Dutch Slough Tidal Marsh and Floodplain Restoration Project

Revised Proposal to CALFED

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Applicant: Mary Small, California Coastal Conservancy

Participants and Collaborators:
Stan Emerson, Emerson Dairy
Robert Burroughs
Brent Gilbert
Nancy Schaefer, Conservation Fund
John Cain, Natural Heritage Institute

A. <u>Project Description: Project Goals and Scope of Work</u>

1. Problem

Problem Statement

The Sacramento-San Joaquin Delta was historically composed of over 350,000 acres of tidal marsh and adjoining seasonal wetlands (Atwater, 1982). Over 97 percent of the Delta's tidal marshes have been eliminated (The Bay Institute, 1998) and many of the native fish species that once depended upon them are in danger of extinction.

The CALFED Ecosystem Restoration Plan (ERP) assumes that restoring large tracts of tidal marsh will improve conditions for the Delta's native fish assemblages. Unfortunately, much of the Delta is deeply subsided and lacks topographic diversity, making it very difficult to restore to marsh. There are few potential restoration sites in the western delta, where many endangered native fish congregate or migrate. In addition to the lack of appropriate sites, large-scale restoration efforts have also been hampered by local opposition to the conversion of farmland for habitat, limited understanding of restoration ecology and the potential for invasion by exotic species.

The Dutch Slough site is the best remaining opportunity for habitat restoration in the western delta. The site presents an important opportunity for restoration because of the following critical features:

- Topographic diversity - allows for creation of habitat mosaic
- Appropriate elevations – relatively minor subsidence
- Zoning – the site is zoned for development, and is not prime farmland
- Willing sellers
- Local support

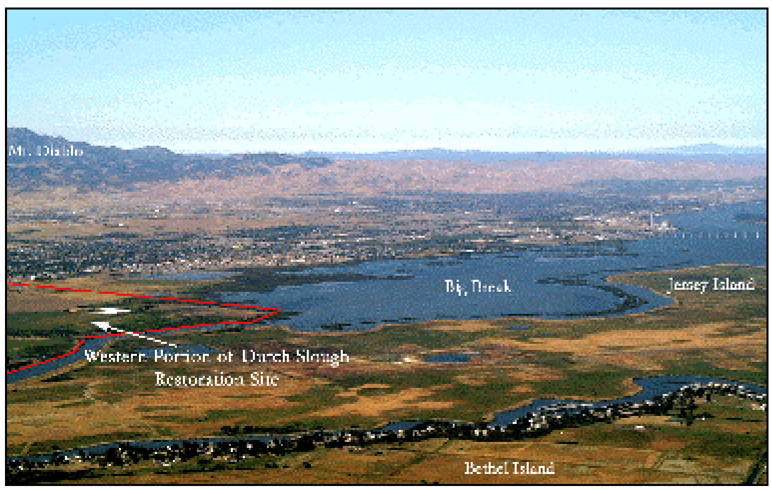


Figure 1: The western Delta location of the Dutch Slough restoration site provides a unique opportunity to restore a large area of tidal marsh.

Lastly, the site configuration lends itself to phased implementation and restoration within an adaptive management framework that will increase understanding of tidal marsh restoration ecology (Figure 1).

1 EMERSON PARCEL

2 GILBERT PARCEL

3 BURROWS PARCEL

4 FUTURE PARK SITE

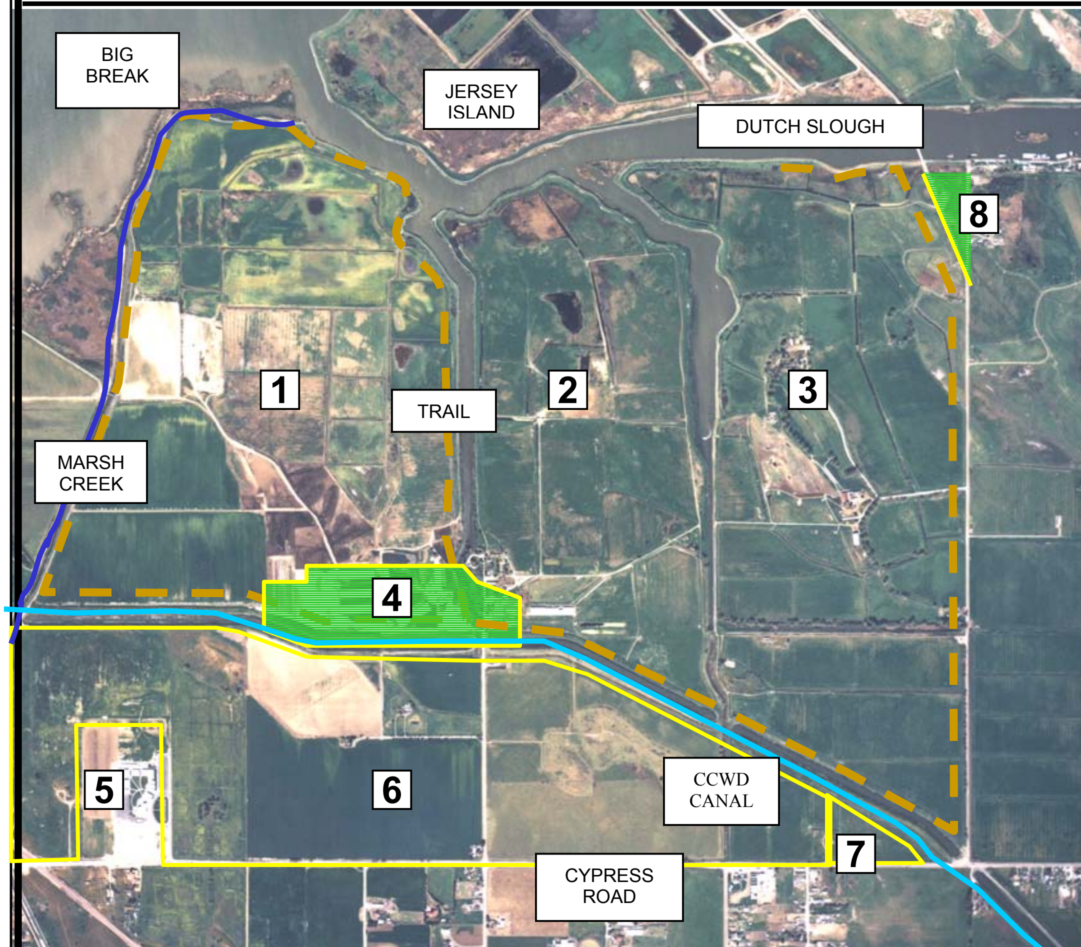


Figure 2: The Dutch Slough properties consist of 1,230 acres on the historical delta of Marsh Creek north of the Contra Costa Canal. The land was once a tidal marsh that was reclaimed for agriculture during the Gold Rush Era. The parcels are owned by the Emerson, Gilbert, and Burroughs families who have proposed restoring them to tidal marsh with the financial support of the Coastal Conservancy and the CALFED Bay-Delta program. Under the proposal to CALFED, the project would restore 1,166 acres of wetland and upland habitats. The landowners would deed the remaining 63 acres to the City of Oakley for recreational purposes consistent with the restoration goals of the project. The City of Oakley plans to develop a 55 acre community park, an 8 acre waterfront access area at the end of Jersey Island Road, and 4.5 miles of trail around the edges of the Emerson parcel and on portions of the Gilbert and Burroughs properties. Over 400 acres south of the Contra Costa Canal will be developed for housing.

5 DELTA VISTA MIDDLE SCHOOL

6 FUTURE HOMES

7 LAND TO BE CEEDED TO CITY OF OAKLEY

8 FUTURE CITY OF OAKLEY WATERFRONT ACCESS

0 0.25 0.5
Miles

N

DUTCH SLOUGH2 RESTORATION SITE

Project Description
This proposal requests $25,588,178 million dollars to acquire 1,166 acres, develop restoration plans, and initiate a tidal marsh restoration project. The project site encompasses three adjacent parcels: the 438-acre Emerson, the 292-acre Gilbert, and the 436 acres Burroughs properties (figure 2). The site will be restored to a mixture of shallow water, intertidal marsh, floodplain, and riparian habitats for many CALFED target species.

In addition to the restoration benefits, the site will provide open space and compatible public access, creating opportunities for recreation and environmental education. The project will follow the model of other restoration projects that have successfully combined public access and habitat restoration, including: Arcata Marsh, Carmel State Beach, Carpinteria Marsh, and Oakland's Middle Harbor. Through careful, coordinated design, the project will provide benefits to the public while achieving its restoration objectives.

Site Location
The site is located in the City of Oakley in northeast Contra Costa County and encompasses nearly 2 square miles bounded on the north by Dutch Slough, on the south by the Contra Costa Canal, on the east by Jersey Island Road, and on the west by Marsh Creek (figure 3). It is located on the Brentwood 7.5-minute USGS quadrangle, and the UTM (Zone 10) coordinates for the geographic center of the project are N4207383 and E617220. The restoration project will be planned cooperatively with an adjacent 55-acre regional recreational facility owned by the City of Oakley.

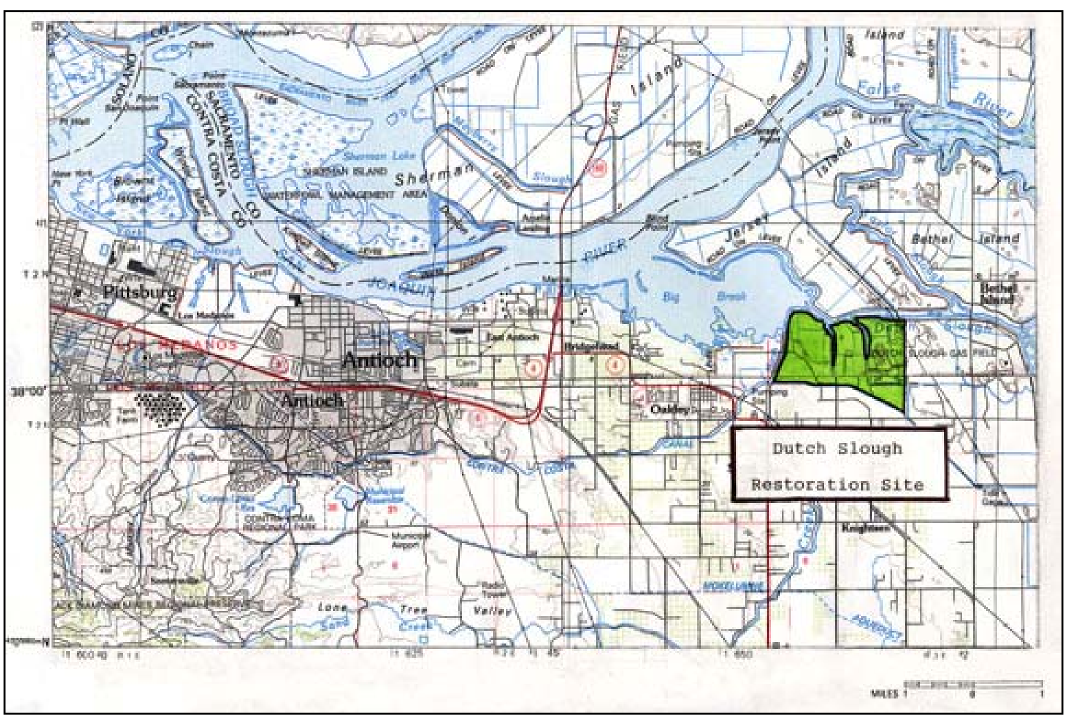


Figure 3: Dutch Slough site location

Project Goals
The project goals are to:

1) Implement a large-scale, locally supported restoration project that will serve the local community with shoreline access as well as educational, recreational, and economic opportunities.
2) Restore the Dutch Slough properties to a fully functioning, self-sustaining ecosystem that includes shallow water, emergent marsh, intertidal marsh, seasonal wetlands and floodplains, Antioch dune scrub, riparian forest, and oak savannah.
3) Significantly contribute to scientific understanding of tidal marsh and floodplain restoration through experimentation and monitoring under an adaptive management framework.

