State Water Resources Control Board project, directed by the Grassland Water District will move into implementation of these concepts on paired seasonal wetland units within the Grassland Ecological Area. The proposed small−scale implementation project complements and will cost share with the proposed project, should it be funded – expanding the paired wetland study to the scale of individual duck clubs. Unlike the State and Federal refuges, private duck clubs are

managed more closely to irrigated agriculture with hunting success substituting for crop yield and wetland biologists for irrigators – all answerable to boards of directors. Successful long-term implementation of the concept of real-time wetland water quality management depends on the success of technology transfer to these private wetland entities. Two private duck clubs, one in the southern division of Grassland Water District, the other in the northern division will be the hosts of the study. Comprehensive flow and salinity monitoring of all inputs and exports to these clubs will be conducted using state-of-the-art instrumentation. We will work with these landowners to make sure the monitoring designs are appropriate to the aesthetics of each club. Water and salinity balances will be developed for each wetland unit within each duck club. Wetland soil and moist soil vegetation assessment technologies, developed in the previous projects will be deployed each year to measure impacts of real-time salinity management actions on long-term habitat health and function.

Sustaining Private Seasonal Wetland Habitat Value and Function Under Ag Waiver Mandated Salt Management

CALFED Ecosystem Restoration Program

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In cooperation with :

Grassland Water District

Department of Fish and Game

Department of Water Resources

US Bureau of Reclamation

December 10, 2005

Title: Sustaining Private Seasonal Wetland Habitat Value and Function Under Ag Waiver Mandated Salt Management

1. Project justification

Restoration and improvement of seasonal wetlands in the Bay-Delta ecosystem is an important objective of the overall Bay-Delta Plan (CBDA 2003a). Since its creation, the California Bay-Delta Authority (CBDA) has provided funding for 39,000 acres of habitat restoration, including 9,500 acres for shallow water and marsh habitat (CBDA 2003a). Unlike wetlands used for wastewater treatment which remove contaminants and yield return flows of significantly improved water quality, the use of seasonal wetland habitat by over-wintering waterfowl and shorebirds degrades the water supply delivered to private duck clubs, State and Federal Refuges from the Delta, returning surface drainage with elevated salts, carbon and nutrients loads. This degradation results from bird use, the life cycle of other biota and invertebrates, decaying aquatic vegetation, wind-blown sediment and the natural processes of evaporation and plant evapotranspiration.

The California Regional Water Quality Control Board (CRWQCB) has classified the Lower San Joaquin River as an impaired water body and has developed a Regional Drainage Water Disposal Plan for the Lower San Joaquin River Basin to encourage compliance with water quality objectives through reductions in drainage volumes and pollutant loads through best management practices. The CRWQCB adopted a quantitative control plan to encourage a watershed approach to salt and boron management within the Basin, recognizing the variety of different contributing sources and the need for cooperative solutions to the problem. As such, the CRWQCB applied the same requirements of salt and boron load management to managed wetlands as is has to agricultural drainage return flows. Agriculture has had more than a decade to adapt to drainage constraints since the Kesterson crisis placed the first restrictions on agricultural return flows in 1985. Managed wetland on the other hand have been single-minded in their quest for a firm water supply and have paid little attention to the salt and boron contributed to the San Joaquin River – until relatively recently there has been no routine monitoring of these constituents during wetland drawdown. Adoption of a salt and boron TMDL by the CRWQCB has created concern among wetland managers - in particular the potential negative impact of changed management practices on wetland habitat and the biological resource – and has stimulated interest in alternatives to traditional TMDL's, such as real-time water quality management. This innovative approach to salt and boron management, which takes advantage of San Joaquin River assimilative capacity and permits greater average annual salt and boron loads while meeting concentration objectives, has been encouraged by CRWQCB staff.

This proposal is a continuation of two previously funded concept studies – the first started under the CALFED Ecosystem Restoration Program with the Grassland Water District (Contract No. ERP-00-B05) and the second with the Fish and Wildlife Service in the federal San Luis National Wildlife Refuge (DWR-DWP Contract No. 4600001642). These projects laid the theoretical ground work for the application of real-time water quality management to seasonal wetlands, developed a network of real-time water quality monitoring stations, enhanced the capability of remote sensing technologies for moist soil plant recognition and for the assessment of the long-term impact of salinity management actions. A recently funded State Water Resources Control Board project, directed by the Grassland Water District will move into implementation of these concepts on paired seasonal wetland units within the Grassland Ecological Area. The proposed small-scale implementation project complements and will cost share with the proposed project, should it be funded – expanding the paired wetland study to the scale of individual duck clubs. Unlike the State and Federal refuges, private duck clubs are managed more closely to irrigated agriculture with hunting success substituting for crop yield and wetland biologists for irrigators – all answerable to boards of directors. Unlike publicly-held wildlife

refuges where decision making is centralized – each private duck club in the Grassland Water District has its own Board of Directors – and there are 160 private duck clubs in the Grassland Water District. It is obvious that successful long-term implementation of the concept of real-time wetland water quality management depends on the success of technology transfer to the private wetland entities.

2. Conceptual Model

The central hypothesis that underpins this proposed Ecosystem Restoration Program study is that adoption of wetland best management practices for real-time water quality management is constrained by lack of information and lack of highly visible exemplars as to how this technology might be applied cost-effectively and with measurable impact on water quality in the San Joaquin River. This project will test this hypothesis by implementing real-time water quality management on two well managed and highly visible duck clubs in the Grassland Water District. One club will be located in the Southern Division of the District, which in the past was the recipient of selenium tainted agricultural subsurface drainage water and where land is uniformly salt-affected and another club in the Northern Division of the Grassland Water District, which has received and continues to receive better quality agricultural return flows and which does not have the same history of salinization. State–of-the-art, robust and simple-to-deploy technologies will be installed in these clubs in a unique collaboration with a sensor manufacturer YSI Incorporated, which will use this project as its own California test-bed. Improvements to system hydraulics will be made at each duck club to allow the first scientifically defensible water and salt balances to be developed as part of this research and implementation project. A corollary of this central hypothesis is the supposition that the benefits of this research and the technology transfer that will ensue will exceed the costs to the environment of uncoordinated and unregulated wetland drainage discharge to the San Joaquin River during periods of inadequate assimilative capacity.

3. Water Quality Protection

The Porter-Cologne Act is the principal law that governs water quality regulation in California. It applies to agricultural drainage and wetland drainage alike - both point and non-point return flows. The California Regional Water Quality Control Board regulates these discharges through the issuance of NPDES and waste discharge requirement (WDR) permits (SWRCB, 2004). The WDR permits usually specify the allowable discharge concentration or load or the resulting condition of the receiving water. Water quality degradation in the San Joaquin River was first recognized by the SWRCB in the 1975 Basin Plan causing the Lower San Joaquin River to be designated a “Water Quality Limited Segment” (CRWQCB,2004). After the demise of the San Joaquin Basin “Master Drain” the CRWQCB put forth amendments to the Basin Plan recognizing that a regional solution, involving all contributors of salt within the Basin (including seasonal wetland entities), was needed for compliance with water quality objectives. The 1988/1989 amendment to the Basin plan emphasized drainage volume and contaminant load reduction as the primary means of meeting objectives.

Consistency with state and local water quality protection plans

Resolution No. R5-2004-0108, passed by the CRWQCB on September 10, 2004, further modified the Basin Plan to address persistent non-compliance with Lower San Joaquin River water quality objectives, not being addressed through voluntary adoption of irrigation and drainage Best Management Practices (BMP’s). In this resolution the CRWQCB declared its intention to actively participate in the San Joaquin River Management Program implementation phase, as authorized by AB 3048, and “to promote salinity management schemes including timed discharge releases, real-time monitoring and source control”. Implementation of timed and coordinated discharge releases and real-time monitoring is the major thrust of this project proposal.

