PART A. Cover Sheet

A1. Proposal Title:

Wetland Response to Modified Hydrology with Respect to Salinity Management

A2. Lead Applicant or Organization:

Contact Name: John Beam, California Department of Fish and Game
Address: 22759 S. Mercey Springs Rd, Los Banos, CA 93635
Phone Number: (559) 908-6059
Fax Number: (209) 826-4984
E-mail: jbeam@dfg.ca.gov

A3. Project Manager or Principal Investigator

Contact Name: John Beam
Agency/Organization Affiliation: California Department of Fish and Game
Address: 22759 S. Mercey Springs Rd, Los Banos, CA 93635
Phone Number: (559) 908-6059
Fax Number: (209) 826-4984
E-mail: jbeam@dfg.ca.gov

A4. Cost of Project: See attached Exhibit A: Budget Detail
Requesting $260,000 over the term of the project from Cal Fed. Cost share contingent on the Cal Fed funding from CDFG, DWR, USBR, UCD and GWD totaling $752,700.

A5. Cost Share Partners:*

California Department of Fish & Game (CDFG) cost share includes the project manager's time ($38,500), as well as field time from (3) DFG Resource Assessment Program staff ($270,000), office space and utilities ($10,800). Grassland Water District (GWD) cost share includes support time from one staff person ($23,400). Department of Water Resources (DWR) cost share includes time from staff, and equipment ($300,000). United States Bureau of Reclamation (USBR) cost share includes time from staff, and equipment ($80,000). University of California Davis (UCD) cost share includes primary investigator and statistical consultant time ($30,000).

A6. List of Subcontractors:

Agency/Organization Affiliation: Ducks Unlimited
Contact Name: Frederic A. Reid, Ph.D.
Address: 3074 Gold Canal Drive
Phone Number: (916) 852-2000
Fax Number: (916) 852-2200
E-mail: freid@ducks.org

A7. Other Cooperators:*

Agency/Organization Affiliation: UC Davis
Contact Name: John M. Eadie
Address: 1053 Academic Surge Davis, CA 95616-8751
Phone Number: (530) 754-9204
Fax Number: (530) 752-4154
E-mail: jmeadie@ucdavis.edu

Agency/Organization Affiliation: Lawrence Berkeley National Laboratory
Contact Name: Nigel Quinn
Address: 1 Cyclotron Road, Bldg. 70A-3317H, Berkeley, CA 94720
Phone Number: (510) 486-7056
Fax Number: (510) 486-7152
E-mail: nwquinn@lbl.gov

Agency/Organization Affiliation: Department of Water Resources
Contact Name: Stuart Itoga
Address: 3374 East Shields Ave., Rm B19, Fresno, CA 93726
Phone Number: (559) 230-3314
Fax Number: (559) 230-3301
E-mail: sitoga@water.ca.gov

A8. Project Topic Area*
Primary: Shallow Water and Marsh Habitat
Secondary: Ecosystem Water and Sediment Quality

A9. Project Type*
Primary: Research
Secondary: Not Applicable

PART B. Executive Summary

B1. Proposal Title:

Wetland Response to Modified Hydrology with Respect to Salinity Management

B2. Project Description

The 180,000 acre Grassland area constitutes the largest contiguous wetlands left in California. It is a significant waterfowl wintering area, as well as an important fall and spring migration stopover site for shorebirds. During winter, wetlands and agricultural habitats in the Central Valley support the largest single concentration of waterfowl (3-4 million) in North America (Gilmer et al. 1982, Heitmeyer et al 1989). 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. The most abundant moist soil plant managed and selected for in the Grassland Wetlands is swamp timothy. Management for swamp timothy requires flooding in the fall, typically in August and September, and retaining the ponded water throughout the winter to provide foraging and loafing habitat for waterfowl, shorebirds and other marshbirds. In the spring, between mid-March and early-April when soil temperatures are high enough for optimal swamp timothy seed germination and plant growth, the wetlands are drained. As a component of the San Joaquin River, waters drained from these wetland areas move via Mud and Salt Sloughs providing flow and nutrients to this system.

The Central Valley Regional Water Quality Control Board has adopted 1) a conditional waiver of Waste Discharge Requirement for discharges from irrigated lands which requires characterization of wetland water quality, and 2) a salt and boron TMDL limiting the amount of

salt and boron that can be discharged into the San Joaquin River at certain times of the year. Wetland managers are being asked to drain their wetlands later in the spring when there is assimilative capacity in the San Joaquin River. However, wetland managers are concerned that altering the hydrology will impact the productivity of these wetlands over time. It is important to start this pilot project before management changes begin to be able to observe any changes in habitat and bird use over time.

The focus of this study is to investigate the impact of altered spring drawdown of managed wetlands on plant productivity and waterbird use in the Grassland Wetlands of the northern San Joaquin Valley within the Lower San Joaquin River Watershed. We seek to answer the following question: does altering the timing and rate of discharge from managed wetlands to the San Joaquin River effect wetland salinity and subsequently the productivity, distribution, and forage value of wetland plants for resident and migratory shorebirds and waterfowl? This project would investigate the feasibility of developing multi-objective wetland operations to both maximize wildlife habitat and improve water quality in the Grassland Basin and San Joaquin River.

This proposal would develop information in response to many wetland/water quality CALFED goals and objectives identified in the following documents: the *Water Supply, Reliability, and Environmental Improvement Act (H.R. 2828), Ecosystem Restoration Program EMZ Targets and Programmatic Actions, Delta Implementation Package Implementation Plan, Science Program PSP process,* and *Water Quality Program Plan.* See the "Consistent with California Bay-Delta Authority objectives" section below for more information

PART C. Work Plan

C1. Project Background and Information:

The Grassland Wetlands are centered around the city of Los Banos in Merced County. This area is approximately 180,000 acres in size constituting the largest contiguous wetlands left in California. Wetlands in California have declined by over 90% from an estimated 2 million hectares historically to less than 182,000 hectares at present (Dahl 1990). In the Central Valley, only about 117,000 hectares remain as a result of agricultural and urban development, water diversion and flood control measures. This loss of wetlands exceeds that of any other state in the nation (Dahl 1990). The Grassland Wetlands are a significant waterfowl wintering area supporting peak waterfowl populations in excess of one million birds, as well as an important fall and spring migration stopover site for shorebirds, with peak numbers of more than 200,000 shorebirds observed. In 1991, the Western Hemisphere Shorebird Reserve Network recognized the Grasslands as an Internationally Significant Shorebird Site. It has also been designated as a Globally Important Bird Area by the American Bird Conservancy and the National Audubon Society. In 2005, the Area has been designated a Wetlands of International Importance under The Convention on Wetlands of International Importance, making it one of 22 Ramsar sites in the United States.

In order to characterize outflow and develop Best Management Practices to manage salt and boron discharges from San Joaquin Valley wetlands into the San Joaquin River and tributaries, this project will evaluate changes in wetland productivity resulting from modified timing of

spring drawdown. In the future, altered spring drawdown could be timed to coincide with opportunities of assimilative capacity with the San Joaquin River watershed to minimize salt and boron induced impacts. There is concern that retaining water later into the spring results in increased salinity of water in these wetlands, specifically salt and boron concentrations, which may affect wetland productivity and have negative impacts to the wetland and associated wildlife species dependent upon them. Later draw downs dates, which occur during times of higher temperature, can also inhibit plant establishment. In addition drawdown date may have a stronger effect on plant species composition than on total seed production in moist-soil habitats (Fredrickson and Taylor 1982).

This project builds upon two previous CALFED sponsored studies which helped to validate the conceptual framework for the current study. The first study in the Grassland Water District was sponsored by the Ecosystem Restoration Program and was successful in building a monitoring network for the Northern Division of the District. Although flow and salinity data have been gathered in the District along the main distribution canals for years, this study showed the need for continuous monitoring to obtain more accurate mass balances and the need for telemetry – to facilitate drawdown management. This first study also explored the use of satellite imagery and wetland soil salinity mapping to develop the tools necessary to establish potential trends in moist soil plant germination as a result of potential future drawdown manipulation. This study also used the data collected at the one inlet and five drainage outlet stations to construct a mass balance model of flow and salt loading in the Northern Division Grassland Water District wetlands. The model was shown to perform reasonably well and was used to simulate potential drawdown schedules to minimize salt load impacts to the San Joaquin River during times of low assimilative capacity.

This project was followed by a smaller scale study, sponsored by the CALFED Drinking Water Program in San Luis National Wildlife Refuge. The study implemented a monitoring network of inflow and salt loading into the San Luis Unit of the Refuge Complex and of drainage and salt load export from the major outlets to Salt Slough. The data gathered was used to develop a generalized seasonal wetland hydrology model (WETMANSIM) which was subsequently incorporated into CALSIM-II as the simulator of present and future wetland return flows and salt export. Ongoing work within the US Bureau of Reclamation is helping to refine this model. It is anticipated that the data collected in the proposed Directed Action will allow further refinement of this model for different hydrologic conditions. At present WETMANSIM considers only normal water years.

Further data collection on individual wetland units, such as what will be performed in the proposed study will also help to refine the hydrology and salt mass accounting for traditional and adaptive salt management practices. It is anticipated that some adjustment to traditional practices will be necessary to meet CRWCB TMDL requirements during dry and critically dry water years.