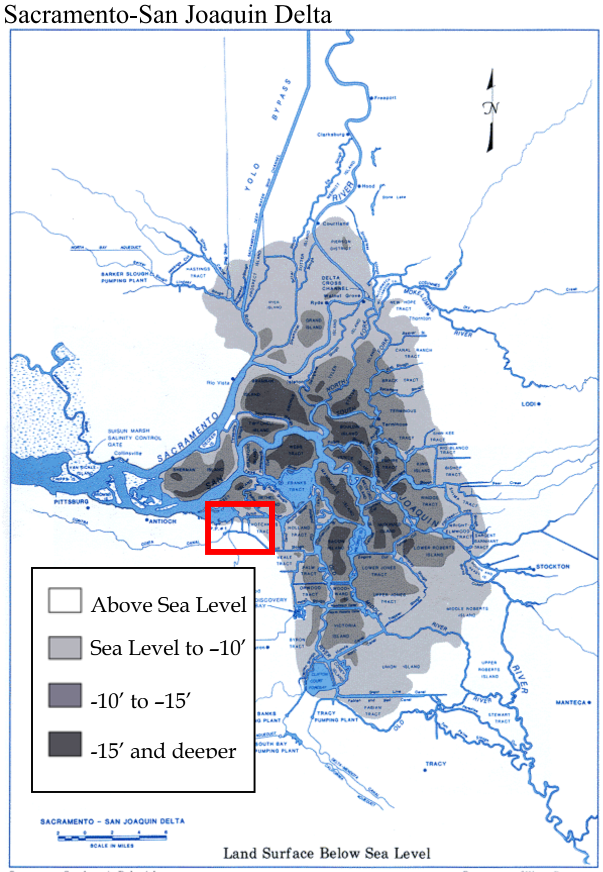
The project will be designed to create dendritic tidal marsh and floodplain habitats that benefit native fish species including juvenile salmonids, Sacramento splittail, and possibly Delta smelt. Its design will first focus on creating conditions for these fish, and then secondly, consistent with native fish requirements, will create habitat for other endangered or declining species including California black rail and other birds, giant garter snake, western pond turtle, and Antioch Dune species. Additionally, the project will be designed to provide public access to the shoreline and will offer recreational and educational opportunities.

2. Justification

The Dutch Slough site is the best and most logical site in the Delta to pursue large-scale, freshwater tidal marsh restoration.

Elevation and Topography
Over 100 years of farming has caused the oxidation and subsidence of the Delta's fragile peat soils and left much of the Delta 10-25 feet below sea level, too deep for restoration as tidal marsh (Figure 4). Lands near sea level on the eastern and southern fringes of the Delta cannot be restored to marsh without deeply inundating large tracts of farmland or building a new network of levees. Although lands with suitable elevations are relatively abundant on the southern margins of the Delta, the CALFED ERP cautions against marsh restoration in this area out of concern

Figure 4: Lands subsided below sea level in the Sacramento-San Joaquin Delta



that it will increase entrainment of native fish in the south Delta pumps. Agricultural use has also eliminated topographical diversity on most sites, making it difficult and expensive to restore diverse habitats because of the extensive grading required.

The Dutch Slough site is one of the only large-scale sites in the Delta, not already acquired for restoration, that is at suitable elevations for tidal marsh restoration. The diverse topography of the site will allow for restoration of an ecological continuum of tidal wetland, low marsh, high marsh, riparian habitat, and upland transition zones, including inland dune scrub habitat, with only minimal grading.

Location

Tidal marsh restoration in the western Delta is particularly important to create a habitat corridor between the Delta and Suisun marsh that encompasses a range of salinity gradients. Target species such as Delta smelt and splittail congregate in the Suisun Marsh and the western Delta and, unlike tidal marsh on the periphery of the Delta, all anadromous fish pass through the western Delta. Restoration of the Dutch Slough site would extend the complex of marshes from Suisun marsh, Browns Island, and Sherman Lake further into the western Delta along a range of salinity gradients providing more habitat options for native fish that congregate in the vicinity. Slight salinity levels may control exotic species in favor of native species. In the event of further saltwater intrusion into the Delta due to drought or other factors, the project will provide key fresh or brackish water marsh habitat for native target species.

Insufficient Knowledge of Tidal Marsh Restoration

The CALED strategic plan for ecosystem restoration (CALFED, 2000) recommends establishing large-scale pilot projects designed as experiments to test different approaches to restoring tidal marshes, assess the benefits of marsh habitat for native species, evaluate options for minimizing or controlling exotic fish species, and to test and monitor techniques for restoring subsided Delta islands to sea level. The Dutch Slough site is ideally suited for achieving these objectives. The site is configured in three similar sized parcels creating a unique opportunity for large-scale comparative studies to measure the efficacy of various restoration strategies. Unlike deeply subsided sites on Delta Island, the subsided portions of the site are shallow enough for testing large-scale subsidence reversal strategies that could yield useful information in the next decade. The project's location at the transition between fresh and brackish water is provides an excellent opportunity for comparison with other tidal marsh restoration projects with different salinities and environmental conditions in the northern Delta, Suisun Marsh, and San Pablo Bay.

Urbanization

As with other areas around the Delta, the City of Oakley is rapidly developing. This urbanization precludes future restoration and further degrades what remains of the Delta ecosystem. The Dutch Slough site has been historically managed for dairy and range, but the site and adjoining lands have been approved for development as a master-planned community of 4,500 to 6,100 housing units. This restoration project would prevent urbanization of more than 6 miles of Delta shoreline (including sloughs). The Contra

Costa Canal provides an ecological buffer between the site and the development to the south.

Public Support

Some Delta residents and public officials have expressed concerns about the impact of habitat restoration on existing farms and the Delta economy. The Dutch Slough site is not in the agricultural heart of the Delta, is not prime farmland, and is zoned for urban development. The Dutch Slough project has won the support of numerous local entities, politicians and residents including the City of Oakley, the Contra Costa Board of Supervisors, the Bethel Island municipal advisory group, the Knightson Town Advisory Council, Assemblyman Joe Canciamilla, State Senator Tom Torlakson, and Congress members Ellen Tauscher and George Miller.

The co-applicants have worked diligently with the City of Oakley and other interested parties over the past year and will continue to work with these important partners to coordinate planning of the project. The co-applicants and the City agree that if planned correctly, the project can create a significant regional amenity providing open space, as well as recreational and educational opportunities.

Conceptual Model

Restoration projects that create heterogeneous wetlands with complex tidal and riverine hydrology will benefit native endangered fish including Sacramento splittail, juvenile Chinook salmon and, potentially, Delta smelt.

The Dutch Slough restoration project will create a mosaic of natural wetland habitat types along a gradient from dendritic tidal marsh to seasonally inundated floodplain and riparian forest. Daily fluctuations of the tides, winter flooding, and seasonal variations in salinity will favor native fish and the macroinvertebrates they feed upon by creating habitat niches that are not subject to colonization by exotic predators or invasive aquatic vegetation. The daily and seasonal cycles of wetting and drying combined with the spatial complexity of dendritic tidal marsh and riparian habitats provide essential refuge and feeding opportunities during critical early life stages of endangered transient and anadromous fish when they are both growing and vulnerable to predation. The site's location at the mouth of Marsh Creek and in the western portion of the Delta where the tidal range and salinity fluctuation is greater will accentuate this spatial and temporal diversity. The site's proximity to the confluence of the Sacramento and San Joaquin Rivers and its relatively good connectivity to Suisun Marsh along a corridor of wetland sites[1] increases the probability that native fish will utilize the site.

This conceptual model is supported generically in the ecological literature on complexity and intermediate disturbance hypothesis (Connell 1978; CALFED 2001; Resh et al. 1988; Wooten et al. 1996; Ward and Stanford 1983). It is also supported in estuarine environments, including the Delta, by recent studies on the Yolo Bypass (Sommer et al. 2000), Delta marshes (Grimaldo et al. 1998), and other estuaries (Healey 1991). Research suggests that seasonally inundated floodplains and intertidal marshes provide important

[1] These include Big Break, Little Break, Sherman Island, and Browns Island

habitat for the rearing and spawning life stages of native aquatic species including Sacramento splittail, juvenile salmon, Delta smelt, and the giant garter snake (Chotkowski 1999; Junk et al. 1989; Sommer et al. 2000). Furthermore, these and other studies (Bayley 1991) indicate that a range of elevation gradients within a wetland site, as well as disturbance regimes associated with sediment input and other fluvial processes, result in greater biodiversity and utilization by native aquatic species. The lack of these types of habitats and processes for early life stages of endangered fish may be a major reason for the decline of these populations (Bennett and Moyle 1996).

1. Restoration of Dutch Slough Will Create a Diversity of Habitat Types

Restoration of the site will create a heterogeneous mosaic of habitats that will benefit numerous native species. Hanson attributed Big Break's species diversity—over 35 fish taxa including Delta smelt, splittail, and Chinook salmon identified during 1997 surveys between Big Break and Antioch—to its unique habitat complexity (Hanson pers com, 2000). Table 1 and Figures 5 and 6 illustrate the diversity of habitats types that could be restored without any grading.[2]

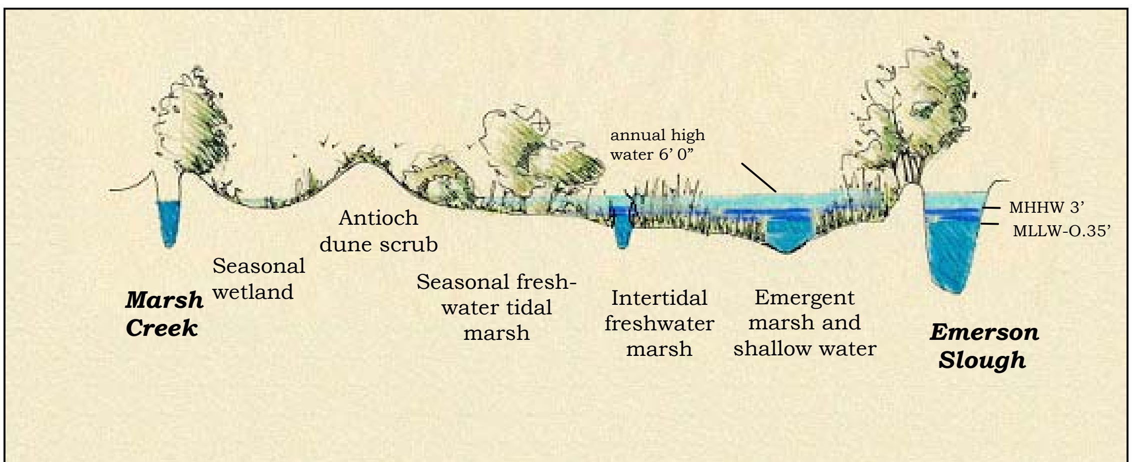
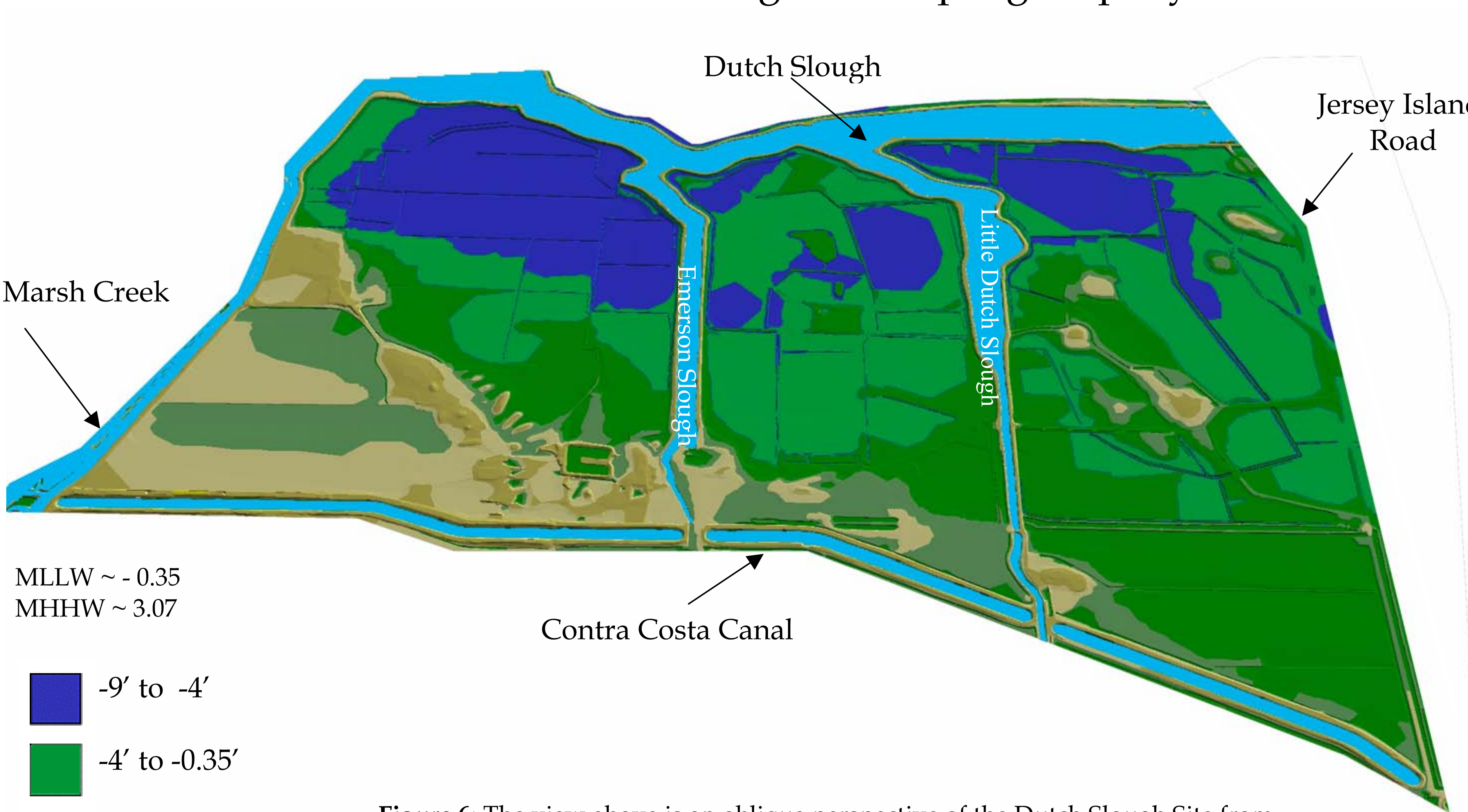


Figure 5: Representative cross section of restored Emerson parcel.