Project implementation coordination with local watershed groups

The Waste Discharge Requirement (WDR) was the primary control program chosen by the CRWQCB for the Grassland subarea, a drainage area of approximately 1,370 square miles which includes all areas draining into Mud Slough, Salt Slough and Los Banos Creek. The Grasslands subarea contains a mix of urban, agricultural, light industrial and wetland land uses. In the WDR salt load allocations were apportioned to the Grasslands subarea and the other geographic sub-areas of the Basin, according to a synthetic pre-development hydrology. However, a waiver of waste discharge requirements was granted provided the entity "participate in a Regional Board-approved, real-time management program" and adopt load targets described in a table provided with Attachment 1 of the Resolution. The CRWQCB further required the development of a real-time monitoring network that measured continuous flow and electrical conductivity (EC) using accepted practices and appropriate technologies. Compliance with the control program was to be measured by attainment of salt water quality objectives. This is consistent with the August 18, 2000 CalFed Programmatic Record of Decision which included a target concentration for river salinity at the Vernalis compliance monitoring station. Institutional arrangements to allocate salt loads within the Basin or to develop forecasts of San Joaquin River water quality, as an alternative to statutory real-time load limits were left to watershed groups such as the Westside San Joaquin Drainage Authority.

4. Environmental Compliance

This proposed project involves real-time monitoring and drainage management, which, in accordance with Section 15306 of the California Public Resources Code, has been determined to not result in serious or major disturbance to any environmental resource. A Categorical Exemption will be filed with the California State Clearinghouse to comply with CEQA. The lead agency for this project is not a Federal Agency and NEPA does not apply.

Since wetlands in the San Joaquin Valley are intensively managed, opportunities may exist to modify management practices to improve water quality. The results of this project could be used to develop best management practices (BMP) and a decision support system to assist wetland managers adjust the timing of salt loads delivered to the San Joaquin River during spring drawdown. Adaptive drainage management could, during dry and critically dry years reduce the frequency of violation of Vernalis salinity standards, improving environmental compliance in the Lower San Joaquin River. Full implementation of this concept may take 5-10 years and will require coordination of east-side reservoir releases, agricultural drainage and municipal discharges to ultimately be successful. The climate for moving ahead with an implementation proposal for wetland real-time drainage management could not come at a more opportune time with the convergence of watershed monitoring requirements, formation of watershed coalitions and need for information sharing across stakeholder groups. These initiatives are being driven by statutory requirements of the Agricultural Waiver program and the environmental compliance requirements of the salt and boron TMDL.

The technical salinity TMDL distributed for public comment in April 2002 (*http://www.swrcb.ca.gov/~rwqcb5/ programs/salt_boron/documents.html*) describes the option of real-time water quality management as a means of meeting CRWQCB objectives as follows:

"*...This option involves the identification or formation of an entity that would operate a real-time management program. This entity would be responsible for real-time forecasting and the allocation of loads among participating parties. The entity would also coordinate efforts to identify and implement salt and boron control efforts among participants with the goal of meeting the objectives set by the Board. Under this approach, the load limits allocated to this group of dischargers would vary depending on the assimilative capacity of the river…… Real-time management would involve the*

coordinated release of saline discharges at times when there is assimilative capacity and retention of the wastewater at other times. This has the potential of increasing the allowable discharges, which in turn could result in lower costs for waste management…….Salinity levels in the LSJR could be managed at a basin scale if a real-time management program capable of tracking and scheduling discharges was put into place. The Regional Board could encourage such a program by indicating that the one entity that operates the real-time program will receive the allocation of all assimilative capacity over a base-line amount. The base-line amount would be the load the river can carry in drought years while still meeting objectives..."

The proposed project provides a necessary first step to developing the wetland watershed coalition necessary to implement the scheme described above in the CRWCB preliminary TMDL planning document, recognizing the importance of private wetland compliance to ensure success.

4. Project Description

Wetlands in the San Joaquin Valley are intensively managed to produce standing crops of moist soil food plants and invertebrates with high value to wildlife, particularly waterfowl (CWA 2003). The majority of these wetlands are classified as seasonal and are generally flooded from September to April. The most important management parameters include the timing of the spring drawdown, the amount of soil disturbance, the rate of drawdown, timing and number of summer irrigations, the timing of fall flooding, and water depth (CWA 2003). This project is motivated by a desire by two major wetland entities in the San Joaquin Basin to proactively investigate the potential for adaptive real-time water quality management to respond to forecasts of short-term limited assimilative capacity for salt loads as measured at the Vernalis compliance monitoring station, hence providing benefit to farmers of the South Delta at a critical time of plant germination and saving the need for significant water quality release volumes from New Melones Reservoir to meet salinity objectives.

Project Location

The Grassland Water District is a 50,000 acre area to the north and south of the city of Los Banos on the west side of the San Joaquin Valley located within Merced County. The project area includes approximately 90 miles of wetland channels and is bounded by the Main Canal and Delta Mendota Canal to the west and the San Luis Drain to the east. Wetland drainage from the Grassland Water District is conveyed to the San Joaquin River through either Mud Slough (north) or Salt Slough. The Los Banos Wildlife Management Area is an area of approximately 14,000 acres located north and east of the City of Los Banos.

Project Linkage

This project takes advantage of the science developed during two previously funded CALFED real-time water quality projects in the San Luis National Wildlife Refuge (DWR-DWP Contract No. 4600001642) and in the Grassland Water District (Contract No. ERP-00-B05) and the experience gained on these projects in the monitoring of seasonally flooded wetlands. The project will complement a recently funded State Water Resources Control Board study by focusing on whole duck clubs, rather than just adjacent paired wetland units, and will develop techniques to improve water management for salinity drainage control for each duck club as a whole. This will be provide more practical salinity management decision support which is more likely to be adopted by non-project duck clubs. The results of this study will be of direct relevance to other TMDL efforts in the san Joaquin basin, inparticular the san Joaquin River Dissolved oxygen TMDL – where algal loads from the Basin are implicated in causing dissolved oxygen sag in the Deep Water Ship Channel. Significant algal loads and dissolved organic carbon are discharged from these seasonal wetlands of the grassland Ecological Area each year.

5. Project Detail

The proposed project will deploy a state-of-the-art telemetered monitoring system (YSI EcoNet) in two duck clubs targeted in this study. The difference between this study and allied projects that have preceded it - is that the intent of this project is to create exemplars of adaptive real-time wetland water quality management in two high visibility duck clubs, among the one hundred and sixty duck clubs in the Grassland Water District. High visibility is defined in terms of the potential technology transfer potential that this project might achieve. High visibility is related to the standing of the Club among its peers, the leadership members of the Club display in their professional lives and the influence a might have on the rest of the hunting community through such actions as: (a) adoption of state-of-the-art monitoring systems; (b) experimentation with innovative water conservation and drainage management practices; (c) use of new, highly accurate assessment technologies to quantify the areal-extent and food-value of existing bird habitat; and (d) development of cost-effective optimization strategies for habitat improvement, based on habitat maps and other information generated from (c) while helping to meeting Basin salinity management objectives. We assert that our partner in this proposal the Ducky Strike Duck Club, is a potent exemplar for the South Grassland Water District. In the initial stages of a funded project we will seek a similar partner in the North Grassland Water District.

The Salinas Duck Club in the Northern Division of GWD was a partner in the first wetland real-time water quality management project (Quinn et al, 2004). Their watermaster and wildlife biologist helped to develop initial work products such as the "Wetland Plant Guide – Quinn and Feldmann, 2005) and provided a test-bed for the development of a method for estimating the areal extent of various moist soil plants using multi-spectral remote sensing imagery. One of the members of the Salinas Club also publishes the "Grassland Today" newsletter – which was invaluable in disseminating the results of the two year study. We will partner with a Duck Club of similar "visibility" in the Grassland Water District northern division.