There are direct linkages between the proposed Directed Action and other ongoing San Joaquin Basin projects such as the Stockton Dissolved Oxygen TMDL, the Basin-wide temperature studies and the Grassland Bypass Project. Algal loads from seasonal wetlands can be significant during wetland drawdown – forecasting of these algal loads can help water quality planning staff choose between options for maintaining minimum dissolved oxygen levels in the Stockton Deep Water Ship Channel. Salt load may be shown to be correlated with algal biomass loading since

residence time and algal accumulation are commonly correlated. All electrical conductivity sensors are temperature compensated hence all outlets monitored as part of the proposed Directed Action study will provide temperature data for wetland return flows. If these return flows and their temperatures are extrapolated across the entire wildlife management area – this information can be used to characterize seasonal wetland inputs to the Basin temperature models. In the case of the Grassland Bypass Project – real-time water quality management has been suggested by the Regional Board in their amended Basin Plan for meeting water quality objectives. If the Grassland Basin agricultural water districts embraced the concepts of real-time water quality management rather than adopt a moratorium on salt load exports to the San Joaquin River, then coordination of agricultural and seasonal wetland drainage return flows would become necessary. The data collected in the proposed Directed Action and the implementation of the EcoNet data collection and telemetry platform, proposed in this study, will furnish the type of real-time information needed to aid decision making related to spring drawdown planning and management of salt exports.

C2. Project Goals and Objectives:

The goal of this project is to determine how wetland productivity, water quality and waterbird use is impacted by changes in traditional management of swamp timothy wetlands within the Grassland Wetlands.

Objective 1. Determine, monitor and compare productivity of differently managed wetlands.

Objective 2. Monitor waterbird use of differently managed wetlands.

Objective 3. Collect water quality data to further characterize outflow from managed wetlands.

C3. Conceptual Model:

The overarching conceptual framework for this project is based on four underlying components: (1) a conceptual model of the driving forces in a managed wetland system; (2) a conceptual model of the traditional yearly management schedule for swamp timothy managed wetlands, with existing goals and assumptions; (3) a framework to identify the key uncertainties of a modified hydrology scenario; and (4) a framework to identify motivations, processes, and potential positive and negative outcomes of adaptive, coordinated real-time management of wetland drainage.

(1) Driving Forces of a Managed Wetland System (Figure 1) - A central goal of wetland management is to promote wildlife use by providing high quality habitat. Management efforts therefore seek to achieve desired abundances and composition of wildlife by influencing wetland composition, structure and productivity (Figure 1). For migrating and wintering bird species, food quality (moist-soil plant seeds and invertebrates) and vegetation structure (cover, refuge) are thought to be the primary determinants of wildlife use. The quality of a given habitat, and therefore its priority for protection or enhancement, is determined by availability of food (seeds, vegetation, waste grain and invertebrates; (Heitmeyer, 1989). Food availability is dictated by the type of wetland habitat, water availability and by the management actions undertaken (Fredrickson and Taylor, 1982). Accordingly, management activities focus on mechanical manipulation of soils and vegetation, and manipulation of the hydrological regime (timing of water irrigations, timing and rate of drawdown) for seasonally flooded wetlands. The

appropriate levels of management activity, and the expected benefits of such activity, are determined by both physical conditions (soil salinity, water quality and microtopography) and biological conditions (substrate productivity, composition and structure of both plant and animal communities).

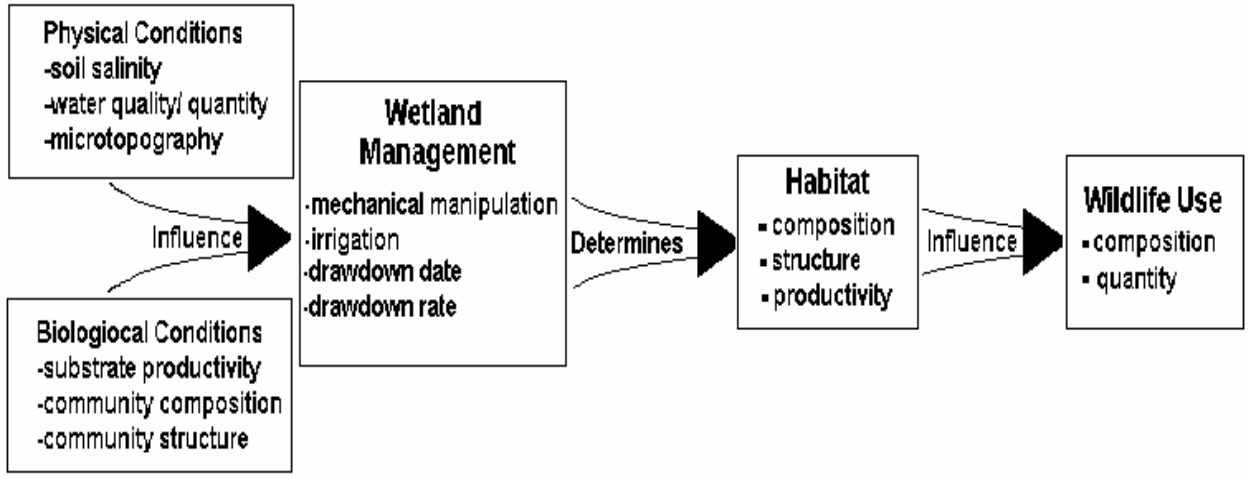

Figure 1. Driving Forces of a Managed Wetland System

(2) Yearly Management Cycle for Swamp Timothy Managed Wetlands (Figure 2) – Wetlands in the San Joaquin Valley are managed intensively to produce standing crops of moist soil food plants and invertebrates with high value to wildlife, particularly waterfowl. The most abundant moist soil plant managed for in the Grassland Wetlands is swamp timothy. The goals and assumptions of this management program are:

Goals:

- To produce standing crops of swamp timothy grass and invertebrates with high value to wildlife, particularly waterfowl.
- To maximize waterfowl usage.
- To provide habitat attracting other wildlife.

Assumptions:

- Managing wetlands to maximize swamp timothy production will maximize wintering waterfowl usage in swamp timothy managed wetlands

Management for swamp timothy requires flooding in the fall, typically in August, and retaining the ponded water throughout the winter to provide foraging and loafing habitat for waterfowl, shorebirds and other marshbirds. In the spring, between mid-March and early-April when soil temperatures are high enough for optimal swamp timothy seed germination and plant growth, the wetlands are drained (Figure 2).

Figure 2. Swamp Timothy Managed Wetlands Yearly Management Cycle

VARIABLES ASSUMED TO AFFECT SWAMP TIMOTHY PRODUCTIVITY

Several variables play an important role to influence the production of swamp timothy (Naylor, L. 1999 Evaluating Moist Soil Seed Production and Management in Central Valley Wetlands to Determine Needs for Waterfowl. Thesis. U.C. Davis). These include:

- Drawdown date
  * Seed germination, and plant growth temperatures
  * Length of growing season (ability to produce seed prior to fall flood up)
- Drawdown rate
- Irrigation
- Management activities such as disking
- Water quality

DYNAMICS OF MAXIMIUM SWAMP TIMOTHY PRODUCTION

Maximum swamp timothy production is, in turn, thought to be promoted under the following conditions (Fredrickson and Taylor 1982, Smith et al. 1995, Kelley 1986:40-41, Kirkman and Sharitz 1994, van der Valk and Davis 1978):

- Mid-March to early-April drawdown when soil temperatures are high enough for optimal swamp timothy seed germination and plant growth.
- Draw down rate complimentary to maximum swamp timothy production.
- Irrigation prior to plants being stressed.

- Disking of unfavorable plants to reduce competition in the following year, promote moist-soil seed production by elevating seeds to upper soil horizons where more favorable conditions for germination exist.
- Flooding in fall only after timothy has matured and gone to seed.

(3) Key Uncertainties of a Modified Hydrology Management Scenario (Figure 3,4,5) – There are several uncertainties regarding the effects of a delayed drawdown on swamp timothy productions. Modification of the timing of drawdown would influence: (i) the timing for the start of swamp timothy germination, (ii) the length of the growing season, given that the flood-up dates are determined by the time of arrival of fall migrants and therefore are relatively invariant; (iii) the need for summer irrigations and the effect of such on the length of the growing period (Figure 3).