Restoration of the site would also create shaded riverine and riparian habitat along the property's extensive shoreline. The site has nearly six miles of relatively barren levee shoreline along major tidal sloughs and Marsh Creek that can easily be revegetated. Tidal inundation to the interior of the site would add nearly ten miles of edge habitat. The project will restore this shoreline into shaded riverine aquatic habitat benefiting avian, terrestrial, and herpto fauna. Leaf litter from riparian forests will provide an important source of nutrients, while overhanging vegetation, exposed root masses, and large woody debris will create shade, cover, spawning substrate, and macroinvertebrate habitat. During flood stage, riparian forests provide important rearing and spawning habitat for splittail and salmon (Crain et al, 2000; Sommer et al, 2001).

[2] More acres of particularly valued target habitats could be restored with some site grading.

Dutch Slough Topography



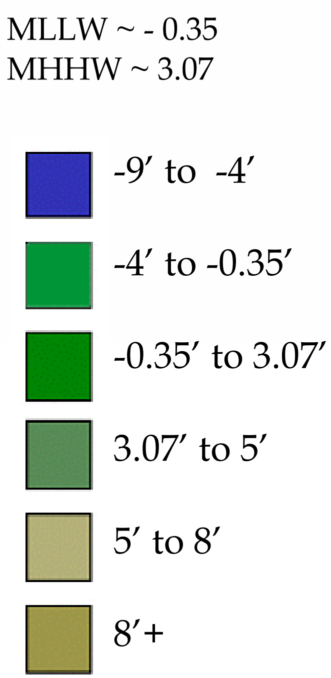


Figure 6: The view above is an oblique perspective of the Dutch Slough Site from the south. With tidal inundation, lands between -0.35 and 3.07 feet elevation will support intertidal marsh. Lands between -0.35 and - 4 feet elevation may support emergent marsh. Elevations 3.07 to 5 feet would be seasonally inundated each year. The 5-8 feet elevation could be restored with riparian and grassland species, and the areas above 8 feet are mostly Delhi sands that may be suitable for dune restoration.

Table 1. Land area summary for existing topography and corresponding habitat restoration potential at Dutch Slough, City of Oakley, California.

Current Elevation (feet below MLLW)	Potential Habitat Type	Total (acres)
-10 to –3	Shallow Water	373
-3 to 0	Emergent Marsh	224
0 to 3	Intertidal Marsh	259
3 to 5	Seasonal Marsh & Floodplain	137
5 to 8	Mixed Riparian-Oak Woodland	82
8 +	Antioch Dune Scrub	91
	Total (acres)	**1,166**

Delhi sands and bush lupines on the site demonstrate potential for restoring Antioch Dune plant species on the site (Figure 7). Although restoring a fully functioning dune community will be challenging, the project would be able to propagate and maintain populations of Antioch Dune plant species such as Contra Costa wallflower and Antioch Dune primrose (Pavlik, pers com).

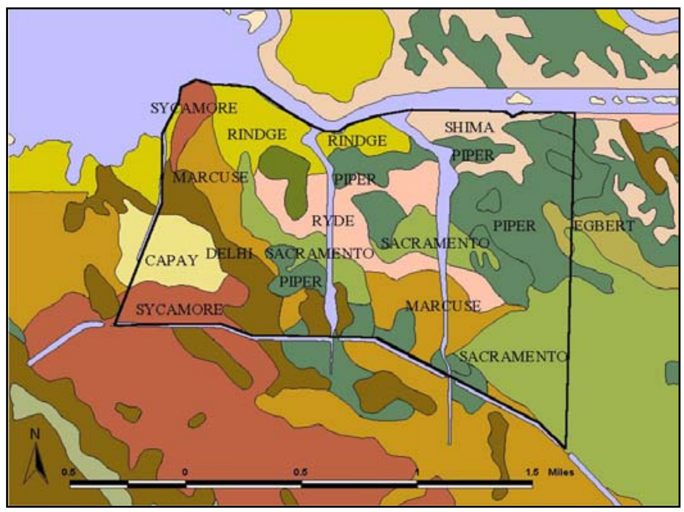


Figure 7: The soils at the Dutch Slough site provide a diverse selection of substrates upon which to test marsh evolution and ecology.

2. Diverse Habitat and Disturbance Regimes Favor Native Species

When restored, the diverse habitats of the Dutch Slough site will be exposed to a number of disturbance events, including daily and seasonal tidal fluctuation, annual flood inundation, pulses of water and sediment from Marsh Creek, seasonal changes in salinity, and wind and wave action. Evidence from the Yolo Bypass and Consumnes Rivers suggests that seasonal inundation of floodplains and riparian forests at Dutch Slough (30 days between Feb.15 and May) will create spawning habitat for splittail and rearing habitat for juvenile salmon and splittail. (Sommer pers com 2001; Sommer et al. 1997, Sommer 2001, Crain, et al 2000). We hypothesize that winter and spring flooding of the marsh plain will similarly benefit native fish by creating areas for them to disperse and feed on the marsh plain relatively free of predators. Restoration of Dutch Slough may create prolonged tidal flooding in some dry years, preventing catastrophic declines in splittail by creating critical splittail spawning habitat in dry years when the Yolo Bypass does not flood (Sommer, 2000).

The large area of each of the Dutch Slough parcels will allow for the development of a dendritic channel network (figures 8 and 9) on each of the three parcels, creating a diversity of different sized tidal sloughs ranging from first order dead-end sloughs that will flood and drain daily to deep, high velocity, fourth order channels. The spatial complexity and the daily wetting and drying of the mash edges should help young salmon and splittail avoid predators and provide an abundant source of chiromindae larvae, one of the main food sources for rearing splittail and salmon (Brown, in press). Dendritic channels are less likely to be colonized by submerged aquatic vegetation and associated exotic fish species because they are more hydrodynamically active than shallow water habitats (Williams, pers com).

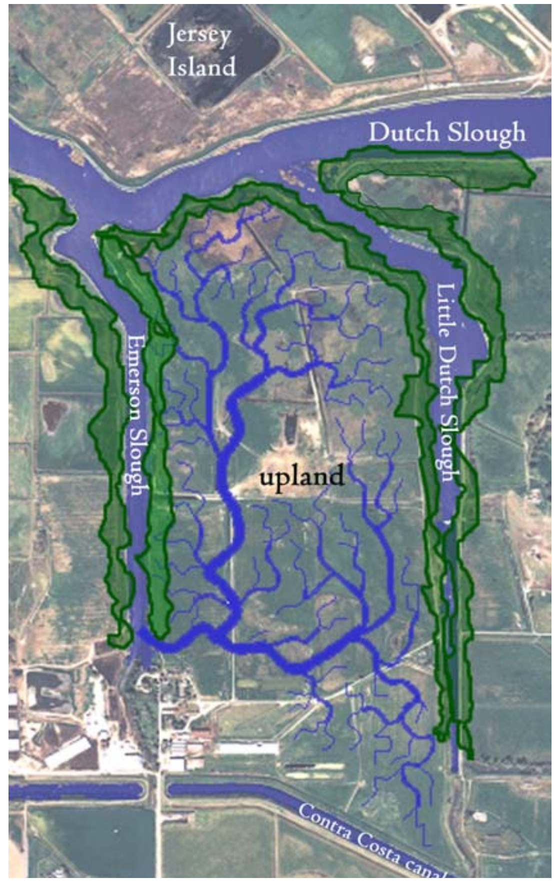


Figure 8: Representative design for the Gilbert parcel with dendritic channels in interior and riparian vegetation on the levees.

Periodic disturbance events associated with fluctuating Delta salinities and flood flows in Marsh Creek will create conditions favorable to native fish. During dry years, salinity levels of 2 ppt at Dutch Slough (DWR, 1995) may impede non-native species such as egeria densa.[3] Increased local turbidity from flood flows on Marsh Creek will reduce predation on juvenile salmon and splittail, and flood flows will deposit sediment and reshape habitat at the delta of Marsh Creek, triggering early successional processes and increasing habitat complexity.

Figure 9: Dendritic mash channels at China Camp saltwater marsh in Marin County.

[3] Research from the Maldivia River Basin in Chile indicates that egeria declines at 2 ppt in the field (Havenstein et al, 1986)

3. Western Delta is the Right Place to Restore Habitat

Restoration in the western Delta at Dutch Slough would: 1) provide habitat where numerous target fish congregate or migrate, 2) create habitat at a critical transition zone between freshwater and saltwater habitats, and 3) extend a habitat corridor from Suisun Marsh, Browns Island, and Sherman Lake eastward along a range of salinity gradients. The Strategic Plan for ecosystem restoration recommends restoration of large-scale pilot projects in the western Delta near Sherman Island to examine the relation between variable salinity and the maintenance of native species in marsh habitats. Dutch Slough is the only site in the western Delta near Sherman Island with suitable elevations for tidal marsh restoration. In the event of further salinity intrusion into the western Delta due to drought or water management operations, restoration of the Dutch Slough site would ensure suitable fresh or brackish water habitats for numerous plant and fish species that currently depend upon the Suisun Marsh.

Figure 10: The intertidal elevation of the Dutch Slough restoration site is ideally suited for rapidly reestablishing a vegetated marsh plain dissected by a dentritic channel network. Mt. Diablo towers in the background.

Big Break, the Marsh Creek delta, and lower Marsh Creek already harbor Sacramento splittail, Chinook salmon, Delta smelt, and other aquatic species for which the Dutch Slough site will be restored. Big Break is one of only three locations where adult splittail congregate in large numbers (Meng and Moyle, 1995; Baxter, 1996). Surveys have collected adult splittail, juvenile salmon, and late juvenile Delta smelt there (Hanson, 2000; Baxter, 2000). Juvenile salmon were also collected in lower Marsh Creek during two consecutive years (Slotton, 1998). Over a dozen were netted in less than an hour immediately below the creek's fish passage barrier, indicating that salmon are reproducing there (Cleugh, pers com, 2002). Adult salmon have been repeatedly observed in the Marsh Creek flood control channel, approximately two miles upstream of Big Break (Bright, pers com, 2001; Painter, pers com, 2001).

The diversity of birds and other animals along the Big Break shoreline, in Marsh Creek, and upstream suggest that many other CALFED priority species will use the restored Dutch Slough site. Over 150 native species (Appendix 1) have been observed (Glover, pers com; Orlof 2000), of which 18 are CALFED priority species (r- Bank Swallow, Black Rail, Sandhill Crane, Swainson's Hawk, Yellow Warbler; m - Black Tern, Black-Crowned Night-Heron, California Gull, Common Yellowthroat, Cooper's Hawk, Great Blue Heron, Great Egret, Northern Harrier, Snowy Egret, White-Faced Ibis, White-Tailed Kite, Yellow-Breasted Chat, Western Pond Turtle). A recent survey of lower Marsh

Creek by DWR biologists confirmed a western pond turtle population of approximately 15-20 individuals (Hamilton pers com, 2001). East Bay Regional Park District scientists and USFWS experts believe the area supports giant garter snakes (Bobzien, pers com, 2001).