Real-time water quality management in the Grassland Ecological Area will only be possible and the goals of quasi-dynamic salinity TMDL's achieved, when the privately owned duck clubs collectively embrace the concept. They are more likely to embrace the concept of real-time water quality management when they understand the consequences of adoption, are clear that the benefits outweigh the costs and when provide technical and financial assistance to achieve some well defined long-term environmental objective.

Monitoring innovations

The YSI EcoNet system represents a breakthough in environmental monitoring by providing a straight-forward and inexpensive solution to data acquisition and visualization. One of the greatest and most often underestimated costs of monitoring are in data acquisition, data synthesis and quality control. Monitoring networks often fail because of weaknesses in these procedures. The YSI Econet system automates the data retrieval and allows easy customization of data reporting on the web – reducing by a factor of three or more the time normally taken with these tasks. This is performed at a relatively low cost. The system configuration allows fast set up times and data security. Sensors have improved significantly in performance and in unit cost in the past 5 years. Whereas in the past, projects such as the one described in this proposal, were confined to a few monitoring stations – the YSI-Econet system allows the type of intensive monitoring required for accurate water and salt balances. There are no scientifically defensible studies of water and salt balance in the seasonal wetlands of the San Joaquin Basin, save those attempted by the author of this proposal at a more macro scale (Quinn et. al., 2004).

Reporting the performance of innovative best management practices

This project will provide science-based tools for the management of salts in drainage discharges from two wetland entities draining into the SJR – from one duck club located in the south Grassland Water

District (Ducky Strike Duck Club) - the other, yet to be decided club, in the northern division of Grassland Water District. Choosing high-profile, representative Clubs in the northern and southern divisions of Grasslands is necessary because of the significant differences in conditions that exist with respect to residual soil salinity and long-term supply water quality. Residual soil salinity is a function of water supply history – these wetlands received the majority of their water supply from agricultural return flows until 1985 when selenium toxicity issues led to a moratorium on use of selenium contaminated drainage water – and drainage conditions. Management issues are sufficiently different that potential technology transfer is enhanced by having an exemplar in each area.

The proposed project will complement a recently funded SWRCB sponsored study, which has selected pairs of wetlands in the State wildlife areas (two sites) and two private duck clubs (the Ducky Strike Duck Club will be shared by both projects) and will compare adaptively managed and traditional practices. The proposed project will provide more scientific rigor to the SWRCB study by increasing inflow – outflow monitoring within a single duck club, replacing inadequate structures with more accurate and reliable flow measurement structures and financing certain land improvements that will improve the ability to manage soil salinity more efficiently and cost-effectively. One of the major goals of the SWRCB study is to observe and measure, quantitatively, the short and long-term impacts of delayed drawdown on drainage water quality, and moist soil plant habitat. The project will also infer quantitative measures of the potential impacts of wide scale emulation of the project actions on the timing of salt loading to the San Joaquin River. Analysis of water quality violations at the Vernalis compliance monitoring station will provide the means of estimating the project benefits in terms of a reduction in violation frequency. If additional New Melones reservoir releases were needed to dilute excess load during a time of excessive wetland drainage the load reduction benefit can be measured in terms of dilution volume saved in New Melones Reservoir.

Environmental and economic impacts of proposed project including mitigation

A concern that has been expressed by the State and Federal wildlife agencies with respect to real-time water quality management and delayed wetland drawdown is the possibility of long-term damage to the ecological resource in the wetland complex caused by soil salinization and propogation of undesirable moist soil plants through sub-optimal irrigation and drainage scheduling. Changing the scheduling of wetland drainage to the San Joaquin River affects the timing and rate of drawdown of wetland ponds and hence the forage value of the wetlands for migrating and wintering shorebirds and waterfowl. Wetland salinity management measures can also affect the productivity and diversity of vegetation that can be grown in the watershed. A rapid waterfowl habitat assessment protocol, using a combination of remote sensing and wetland soil salinity mapping, has been developed in the previous study (Quinn et al. 2004) to assess changes in waterfowl habitat value over time. Biological and ecological monitoring are necessary to document the effects of changing traditional flood-up and wetland drainage discharge patterns on wetland habitat (i.e., moist-soil plant production and water bird usage). Data developed in the monitoring program proposed in this study at two representative duck clubs will help wetland managers design adaptive management approaches to optimize wetland habitat conditions while minimizing the negative effects of wetland drainage on the water quality in the San Joaquin River.

6. Project Tasks

Task 1: Project Administration

This project will be managed and administered by the University of California, Merced. The University of California, Merced will develop subcontracts with Berkeley National Laboratory and local contractors to perform the heavy equipment earthmoving and installation of control structures necessary to fulfill the task assignments listed in the proposal at both duck clubs.

Deliverables : Submission of timely quarterly and annual reports to the CALFED Ecosystem Restoration Program.

Task 2: CEQA/NEPA Documentation

This proposed project involves only monitoring and research, and, in accordance with Section 15306 of the California Public Resources Code, has been determined to not result in serious or major disturbance to any environmental resource. A Categorical Exemption will be filed with the California State Clearinghouse to comply with CEQA. Similar exemptions apply to NEPA.

Deliverables : Completion and submission of necessary environmental documentation.

Task 3: Project Monitoring, PAEP and Data Quality Assurance Project Plan

A project assessment and evaluation plan (PAEP) and a quality assurance project plan (QAPP) will be developed alongside the project monitoring plan (PMP) according to SWRCB SWAMP guidelines and CalFed requirements and accepted scientific practice. Budget for QA/QC is included in Task 5. Peer Review of this project will be coordinated with CalFed, the CRWQCB and a representative from the Department of Fish and Game. It is expected that a review panel of at least three outside experts will be convened to review the project reports and activities.

Deliverables : Completion of QAPP. Annual letter reports from review panel

Task 4: Design and Implementation of Real-Time Water Quality Monitoring Network

The goal of this project is to develop exemplars of real-time water quality management in two high-visibility duck clubs in the Grassland Water District. The hydrologic budgets for each wetland impoundment in these duck clubs will be instrumented to allow a high resolution water and salt balance to be calculated for each impoundment. In this task we will conduct an initial reconnaissance to assess the needs for structural and non-structural monitoring upgrades at each site. This may require the replacement of existing structures, improvements to water district level monitoring at Club turnouts and the matching of monitoring equipment to site characteristics. A letter report (interim report 1) will be submitted to CALFED documenting the monitoring network design and specifications of the necessary upgrades to the current water delivery and wetland drainage system will be presented in detail.

The monitoring system hardware has already been selected and will follow the lead of a recently funded State Water Resource Control Board drainage study, by installing the YSI EcoNet system. This state-of-the-art environmental monitoring system will provide data to a project website, updated hourly. All inflows and outflows to each selected duck club will be instrumented. Each monitored site will be equipped with state-of-the art stage, EC and acoustic velocity sensors. The website will include links to CIMIS and other State CDEC climate data allowing data feeds into a wetland simulation model.

Field installations of monitoring stations will be supervised by Quinn at UC Merced. Maintenance of the stations after installation will be undertaken by staff from the University of Merced with assistance from the duck clubs and Grassland Water District. Real-time data protocols for the new monitoring sites will follow those developed for the CALFED - sponsored Grassland WD pilot real-time water quality management project, completed in September 2004. Real-time data will be validated according to procedures established in the project QAPP

Deliverables: Completion of field installations, interim design report, website postings of real-time flow and water quality data. Archived project data.

Task 5: Flow path, hydrodynamic flow-salinity studies using Roboduck

Each wetland will be internally monitored for electrical conductivity using roboduck technology, an advanced mobile sensor which will help to map water flow paths within each wetland unit, identify salinity "hot spots" and provide data to guide adaptive salt management in these wetland units. This project task will also address the issue of wetland short circuiting which creates zones of increasing salinity at greater distances from a nadir drawn between inlet and outlet. UC Merced in partnership with scientists at UCLA and Crossbow Technologies have developed a mobile sensor with an EC/temperature sensor, a GPS and a radio transmitter which can be mounted inside a decoy duck. These sensors will provide average salt concentrations within each wetland and allow the computation of real-time salt load.