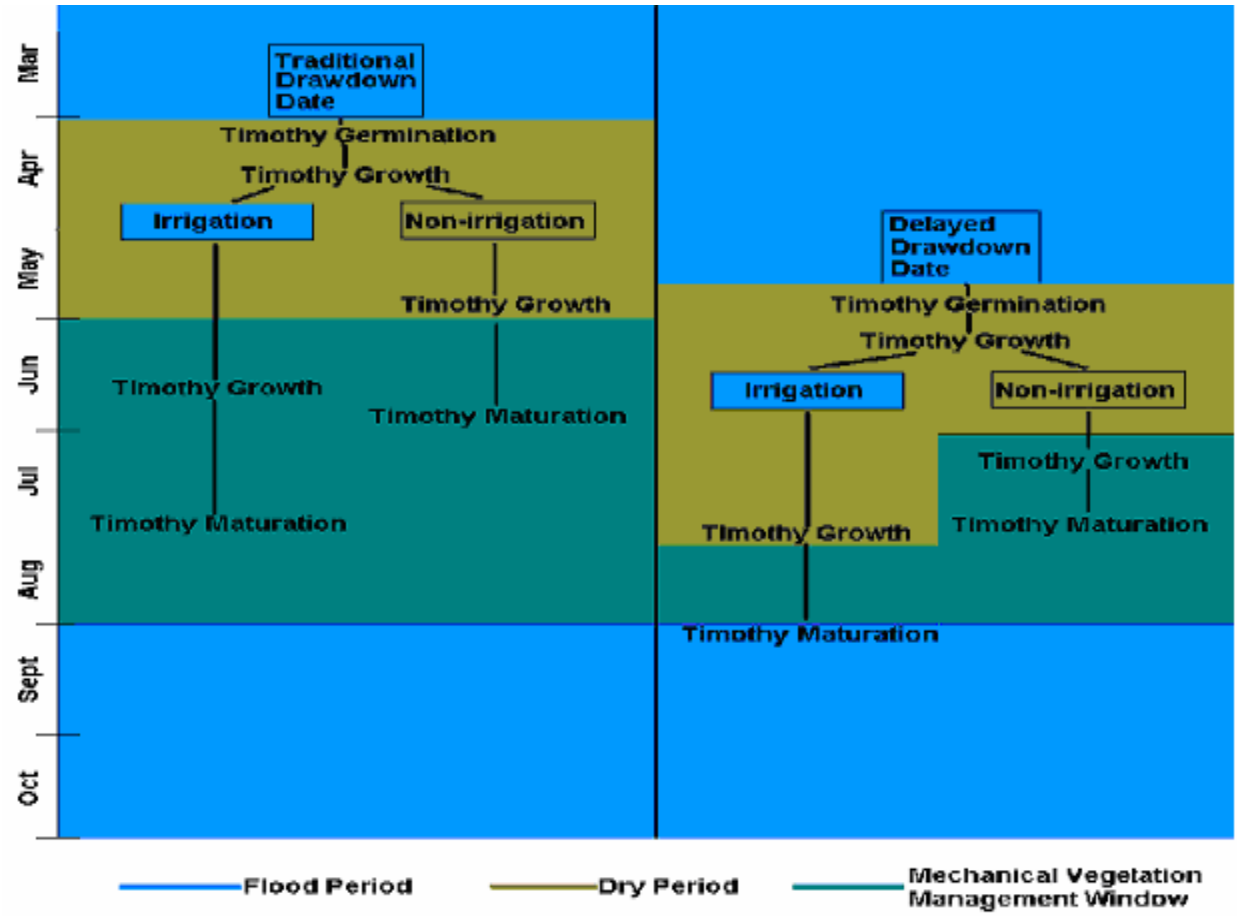

Figure 3. Traditional Vs. Delayed Drawdown Timing of Timothy Managed Wetlands

There are few if any data to determine the effect of such a modified drawdown schedule on the ability to produce the moist-soil and invertebrate seed base that provides optimum habitat for migrating and wintering wildlife. Based on best knowledge from wetland mangers experienced with these systems, the following effects are hypothesized (Figure 4):

(i) Delayed drawdown would result in increased salinity and hence diminished wetland water quality;
(ii) Increased salinity would lead to increased soil salinity, and in turn changes in wetland species composition and distribution and hence habitat structure;
(iii) Increased salinity and changed vegetation structure would reduce swamp timothy production;
(iv) Wildlife use, particularly waterfowl, would be reduced by a combination of the changed species composition and habitat structure (ii above), the reduction in swamp timothy production specifically (iii above) and directly by potential delays in flood-up of seasonal flooded habitat.

The null hypothesis for all of the above hypotheses is that no effects of delayed draw down would be detected (Figure 4). An alternative hypothesis is that delayed drawdown might provide a benefit to wildlife by providing late season wetland habitat for pre-breeding waterfowl and migrant shorebirds at a time when other wetlands have been drained. Conversely a delayed draw down could encourage water birds to breed and nest in areas that are going to dry up prior to broods fledging.

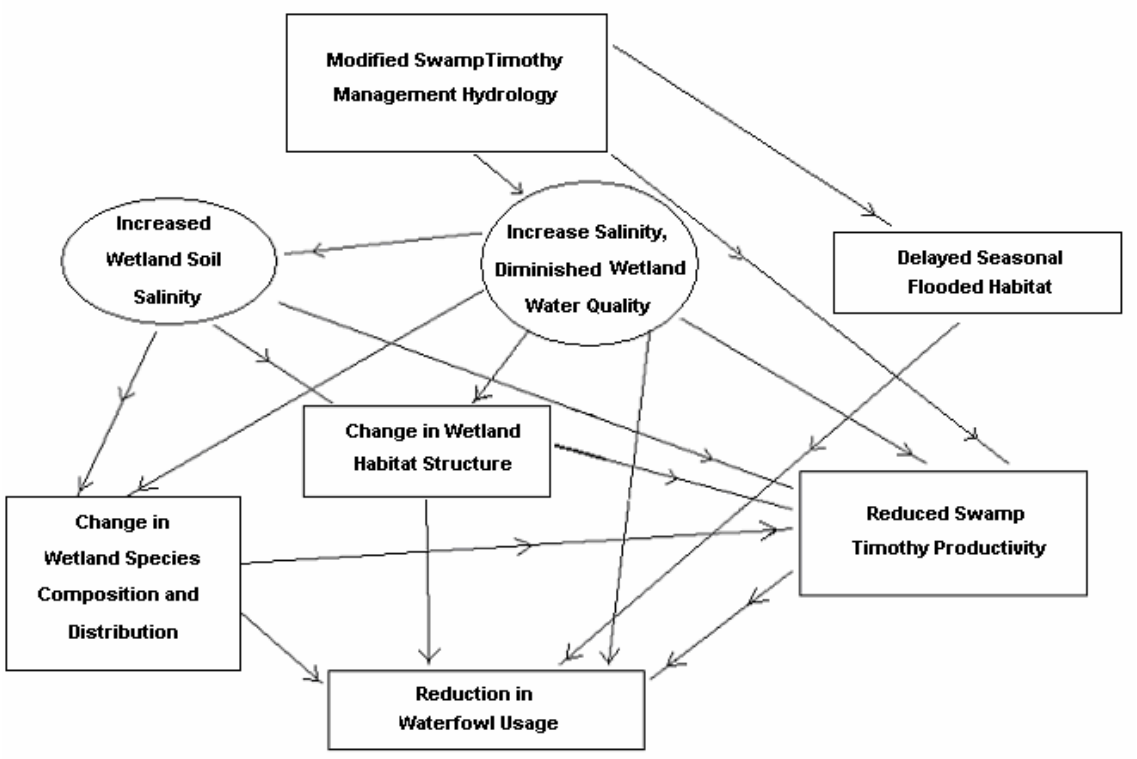

Figure 4. Key Uncertainties of a Modified Hydrology Management Scenario

We lack data to evaluate these predicted responses. The only data available to date are those from a study by Naylor et al (1999) at UC Davis. They found a significant effect of timing of drawdown on swamp timothy production, with early (15 Feb – 15 Mar) and late (after 16 Apr)

drawdown dates resulting in lower swamp timothy production than middle dates (16 Mar – 15 Apr) (Figure 5).

ANOVA Table for HESC kg/ha

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Drawdown Date cat	2	5296706.646	2648353.323	9.144	.0001	18.288	.985
Residual	399	115560652.022	289625.694				

Means Table for HESC kg/ha
Effect: Drawdown Date cat

	Count	Mean	Std. Dev.	Std. Err.
Early	88	109.265	304.617	32.472
Mid	224	304.292	691.533	46.205
Late	90	45.750	97.459	10.273

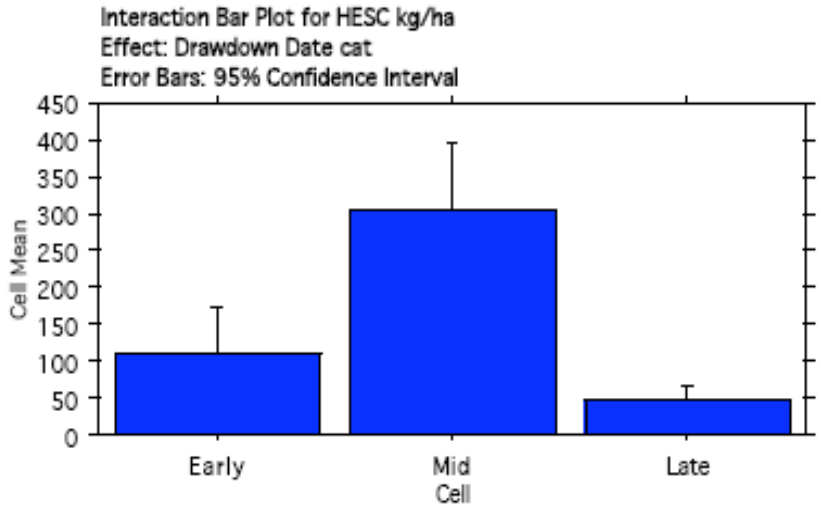

Figure 5. Effect of Delayed Drawdown on Swamp Timothy Production (Naylor, 1999)

(4) A framework to identify motivations, processes, and potential positive and negative outcomes of adaptive, coordinated real-time management of wetland drainage. (Figure 6).