Uncertainties and Hypotheses

According to the Strategic Plan (CALFED, 2000), Stage 1 of the "ERP aims to resolve critical uncertainties… that currently hamper our ability to adequately define problems or design restoration actions." The Dutch Slough project will directly address three key uncertainties:

- Strategic Plan Uncertainty #1, Introduced Species: Initiate a program that, among other things, establishes habitat conditions that favor native fishes.
- Strategic Plan Uncertainty #6, Importance of Fresh Water Marsh Habitat: Develop large-scale pilot projects accompanied by long term monitoring to resolve key uncertainties regarding the role of fresh water marsh for sustaining native fish and ecosystem productivity.
- Strategic Plan Uncertainty #12, Importance of the Delta for Salmon: Pilot projects to enhance and measure fry rearing in the Delta.

1. How Will the Restored Habitats Be Utilized By Native Species?

Studies of fish in Delta wetlands are rare, but there are several studies of fish in its shallow-water habitats (California Department of Fish and Game Resident Fish Monitoring Survey 1980–84, 1995, 1997, 1999 in Brown, in press). They indicate that introduced species are likely to dominate freshwater tidal marsh and associated shallow-water habitats. Juvenile splittail and salmon are the native species most likely to benefit from tidal marsh restoration (Brown, in press). The importance of freshwater tidal wetlands to native Delta smelt is more speculative (Lindberg and Marzuola 1993). Although they are primarily an offshore species, tidal wetland vegetation seems like an obvious substrate for Delta smelt spawning, but this has neither been observed in the field nor the laboratory (Brown, in press).

Studies elsewhere, however, suggest the Delta's marshes may be more important than recognized in prior studies. In coastal California and the Pacific Northwest, estuarine and tidal wetlands provide important habitat for anadromous salmonids (add California cite; Healy 1991; Shreffler et al. 1990; Simenstad et al 1993). Floodplain habitat enhances juvenile Sacramento River Chinooks' growth and survival (Sommer et al. 2000). Atlantic and Gulf estuaries' vegetated shallow near-shore habitats, including tidal wetlands, are fish nurseries, too (Boesh and Turner 1984; Baltz et al. 1993).

Historically, the Delta was characterized by vast tidal marshes with extensive networks of dendritic channels (Atwater, 1982) and supported several unique native fish that are now endangered. Because all of the Delta's tidal wetlands with extensive marsh plain and dendritic channel networks have been destroyed (The Bay Institute, 1998; Brown, in press), it is not possible to determine whether native fish would benefit from their presence. A recent CALFED-sponsored paper on the fish benefits of tidal marsh restoration concluded that:

> *"Large-scale adaptive management experiments (100's to 1,000's of hectares) appear to be the best available option for determining if tidal wetlands can be restored in ways to provide significant benefits to native fish populations. Even if these experiments are unsuccessful at increasing native fish populations, the ecosystem benefits of such restored sites would make them worthwhile."*

The Dutch Slough site provides an opportunity to implement exactly this kind of adaptive management restoration project to address the following uncertainties:

- What are the important characteristics of dendritic channels that benefit native fishes?
- What are the process linkages that lead to these benefits?
- Do Delta smelt spawn in emergent marsh vegetation?
- What are fish responses to dendritic tidal marsh habitat in estuarine vs. tidal riverine dominated systems?
- Will splittail spawn and rear in tidally controlled seasonal floodplain within the western Delta?

Our specific hypotheses include:[4]

1. Fish reproduction, growth and survival depend on morphological characteristics of the tidal channel-marsh system, specifically:
    - Channel density (hypothesized positive relationship)
    - Channel shape in cross-section (hypothesized positive relationship with steep side slopes)
    - Channel order (hypothesized negative relationship)
    - The ratio of marsh edge to marsh area (hypothesized positive relationship)

2. A dendritic channel system will provide more and different food for fish, (e.g., microalgal, primary and secondary production, accumulation of detrital material) than open subtidal habitats.
3. Emergent marsh rooted below the spring-tide low water elevation will provide spawning habitat for Delta smelt.
4. Salinity of over 2-4 parts per thousand will limit reproductive success of egeria densa and associated exotic fish.
5. Splittail will spawn on tidally inundated floodplain and marsh that is inundated for over 30 days in the late winter and fall.

[4] These hypothesis are borrowed heavily from a working paper developed by a group of scientists including Denise Reed, Philip Williams, Larry Brown, Bruce Herbold, Lenny Grimaldo and others.

2. What are the Minimum Elevations Required to Sustain Dense Emergent Marsh?

Subtidal emergent marsh habitat consists of vegetation (Scirpus spp., Typha spp., Phragmites spp.) rooted below the mean lower low water. Subtidal emergent marsh establishment is a critical threshold in the evolution of sites from open water to dendritic tidal marsh (Simenstad et al. 2000) and thus a step in the right direction from undesirable shallow open water to desirable tidal marsh. Over time, subtidal tule marsh facilitates marsh plain accretion and evolution to intertidal marsh.

The Dutch Slough site includes approximately 200 acres of land at elevations between -2 and -4 feet or deeper. Surveys by Simenstad et al. (2000) suggest that these elevations are on the low end of the range in which emergent marsh vegetation exist in the Delta. Emergent marsh generally ranges as low as -2 to -2.6 feet, though it is not found consistently at these low elevations (Simenstad et al. 2000; M. Orr pers com). If it is possible to establish tule stands before breaching the site, we expect that vegetation may persist after breaching at even lower elevations, perhaps as low as 4 feet below mean lower low water. This would significantly decrease the area of open water habitat subject to invasion by *Egeria densa* and associated exotic species. Experimentally testing the establishment of tidal marsh at subtidal elevations could have important implications for future restoration of subtidal areas on leveed and flooded Delta Islands.

The following are the specific hypotheses to be tested regarding emergent marsh:

- Will tule vegetation cultivated at subtidal elevations at between 2 and 5 feet before tidal inundation of the site persist as emergent marsh after the parcels are inundated with tidal waters?
- Will the subtidal emergent marsh accrete from biomass accumulation and, if so, how fast?

3. Will Egeria Densa and Associated Exotic Species Invade the Site?

The majority of tidal wetlands in the Delta are subtidal areas dominated by exotic species particularly egeria densa. If these shallow water areas are located adjacent to tidal marsh and inundated floodplains, they may diminish the value of these habitats for target native fish species by increasing predator populations. Tidal inundation of the entire site at its current elevations, however, would create approximately 380 acres of shallow open water. Fortunately, there are several options for minimizing areas of open shallow water habitat and egeria densa or mitigating its impact on native fishes.

The project team will evaluate several options for minimizing the amount of restored area susceptible to invasion by egeria densa and associated exotic fish species including:

- Grade the entire site to maximize the area of marsh plain with dendritic channels and minimize the amount of sub-tidal habitat either by raising elevations on the site with fill from upland sources on site or by excavating deeper subtidal areas and placing that fill to raise the elevation of shallower areas.

- Construct or otherwise route main tidal sloughs directly to lands with elevations suitable for intertidal marsh, providing target fish species with direct access to intertidal marsh and floodplain areas without having to traverse hostile subtidal areas.
- Construct and operate a water control structure(s) to manage water and salinity levels in subtidal areas to the detriment of exotic species. Increasing salinities in the subtidal areas to 2 ppt or more will cause the decline of egeria densa (Havenstien and Ramirez 1986) and other exotic species (CALFED, 2000) during late summer and early fall when native fish will not be using the site. Similarly, draining subtidal areas during late summer or fall would prevent establishment of exotic fish while still providing seasonal habitat for native fish.
- Plant relatively high subtidal areas (-2 to -4) with tule vegetation prior to tidal inundation under the assumption that the tules would persist as emergent marsh, rather than SAV habitat, after tidal inundation.

Although site grading is a fairly certain method for reducing the potential invasion of *egeria densa*, it is expensive and would reduce the area of upland habitats. Other methods may be more cost effective. The project will test the hypothesis that *Egeria densa* or its negative impacts can be minimized by restoration designs that isolate shallow water areas from the tidal marsh channels or alter salinity regime, water depth, type of rooting substrate, water velocities, turbulence, and light penetration. We plan to design the site to maximize the area of tidal marsh with dendritic channels. The higher velocities in dendritic channels should impede the establishment of egeria densa and other exotic species. Grading costs may require leaving some subtidal shallow water areas that will be susceptible to egeria colonization. Under such a scenario we would concentrate the shallow water areas at the head of the slough network (rather than at the mouth) so that target species can access the marsh plain without migrating though egeria dominated habitat (figure 11). During the design process the project team will explore the technical merits of using water control structures to control egeria by locally elevating salinities or manipulating water levels. For example, a tide gate on a slough draining a subtidal area could be operated to seasonally increase

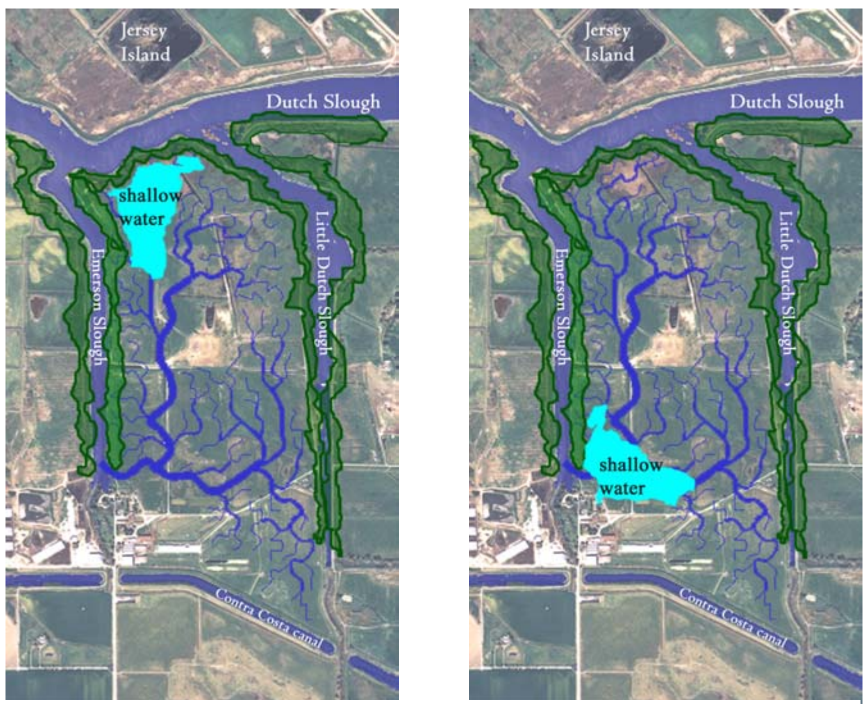


Figure 11: The representative schematic on the left isolates openwater areas at the head of the slough permitting fish to access the site without traversing egeria dominated habitat in contrast to the schematic on the right.

salinity levels in subtidal areas or even to drain subtidal areas during summer months when egeria growth peaks and native fish are not present.

The potential of these options will depend on the following uncertainties.

- Will large subtidal areas vegetated by emergent marsh be less dominated by invasive fish then shallow water areas with SAV's?
- Will SAV's in backwater areas separate from the tidal marsh areas (at the end of tidal channels) degrade the value of tidal marsh as much as subtidal marsh with SAV's adjacent to tidal marsh. i.e. will subtidal areas relatively disconnected from the remainder of the marsh by berms or channel routing have the same deleterious effects.
- Is it possible to manage salinities or water levels on the site to the detriment of exotic species without causing other adverse environmental impacts to water quality?

4. What are the Optimal Restoration Techniques?

There is some uncertainty as to what are the best approaches for restoring and managing a diverse mosaic of habitats. These uncertainties include:

- Channels. Can tidal action alone develop and maintain dendritic channels? Can we cost effectively design and construct tidal marsh plain channel systems that are stable and sustainable in the long term (over decades)?
- Marshplain. What is the optimal fill elevation to achieve the desired marshplain habitat and minimize grading costs? Is pre-vegetation (planting prior to breaching) a cost effective way of creating emergent marsh at lower elevations? How will sediment from Marsh Creek benefit marshplain formation?
- SAV deterrence. What site features (tidal velocity, depth, etc.) will reduce the potential for SAV establishment? Can tidal flow be managed to control invasion of exotic species by altering water levels, salinity, temperature, or other factors?

Hypotheses related to most effective restoration techniques include:

1. Grading can be used to design and construct functional tidal channels.
2. Sedimentation from Marsh Creek will hasten the development of a dendritic tidal channel system.
3. Establishing tule vegetation in a non-tidal environment will allow emergent tule marsh to persist after breaching at lower elevations than it is consistently found in the Delta currently.