A groundwater monitoring cluster well will be installed at each duck club site and tied into the surface water quality monitoring network. In addition shallow piezometers will also be installed to allow computation of wetland pond seepage and the dynamics of salt transfer across the sediment-water interface to become better understood.

Deliverables: Completion of field installations, interim design report, website postings of roboduck salinity maps, shallow and deep groundwater level data and estimated groundwater fluxes. Groundwater data input into a wetland hydrology and water quality model. Archived project data.

Task 6: Analysis and Reporting of Monitoring Data, Modeling, San Joaquin River Salinity Forecasts

Successful implementation of real-time salinity management in both wetland and agricultural subbasins will require the cooperation of stakeholders and the formation of a institutional entity to develop and allocate salt loads among those discharging to the San Joaquin River. Real-time data will be synthesized, analyzed and interpreted according to procedures established in the project PAEP. Project reporting will take advantage of opportunities for information dissemination such as community gatherings, wetland newsletters, annual field days (Wild on Wetlands) and traditional scientific outlets such as professional journals to provide technology transfer. The project will cooperate and coordinate actions with the Department of Water Resources San Joaquin District office, which is responsible for real-time salinity forecasts in the San Joaquin River. Short and longer term forecasts will be developed for each duck club and each wetland unit within each duck club, and communicated to the Department of Water Resources. In this way the project will attempt to lay the institutional groundwork for a Grassland Ecological Area-wide, real-time wetland drainage forecasting system.

A wetland water quality model will be developed following on from the spreadsheet model developed for the previous ERP Project (Quinn et. al., 2004), which was limited in its simulation success owing to lack of complete and accurate regional data. The focus of this study on single duck clubs and the intensive data collection contemplated will address many of the limitations of the 2004 ERP study.

The new model will be used for drainage flow and salt load forecasting in years 2 and 3 of the proposed project.

Deliverables: Data synthesis results and report on technology transfer activities in watershed prepared for annual reports. Model development and model results described and discussed in annual reports in years 2 and 3. Assessment of forecasts using models for each duck club and discussion of implications for Basin salinity management.

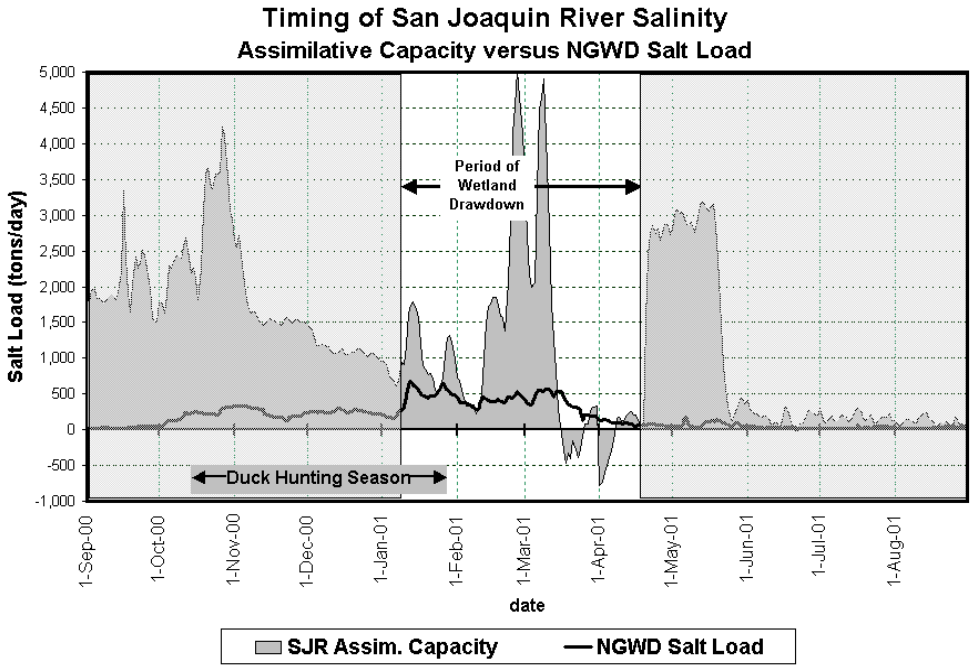

Figure 1. San Joaquin River assimilative capacity during period of wetland drawdown showing impacts on San Joaquin River water quality.

Task 7: Measuring Impacts of Delayed Drawdown and Real-Time Salinity Management

This task will consist of a series of field studies conducted during the winter when the wetlands are flooded. It is hypothesized that the water quality in the flooded wetlands will change over time as the water stands in the wetland and that the rate and amount of water quality change will differ in sections subject to different management practices. The null hypothesis is that water quality will not vary with time or management practice. Samples will be collected in designated management areas beginning at the termination of the flood-up period (when the wetlands are filled for the winter season).

Task 7.1: Moist Soil Plant Response Mapping using High Resolution Remote Sensing

Recent research at LBNL has demonstrated the ability of segmentation algorithms and high-end image processing software to discern populations of common moist soil plants from high resolution multispectral imagery. Three sets of satellite images for post drawdown periods in 2003 and 2004 were analyzed from sites in North Grassland Water District and the San Luis Nartional Wildlife Refuge. Two sets of images at different times post-drawdown will be purchased for the study sites and the above-mentioned techniques used to map moist-soil plant populations. This analysis will be repeated each year and desirable moist soil plant abundance mapped and compared over the three years of the study. Large areal extents of moist soil plants such as swamp timothy, watergrass and smartweed are indicative of optimal wetland habitat.

Task 7.2: Wetland Soil Salinity Mapping using Motorized EM Surveys

In 2003 and 2004 after wetland spring drawdown, soil salinity maps were developed for sites in the Salinas Duck Club in North Grassland WD and in the San Luis NWR. The technique uses a motorized ElectroMagnetic (EM) sensor, using techniques developed at the US Salinity Laboratory and commercialized at Fresno State University. These maps provide a means of

tracking a slow build-up of salt in surface soils over time – which can affect the abundance of desirable moist soil plants and hence may impact the biological health of these managed wetlands. Annual wetland salinity surveys will be conducted using the EM technique using a customized rig, capable of driving through each wetland management unit.

Deliverables: Maps of moist soil plant abundance for each of the wetland units at two times each year in each duck club. Annual surveys of shallow root zone salinity.

Task 8: Draft and Final Reports

At the project's completion, a final report will be prepared to document project completion and summarize the results of the project. The draft report will include the products of the tasks listed above and provide a brief introduction section, including a statement of purpose, the scope of the project, and a description of the approach and techniques used during the project, compliance with quality assurance, and the success of the project. The final report will address comments made by the Contract Manager on the draft report.

7. Project Effectiveness

The goals of this project are to take the first steps toward real-time management of wetland drawdown so as to limit salt loading to the San Joaquin River during times of limited assimilative capacity. This project represents a significant opportunity to implement sustainable water quality benefits in the region.

This project will compile data which will be used , by extrapolation, to simulate the collective water quality impact of the many different wetland management strategies being implemented in the region. Better understanding the complete water quality impacts of their management practices will allow the other duck clubs to evaluate the risks and benefits of changing management practices.

The information collected by the project will include continuous stage, temperature and salinity data within two duck clubs, practicing both traditional and adaptive drawdown practices for moist soil plant production. Project effectiveness will be measured by the ability of wetland managers to adhere to the altered wetland drawdown period and the consistency by which this target is met each year. A further measure of project effectiveness will be the willingness of other duck clubs as well as the state and federal wetland entities to follow the lead of these clubs and adopt similar management strategies.

Grassland Water District contains 160 separate duck clubs, land and cattle clubs and private land holdings – each with their own boards and management structure. Hence the District faces greater hurdles in developing a system that is equitable, easy to understand and that addresses the concerns of their constituency. State and federal refuges are relatively free to experiment with different management systems without fear or penalty.