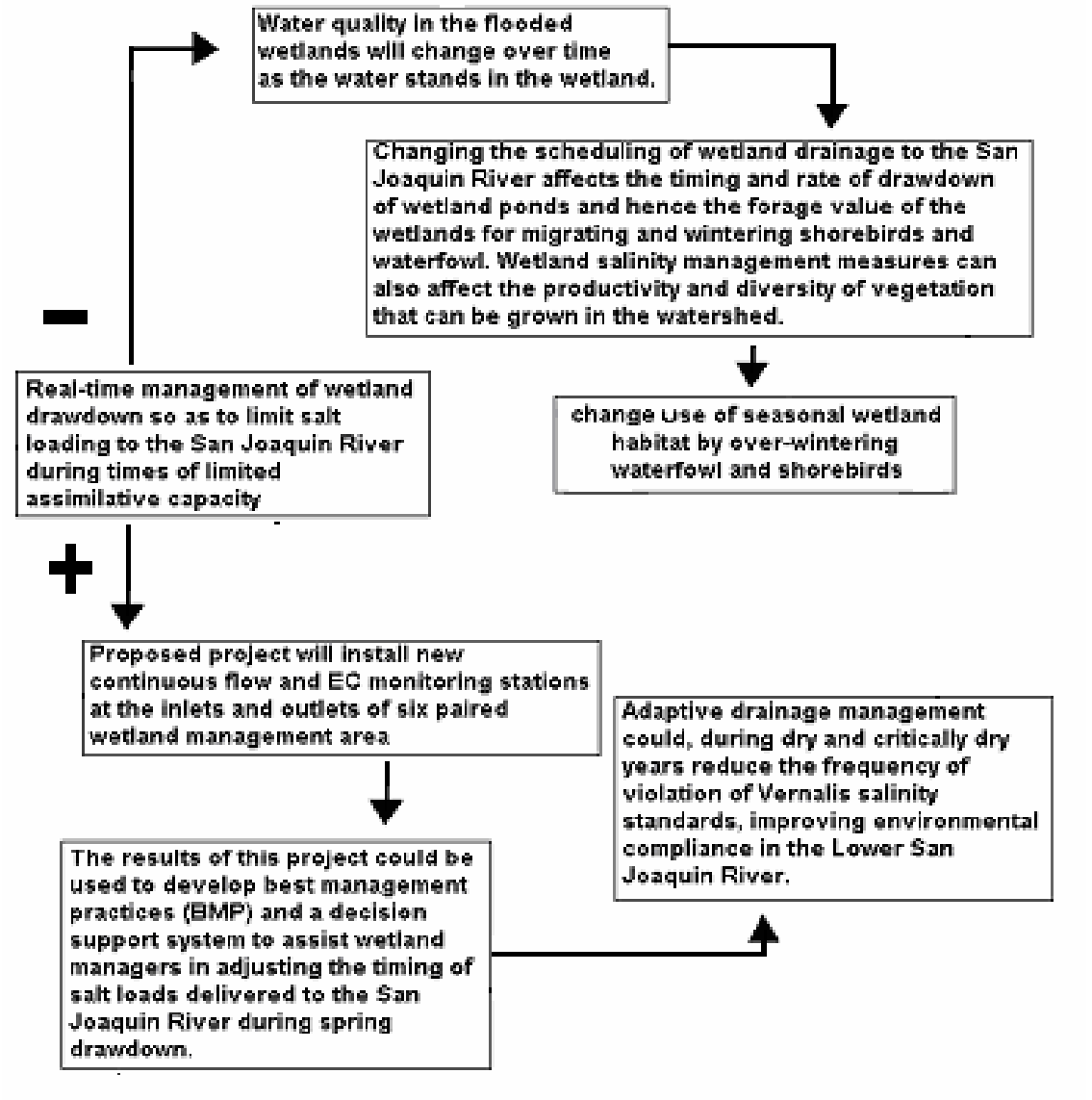

Figure 6. Adaptive, Coordinated Real-Time Management of Wetland Drainage

**Primary motivation*- Real-time adaptive drainage management of wetlands in the San Joaquin Basin to maximize water quality and quality of wildlife habitat in the San Joaquin River.

**Positive outcomes*- Real-time adaptive drainage management of wetlands in the San Joaquin Basin could improve water quality in the lower San Joaquin River by limiting the salt loading during limited assimilative capacity.

**Negative outcomes*- Real-time adaptive drainage management such as altered draw down dates, or changing draw down rates conducive to maximizing moist soil plant productivity could cause deleterious effects to wetland water quality, moist soil plant productivity, wetland structure and ultimately effect the overall usage by over-wintering waterfowl and shorebirds.

C4. Approach/Methodology:

The proposed framework for monitoring and evaluation is presented in Figure 7 and describes our 3 primary objectives.

Objective 1. Determine and compare productivity of differently managed wetlands

To determine how management affects the productivity of swamp timothy wetlands within the Grasslands, we will map and monitor spatial change within the basic habitat types of each wetland cell utilizing high resolution aerial photography, GIS and image segmentation software in conjunction with an in-the-field truthing effort on a yearly basis. We will collect moist soil core samples as well as mature dry clipping samples of swamp timothy to calculate the amount of seed production per wetland acre. This will allow us to accurately determine the amount of swamp timothy grass being produced by each wetland cell, and in turn the amount available to waterbirds, especially waterfowl, just prior to field flood up and immediately following flood up. We will then compare the swamp timothy productivity, and the spatial distribution of the basic moist soil habitat types between the traditionally managed wetland cells with those that are managed in response to San Joaquin River assimilative capacity load targets for salt. We will use this information in conjunction with water quality data, water depth data and waterbird use findings to develop best management practices for intensively managed wetlands within the San Joaquin River Basin.

Objective 2. Monitor waterbird use of differently managed wetlands

To determine how waterbirds respond to changes in wetland management, beginning post waterfowl hunting season and continuing through the remainder of the winter flood-up period (February through May), we will survey each wetland field weekly. In addition to identifying all waterbirds utilizing each wetland, we will also record water depth, time and duration of surveys, weather conditions and any disturbances. In addition to comparing waterbird use with changes in water depths, we will also compare waterbird use with changes in water quality, within a wetland, to determine if water quality impacts waterbird usage.

Objective 3. Collect water quality data to further characterize outflow from managed wetlands

Salinity, temperature, and flow have been identified by the San Joaquin River Management Program Executive Council as water quality stressors of concern in the San Joaquin River. This project proposes salinity, temperature, and flow monitoring and adaptive management of field operations, in cooperation with currently funded CALFED and non-CALFED efforts to characterize water quality impacts and coordinate seasonal wetland drainage with the assimilative capacity of the San Joaquin River.

A state-of-the-art monitoring, data acquisition and dissemination system will be deployed in the project. The EcoNet monitoring system is a revolutionary concept for routine environmental monitoring, although similar systems have been employed within the Oil and Gas Industry for the past decade. EcoNet provides near real-time access to monitoring data using advanced telemetry capability at each site and hence cuts out the data management aspect of environmental monitoring, which often turns out to be the most expensive and most poorly performed component of environmental monitoring. The ability to utilize sensor networks for monitoring wetland flow and salt export lends itself to the development of computer-aided decision support systems – which is a necessary component of real-time water quality management.