Site Constraints and Additional Uncertainties

As with any restoration site, there are some constraints on this site that will have to be addressed during the design process. Specifically, the project will need to be designed to avoid or mitigate production of methylmercury and dissolved organic compounds and to prevent any negative impacts to adjacent infrastructure. As discussed below, the project team is confident that the site constraints can be addressed with careful project planning and monitoring. Before implementation, potential adverse impacts will be thoroughly evaluated in an environmental impact report pursuant to CEQA. The project team has budgeted funds to monitor baseline conditions, develop design criteria, and develop a plan to monitor or mitigate any impacts that might occur.

Methylmercury
Mercury methylation resulting from tidal marsh restoration is a serious issue for all tidal marsh restoration projects in the Bay-Delta ecosystem (Davis et al. 2002). Mercury enters the Bay-Delta environment from urban run-off and several upstream sources in the Sierra and Coast Ranges (Davis et al. 2002). Mercury can present a health problem if it is converted to methylmercury. Methylation of mercury is controlled by environmental conditions such as pH, dissolved organic carbon, oxidizing environment, and the presence of ions such as chloride and sulfate. Surveys of mercury levels in Big Break, Marsh Creek, and throughout the Delta indicate that methylmercury levels near Dutch Slough are lower than those observed elsewhere in the Bay-Delta (Slotton, 1998; Suchanekl, et al. 1999; Davis et al. 2002) Information from these studies and other analyses is provided in Appendix 2.

The project team will collect data, conduct a comprehensive environmental review under CEQA, and design the project to minimize the potential for mercury methylation. With careful project design it should be possible to minimize or avoid any deleterious effects (Davis et al. 2002; Suchanekl 1999). For example, maximizing tidal circulation will reduce the potential for anoxic conditions that could increase mercury methylation. Prior to project implementation, the project partners will work with experienced scientists to measure baseline levels of mercury in animal tissues and sediment on the Dutch Slough properties and adjacent sloughs as recommended by Davis et al. (2002). Monitoring will continue after implementation to measure any changes in methylmercury levels. The project team will identify mitigation measures in the design process and implement them if methylmercury levels rise significantly over the long term.

Dissolved Organic Carbons
Improving drinking water quality and increasing ecosystem productivity are central goals of the CALFED program (CALFED, 2001), but there may be conflicts between ecosystem restoration projects that increase dissolved organic carbon (DOC) and CALFED's drinking water quality goals. Dissolved organic carbons provide nutrients that can benefit the ecosystem by enhancing productivity (Jassby et al. 1993), but when disinfected with chlorine, chloramine, or ozone as part of the drinking water treatment process, they can be harmful to human health (California Department of Water Resources 1994). Current land uses in the Delta and its watershed currently provide significant inputs of dissolved organic carbons to Delta waters (Amy et al. 1990).

As with other tidal marsh restoration projects, it is unclear whether the Dutch Slough project will result in increased DOC from existing conditions. Currently the land is managed for a dairy operation and irrigated pasture. Irrigation drainage water from these operations may presently be contributing large quantities of DOC and other potentially harmful constituents, such as nitrates, to Delta waters. Before implementation of the project, the project team will work with regulatory agencies, CALFED, and research scientists to measure existing levels of DOC discharge from the site and to identify restoration design strategies to reduce DOC export from the site.

During and after project implementation, the project team will monitor levels of DOC and other nutrients after the site has been restored to tidal marsh. If the site does increase levels of DOC that adversely affect drinking water quality, the project partners will work with the CALFED program to appropriately identify mitigation measures. The CALFED BDPAC drinking water subcommittee is currently working on a mitigation framework that could facilitate mitigation of all CALFED sponsored projects that might impact drinking water quality, including water supply enhancement and ecosystem restoration projects (Gartrell, pers com, 2002). Under such a framework, the CALFED program would fund water quality improvement projects to more than offset the potentially adverse effects of other projects to ensure that the CALFED Bay-Delta Program can meet its goal of continuous improvements in drinking water quality. The Contra Costa Water District has suggested that funding to implement the CALFED Rock Slough and Old River Water Quality Improvement Projects or to line the Contra Costa Canal might be appropriate mitigation measures for projects that harm Contra Costa drinking water quality (Gartrell, pers com, 2002). The project partners anticipate that this sort of global mitigation program would be the most appropriate vehicle for resolving conflicts that are likely to arise from implementation of the CALFED program. More information on DOC issues is included in Appendix 3)

Altering Salinity Gradients Through Changes in Tidal Prism
Recent modeling has shown a strong link between changes to the geometry of the Delta/Suisun Marsh and hydrodynamic changes, which affect salinity mixing. Consequently, DWR conducted preliminary hydraulic modeling to evaluate potential changes to the salinity regime throughout the Suisun Marsh and Delta. DWR conducted its own one-dimensional analysis and contracted with RMA to run a two-dimensional analysis with their model. Modeling of the preliminary breach scenarios for the full 1200-acre Dutch Slough project indicated only a slight and very local increase in salinity during critically dry hydrology. These small changes are within the tolerance of the model. Urban water supply diversions were not affected. With further refinement of the hydraulic features of the project, the proponents are hopeful that even the very small local changes in the model results can be eliminated. Furthermore, when the project is analyzed as part of preliminary regional plans for Big Break, Frank Tract and Lower Sherman Lake, salinity changes are very positive.

Flood Control and Seepage along the Contra Costa Canal
Because the projects will re-introduce full tidal stages to the lands bordering CCWD's Rock Slough intake channel, CCWD has raised two concerns. First, whether the canal would be subject to high water over topping. And, second, whether localized changes in the shallow ground water table would increase seepage of higher saline waters into the unlined canal. The Knightsen Town Advisory Council, which supports the project, has also raised the concern that seepage and elevated groundwater levels may impact septic systems south of Cypress Road. Groundwater levels in this area are already within 18" of the ground surface (Contra Costa County Department of Health Services).

With regards to the over topping issue, the project will be designed with a natural gradient sloping to an elevation with sufficient freeboard above the 100-year flood for the entire southern boundary. The slope will be well vegetated to reduce the possibility of erosion.

The potential seepage of local groundwater into the canal and areas south will be monitored, analyzed and modeled to determine the magnitude of any impacts. If impacts are identified, mitigation may include:

1) Engineered features to isolate any southerly migration of shallow ground waters toward the canal;
2) Cost-sharing with CCWD to isolate this reach of the canal by lining the canal or containing it within a pipeline;
3) Cost-sharing to help establish sewer service for a limited number of homes south of Cypress currently on septic.

Public Support and Public Access

The City of Oakley is rapidly urbanizing and has very limited parks and open space. There are very few public access points in Oakley out to the Delta shoreline. Under the existing development agreement, the landowners would deed 100 acres to the City to develop a community park. Thus, if the entire site was restored, the project would preserve more open space but the City would end up with less park space. Both the City Council and members of the community have stated that they would oppose this project unless the City received some land for a community park and there was a guarantee of some public access out to the water.

Over the past ten months, through a series of public meetings and negotiation sessions, the co-applicants have reached an agreement with the City on the issue of a community park and public access. If funding is approved by CALFED, the landowners have agreed to deed 63 acres to the City of Oakley in a separate transaction. Fifty-five acres of upland, including the Gilbert house and outbuildings, will be given to the City for the exclusive purpose of developing a community park. This property is disturbed, at the end of Emerson Slough. The landowners have agreed to move the historic Emerson house onto the City's land. In addition, eight acres east of Jersey Island Road along Dutch Slough will be given in fee title to the City. This property is isolated from the remainder of the project by the levee of Jersey Island Road.

The co-applicants and the City agree that if planned correctly, public access can enhance the restoration project through the creation of recreational, interpretive and educational opportunities. The site could provide recreational amenities such as a new trail and a non-motorized boat launch. The City has also expressed interest in developing a swimming lagoon on their property. The site will also create recreational opportunities for bird watching, nature walks, photography, and fishing. Educational and interpretive programs could be developed that increase public understanding and support for ecosystem restoration. Potential partners in developing these programs include: the City of Oakley, East Bay Regional Park District, the Delta Science Center, California State University at Hayward, Los Medanos Community College, and the local school districts.

The co-applicants will work with the City to develop a master plan for public access to both the restoration site and the community park that balances the objectives of the restoration project with the community recreational objectives. A conceptual illustration of potential public access on the restoration site is depicted in Figure 2. This conceptual plan limits public access to a trail along the levee of the Emerson property and the community center site at the end of Emerson Slough.

Finally, the co-applicants believe the Dutch Slough project will create economic benefits for the City of Oakley and improve the quality of life for City residents. Parks and open space are known to increase adjacent property values by approximately 20 percent, and this percentage increases when parks are over 25 acres (Crompton 2001). Owners of small companies rank recreation/parks/open space as the highest priority in choosing a new location for their business (Crompton 1997). The Dutch Slough site has the potential to attract wildlife viewers and sportsfishers. Sportfishing added $7.1 billion to the California economy in 1996, and people who feed birds or observe and photograph wildlife generated $85.4 billion to the U.S. economy in 1996 (Maharaj and Carpenter 1996; USFWS 1998).

Experimental Design

There are several potential experimental designs that could be employed at Dutch Slough to tests the hypotheses stated above. As discussed in the Approach Section, the project partners will form an Adaptive Management Working Group and hire technical consultants to develop an experimental restoration design that will both achieve restoration objectives and generate information to guide future marsh restoration projects. Below, we have outlined a promising experimental design that builds upon a proposal by a group of scientists for other sites in the Delta. This design would test the hypotheses outlined above using different approaches for creating tidal marsh habitat, and testing these approaches in each of the three Dutch Slough parcels.

The design will restore cells of at least 200-acre that are not subsided more than 3 feet. 200-acre cells or larger are necessary to allow for the development of 4 orders of channels, and elevations of more that 3 feet are necessary to increase the likelihood of achieving intertidal marsh elevations through natural sedimentation processes.

Each of the three parcels will receive a different experimental treatment:

Treatment 1: No intervention. Probably best suited to the Burroughs parcel due to existing elevations. At this site, tidal action will be introduced to the parcel via a wide levee breach.[5] No further action will occur and the site will be monitored to assess performance relative to the measures described below.

Treatment 2: Grade to appropriate elevations. Probably best suited to the Gilbert parcel due to the large area of existing sub-tidal elevation. The site will be graded or filled to achieve an elevation in the intertidal range, and tidal action will be introduced to the site in a manner similar to the Burroughs' parcel. During implementation on the Gilbert parcel, the first phase of restoration, we will test the potential for establishing persistent emergent marsh at subtidal elevations of more than 2.6 feet below mean lower low water.

[5] The size of the levee breach may be constrained in order to avoid potentially negative effects on Delta water quality that could result from an oversized breach.

Treatment 3: Excavate tidal channels network. This treatment is probably best suited to the Emerson parcels in order to integrate the Marsh Creek channel into the channel network. The site will be graded or filled, as in the Gilbert parcel, but in addition a dendritic channel template will be excavated to facilitate the channel development process.

Due to their sizes of over 400 acres each, it might be possible to further divide both the Burroughs and Emerson parcels into 2 parcels each and still be able to achieve the minimum of 200 acres per parcel that we believe is necessary to establish a 4^{th} order tidal channel network. The Emerson parcel could be designed so half of it is integrated into Marsh Creek to test the influence of sediment, while the other half is largely disconnected from the creek.

The project team will coordinate with other marsh restoration and monitoring programs in the Bay-Delta ecosystem, to replicate these treatments where possible at other sites with different tidal, sediment, and salinity regimes (north Delta, Suisun Marsh, and San Pablo Bay). The replication of these treatments in each area will allow the experimental evaluation of the role of riverine vs. tidal sediment sources to bring elevations to appropriate levels as well as allowing the testing of various hypotheses discussed above at a range of salinity, turbidity and hydrodynamic conditions.

The project team and the Adaptive Management Working Group (AMWG) will develop a detailed monitoring program to evaluate project performance and collect data to test the project hypotheses. The monitoring design will be process-oriented and examine the structural and functional evolution of the site. Specific measurements will include evaluation of physical processes (hydrodynamics, sedimentation, geomorphic character), emergent plants (composition over time and coverage), submerged and floating plants (diversity, coverage, and change over time), organic carbon fractions (forms of OC produced within and exported from the sites), invertebrate use and change over time, benthic algae, plankton, small pelagics, fishes, turbidity/light attenuation (algal production is light-limited), mineral nutrients, spatial habitat complexity, and fish use and response. The monitoring program will evaluate what the fish are eating; where the food came from (local or imported); and the base of the food source (e.g., epiphytes vs. benthic microalgae vs. phytoplankton). Such measures will be essential to determine why the fish are coming to the habitat; how the habitat is feeding the fish; and ultimately what aspects of the habitat should be replicated in other habitat designs.