Data for the project will be made available through the project website. The project database will be designed to adhere to SWAMP protocols and provide the requisite quality assurance documentation and metadata information allowing gainful sharing among peer duck clubs as well as the public agency and scientific community.

8. Project Schedule

The proposed project will have a three year duration with planning and installation of the flow and EC monitoring system and the refinement of the current wetland habitat water needs and salt accounting model occurring during year 1. Coordination of wetland drainage with a team similar in function to the SJRMP Water Quality subcommittee in both years 2 and 3 of the proposed project. The work

schedule is shown in the table below. Two progress reports and one final project report will be prepared summarizing the objectives accomplished during the year and results from monitoring activities in the two duck clubs. A number of workshops will be conducted to educate potential users of the EcoNet monitoring system and other evaluation and assessment tools covering topics such as : accessing data from the monitoring system, determining habitat water requirements, planning drainage release schedules and developing long-term best management practices for seasonal wetlands within individual duck clubs in the southern and northern divisions of Grassland Water District. The timeline assumes an June 1, 2006 project start date with a project term of three years (end date May 31, 2009).

Task No. Deliverables	**Target deliverable timeframe (June 1, 2006 start date assumed)**
TASK 1: Project Administration	
Quarterly Progress Reports	August 10, November 10, February 10, May 10, each year 2006-2006
TASK 2: CEQA Documentation	July 31, 2006
TASK 3: Project Monitoring, Quality Assurance and Project Evaluation and Assessment Plan	July 31, 2006
TASK 4: Design and Implementation of Real-Time Water Quality Monitoring Network	September 30, 2006
TASK 5: Flow path, hydrodynamic flow-salinity studies using Roboduck	Annual reports and quarterly progress reports, 2006, 2008, 2009
TASK 6: Analysis and Reporting of Monitoring Data, Modeling, San Joaquin River Salinity Forecasts	Annual reports and quarterly progress reports, 2006, 2008, 2009
TASK 7: Measuring impacts of delayed drawdown and real-time salinity management 8.1 Moist soil plant response mapping 8.2 Wetland soil salinity mapping	Annual reports and quarterly progress reports, 2006, 2008, 2009 March – June each year April – May each year
TASK 8: Draft and Final Reports Draft final report Final report	 March 31, 2009 April 30, 2009

8. Education and Outreach

Technology transfer, which is part of the outreach and education effort, is more difficult in the private wetland sector than for the State or Federal Refuges. In the case of the private Grassland Water District (an entity formed under the California Water Code to purchase Federal water supply and convey this water supply to its customers) this aspect will be particularly challenging. Fortunately there are a number of media and community events that focus on the variety of wetland activities in the surrounding private, state and federal lands centered around the City of Los Banos. Several on the project team have organized events and participated in many of these events in the past and will continue to take advantage of these opportunities. For real-time water quality management to be accepted and practiced by private, state and federal wetland managers a large amount of outreach and education will be needed.

The project publish will reports that will be made available to local landowners, duck club operators and managers of State and other Federal refuges in the San Joaquin Basin. Although this project will concentrate on the two duck club continuously monitored inlet and outlet sites, one of the goals of the project is to disseminate the findings of the project more widely. The Grassland Water District has a successful history of local involvement through the District newsletter, published monthly; high school and college-level educational outreach programs and through "Wild on Wetland" days which help to educate the public about the techniques of wetland management. These established communication outlets will be utilized to help disseminate information developed by the proposed project.

Deliverables: Reports, workshops, outreach programs and field demonstrations.

9. Costs and Financial Feasibility

The proposed project budget of $1,480,000 is presented below. Financial feasibility is somewhat well defined given that the principal investigator has been a leader in the development of the concept of real-time wetland water quality management and has more than 15 years of experience in the deployment of continuous monitoring systems in remote locations.

The project will gain cost-share support from a recently started SWRCB project, estimated at $19,000 in year 1 and $12,000 in years 2 and 3. In year 1 costs of monitoring in the Ducky Strike duck club will be shared by the two projects. Estimates for years two and three are based on in-kind services from Grassland Water District and Department of Fish and Game personnel.

10. Readiness to Proceed

The project is experimental in nature and hence is not subject to federal or state environmental regulation. Project goals have endorsed by the Board of the Ducky Strike Duck Club and approved by the General manager and Watermaster of the Grassland Water District. The project objectives are similar to those of the SWRCB project and have been endorsed by management at the Department of Fish and Game and have been discussed with the committee of the interagency Habitat Joint Venture – a consortium of wetland entities throughout the State of California.

Project partners are committed to the project for the three year term. The University of Merced campus is relatively close to the Grasslands Ecological Area and the University sees their involvement in this project as a significant opportunity for recruitment into their science programs from the immediate Central Valley community. Having students involved in real watershed problems can be a powerful force for change and environmental responsibility into the future. Our commercial vendor in this project has promised significant purchasing discounts on EcoNet system acquisition – also seeing the advantage of a high-visibility project in the San Joaquin Basin.

10. Project Participants and Qualifications

Lead Investigators

Nigel Quinn – Project Director, Geological Scientist, Berkeley National Laboratory

Nigel Quinn PhD, P.E. has been the Principal Investigator on a number of CALFED Ecosystem Restoration and Drinking Water Program Projects related to real-time water quality monitoring and the

development of real-time forecasting tools for the San Joaquin River and its contributing watersheds. He also has experience in selenium fate and transport modeling and bioremediation research projects. He has been affiliated with Lawrence Berkeley National Laboratory for the past 15 years and the University of California, Berkeley for the past three years. He is the author of over 50 publications and reports on various aspects of water resources and drainage engineering.

Daniel Nelson – Project co-Director, Landowner and Watermaster, Ducky Strike Duck Club

Daniel Nelson is the Executive Director of the San Luis and Delta Mendota Water Authority as well as the Watermaster and Director of the Ducky Strike Duck Club. He has extensive experience in west-side agriculture as former Manager of the Broadview Water District and later, the San Luis Water Districts in the San Joaquin Basin, prior to assuming leadership of the Authority. The Authority oversees operations and maintenance of US Bureau of Reclamation conveyance facilities in the San Joaquin Basin.

Project Team

Tom Harmon – Professor, University of California, Merced

Professor Harmon teaches hydrology and environmental monitoring design at UC Merced. He has extensive experience with embedded sensor networks and currently leads a component of the NSF funded CLEANER project – which is exploring innovative sensor deployment in a variety of environmental applications.

Lara Sparks – Field Investigator, Department of Fish and Game

Lara Sparks trained in avian sciences from the University of California, Davis. She has worked for the Department of Fish and Game as part of the biological staff on the Los Banos Wildlife Area. Her duties include conducting monitoring surveys on all avian species throughout the Grassland Wetlands, training new field staff on monitoring protocols, managing and analyzing data, and writing reports.

Ricardo Ortega - Field Investigator, Department of Fish and Game

Ricardo Ortega is a contract biologist with the California Department of Fish and Game San Joaquin Valley Resource Assessment Program. He has lead the vegetative inventory effort for the past two seasons in addition to filling a multi-taxonomic inventory and monitoring roll based out of Los Banos. He trained as a Wildlife Biologist at Cal Poly State University and has conducted research in restoration ecology, avian ecology, and vegetation assessments throughout Central California.

Jos Burns – GIS and Remote Sensing Specialist, Berkeley National Laboratory)

Josephine Burns is a Research Technician at Lawrence Berkeley National Laboratory. She has worked on diverse projects including ecological, geological, and transportation applications. Her current focus is to further the development of a remote sensing program that will evaluate changes in vegetation and other environmental indicators in response to varying wetland management techniques.

Project Collaborators

Don Marciochi – General Manager Grassland Water District

Don Marciochi has been employed by the Grassland Water District since October 1973 and has served as the District's General Manager since 1983. He led the District's efforts to secure a firm water supply by active participation in the development of the refuge provisions of CVPIA and similarly was involved in bringing about the implementation of projects to remove selenium contaminated drainwater from the District's water supply.