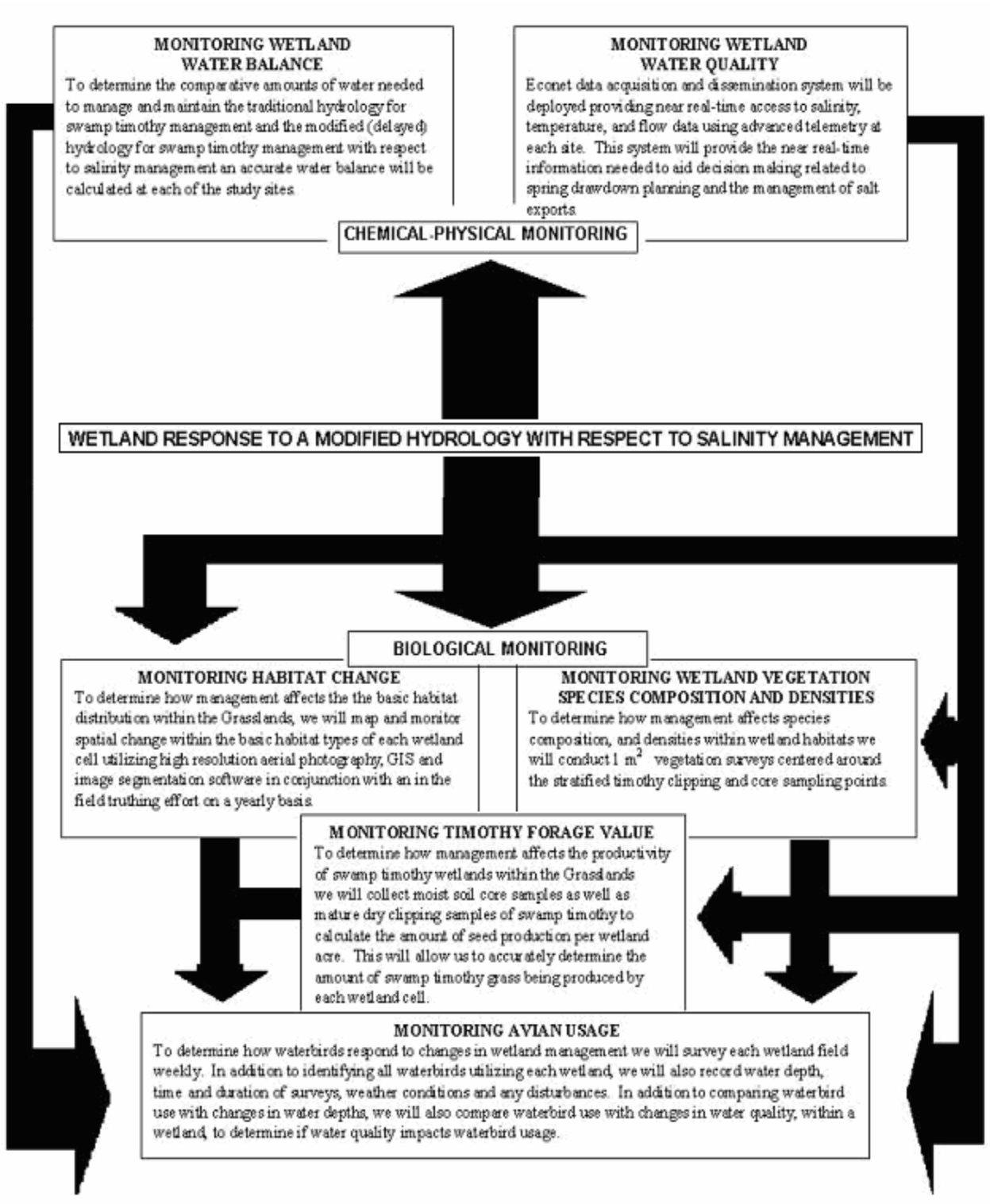

Figure 7. Framework for Monitoring Wetland Response to a Modified Hydrology

Quality assurance project plans (QAPP) have been developed for previous CALFED-funded projects in the watershed and will be adapted for application to the current project. These

QAPP's follow SWAMP monitoring protocols which have been established to promote data sharing and good science. Assurances of common data quality protocols will allow data sharing and information coordination with ongoing efforts to characterize water quality resources within the Westside San Joaquin River Watershed Coalition (Central Valley RWQCB conditional waiver of Waste Discharge Requirements for discharges from irrigated lands).

Experimental Design:

Data: The following data will be collected to evaluate the effects of modified hydrological regime on swamp timothy production:

- Swamp timothy yield in kg/hectare measured by core samples (66 mm core samples taken to a depth of 2-4 inches).
- Swamp timothy yield in kg/hectare measured by clipped samples (plants clipped and removed at surface).
- Image analysis of distribution of swamp timothy habitats.

Sampling Design: Twelve independent wetland units (fields) will be used, established in six sets of pairs with each pair separated by geographic location (i.e., six blocks of size two). As these geographic locations represent differing microclimates, soil condition, water quality, and other variables, the design will block on these locations. The fields vary in size from around 30 to 80 acres. The statistical design will need to respect the blocking structure.

This will be a three year study. The distribution of swamp timothy habitats across the fields can change dramatically in the course of one or two years. The introduction of varying regimes may have long-term effects measurable only over years. Therefore, the experimental design needs to cope with large potential year-to-year variation and potential carry-over effects.

The following designs were considered:

Paired-comparison design:

- One factor (delayed vs. traditional drawdown), with two levels of treatment.
- Both treatments are allocated at random to each block.
- Treatment allocation remains stable over the course of the experiment.

Balanced incomplete block design 1:

- One factor is studied, with three levels of treatment.
- Treatments are allocated in three replicates.
- Treatment allocation remains stable over the course of the experiment.

Balanced incomplete block design 2:

- Two factors are studied, each with two levels of treatment.
- Treatments are allocated in three replicates.
- Treatment allocation remains stable over the course of the experiment.

Crossover designs were also explored. However, these rely on lack of carryover effect from year to year, which is highly unlikely in this experiment. Therefore, carryover designs were not further considered.

Salient characteristics of the designs are summarized below:

Table 1. Potential Experimental Designs

Characteristic	PCD	BIBD 1	BIBD 2
Number of factors studied	One factor, two levels	One factor, three levels	Two factors, two levels each
Number of replicates needed	One replicate	Three replicates	Three replicates
Analysis method	Paired t-test	Paired t-tests within replicates for each comparison	ANOVA within replicates for each term
Degrees of freedom for comparison	5 df for comparison	1 df for each comparison	3 df for each comparison

After consideration of the three designs in consultation with statisticians from the Dept. of Statistics at UC Davis, the opinion was that the paired-comparison design provided the greatest power statistically and also provided the greatest number of degrees of freedom for comparison.

Power Analysis

A power analysis was conducted using data from a previous experiment (Naylor, 1999) based on estimates of swamp timothy yield from 225 cores samples across 15 sites (Figure 8).

Data were initially log-transformed due to wide variation – this was found to stabilize variation well. On the log-scale, zero values were dropped from analysis, resulting in 38 dropped cases (17%) – most of these were from two sites. The effects of this transformation in the planned experiment are unknown. On this basis, after log-transform, the field variation is approximately 1.0, while core variation is approximately 2.2. Each field mean then is modeled as having variance of var(field) + var(core)/n.

On examination, the log-transformed values of the arithmetic means were relatively close to the means of the log-transformed non-zero values. Analysis will likely be carried out on the log-transformed mean yields per field. The following analysis provides guidelines for sub-sampling size. Under these assumptions, we obtain the following figure for sample size based on n=40 sub-samples and α=0.05 for each comparison.

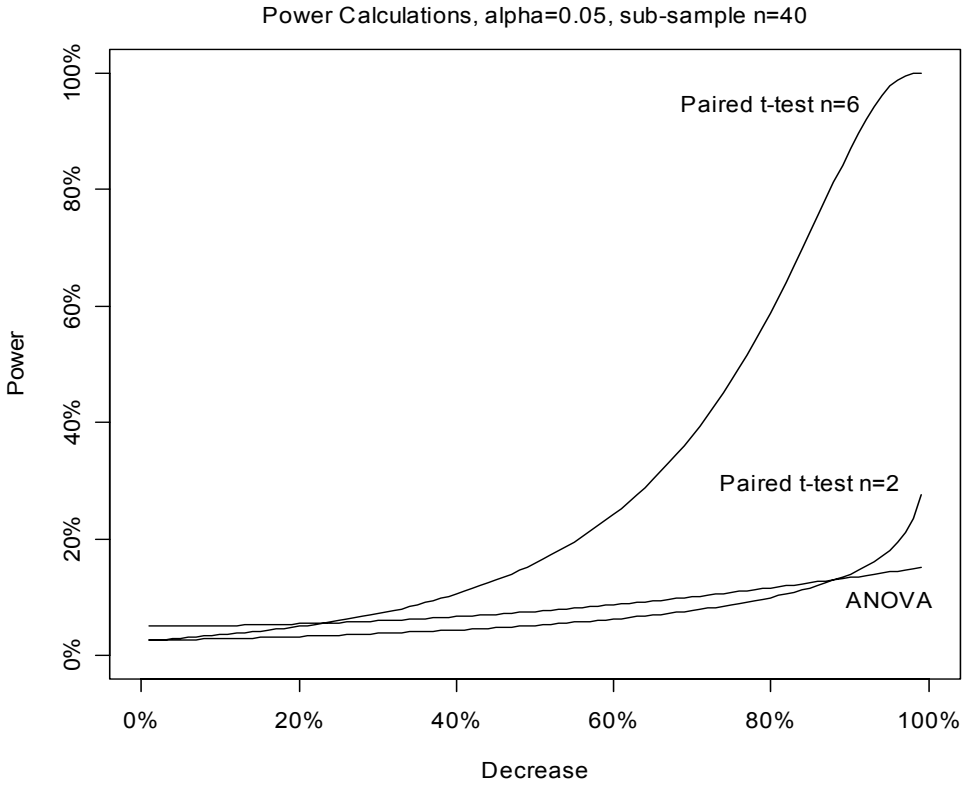

Figure 8. Power Analysis

This analysis revealed the following:

- Although the ANOVA should be somewhat more sensitive than the paired t-test with n=2, since it has 3 degrees of freedom in the denominator for testing each term, the power calculation performed here shows it as less sensitive. However, the qualitative result that the paired t-test with n=6 is better than the other two, and that the other two are somewhat comparable, is reasonable.
- The calculations for the paired t-test with n=2 and the ANOVA ignore the fact that there are three comparisons to be made in those cases, compared to only one in the case of the paired t-test with n=6. Therefore, the overall power for the multiple comparison cases is likely to be much lower than stated after all three comparisons are taken into account.
- The curves are surprisingly insensitive to changes in the sub-sampling size.

From this analysis, the optimal experimental design was determined to be the paired comparison design (PCD).

Sub-sampling design - The primary purpose of the sub-sampling design is to estimate swamp timothy yield per acre for each field. The secondary purpose of the design is to allow correlation of clip samples versus core samples and imagery versus clip and/or core samples.

Several possible methodologies were considered for sub-sampling. Sub-sampling may be at random, by area, or stratified with respect to swamp timothy habitat. Sub-sampling could also be fixed at the initial year or vary from year to year.

Given the wide variation expected in distribution of swamp timothy habitat from year to year, the possibility of variation in field management from year to year, and the unknown distribution of swamp timothy yield compared with actual distribution of swamp timothy habitat, random sampling of a set number of points from each field from year to year was determined to be the most robust procedure. Random sampling yields unbiased estimates of swamp timothy yield for each given field. Unbiased estimates may be made within each stratum and from year to year. Although more precise estimates might be possible by stratifying on swamp timothy habitat as assessed by imagery, this is by no means certain. This is actually a possible outcome of the current experiment (that is, whether imagery can serve as a proxy for core samples or clip samples).