With the guidance of the AMWG, the project applicants will ensure that monitoring is coordinated with other monitoring programs (in terms of procedures, protocols, and timing). The project team has already been in communication with the Interagency Ecological Program to determine if IEP could add new sites or utilize existing sites to characterize fish abundance and distribution in the areas adjacent to Dutch Slough. The project team plans to coordinate with a number of other efforts to share data or synchronize programs including the CSUH Big Break biological surveys, the Flooded Island Restoration Project (DWR and NHI are team members), the Delta native resident fishes group, the USFWS beach seine survey, the Marsh Creek and Big Break Water Quality and Habitat Restoration Project (if funded), BREACH 1 and 2, and the NOAA Ecological Reserve Program at Browns Island. Where available and appropriate, the project partners will use data from other wetland sites such as Sherman Lake, Browns Island, and Sand Mound Slough to establish reference site conditions.

3. Approach

The Dutch Slough project will be implemented as a large-scale adaptive management restoration project. This proposal requests funding for acquisition, baseline data collection, planning, environmental review, the first phase of restoration, and monitoring.

The overall project approach incorporates a thirty-year planning horizon, anticipating that restoration will be implemented over several years and that the site will continue to evolve after construction is completed. Monitoring will allow the project to be adaptively managed both during the phases of construction and as the site evolves after construction is complete. Project implementation will involve five phases of work. This proposal requests funding for the first three phases:

Phase 1: Acquisition
Phase 2: Planning, Environmental Review, and Design
Phase 3: Restoration of Gilbert Parcel
Phase 4: Restoration of the Emerson and Burroughs Parcels
Phase 5: Long-term Adaptive Management Monitoring

Phase 1 - Acquisition

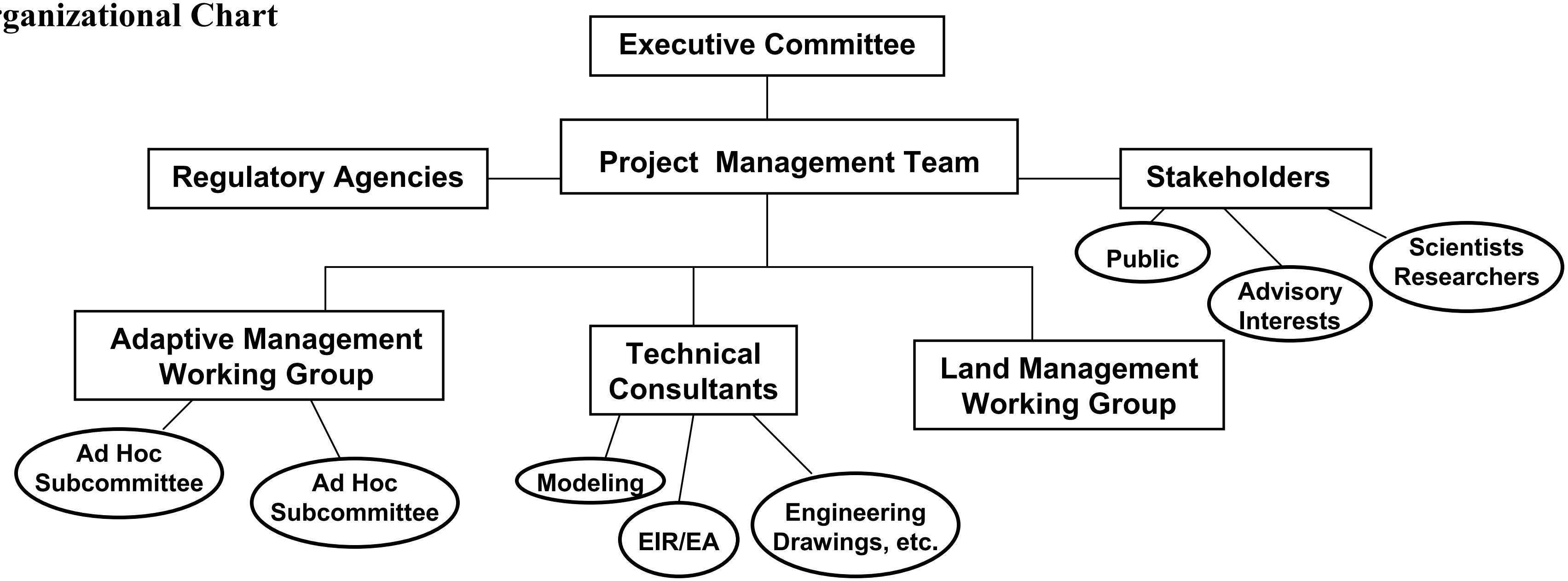
Agreement on the basic terms of the land acquisition has been reached between the landowners, the City of Oakley and the project partners. The Conservation Fund is continuing to act as the lead negotiator for the co-applicants in finalizing the terms of the purchase agreement. The Fund will manage all aspects of the due diligence and acquisition process in close coordination with the funding agencies and coordinate the closing to accommodate the two to three purchase funding sources.

The Conservancy will grant acquisition funds to the Conservation Fund. The Conservation Fund will purchase 1,166 acres from the landowners and will transfer that land to a land managing agency. The co-applicants strongly recommend DWR as the long-term landowner because of the agency's experience in Delta wetland habitat restoration (at both Sherman and Twitchell Islands) and constructing and managing levees. In addition, the City of Oakley has expressed its confidence in DWR as the land manager within its boundaries. In a separate transaction, the landowners will give the City fee title to 63 acres north of the Contra Costa Canal and a trail easement along the existing levees of the Emerson property as shown in figure2.

Phase 2 - Planning, Environmental Review, and Design

Once funding has been committed to the land acquisition, the project partners will initiate baseline data collection, project planning, design, public outreach, agency coordination, and scientific review, environmental review, and permitting design. The Coastal Conservancy will be the project manager for this phase of the project. A conceptual organizational chart for this phase of the project is provided in figure 12 . The project team will convene an interdisciplinary team of 6-8 scientists to form the Adaptive Management Working Group (ADMG) that will provide technical guidance to the project team on the design of the project. Bruce Herbold Ph.D, EPA; Larry Brown Ph.D, USGS; John Burau Ph.D, USGS; and Philip Williams Ph.D, P.E., PWA; have all agreed to serve on the AMWG. The project team will recruit 2-4 more scientists to serve on the AMWG including one or two university scientists.

Figure 12. Phase 2 – Project Planning Organizational Chart



Executive Committee: Composed of agency executives and elected officials; will meet as needed to resolve conflicts.

Project Management Team: The State Coastal Conservancy will manage project planning. NHI and DWR will also be on the management team. The team will coordinate input, make decisions, and keep the project on schedule and within budget.

Adaptive Management Working Group
Interdisciplinary team of about eight experts to provide technical input on project objectives, performance criteria, monitoring plan and the design of the alternatives. The group will include agency scientists, university researchers, and other experts. The AMWG will help develop and will review the adaptive management monitoring program. It is anticipated that this group will meet once a month during phase two of the project. Ad hoc subcommittees focusing on specific issues may be created periodically.

Technical Consultants: Will be hired as needed to complete specific tasks, including modeling, environmental impact analysis, and develop the grading plans.

Land Management Working Group: This group will coordinate and resolve ongoing issues related to site management and maintenance. It will be lead by DWR and will include the City of Oakley, the Delta Science Center, East Bay Regional Park Dist. and leasees.

Stakeholders, Advisory Organizations: This group includes: the City of Oakley, the Contra Costa Co. Water Dist., the Ironhouse Sanitary Dist., East Bay Regional Park Dist., Contra Costa Co. Mosquito Abatement Dist., the Dept. of Boating and Waterways, the Contra Costa Co. Flood Control Dist., and the Delta Science Center among others.

Stakeholders, Public: Given the significant community interest in this project, the planning process will create opportunities for public involvement in the planning.

Stakeholders, Scientific Researchers: The project will facilitate (but not implement) separately funded research projects, NHI will coordinate with scientists interested in using the site as a research opportunity.

Regulatory Agencies: the Regional Water Quality Control Board, California Department of Fish and Game, State Land Commission, the US Army Corps of Engineers, the US Fish and Wildlife Service and the National Marine Fisheries Service.

The major tasks required to complete the planning, design and environmental review are described below. The project team in cooperation with the AMWG and other technical experts will develop an integrated report describing the constraints and opportunities of the site; the goals and objectives of the restoration project; alternatives for restoration and public access; and the adaptive management plan. This document will be the foundation for environmental review under NEPA and CEQA and permitting. The tasks associated with Phase 2 of the proposed project are described in more detail below.

Task 2a. – Identify Opportunities and Constraints, Measurable Objectives, and Performance Criteria

The Coastal Conservancy, NHI and DWR will prepare an opportunities and constraints report summarizing the regional context, existing data and the site constraints and opportunities. Through facilitated workshops and meetings with the stakeholder groups, the report will be reviewed and the team will collect input on the project objectives. The Adaptive Management Working Group (AMWG) will provide input on the objectives and measurable performance criteria. The Coastal Conservancy may convene ad hoc subcommittees focusing on specific technical areas (for example: aquatic ecology, water quality, etc.) to identify specific performance criteria.

Task 2b. – Develop Long-Term Adaptive Management Monitoring Program and Collect Baseline Data

The project team and the AMWG will develop a long-term monitoring plan and identify the baseline data that will be needed to support the design process and evaluate the success of the project in achieving its objectives. The plan will outline the specifics of the site monitoring, such as: exact indicators, methods, frequency, duration, etc. Once the plan is completed, the project partners will submit an additional proposal to CALFED to fund long-term post project monitoring.

Table 2: Data Available for Planning and Permitting

Data Type	***Date/ Period of Record***	***Source***	***Coverage/Description***	***Resolution***
Topographic	1999	Carlson and Barbie		
Tidal Hydrology	2000-2002	Natural Heritage Institute	3 tidal gauges on Marsh Creek	Sub-hourly
Salinity	1921-2002	DWR		
Water Quality		CCWD		
Mercury		Slotton, 1997; Andrews, 2000	Marsh Creek, Big Break	High Quality
Marsh Creek Hydrology	1955-1983; 2000-2002	USGS		
Soils		NRCS	All	1:24,000
T&E Biological	Jan.1999	Sycamore Associates	Burroughs and Emerson	
Wetlands Delineation	Dec. 1998	Sycamore Associates	Burroughs and Emerson	ACE Certified
Phase 1 hazardous materials	in process		All	

The project team will contract with scientists or consultants to collect the baseline data needed to design and permit the project and to evaluate the long-term success of the project. A large amount of the baseline data needed for planning and permitting has already been collected (Table 2). Table 3 illustrates the type of data we expect to collect during the planning and early implementation phases.

Task 2c. – Initiate a Dutch Slough Research Program

The project team will work with the AMWG to initiate a research program that will harness the learning opportunities provided by the Dutch Slough site. NHI will work with AMWG to recruit respected university scientists to develop and lead a long-term restoration program at Dutch Slough. With university scientists and the AMWG, the project team will identify the most important hypotheses regarding the Delta ecosystem that can be best evaluated at the Dutch Slough site. Where feasible and consistent with the restoration objectives, the conceptual restoration alternatives will be designed to test these hypotheses.

The project partners will coordinate with other research scientists from agencies, universities, and private consulting firms to make the Dutch Slough site available for a diverse range of studies. The project partners will work with a respected university scientist, or group of university scientists, and other institutions such as the University of California Reserve Program, California State University at Hayward, the Delta Science Center, and the CALFED Science consortium to identify principal investigators and design studies to test non-core hypotheses. The principal investigators would be responsible for independently obtaining full funding to conduct their research. Where possible, the project team will provide access and facilities at Dutch Slough to assist the research.

Task 2d. – Public Access Master Plan

The Coastal Conservancy and NHI will closely with City of Oakley to develop a public access master plan compatible with the restoration goals of the project. The planning effort will focus on integrating the restoration elements, regional public trail access, and the adjacent community park that will be owned and operated by City of Oakley. The plan will identify potential coordination with environmental education programs such as the Delta Science Center, opportunities for public involvement in the restoration, and connections to other regional parks and trails. This proposal requests $50,000 in matching funds to share the costs of this planning process with the City of Oakley.