Scott Lower – Water Superintendent, Grassland Water District

Scott Lower is the water master for the Grassland Water District where he has worked since 1983. Scott's duties at the Water District involve managing the water distribution system within Grassland Water District, accounting for water deliveries to Water District contractors and overseeing the District's monitoring program.

John Beam - Project co-Director, Department of Fish and Game

John Beam is a Supervisory Biologist with the California Department of Fish and Game stationed in Los Banos. He was previously the Refuge Manager for the Los Banos and Volta Wildlife Management Areas that comprise the major State wetland resource in the Grasslands Ecological Area. He trained as a Resource Biologist an Humbolt State University and did graduate work at UC Davis.

William Cook- Refuge Manager, Department of Fish and Game

William Cook has been the Refuge Manager for the Los Banos and Volta Wildlife Management Areas within in the Grasslands Ecological Area since 2000. He trained in Wildlife Management from Cal Poly State University and has 20 years of experience in the areas of wetland management, wetland restoration, and water management throughout the Grassland Ecological Area.

11. References

1. **Quinn N.W.T. and K.C. Jacobs 2005**. An Emergency Environmental Response System to Protect Migrating Salmon in the Lower San Joaquin River. *Accepted* : Environmental Modelling and Software. Elsevier Science Ltd. Summer 2004.
2. **Quinn N.W.T. and W.M. Hanna. 2003.** A Decision Support System for Adaptive Real-Time Management of Seasonal Wetlands in California. 2003. Environmental Modelling and Software. Vol. 18, Issue 6, pp 503-511. Elsevier Science Ltd. (LBNL Report : 50238)
3. **Quinn N.W.T. and W. Mark Hanna. 2002.** Real-Time Adaptive Management of Seasonal Wetlands to Improve Water Quality in the San Joaquin River. Advances in Environmental Research. Vol. 5, pp 309-317. Elsevier Science Ltd.
4. **Quinn N.W.T. and J. Karkoski. 1998**. Potential for real time management of water quality in the San Joaquin Basin, California. Journal of the American Water Resources Association, Vol. 36, No. 6, December.
5. **Quinn N.W.T. and P. Vorster. 1998**. The comparative role of science in in resolving environmental problems at Kesterson Reservoir and Mono Lake, California. Lakes and Reservoirs : Research and Management, Vol. 3, 187-191.
6. **Quinn, N.W.T., J. McGahan and M. Delamore. 1998.** Innovative drainage management techniques to meet monthly and annual selenium load targets. California Agriculture, Vol. 52, No. 5, September-October. 1998.

11 b. LBNL/CALFED Completion Reports, Posters And Presentations

1. **Quinn, N.W.T. W.M. Hanna, J.S. Hanlon, J.R. Burns, C.M. Taylor, D. Marciochi, S. Lower, V. Woodruff, D. Wright and T. Poole. 2004.** Real-Time Water Quality Management in the Grassland Water District. Berkeley National Laboratory Topical Report No. 56825. November 15, 2004, Berkeley, CA 94720
2. **Quinn, N.W.T and S.A. Feldmann. 2004.** Wetland plant guide for assessing habitat impacts of real-time salinity management. Berkeley National Laboratory Topical Report, LBNL-56668.
3. **Quinn, N.W.T. 2004.** Concept paper for real-time temperature and water quality management for San Joaquin River riparian habitat restoration. Berkeley National Laboratory Topical Report, LBNL-56815.
4. **Quinn, N.W.T, C.W. Chen and W.T. Stringfellow. 2003**. A Decision Support System for Real-Time Management of Dissolved Oxygen in the Stockton Deep Water Ship Channel. 9th International Symposium on Environmental Software Systems (ISESS'2003), May 28-June 2. Semmering, Austria.
5. **Quinn N.W.T. and D. Follette. 2003.** Demonstration of real-time water quality management for seasonal wetland drainage. ESD Science review, Poster Session. Mar 3-4.
6. **Quinn N.W.T and W. Mark Hanna. 2002**. Real-time management of seasonal wetland drainage to satisfy salinity TMDL objectives in California's Grasslands Basin. Proceedings of the US Committee on Irrigation and Drainage Water Management Conference on Helping Irrigated Agriculture Adjust to TMDL's, Sacramento, CA. October 23-26.
7. **Quinn N.W.T and M.C.S. Eacock. 2002.** Real-Time Water Quality Modeling And Management In The San Joaquin River. Proceedings of the US Committee on Irrigation and Drainage Conference on Energy, Climate, Environment and Water – Issues and Opportunities for Irrigation and Drainage, San Luis Obispo, CA. July 9-12.
8. **Quinn, N.W.T. and W. M. Hanna. 2002.** A Decision Support System for Adaptive Real-Time Management of Seasonal Wetlands. Berkeley National Laboratory Topical Report, LBNL-50238.
9. **Follette D. and N.W.T. Quinn. 2002.** Salt Balance in San Joaquin Basin Wetlands. . California Water and Environmental Modeling Forum and Interagency Ecological Program Annual Meeting, Asilomar, CA. Feb 26-Mar 1.
10. **Hanna W.M. and N.W.T. Quinn. 2002**. A wetland drainage decision support system using Arcview 8.1 to enhance coordination with San Joaquin River salinity objectives. ESRI Regional GIS Conference, Sacramento, CA.
11. **Quinn N.W.T and W. Mark Hanna. 2001**. Real-Time Wetland Water Quality Management in the Grasslands Basin. Invited Seminar, U.C. Berkeley Dept. of Civil and Environmental Engineering, Nov 30.

12. Professional Resume of Project PI

Nigel W.T. Quinn, PhD, P.E..

Staff Geological Scientist (510) 486-7056
Earth Sciences Division, 70A-3317H (510) 486-7152
Lawrence Berkeley National Laboratory nwquinn@lbl.gov
Berkeley, CA 94720.

ACADEMIC DEGREES

BSc (Hons) Agricultural Engineering (summa cum laude)	Cranfield University, England	1977
MS Agricultural and Civil Engineering	Iowa State University, Ames, IA.	1981
PhD Water Resource Systems Engineering	Cornell University, Ithaca, NY.	1987

ACADEMIC

Staff Scientist II : Lawrence Berkeley National Laboratory	Oct 90 - present
Group Leader : HydroEcological Engineering Advanced Decision Support	Sept 02 – present
Adjunct Research Professor, Department of Plant Science, California State University, Fresno	May 05 – present
Associate Project Engineer, Department of Civil Engineering, University of California, Merced	Jun 05 – present
Visiting Research Professor, University of the Pacific, Dept. Civil Eng. and Comp. Sci, Stockton	Jul 05 - present
Research Engineer, University of California, Merced	Jul 05 - present
Research Engineer : University of California, Berkeley	Oct 99 – Sep 03
Research Associate IV : Cornell University	Jan 87 - Sep 90
Program on Science, Technology and Society	
General Electric Fellow : Cornell University	Jan 85 - Jan 87
Program on Science, Technology and Society.	
Research and Teaching Assistant : Cornell University	Jan 81 - Jan 85
Department of Agricultural Engineering.	
Lecturer : Iowa State University Faculty	Dec 77 - Jan 81
Department of Agricultural Engineering.	

INDUSTRY / GOVT.

Consultant Hydrologist : US Bureau of Reclamation, Division of Planning	Sep 90 - present
Consultant Hydrologist, MFG Inc. (TetraTech Inc.)	Sep 00 - Oct 04
Senior Water Resources Engineer:	Jan 87 - Sep 90
Interagency San Joaquin Valley Drainage Program	
Research Engineer, US Dept. of Agriculture, Agricultural Research Service	Jan 88 – Dec 89
Irrigation Engineer : Tate and Lyle Corporation	Jun 77 - Dec 77
Spalding, England.	

RECENT AND ONGOING RESEARCH

- Principal Investigator; (2005–2008) : Cooperative project with Grassland Water District and California Dep of Fish and Game. Implementation of Real-Time Water Quality management in the Grassland Ecological A State Water Resources Control Board.