Baseline Year: the first year of the study will be used as a baseline year to refine the appropriate analysis and sampling procedures. The following items will be assessed:

- Distribution and prevalence of zero values for sub-sampling.
  If these are found to be distributed in correlation with swamp timothy habitat, then swamp timothy habitat may be considered for stratifying sampling in the following years.
- Expected throughput of core sampling. It may be possible to develop improved methods of analyzing the core samples to allow larger sample sizes or less effort for the same sample size, allowing a greater number of sub-samples to be taken in subsequent years.
- Effects of practices that may hinder data collection, such as mechanical management. In extreme cases, half the sample may be affected by mowing or discing. The effects of mechanical management will be assessed. If these are large then it may be necessary to reduce mechanical management during the experiment.
- The likely distribution of swamp timothy seed compared to imagery of swamp timothy habitat distribution. A large enough sample size should be taken so that each habitat stratum is represented fairly well. At least n=40 or 50 seems reasonable, assuming roughly four strata in roughly equal proportions (about n=10 or 12 per stratum). If "too many" or "too few" samples are taken, this can be assessed and modified in subsequent years.
- Although quite unlikely, if the correlation between pairs of plots is too low, then it will be best to randomize them separately rather than in pairs. In order for pairing to be helpful, the correlation between the members of the pair must be high enough to justify the increase in variance caused by taking the difference. A correlation of $\rho=0.5$ or more is

needed. If the correlation between members of pairs is too low, then the experimental design should be adjusted to a randomized design.

C5. Tasks and Deliverables: See Exhibit B- Schedule and List of Deliverables**.**

The timeline for this project assumes an April 1, 2006 start date with a project term of three years (end date March 30, 2009). Moist soil habitat image acquisition, image segmentation, ground truthed mapping, vegetation surveys, and dry swamp timothy seed head collection will begin April 1 each year and end at the end of September. Analysis will be completed by the end of January each year. Submerged swamp timothy core sampling will begin September 1 each year and end at the end of October. Analysis will be completed by the end of January each year. Waterbird surveys will begin after the closing of waterfowl hunting season on February 1, 2007 and continue through the remainder of the flood season ending in late May. Analysis will be completed by the end of July each year. Continuous electrical conductivity, temperature, and flow monitoring will begin Sept 1 each year and end at the end of May the following year. A draft final report will be completed by March 30, 2009.

C6. Subcontractors: See Exhibit

Ducks Unlimited will act as project administrator/ subcontractor and employ the primary field investigating graduate student, undergraduates, and seasonal staff. Primary investigators' responsibilities include the statistical and experimental design including the methods and sampling effort of the vegetation surveys, swamp timothy sample collection, swamp timothy processing and avian monitoring. Primary investigators will also lead and supervise the vegetation and avian monitoring data collection efforts including the habitat mapping, swamp timothy sampling, vegetation surveys, undergraduate swamp timothy sample processing, and avian surveys. Primary investigators will also analyze the vegetation and avian data collected and will also be responsible for the final report.

C7. Work Schedule: See Exhibit B, Schedule and List of Deliverables.

Start Date: April 1, 2006 project term of three years (End Date March 30, 2009)

C8. Special Equipment and Supplies Required:

The $36,000 for swamp timothy processing covers undergraduate wages and overhead for processing of the dry clipping samples each year. The $41,760 covers the cost of two 4-wd vehicles leased from general services for 3 years. The $19,850 for minor equipment costs include such items as aerial imagery, a computer software license, cell phone service for the field crew, swamp timothy clipping sampling equipment, timothy processing equipment, a dissecting scope, a 0.0001g digital scale, a chest freezer, an oven dryer, spotting scopes, binoculars, swamp timothy core samplers, digital recorders for avian data collection, and office supplies. See Exhibit B, Equipment Detail.

C9. Project Impacts:

Provide insight to the water balance of the selected wetland cells under traditional swamp timothy management and the wetland cells under the modified hydrologic scenario.

Provide insight to drainage water quality and quantity of the selected wetland cells.

Provide insight to the methods of remote sensing technologies for moist soil habitat recognition, delineation, and the assessment of the long-term impact of salinity management actions.

Provide insight into assessing swamp timothy productivity in the pre and post flood condition.

Provide insight to the methods of monitoring bird usage overtime in response to water quality, water depths, and a delay in draw down.

Provide insight into maximizing quality of wildlife habitat and water quality in the San Joaquin River.

C10. Stakeholders and Interested Parties:

This project will involve local landowners, private duck club operators and managers located with in the Grasslands Ecological Area. Other government agencies and organizations that will participate directly in this project include Grassland Water District (GWD), University of California –Davis (UCD), Lawrence Berkeley National Laboratory (LBNL), Department of Water Resources (DWR), and the U.S. Bureau of Reclamation (USBR). Vegetation mapping, swamp timothy sampling, and waterbird monitoring will be supervised by CDFG. Field installations of water quality monitoring stations will be supervised by LBNL. LBNL will also assist in the moist soil habitat ground truthing, aerial image acquisition, image segmentation and processing. DWR will participate in the field installations of water quality monitoring stations, avian monitoring, and will be responsible for the moist soil swamp timothy core sampling, sample processing and analysis. Maintenance of the stations after installation will initially be undertaken by technicians from UC Merced until some of these functions can be turned over to trained CDFG staff toward the end of the project. One of the goals of the Directed Action study is to develop data acquisition and reporting systems that are accurate, robust and easy to set up and maintain by private duck clubs and water managers within the State and Federal Wildlife Management Areas and Refuges. UCD will serve as the project administrator. USBR will contribute water quality equipment for eight stations and provide staff to assist in the ground truthing effort, and avian surveys.

C11. Consistency with CALFED ERP Goals:*

1) Identify Project Applicability to Eco-Elements
Primary: Seasonal Wetlands
Secondary: Contaminants
Secondary: Central Valley Stream Temperatures

2) Identify Project Applicability to ERP Goals and Objectives:
This proposal is highly integrated with many CBDA programs and objectives regarding water quality in the lower San Joaquin River watershed including:

1. Previously funded CALFED projects

This pilot proposal would continue to collect data from managed wetlands within the Grassland Wetlands area. Specifically, collection of electrical conductivity, temperature and flow data under this proposal would occur at many of the same locations monitored under the previously

funded Grassland Water District project titled *Adaptive Real-Time Management of Seasonal Wetlands in the Grassland Water District to Improve Water Quality in the San Joaquin River*, CALFED Contract No. ERP-00-FC-B05. This proposal would also add to the USFWS investigation of salt and boron in the San Luis National Wildlife Refuge Complex (Beckon and Milar, 2003).

2. Water Supply, Reliability, and Environmental Improvement Act (H.R. 2828)

RWQCB historic records indicate that wetland flows contribute about 8% of the annual total salt load to the San Joaquin River at Vernalis (Refuge Water Supply Long-Term Water Supply Agreements San Joaquin River Basin, USBR, USFWS, DFG, GWD, January 2001). Current efforts to further characterize managed wetland salinity discharge include H.R. 2828 which requires the Secretary of the Interior to develop and implement a best management practices plan to reduce water quality impacts of discharges from wildlife refuges that receive water from the federal government and discharge salt or other constituents into the San Joaquin River.

3. Delta Implementation Package Implementation Plan

CBDA Resolution 04-08-04 adopted the Delta Improvements Package Implementation Plan which requires DWR, USBR and other CALFED agencies (including DFG) to develop and implement a comprehensive San Joaquin River Salinity Management Plan including a coordinated agricultural and managed wetland drainage strategy for the San Joaquin River, and initiation of a San Joaquin River Salinity Management Group study of refuge salinity management. The resolution also includes a Science Program PSP process to evaluate studies which address the relationship between water management activities and biological resources.

4. Ecosystem Restoration Program

The Ecosystem Restoration Multi-Year Program Plan (MYPP) identifies Strategic Goals and Objectives for ERP to meet over the 30 year course of the Bay-Delta Program. This project is identified as a Major Activity in the July 2005 draft of the MYPP for Years 6-9. This proposal specifically addresses several *Restoration Targets* and *Programmatic Actions* in the following Ecological Management Zones:
San Joaquin River EMZ – Habitats, Seasonal Wetlands, Target 2: Develop and implement a cooperative program to enhance 120,300 acres of existing public and private seasonal wetland habitat consistent with the goals of the Central Valley Habitat Joint Venture and the North American Waterfowl Management Plan. **Programmatic Action 2A:** Improve and manage seasonal wetland habitat throughout the EMZ. **Contaminants, Programmatic Action 1C**: Work with local landowners and State and federal agencies to improve land management practices to reduce contaminant input.

West San Joaquin Basin EMZ – Ecological Processes, Central Valley Stream flows, Programmatic Action 1A: Enter into agreements with water districts and wetland managers to provide return flows of high quality water from irrigated agriculture and seasonal wetlands to the San Joaquin River.

5. CALFED Science Program PSP process

This proposed project will develop information consistent with key research topics identified in the 2004 Proposal Solicitation Process including water operations and biological resources,

ecological processes and their relationship to water management and key species, and performance assessment to improve tools and implications of future changes.