The master plan will establish specific public access objectives, set priorities, and identify the benefits of different alternatives. The plan will also include preliminary cost estimates and will identify potential project partners. The plan will be developed through a public process, facilitated by a consultant. As demonstrated by the letters of support submitted for this proposal, there is significant local interest in the public access, environmental education opportunities, and restoration plans for the Dutch Slough site.

The public access master planning process will be scheduled to coincide with the restoration planning process so that information can flow back and forth between the two planning efforts. The Conservancy and NHI will be actively involved in both planning processes and will be responsible for the coordination. Both the restoration plan and the public access master plan will need to address potential interface impacts between the two projects, such as noise and light pollution.

Task 2e. – Develop Restoration Alternatives
The project team will develop conceptual restoration alternatives based on the recommendations of the AMWG. The alternatives will include different approaches for achieving the project goals. The alternatives will be presented to stakeholders, the land management group, and regulatory agency staff.

The project team and their consultants will subject the alternatives to various technical analyses, refine the conceptual alternatives, predict potential impacts, and evaluate how they will be expected to evolve through time. The following modeling efforts are planned:

- Hydrodynamic modeling to evaluate potential impacts on regional water quality and salinity at the Rock Slough intake;
- Flooding – Potential for overtopping Contra Costa Canal;
- Salinity impacts on the canal via groundwater seepage;
- Geomorphology - Site evolution through time.

The project team, with input from the AMWG and technical consultants, will refine the conceptual alternatives and describe the final alternatives in enough detail to comply with CEQA and NEPA. Final project alternatives will include a description of the construction approach and anticipated site operation activities, as well as short-term and long-term habitat characteristics.

Task 2f. – Environmental Review
As the landowner, DWR will be the lead agency for the environmental review under CEQA. As required by CEQA and NEPA, the project management team will conduct a review of the potential environmental impacts associated with the proposed project. The team anticipates preparing an Environmental Impact Report/Environmental Assessment (EIR/EA) for the proposed restoration of the 1,166-acre Dutch Slough site and the adaptive management and monitoring program. The Conservancy will contract with a consultant to write the EIR/EA.

Task 2g. – Final Design – Gilbert Property Only
Although NEPA and CEQA will be completed for the entire Dutch Slough restoration site, construction and engineering drawings will only be developed for restoration of the Gilbert property, the first phase of restoration implementation. The Conservancy will hire a consultant to develop grading plans, engineering drawings, and a vegetation planting plan for the restoration of this property.

Table 3: Baseline Data Needed for Design or Long-Term Monitoring Program

	Period/Seasons of Collection	*Parameters*	*Potential Source*	*Coverage/Location*
Bathymetry of sloughs	Pre-project and annually after implementation		Funded by this project	
Site elevations	Pre-project and annually after implementation		Available	
Fish in adjacent sloughs	Biannually (winter and summer)		Funded by this project	Trawls and beach seines of Emerson and Little Dutch Slough and Marsh Creek
Regional fish data			IEP and other programs	
Wetlands delineation for Gilbert	One time		Funded by this project	
Detailed soils map for Gilbert			Funded this phase	Collected during wetlands delineation
Elemental Mercury	One time			Sediment cores on Dutch Slough Parcels
Methylmercury	Annually	Concentrations in fish tissue	Coordinate with regional monitoring program	Dutch Slough, Big Break, and Marsh Creek
Hydro-dynamics of sloughs	Pre-project and post project		DWR flooded island study	Doppler sonar calibrated with drogue study
Delta water quality		Salinity, turbidity, DOC, TMP		
Marsh Creek water quality			CSUH	
Groundwater quality	Monthly and on spring tides	Nitrates, salinity, gradient	Funded by this project	
As built topography			Funded by this project	
Reference Sites			Coordinate with other projects	Browns Island, Sand Mound Slough, Sherman Lake

Task 2h. – Regulatory Agency Coordination – Obtaining Permits

Coordination with regulatory agencies[6] will begin while the preliminary restoration plans are being developed. Agency input will help shape the project design to ensure that the project will be acceptable to the regulatory agencies. The permitting process will be initiated once the restoration strategies and construction approach have been defined. Permits will only be sought for the restoration of the Gilbert property.

Phase 3 – Restoration of Gilbert Parcel

DWR will manage Phase 3 of the project, implementing restoration of the Gilbert parcel. Detailed restoration plans and designs for the Gilbert parcel have not yet been developed, but there is enough information about the major components of a design for the Gilbert parcel to specify a work plan and budget.

[6] Agencies with regulatory authority over the proposed project include: the Regional Water Quality Control Board, the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and National Marine Fisheries Service.

Task 3a. – Site Clean-up and Preparation

The Gilbert parcel has a number of abandoned farm structures that need to be moved or demolished before restoration and public access can safely begin. Several decrepit farm buildings on the southwest corner of the Gilbert parcel will be demolished and cleared away to eliminate project liabilities and allow for heavy equipment access. With the permission of the City of Oakley, the public access trail along the levee of the Emerson property will be opened immediately. Improvements to that trail are budgeted under this task.

Task 3b. – Construct Berm along Interior Levee to Prevent Erosion

A berm or beach along the foot of the interior levee is necessary to prevent erosion of the inside of the levee once the site is tidally inundated (Figure 13). Maintaining the levee is essential to prevent an increase in wave fetch that could erode neighboring islands or create changes in hydrodynamics that could impact Delta water quality. The berm will be approximately 100 feet wide, graded to approximately the MHHW level, and planted with tules and other vegetation to dissipate wave energy and minimize erosion.

Task 3c. – Rough Site Grading

The amount of site grading will probably be the most significant cost for the restoration implementation. Based on existing information regarding the undesirable nature of shallow water habitat, we assume that the design for the Gilbert parcel will call for extensive grading to maximize the extent of intertidal habitat and minimize the amount of shallow water habitat susceptible to invasion by *Egeria densa*. Thus we anticipate grading the site to obtain large areas with minimum elevations of -3 to 0 feet (MLLW is -0.35 feet) elevation. We will borrow fill material from upland areas on the Gilbert and Emerson properties and/or excavate a deep area on Gilbert. The final design may call for less grading and instead opt for another approach to minimize the threat of *Egeria densa* and other exotic species such as a water control structure that would locally and seasonally increase salinity in subtidal areas.

Task 3d. – Develop Plant Material For Restoration

Once there is a preliminary planting design, the project team will want to begin growing native vegetation from local seed stock and local cuttings. Due to the size of the project, the project team believes that establishing an on-site plant nursery may be the most cost-effective way to develop plant material for restoration. The project team will either retain an environmental horticulturalist to establish and maintain a nursery on-site to propagate plants and manage vegetation or the team will work with consultants specializing in native vegetation.

Task 3e. – Vegetation Planting and Maintenance

The environmental horticulturalist and vegetation maintenance team (Task 3d) will initiate restoration of the Gilbert parcel with tree planting on the levees and establishment of wetland vegetation on the site interior. Depending on the final design and restoration approach selected, the project team anticipates encouraging establishment of tules and other native wetland vegetation on the low lying areas of the Gilbert parcel, and minimizing colonization of exotic species. Tules and cattails may spread from existing stands simply by adjusting hydrology and without an active planting program.

Task 3f. – Install Water Control Structure
It is possible that the final design may call for a water control structure or other infrastructure to manage the salinity and circulation if there are open water areas on the Gilbert parcel. The structure may help the site managers to minimize DOC, methylmercury, Delta water quality impacts, and salinity.

Task 3g. – Breach Levee and Inundate the site
DWR will hire a contractor to breach the levee and armor the breach according to engineering specifications identified in Task 2. To minimize the potential for adverse water quality impacts, we expect that the levee breach will be less than 500 feet wide.

Task 3h. – Monitor Site During Implementation
Implementation of the monitoring program developed in Phase 2 will begin during Phase 3.

Phase 4 – Restoration of the Emerson and Burroughs Parcels
The project team is not seeking funding for restoration implementation on the Emerson and Burroughs properties at this time. Restoration will probably proceed on the Emerson property before the Burroughs property because restoring tidal marsh on the Burroughs property will require developing a new flood control levee along the eastern border of the site parallel to Jersey Island Road. Funding permitting, the project team may begin designing and constructing and designing the new levee before Phase 3 is completed. Phase 4 tasks have not been defined in the same level of detail as tasks associated with Phases 1 through 3; however, an overview of the anticipated activities is provided below.

Task 4a. – Restoration of Emerson Parcel
Restoration on the Emerson parcel will entail restoring the delta of Marsh Creek to integrate Marsh Creek into the tidal marsh. This will most likely include breaching the east levee of Marsh Creek and allowing the creek, at least during flood stage, to flow onto the Emerson property. To better connect Marsh Creek to the restored marsh and to maximize the amount of tidal marsh, the project design may call for grading or excavating portions of the southwest corner of the Emerson property to marsh elevations and using the excess material to raise elevations on the north end of the parcel.

Task 4b. – Construction of Flood Control Levee on Burroughs
DWR will coordinate construction of a 1.5 mile levee on the eastern edge of the Burroughs parcel to prevent flooding of Hotchkiss Tract when Burroughs is restored to tidal marsh.

Task 4c. – Restoration of Burroughs Parcel
Task 4d. – Public Access Amenities on Emerson and Burroughs Parcels
Task 4e. – Monitor Restoration of Emerson and Burroughs Parcels

Phase 5 – Long-Term Adaptive Management Monitoring
Phase 5 will consist of implementing the long-term monitoring and adaptive management plan developed during Phase 2. As discussed earlier, the project team will make an effort to work with researchers to provide opportunities for restoration-related research on the site.

4. Feasibility

Local Support
The project is supported by numerous local entities, politicians, and citizens including the City of Oakley, the Contra Costa Board of Supervisors, the Ironhouse Sanitary District, the Bethel Island Municipal Advisory Committee, the Knightson Town Council, the Delta Science Center, the Delta Chapter of the Sierra Club, the Mt. Diablo Chapter of the Audubon Society, the Federation of Flyfishers, Save the Bay, and Greenbelt Alliance. Hundreds of local citizens have signed petitions, written letters, and spoken in favor of the project.

Acquisition and Appraisal
The landowners are co-applicants in this proposal and are willing sellers. The Department of General Services has approved an appraisal commissioned by DWR establishing the value of the 1230-acre property at $38,000,000. The landowners have agreed to sell 1,166 acres of the property for $28,000,000 well below the approved appraised value. The Conservation Fund will receive $300,000 from the $28 million for its work negotiating the purchase contract, completing due diligence tasks and coordinating all aspects of the transaction with the funding agencies and co-applicants.

The Conservation Fund is negotiating a purchase agreement with the landowners. Conceptual agreement has been reached with both the landowners and the City. The Fund will manage all aspects of due diligence and acquisition including review and approval of the title, environmental conditions and remediation (if necessary), removal of personal property, relocation issues, negotiating terms of leases, drafting deeds and other legal documents. . The Fund and the Conservancy have reviewed preliminary title reports and indicated unacceptable title exceptions. A Phase I Environmental Site Assessment was completed two years ago for the Emerson and Burroughs properties and is being updated. A Phase I is underway on the Gilbert property. All Phase I and Phase II Environmental Site Assessments will be done to ASTM standards. It is anticipated that the acquisition will close six months after the award of the grant from CALFED.

Environmental Permits
Significant biological, wetland, topographic, geotechnical, and hazardous materials surveys have already been conducted and did not uncover any issues that would slow restoration (or, for that matter, urban development) at the site.

5. Performance Measures
The three treatments described in the experimental design section will be assessed relative to the performance measures 5 years after implementation on each parcel. This

should be enough time for dendritic channel formation to at least begin in Treatments 1 and 2 and for some natural adaptation of the channels to occur in Treatment 3. In addition, it is likely that within 5 years the area in the western Delta will be subjected to at least a moderate flood, supplying riverine sediments to the treatments.

The following performance measures are linked to the development and function of the dendritic channel system—the goal is not just to achieve a channel network but one with attributes and use patterns that allow our hypotheses to be tested.

- Measure 1. Development of channels. Each treatment in each area must develop a dendritic channel network of at least a third order level within 5 years.
- Measure 2. Net vertical sedimentation. Treatments must show vertical accretion (via accumulation of organic matter and/or sediments) at a rate at least equal to sea level rise.
- Measure 3. Composition and coverage of Submerged Aquatic Vegetation (SAV). The coverage of SAV within the channel system must be less than coverage in sheltered subtidal areas close to the treatment. The composition of SAV that is present must include native species.
- Measure 4. Reproduction, growth, and survival of at-risk native species. Monitoring must show that reproduction, growth, and survival of appropriate at-risk species within the treatment areas is equal to or greater than for similar adjacent sheltered subtidal channels.