- Principal Investigator; (2005–2007) : Use of geophysical techniques for reconnaissance assessment of groun pumping potential beneath San Joaquin and Tulare basin wetlands. US Bureau of Reclamation

- Co-Principal Investigator (with Tom Harmon, UC Merced); (2005-2006) ; Real-time sensor development fo adaptive real-time management of wetland salinity. UC Salinity-Drainage Program

RESEARCH INTERESTS

Application of systems analysis techniques to solving complex water resources problems. Analysis of environmental and economic impacts of global climate change in the San Joaquin Valley. Development of decision support systems simulation models to improve understanding and facilitate negotiation of solutions to future water resource and water problems. Primary research focus during past decade has been on developing decision making tools for assessing the of drainage water quality projects on the west side of the San Joaquin Valley with an emphasis on salinity and seleni drainage. Field research has included investigations of natural selenium in-transit losses in a wetland channel used fo drainage discharges and surface water deliveries, cooperative work with private and public wetlands in the Grassland to develop monitoring and management responses to a salinity TMDL and participation in microbial mesocosm studi identify bacterial species capable of selenium bioremediation. Results of these natural system bioremediation experi are being used to help optimize the performance of an algal-bacterial selenium bioremediation plant for treating agric drain water in the Panoche Water District in the western San Joaquin Valley.

PROFESSIONAL MEMBERSHIPS

California Water and Environmental Modeling Forum (Convener, 2002, 2003, 2004, past Convener, 2005)
San Joaquin Dissolved Oxygen Technical Advisory Committee
Integrated Groundwater-Surface Water Model User Group (Chair)
CALFED Water Quality Technical Group
San Joaquin River Management Program (Steering Committee and Water Quality Subcommittee)
San Joaquin Valley Drainage Implementation Program Committees : Groundwater and River Discharge
American Society of Civil Engineers
American Water Resources Association
American Geophysical Union
Water Environment Federation
California Irrigation Institute
US Committee of Irrigation and Drainage
International Water Association
International Symposium for Environmental Software Systems (Board of Directors)

LICENCES

Registered Professional Engineer

SOCIAL/CIVIC

Yolo Polo Club
Sutter Buttes Polo Club
Berkeley Yacht Club
Woodlake Improvement Club
Manorial Society of Great Britain

DUCKY STRIKE DUCK CLUB
624 Monroe Avenue
Los Banos, CA 93635

December 13, 2005

Nigel W. T. Quinn PhD, P.E., Group Leader
HydroEcological Engineering Advanced Decision Support
Berkeley National Laboratory
1 cyclotron Road, Bld. 70A-3317H
Berkeley, CA 94720

Mr. Quinn,

This is to confirm our earlier discussions about our participation in the cooperative proposal, Sustaining Private Seasonal Wetland Habitat Value and Function Under Ag Waiver Mandated Salt Management.

We are excited about the collaborative approach and working with UC Merced, Grassland Water District, the Department of Fish & Game, the Department of Water Resources and the US Bureau of Reclamation to advance water quality management for the wildlife refuges and the San Joaquin River.

We understand that access will be needed to our property for the implementation of the program and feel confident that the program participants understand the sensitivity of the wetlands and will work closely with us on the program's implementation to minimize any disruption to the marsh.

Finally, thank-you for your good work in putting this effort together. We look forward to working with you.

Sincerely,

Daniel G. Nelson
Ducky Strike Duck Club

Tasks And Deliverables

Task ID	Task Name	Start Month	End Month	Personnel Involved	Deliverables
1	Project administration	1	36	Quinn, Nigel W.T.	This task undertaken by UC Merced Administration under directionof project PI. Submission of timely quarterly and annual reports to the CALFED Ecosystem Restoration Program.
2	CEQA documentation	1	3	Quinn, Nigel W.T. Nelson, Daniel	Completion and submission of necessary environmental documentation.
3	Project Monitoring Plan, PAEP and QAPP	2	3	Quinn, Nigel W.T. Thomas, Harmon Nelson, Daniel Sparks, Lara	Completion of QAPP. Annual letter reports from review panel
4	Design and Implementation of Real-Time Water Quality Monitoring Network	2	33	Quinn, Nigel W.T. Thomas, Harmon Fisher, Jason Nelson, Daniel Ortega, Ricardo Burns, Jos Lower,	Completion of field installations, interim design report, website postings of real-time flow and water quality data. Archived project data.

				Scott	
5	Flow path, hydrodynamic flow−salinity studies using Roboduck	3	33	Quinn, Nigel W.T. Thomas, Harmon Fisher, Jason Nelson, Daniel	Completion of field installations, interim design report, website postings of roboduck salinity maps, shallow and deep groundwater level data and estimated groundwater fluxes. Groundwater data input into a wetland hydrology and water quality model. Archived project data.
6	Analysis and Reporting of Monitoring Data, Modeling, San Joaquin River Salinity Forecasts	6	33	Quinn, Nigel W.T. Burns, Jos John, Beam	Data synthesis results and report on technology transfer activities in watershed prepared for annual reports. Model development and model results described and discussed in annual reports in years 2 and 3. Assessment of forecasts using models for each duck club and discussion of implications for Basin salinity management.
7	Measuring Impacts of Delayed Drawdown and Real−Time	6	33	Quinn, Nigel W.T. Sparks, Lara	Maps of moist soil plant abundance for each of the wetland units at two times each year in each

	Salinity Management			**Ortega, Ricardo Burns, Jos John, Beam Don, Marciochi Cassel, Florence**	**duck club. Annual surveys of shallow root zone salinity.**
8	**Draft and Final Reports**	**3**	**36**	**Quinn, Nigel W.T. Thomas, Harmon Fisher, Jason Nelson, Daniel Burns, Jos Cassel, Florence**	**At the project's completion, a final report will be prepared to document project completion and summarize the results of the project. The draft report will include the products of the tasks listed above and provide a brief introduction section, including a statement of purpose, the scope of the project, and a description of the approach and techniques used during the project, compliance with quality assurance, and the success of the project. The final report will address comments made by the Contract Manager on the draft report.**

Total Project Budget Summary by Task and by Fiscal Year

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

BUDGET SUMMARY	Total Amount for Year 1	Total Amount for Year 2	Total Amount for Year 3	Total Amount for All Years
Total Costs for Task One	$ 154,288.00	$ 135,305.00	$ 154,031.00	$ 443,624.00
Total Costs for Task Two	$ 2,664.00	$ -	$ -	$ 2,664.00
Total Costs for Task Three	$ 10,172.00	$ -	$ -	$ 10,172.00
Total Costs for Task Four	$ 323,240.00	$ 112,240.00	$ 108,730.00	$ 544,210.00
Total Costs for Task Five	$ 32,480.00	$ 25,720.00	$ 26,010.00	$ 84,210.00
Total Costs for Task Six	$ 18,020.00	$ 36,864.00	$ 34,324.00	$ 89,208.00
Total Costs for Task Seven	$ 89,360.00	$ 72,440.00	$ 97,940.00	$ 259,740.00
Total Costs for Task Eight	$ 13,991.00	$ 13,581.00	$ 30,707.00	$ 58,279.00
Total Costs for Task Nine	$ -	$ -	$ -	$ -
Total Costs for Task Ten	$ -	$ -	$ -	$ -
Total Costs for Task Eleven	$ -	$ -	$ -	$ -
Total Costs for Task Twelve	$ -	$ -	$ -	$ -
Total Costs for Task Thirteen	$ -	$ -	$ -	$ -
Total Costs for Task Fourteen	$ -	$ -	$ -	$ -
Total Costs for Task Fifteen	$ -	$ -	$ -	$ -
Total Costs for Project Tasks	$ 644,215.00	$ 396,150.00	$ 451,742.00	$ 1,492,107.00
1/Cost Share	$ 19,000.00	$ 12,000.00	$ 12,000.00	$ 43,000.00
2/ Other Matching Funds	$ -	$ -	$ -	$ -

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

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

Environmental Compliance

CEQA Compliance

Which type of CEQA documentation do you anticipate?
− none *Skip the remaining questions in this section.*
− negative declaration or mitigated negative declaration
− EIR
X categorical exemption *A categorical exemption may not be used for a project which may which may cause a substantial adverse change in the significance of a historical resource or result in damage to scenic resources within an officially designated state scenic highway.*

If you are using a categorical exemption, choose all of the applicable classes below.