6. Water Quality Program Plan

The CALFED Bay-Delta Program Water Quality Program Plan, Final PEIS/EIR Technical Appendix, July 2000, Section 7.5.2 Basin wide Actions, states under the *Information Needed - Water Quality Objectives* section that "…the RWQCB needs information on the effects of elevated salt concentrations on the beneficial uses. Monitoring of the spatial and temporal extent of elevated salts, coupled with special studies to determine effects of elevated salts, will provide the necessary information for establishment of water quality objectives. CALFED should support the monitoring and studies." Section 7.5.3 Evaluation of Other Sources of Salinity, states under the *Sources* section that wetlands are a source of salinity and "must be quantified." The *Impacts* section refers to the Regional Board Amendment Addressing Salinity and Boron which references effects of elevated salts to "Environmental uses and impacts related to aquatic habitat."

7. San Joaquin River water quality efforts

Finally, this proposed project would continue to build upon the foundation of an adaptive management strategy that could augment the San Joaquin River Management Program, the Grasslands Bypass Project, and other California Bay-Delta Authority sponsored initiatives on water quality management in the San Joaquin River and with the Vernalis Adaptive Management Program.

3) Identify Project Applicability to Environmental Water Quality Constituents:
Primary: Salinity
Secondary: Not Applicable

4) Identify Project Applicability to CALFED ERP Stage 1 Milestones:
CALFED ERP Stage 1 Milestone 112

C12. Related Projects*

1) If this project is related to another restoration project, identify other projects by number and program (e.g. CALFED, CVPIA), and if CALFED, identify that relationship by category:
Water quality degradation in the San Joaquin River was first recognized by the State Water Resources Control Board in the 1975 Basin Plan causing the Lower San Joaquin River to be designated a "Water Quality Limited Segment". After the demise of the San Joaquin Basin "Master Drain" the CRWQCB promulgated amendments to the Basin Plan recognizing that a regional solution, involving all contributors of salt within the Basin, 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. 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 that were not being addressed through voluntary adoption of irrigation and drainage Best Management Practices. 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". The effects that timed discharge releases have on wetland habitat and waterbird use is the major thrust of this project proposal.

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 U.S. Fish and Wildlife Service in the 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, and 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 Grasslands Water District will move into implementation of these concepts on paired seasonal wetland units within the Grassland Ecological Area.

PART D. Budget Summary

D1. Budget: See attached Exhibit A: Budget Detail, and Exhibit F: Subcontractor Budget

PART E. Project Location Information

E1. Project Location:

All research sites are located within the Grasslands Ecological Area, on California Department of Fish & Game managed lands or on private duck clubs, located within the Grassland Water District Boundary, in the vicinity of Los Banos, California.

E2. County or Counties Project is Located In:

Merced County

E3. ERP Eco-Region, Eco-Zone, and Eco-Unit Project is Located In:*

ERP Eco-Region: San Joaquin Valley
ERP Eco-Zone: West San Joaquin Basin
ERP Eco-Unit: N/A

E4. Project Centroid:

Latitude/Longitude Coordinates
N 37.10062 W120.81908 Datum-(WGS 84, Error-6m)

E5. Project Map:

See attached Exhibit C: 24 K Topo-Quad Wetland Response Project Map

E6. Digital Geographic File:

See attached Exhibit D, Digital Geographic File Wetland Response Project Map

E7. Congressional District:

Congressional District 18

PART F. Environmental Information

F1. CEQA/NEPA Compliance

1) Will this project require compliance with CEQA, NEPA, both, or neither:*
This project is categorically exempt from CEQA and the requirements of NEPA.

2) Is your project covered by either a Statutory or Categorical Exemption under CEQA or a Categorical Exclusion under NEPA:*

This project is categorically exempt from the provisions of CEQA pursuant to CEQA Guidelines Section 15306, Class 6, defined as follows:

Class 6 consists of basic data collection, research, experimental management, and resource evaluation activities, which do not result in a serious or major disturbance to an environmental resource. These [types of projects] 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.

3) If your project requires additional CEQA/NEPA analysis, please indicate which type of documents will be prepared: No Analysis is Required

- Initial Study/Negative Declaration
- Environmental Assessment/FONSI
- EIR/CEQA Findings of Fact
- EIS/ Record of Decision

4) If the project will require CEQA and/or NEPA compliance, identify the lead agency(ies).

- CEQA Lead Agency: Not Applicable
- NEPA Lead Agency (Must be a Federal Agency): Not Applicable

5) If your project is not covered under items 2 or 3, and you checked no to question 1, please explain why compliance is not required for the actions in this proposal: Not Applicable

6) If the CEQA/NEPA process is not complete, please describe the estimated timelines for the process and the expected date of completion: Not Applicable

7) If the CEQA/NEPA document has been completed, what is the name of the document and provide State Clearinghouse number: Not Applicable

F2. Environmental Permitting and Approvals

Please indicate what permits or other approvals may be required for the activities contained in your proposal and which have already been obtained. Please indicate all that 1) are needed, and 2) if needed, have been obtained: There are no permits needed for this project.

PART G. Land Use Questionnaire

G1. Land Use Changes

1) Do the actions in the proposal involve physical changes in the land use, or potential future changes in land use (Yes/No): No

- If yes, describe what actions will occur on the land involved in the proposal.
- If no, explain what type of actions are involved in the proposal (i.e., research only, planning only). Research only

2) How many acres of land will be subject to a land use change under the proposal:

Not Applicable

3) Is the land subject to a land use change in the proposal currently under a Williamson Act contract (Yes/No): Not Applicable

4) For all lands subject to a land use change under the proposal, describe what entity or organization will manage the property and provide operations and maintenance services.
Not Applicable

5) Does the applicant propose any modifications to the water right or change in the delivery of the water (Yes/No): Not Applicable

- If yes, please describe the modifications or changes:

G2. Current Land Use and Zoning

1) What is the current land use of the area subject to a land use change under the proposal:
Not Applicable

2) What is the current zoning and general plan designation(s) for the property:

Mud Slough Unit- Zone A1 (Agriculture 1), General Plan- Agriculture
Los Banos Wildlife Area- Zone A1 (Agriculture 1), General Plan- Agriculture
Volta Wildlife Area- Zone A1/ A2 (Agriculture 1/ Agriculture 2), General Plan- Agriculture
Gadwall Unit- Zone A1 (Agriculture 1), General Plan- Agriculture
China Island Unit- Zone A1/ A2 (Agriculture 1/ Agriculture 2), General Plan- Agriculture
Ducky Strike Private Duck Club- Zone A2 (Agriculture 2), General Plan- Agriculture

3) How is the land categorized on the Important Farmland Series (IFL) maps (published by the California Department of Conservation):

Mud Slough Unit, Los Banos Wildlife Area Complex- IFL Series- Other land
Los Banos Wildlife Area-IFL Series- Grazing Land
Volta Wildlife Area-IFL Series- Other Land
Gadwall Unit, North Grasslands Wildlife Area-IFL Series- Grazing Land
China Island Unit, North Grassland Wildlife Area-IFL Series- Grazing Land
Ducky Strike Private Duck Club-IFL Series- Grazing Land

G3. Land Acquisition

1) Will the applicant acquire any land under the proposal, either in fee or through a conservation easement (Yes/No): No

- If yes, describe the number of acres that will be acquired and whether the acquisition will be of fee title or a conservation easement:
- Total number of acres to be acquired under proposal:
- Number of acres to be acquired in fee:
- Number of acres to be subject to conservation easement:

2) For land acquisitions (fee title or easements), will existing water rights be acquired (Yes/No):
Not Applicable

G4. Land Access

1). Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal (Yes/No): Yes
If yes, attach written permission for access from the relevant property owner(s).
See attached Exhibit E: Property Access Form

PART H. Qualifications

H1. Qualifications

John Beam - Project Director, California 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 at Humboldt State University (HSU) and did graduate work at HSU.

Don Marciochi – Project co-Director, 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 drain water from the District's water supply.

Nigel Quinn - Geological Scientist, Lawrence 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 a Research Group Leader at Lawrence Berkeley National Laboratory for the past 15 years and concurrently holds research and guest scientist positions at UC Berkeley (Research Engineer), UC Merced (Research Engineer), CSU Fresno (Adjunct Research Professor in the Plant Science Department) and the US Bureau of Reclamation (Water Resources Engineer). He is the author of over 50 publications and reports on various aspects of water resources and drainage engineering.

William Cook- Refuge Manager, California 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 wetland management, wetland restoration, and water management throughout the Grassland Ecological Area.

John M. Eadie, University of California, Davis- Primary Investigator
John Eadie PhD is a professor in the wildlife, fish, and conservation biology department at UC Davis. Since 1995 he has served as professor for the Dennis G. Raveling waterfowl professorship. He has served as a member of Central Valley Habitat Joint Venture Technical Committee, Waterfowl & Wetlands Technical Committee, California Waterfowl Association, Wood Duck Steering Committee, USA Rice Federation Waterfowl Committee, Sacramento

Valley Floodplain Management Committee, City of Davis Wetlands Advisory Committee, and the Pacific Flyway Center Advisory Committee.

Ricardo Ortega- Primary Field Investigator
Ricardo Ortega is a contract biologist with the California Department of Fish and Game's 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 in Ecology and Systematic Biology concentrating in Wildlife Biology at Cal Poly State University, San Luis Obispo and has conducted research in restoration ecology, avian ecology, and vegetation assessments throughout Central California.

CONTRACTOR NAME:
DFG CONTRACT #:

Budget Detail

	ANNUAL SALARY	TOTAL HOURS	TOTAL CONTRACT AMOUNT	AMOUNTS FY 05/06 YEAR 1 TOTAL HOURS	FY 05/06 YEAR 1 TOTAL AMOUNT	FY 05/06 Task 1 Amount	FY 05/06 Task 2 Amount	FY 05/06 Task 3 Amount	FY 06/07 YEAR 1 TOTAL HOURS	FY 06/07 YEAR 1 TOTAL AMOUNT	FY 06/07 Task 1 Amount	FY 06/07 Task 2 Amount	FY 06/07 Task 3 Amount	FY 07/08 YEAR 2 TOTAL HOURS	FY 07/08 YEAR 2 TOTAL AMOUNT	FY 07/08 Task 1 Amount	FY 07/08 Task 2 Amount	FY 07/08 Task 3 Amount	FY 08/09 YEAR 3 TOTAL HOURS	FY 08/09 YEAR 3 TOTAL AMOUNT	FY 08/09 Task 1 Amount	FY 08/09 Task 2 Amount	FY 08/09 Task 3 Amount
Personnel Services: Subcontract expenditure																							
Graduate Student	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0
Undergraduate wages	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0
Seasonal Staff	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0
	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0
	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0
	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0
	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0
	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0
	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0
	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0
Sub-Total Personnel Services		0.00	$0			$0	$0	$0	0.00	$0	$0	$0	$0	0.00	$0	$0	$0	$0	0.00	$0	$0	$0	$0
1/ Benefits (Rate)						$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
Total Personnel Services						$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
Operating Expenses																							
General Expense			0.00			$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
Training			0.00			$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
2/ Travel and Per Diem			0.00			$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
3/ Equipment			0.00			$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
Minor Equipment/Supplies			22,610.00		$22,610	$0	$22,610	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
Vehicles			48,240.00		$4,020	$0	$4,020	$0		$16,080	$0	$16,080	$0		$16,080	$0	$16,080	$0		$12,060	$0	$12,060	$0
			0.00			$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
4/ Sub-Contracts (Personnel)			145,500.00			$0	$0	$0		$48,500	$0	$48,500	$0		$48,500	$0	$48,500	$0		$48,500	$0	$48,500	$0
Total Operating Expense			$189,720		$26,630	$0	$26,630	$0		$64,580	$0	$64,580	$0		$64,580	$0	$64,580	$0		$60,560	$0	$60,560	$0
Subtotal Operating Expenses and Personnel Services			$189,720		$26,630	$0	$26,630	$0		$64,580	$0	$64,580	$0		$64,580	$0	$64,580	$0		$60,560	$0	$60,560	$0
5/ Overhead Costs @ Overhead only on personnel services	**30.00%**		$43,650			$0	$0	$0		$14,550	$0	$14,550	$0		$14,550	$0	$14,550	$0		$14,550	$0	$14,550	$0
Total by Task by Fiscal Year						$0	$26,630	$0			$0	$79,130	$0			$0	$79,130	$0			$0	$75,110	$0
Total by FY						**$26,630**						**$79,130**				**$79,130**					**$75,110**		

Contract Total Amount **$260,000**

1/ Indicate Rate in Column immidiately to the right of this cell

2/ Travel Expenses and per diem rates set a the rate specified by the Department of Personnel Administration for employees. (See Attachment 3 - Travel guildlines). The contractor is required to maintain travel receipts and records for auditing purposes. No travel out-side of the state of California shall be reimbursed unless prior written authorization is obtained from the State.

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

4/ Please list each subcontractor and amounts by task if succeeding rows, and provide a full budget sheet for each subcontractor by copying this format and creating a tab in ths worksheet labled with the csubcontractors name

5/ Indicate Rate in Column immidiately to the right of this cell; and provide a description of what expenses are covered by Overhead.

CONTRACTOR NAME: CDFG

SUB CONTRACTOR NAME: DU

DFG CONTRACT #:

Exhibit-B Attachment 2 - Subcontractor Budget Detail

Subcontractor Budget Detail

				AMOUNTS																			
				FY 05/06					FY 06/07					FY 07/08					FY 08/09				
			TOTAL	YEAR 1 TOTAL		Task 1	Task 2	Task 3	YEAR 2 TOTAL		Task 1	Task 2	Task 3	YEAR 3 TOTAL		Task 1	Task 2	Task 3	YEAR 4	TOTAL	Task 1	Task 2	Task 3
	ANNUAL SALARY	TOTAL HOURS	CONTRACT AMOUNT	HOURS	AMOUNT	Amount	Amount	Amount	HOURS	AMOUNT	Amount	Amount	Amount	HOURS	AMOUNT	Amount	Amount	Amount	HOURS	AMOUNT	Amount	Amount	Amount
Personnel Services:																							
Management Staff	$26,500	0.00	79,500.00	0	$0	$0	$0	$0	0	$106,000	$0	$26,500	$0	0	$26,500	$0	$26,500	$0		$26,500	$0	$26,500	$0
Senior Engineer	$12,000	0.00	36,000.00	0	$0	$0	$0	$0	0	$12,000	$0	$12,000	$0	0	$12,000	$0	$12,000	$0		$12,000	$0	$12,000	$0
Scientific/Technical Staff	$10,000	0.00	30,000.00	0	$0	$0	$0	$0	0	$10,000	$0	$10,000	$0	0	$10,000	$0	$10,000	$0		$10,000	$0	$10,000	$0
	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0		$0	$0	$0	$0
	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0		$0	$0	$0	$0
	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0		$0	$0	$0	$0
	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0		$0	$0	$0	$0
	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0		$0	$0	$0	$0
	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0		$0	$0	$0	$0
	$0	0.00	0.00	0	$0	$0	$0	$0	0	$0	$0	$0	$0	0	$0	$0	$0	$0		$0	$0	$0	$0
Sub-Total Personnel Services		0.00	$176,500	0.00	$0	$0	$0	$0	0.00	$128,000	$0	$48,500	$0	0.00	$48,500	$0	$48,500	$0		$48,500	$0	$48,500	$0
1/ Benefits (Rate)	**0.00%**				$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
Total Personnel Services					$0	$0	$0	$0		$48,500	$0	$48,500	$0		$48,500	$0	$48,500	$0		$48,500	$0	$48,500	$0
Operating Expenses																							
General Expense			0.00		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
Software			0.00		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
Office Supplies			0.00		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
Training			0.00		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
2/ Travel and Per Diem			0.00		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
3/ Equipment			0.00		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
Software and Supplies			0.00		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
Rent			0.00		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
Printing / Misc			0.00		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
Workshop Supplies			0.00		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
Nets & Seines			0.00		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
			0.00		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
Total Operating Expense			$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0		$0	$0	$0	$0
Subtotal Operating Expenses and Personnel Services			$145,500		$0	$0	$0	$0		$48,500	$0	$48,500	$0		$48,500	$0	$48,500	$0		$48,500	$0	$48,500	$0
4/ Overhead Costs @	**30.00%**		$29,100		$0	$0	$0	$0		$14,550	$0	$14,550	$0		$14,550	$0	$14,550	$0		$14,550	$0	$14,550	$0
Total by Task by Fiscal Year						$0	$0	$0			$0	$63,050	$0			$0	$63,050	$0			$0	$63,050	$0
Total by FY							**$0**				**$63,050**					**$63,050**					**$63,050**		
Contract Total Amount												**$189,150**											

1/ Indicate Rate in Column immidiately to the right of this cell
2/ Travel Expenses and per diem rates set a the rate specified by the Department of Personnel Administration for employees. (See Attachment 3 - Travel guildlines). The contractor is required to maintain travel receipts and records
3/ Please provide a list and cost of major equipment ($5,000 or more) to be purchased
4/ Indicate Rate in Column immidiately to the right of this cell; and provide a description of what expenses are covered by Overhead.

EXHIBIT B
SCHEDULE AND LIST OF DELIVERABALES

Wetland Response to Modified Hydrology with Respect to Salinity Management

Task	Task Title	Deliverable	Estimated Completion Dates
1	Project Management & Administration	• Semi-Annual Progress Report • Invoices • Draft Report • Final Report • Project Close-Out Report • Final Invoice	• Semi-annual report throughout the contract term. Due 10th of July, Jan. each year • Monthly, 10th of the month following billing period. • See tasks below. • See tasks below. • May 2009 • June 2009
2	Biological Monitoring • Habitat Mapping & Swamp Timothy Sampling • Waterbird Use Surveys • Obtain Water Quality Data from Sister Project "Adaptive, Coordinated Real-time Management of Wetland Drainage" • (QAPP) Quality Assurance Program Plan	• GIS maps of each wetland unit, and swamp timothy productivity for each wetland unit will be included in the annual report in each of the three project years containing • Water bird usage data will be included in the annual report in each of the three project years • Water quality data collected in sister project will be included in the annual report in each of the three project years • Quality Assurance Program Plan will be submitted to Cal Fed	• Final annual reports due March in year following survey March 2007 March 2008 March 2009 • March 2007 March 2008 March 2009 • March 2007 March 2008 March 2009 : • June 2006
3	Outreach • Landowner Workshop • Newsletter Publication • Western Wildlife Society Meeting Presentation • Reporting to (SJRMG) San Joaquin River Management Group	• Yearly presentation at Landowner workshop • Grassland Water District quarterly newsletter publication • Annual poster presentation at the Wildlife Society Meeting • Final Report sent to San Joaquin River Management Group to use in conjunction with current modeling.	• May 2006, 2007, 2008 • Quarterly publication beginning in January 2007-2009 • February 2008, 2009 • Final Report sent: March 2009