X Class 1. Operation, repair, maintenance, permitting, leasing, licensing, or minor alteration of existing public or private structures, facilities, mechanical equipment, or topographical features, involving negligible or no expansion of use beyond that existing at the time of the lead agency's determination. The types of "existing facilities" itemized above are not intended to be all−inclusive of the types of projects which might fall within Class 1. The key consideration is whether the project involves negligible or no expansion of an existing use.

X Class 2. Replacement or reconstruction of existing structures and facilities where the new structure will be located on the same site as the structure replaced and will have substantially the same purpose and capacity as the structure replaced.

X Class 3. Construction and location of limited numbers of new, small facilities or structures; installation of small new equipment and facilities in small structures; and the conversion of existing small structures from one use to another where only minor modifications are made in the exterior of the structure. The numbers of structures described in this section are the maximum allowable on any legal parcel, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.

X Class 4. Minor public or private alterations in the condition of land, water, and/or vegetation which do not involve removal of healthy, mature, scenic trees except for forestry or agricultural purposes, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.

X Class 6. Basic data collection, research, experimental management, and resource evaluation activities which do not result in a serious or major disturbance to an environmental resource, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies. These may be strictly for information gathering purposes, or as part of a study leading to an action which a public agency has not yet approved, adopted, or funded.

– Class 11. Construction, or placement of minor structures accessory to (appurtenant to) existing commercial, industrial, or institutional facilities, except where the project may impact on an environmental resource of hazardous or critical concern where designated, precisely mapped, and officially adopted pursuant to law by federal, state, or local agencies.

Identify the lead agency.
University of California, Merced
Please write out all words in the agency title other than United States (Use the abbreviation "US".) and California (Use the abbreviation "CA".).

Is the CEQA environmental impact assessment complete?
No.

If the CEQA environmental impact assessment process is complete, provide the following information about the resulting document.

Document Name

State Clearinghouse Number

If the CEQA environmental impact assessment process is not complete, describe the plan for completing draft and/or final CEQA documents.

Will file paperwork for a Categorical Exclusion within 2 months of project award. Project involves scientific research and local demonstration of techniques on private land.

NEPA Compliance

Which type of NEPA documentation do you anticipate?
– none *Skip the remaining questions in this section.*
– environmental assessment/FONSI
– EIS

X categorical exclusion

Identify the lead agency or agencies.

University of California, Merced

Please write out all words in the agency title other than United States (Use the abbreviation "US".) and California (Use the abbreviation "CA".).

If the NEPA environmental impact assessment process is complete, provide the name of the resulting document.

If the NEPA environmental impact assessment process is not complete, describe the plan for completing draft and/or final NEPA documents.

Will file paperwork for a Categorical Exclusion within 2 months of project award. Project involves scientific research and local demonstration of techniques on private land.

Successful applicants must tier their project's permitting from the CALFED Record of Decision and attachments providing programmatic guidance on complying with the state and federal endangered species acts, the Coastal Zone Management Act, and sections 404 and 401 of the Clean Water Act.

Please indicate what permits or other approvals may be required for the activities contained in your proposal and also which have already been obtained. Please check all that apply. If a permit is *not* required, leave both Required? and Obtained? check boxes blank.

Local Permits And Approvals	Required?	Obtained?	Permit Number (If Applicable)
conditional Use Permit	–	–	
variance	–	–	
Subdivision Map Act	–	–	
grading Permit	–	–	
general Plan Amendment	–	–	

specific Plan Approval	**–**	**–**	
rezone	**–**	**–**	
Williamson Act Contract Cancellation	**–**	**–**	
other **No Local Permits Required**	**–**	**–**	

State Permits And Approvals	**Required?**	**Obtained?**	**Permit Number (If Applicable)**
scientific Collecting Permit	**–**	**–**	
CESA Compliance: 2081	**–**	**–**	
CESA Complance: NCCP	**–**	**–**	
Lake Or Streambed Alteration Agreement	**–**	**–**	
CWA 401 Certification	**–**	**–**	
Bay Conservation And Development Commission Permit	**–**	**–**	
reclamation Board Approval	**–**	**–**	
Delta Protection Commission Notification	**–**	**–**	
state Lands Commission Lease Or Permit	**–**	**–**	
action Specific Implementation Plan	**–**	**–**	
SWRCB Water Transfer Approval	**–**	**–**	
other **No State Permits Or Approvals Required – Project Is On Private Land**	**–**	**–**	

Federal Permits And Approvals	**Required?**	**Obtained?**	**Permit Number (If Applicable)**
ESA Compliance Section 7 Consultation	**–**	**–**	
ESA Compliance Section 10 Permit	**–**	**–**	

Rivers And Harbors Act	–	–	
CWA 404	–	–	
other **No Federal Permits Or Approvals Required – Project Is On Private Land**	–	–	

Permission To Access Property	Required?	Obtained?	Permit Number (If Applicable)
permission To Access City, County Or Other Local Agency Land Agency Name	–	–	
permission To Access State Land Agency Name	–	–	
permission To Access Federal Land Agency Name	–	–	
permission To Access Private Land Landowner Name **Ducky Strike Duck Club**	–	X	

If you have comments about any of these questions, enter them here.

Land Use

Does the project involve land acquisition, either in fee or through easements?
X No. *Skip to the next set of questions.*
– Yes. *Answer the following questions.*

How many acres will be acquired by fee?

How many acres will be acquired by easement?

Describe the entity or organization that will manage the property and project activities, including operation and maintenance.

project is a joint research collaboration between UC Merced, the Department of Fish and Game and private duck clubs within the Grassland Water District

Is there an existing plan describing how the land and water will be managed?
X No.
– Yes. *Cite the title and author or describe briefly.*

Will the applicant require access across to or through public or private property that the applicant does not own to accomplish the activities in the proposal?
– No. *Skip to the next set of questions.*
X Yes. *Answer the following question.*

Describe briefly the provisions made to secure this access.

Private duck clubs are cooperators in this project. List of project personnel will be furnished to Boards of both Duck Clubs involved in project.

Do the actions in the proposal involve physical changes in the current land use?
X No. *Skip to the next set of questions.*
– Yes. *Answer the following questions.*

Describe the current zoning, including the zoning designation and the principal permitted uses permitted in the zone.

Describe the general plan land use element designation, including the purpose and uses allowed in the designation.

Describe relevant provisions in other general plan elements affecting the site, if any.

Is the land mapped as Prime Farmland, Farmland of Statewide Importance, Unique Farmland, or Farmland of Local Importance under the California Department of Conservation's Farmland Mapping and Monitoring Program?
X No. *Skip to the next set of questions.*
– Yes. *Answer the following questions.*

Land Designation	Acres	Currently In Production?
Prime Farmland		**–**
Farmland Of Statewide Importance		**–**
Unique Farmland		**–**
Farmland Of Local Importance		**–**

Is the land affected by the project currently in an agricultural preserve established under the Williamson Act?
X No. *Skip to the next set of questions.*
– Yes. *Answer the following question.*

Is the land affected by the project currently under a Williamson Act contract?
X No. *Skip to the next set of questions.*
– Yes. *Answer the following question.*

Why is the land use proposed consistent with the contract's terms?

Describe any additional comments you have about the projects land use.

project will involve a change in the timing of wetland drainage drdischarge to Mus and salt Sloughs. There are no anticipated changes to land use.