The performance measures above will be used to determine if the project is progressing towards its stated goal within the 5-year time frame set for the project. If these measures are not met, actions will be recommended to adjust the design/operation. If Performance Measure 1 is not met 5 years after project implementation, we anticipate that the surfaces be graded and sculptured to initiate channel development (similar to the approach proposed for Treatment 3). If channels are developing (e.g., Measure 1 is being met) but Measures 2–4 are not met, then this implies that the dendritic tidal channel habitat is not functioning as expected. The reasons for this should be clear from monitoring data, and the channel systems may be structurally altered to improve function.

6. Data Handling and Storage

Data for this proposal will be managed under the direction of the DWR management team. Data storage will be at DWR offices and on DWR servers. As appropriate, DWR will incorporate project data into the existing DWR Delta GIS database. The DWR GIS network infrastructure will be used to maintain, update, and distribute the DWR Delta GIS database for visualization, communications, and analysis purposes. All data will be made available to CALFED in digital format based on metadata standards and protocols established at the time of award, or as defined in the Comprehensive Monitoring Assessment and Review Program Report (CMARP, CALFED 1999). A project web site will provide data and report accessibility.

7. **Expected Products/Outcomes**
Reports, designs, and project implementation will be outcomes of phases I, II, and III. Deliverables for phases 1 and 2 will include: 1) acquisition of the property, 2) a Constraints and Opportunity Report 3) A Long-Term Monitoring Plan 4) a compilation of baseline data collected in phases I and II; 5) a technical memorandum outlining long-term research opportunities; 6) a Public Access Master Plan; 7) a Conceptual Alternatives Report; 8) technical memorandum detailing the technical analysis of conceptual alternatives; 9) an Environmental Impact Report pursuant to CEQA; and 10) final design documents and engineering drawings. The outcome of phase III will be construction of a 292 acre wetland restoration project on the Gilbert parcel.

8. **Work Schedule**
A detailed schedule is attached as figure 14. CALFED funding is requested for three years, per the ERP guidelines. However, the project partners do not think it will be feasible to begin implementation of restoration until year four. Coastal Conservancy funding will be used to pay for implementation and monitoring during years four and five. The co-applicants will continue to seek additional funding to pay for monitoring year six through year thirty and for restoration implementation funding for the Emerson and Burroughs properties. Listed below are the main activities of each year of the project.

<u>Year One</u>

- Contract with CALFED Agency
- Complete acquisition and stabilize the site
- Refine project objectives, develop performance criteria and develop an adaptive management monitoring plan
- Collect existing data, being other data collection
- Begin public access master plan process

<u>Year Two</u>

- Develop and analyze restoration alternatives during the second year
- Continue data collection
- Begin Environmental Impact Analysis

<u>Year Three</u>

- Complete Environmental Impact Analysis
- Final Design for Gilbert
- Permitting
- Develop plant material

<u>Year Four</u>

- Construction of Gilbert
- Levee stabilization
- Site Grading
- Planting
- Levee Breach

<u>Year Five</u>

- Monitoring of Gilbert
- Vegetation Management – watering riparian trees on levees until established

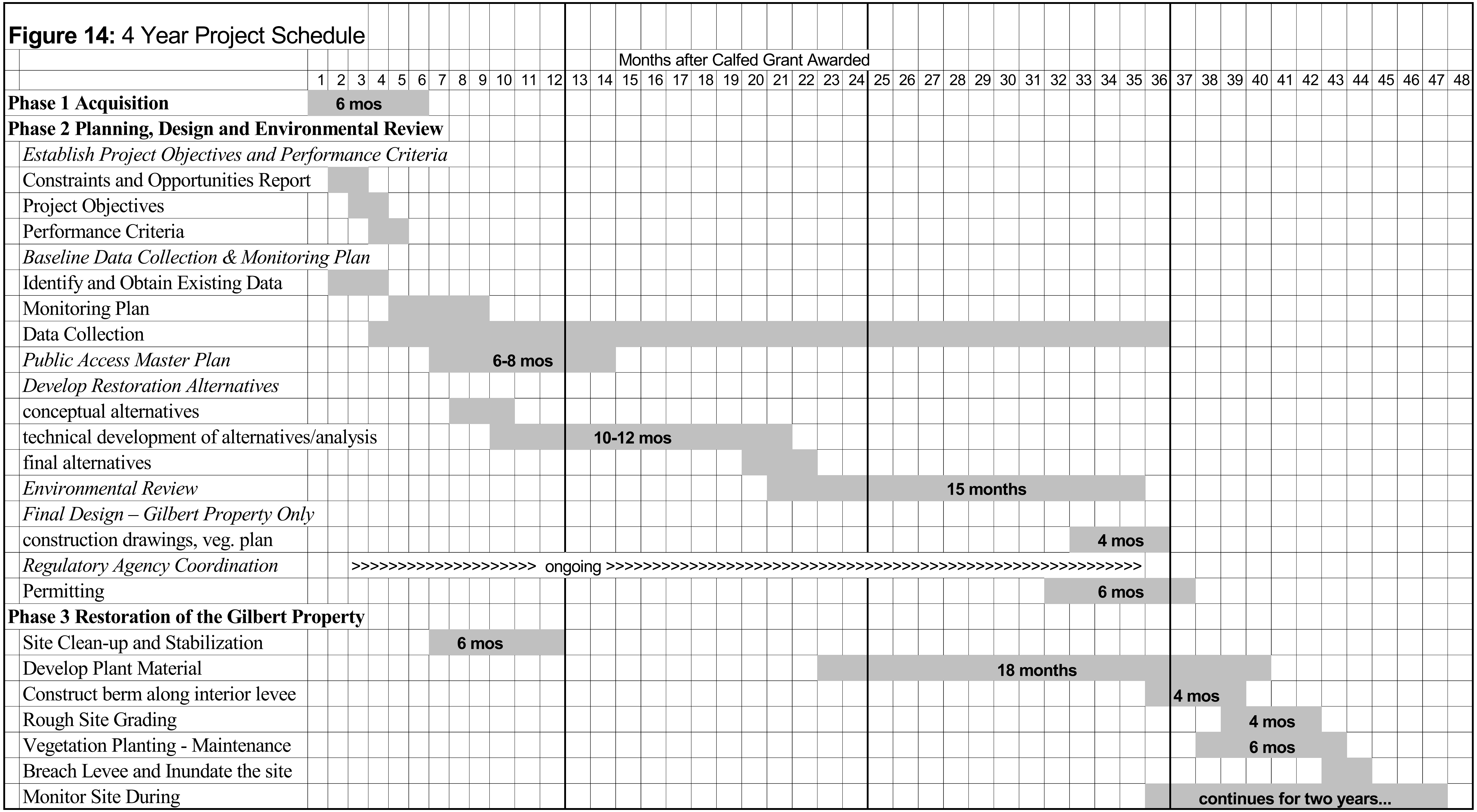


Figure 14: 4 Year Project Schedule

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

1. ERP, Science Program, and CVPIA Priorities

This application directly supports multiple CALFED ERP goals and CVPIA priorities (summarized in Table 5 below). Consistent with CALFED Goal 1, the restoration of complex tidal wetlands at Dutch Slough would most likely benefit several at-risk fish species, including Sacramento splittail, juvenile Chinook salmon, and possible early life stages of Delta smelt. Habitat benefits may also occur for other runs of Chinook salmon and steelhead. Similarly, the project will restore self sustaining, ecosystem processes to approximately 1165 acres through modification of the existing farmlands (Goal 2). The project focuses on the restoration of several types of habitats including emergent marsh, intertidal wetlands, seasonal marsh/floodplain, mixed riparian forest, and upland dune habitat (Goal 4). Implementation of this project would also create educational opportunities in conjunction with the Delta Science Center as well as provide a living laboratory for scientific research. The project will evaluate and apply methods of control or eradication for non-native aquatic and terrestrial species (Goal 5) such as the use of tide gates to manipulate site hydrology. Restoration of the project site will benefit delta water quality (Goal 6) by creating significant wetland acreage, reducing agricultural run-off from the existing drainage, and preventing the negative water quality impacts that would result from urbanization of the parcel.

This application also supports provisions of the CVPIA to protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley [Section 3402(a)]; to improve the operational flexibility of the Central Valley Project [Section 3402(c)]; and to contribute to the State of California's interim and long-term efforts to protect the San Francisco Bay/Sacramento-San Joaquin Delta Estuary [Section 3402].

2. Relationship to Other Ecosystem Restoration Projects

The proposed project is related to DWR's "flooded island" modeling analysis that was funded by CALFED last year. Under that project, DWR and consultants will model how reconfiguring flooded islands might affect Delta hydrodynamic and water quality. Big Break, a flooded island adjacent to Dutch Slough, is one of the sites that they will model. Flooding Dutch Slough and measuring the hydrodynamic changes will provide an opportunity to calibrate the model. The project is located at the mouth of Marsh Creek where CALFED funded a watershed stewardship program initiated by NHI and the Delta Science Center. The project will benefit with and be integrated with the stewardship program and a separate Marsh Creek restoration and water quality enhancement proposal submitted by the Coastal Conservancy (pending as "directed action).

3. Requests for Next-Phase Funding

This proposal is not a request for next-phase funding.

Table 5: CALFED Program Goals and Priorities Addressed	Description of Project Actions and Targeted Parameters
(DR-1.) Restore habitat corridors in the North Delta, East Delta and San Joaquin River	
• Restore tidal marsh and mid-channel island littoral zone - Strategic Goal 4, Shallow water, tidal and Marsh habitat • Acquire protect and restore habitat - Strategic Goal 1, at risk species and Strategic Goal 4, habitats • Restore inland dune scrub habitat - Strategic Goal 1, at risk species and Strategic Goal 4, habitats	• Restore 1,200 acres of freshwater tidal marsh and seasonal floodplain for the benefit of Sacramento splittail, juvenile salmon, Delta smelt, and other native aquatic and avian species. • Create nesting and foraging habitat for black rail, tricolored black bird, yellow breasted chat and perching habitat for Swainson's hawk. • Create south facing slope of less than 25% in silty-clay to clay soil for pond turtle nesting habitat. • Restore several acres of dune habitat for Antioch dune plant and animal species to test efficacy of dune restoration techniques
(DR-4) Restore habitat that would specifically benefit one or more at-risk species; improve knowledge of optimal restoration strategies for these species	
• Adaptive experimentation with species-specific restoration approaches - Strategic Goal 4, habitat • Restoration of Sacramento splittail and Delta smelt - Strategic Goal 1, at risk species assessments and Strategic Goal 4, habitats • Life histories and restoration or habitat requirements of at risk species - Strategic Goal 1, at risk species assessments.	• Create 1000 acres of tidal marsh and inundated habitat for spawning and rearing by splittail and Delta smelt, and rearing by salmonids. • Design and manage wetland features to test hypothesis about the interrelationship of hydrodynamics, vegetative structure, salinity, temperature, avian predation, fish stranding, etc. • Measure spawning splittail and rearing salmon on high marsh and tidally influenced floodplain. • Monitor for CALFED priority fishes; particularly Delta smelt, splittail, Chinook salmon (all runs), steelhead and non-native exotic species.
(DR-5) Implement actions to prevent, control and reduce impacts of non-native invasive species	
Develop pilot projects and research - Strategic Goal 5, non-native invasive species	• Physically manage pilot tidal marsh and floodplain restoration site to test actions that may limit exotic species use, such as dewatering or salinity increase • Implement a monitoring plan to document the number and spatial-temporal distribution of non-native fish and plant species.
(DR-6) Restore shallow water habitats in the Delta for the benefit of at-risk species while minimizing potential adverse effects of contaminates	
• Finding solutions to the constraints to restoring ecosystems of inundated islands by advancing process understanding of Delta ecosystems - Strategic Goal 1,2,5, and 6 • Restoration and monitoring strategies for riparian zones - Strategic Goal 4, riparian • Fish survival in the Central and South Delta - Strategic Goal 6, water and sediment	• Biological and physical monitoring at the Dutch Slough site which includes subsided lands. • Employ innovative and tested shallow water monitoring techniques to measure tidal marsh/flood plain processes and species preference for future tidal marsh restoration projects. • Measure key water quality parameters at the Dutch Slough site. • Employ innovative new enzyme bio-marker technique to identify biological stressors that may not be evident from traditional water quality sampling techniques.
Multi-Regional Bay Delta Areas (MR-3): Implement environmental education actions throughout the geographic scope	
Environmental Education Programs – Draft Stage 1 Implementation Plan	• Develop a environmental education and outreach plan as a component of Phase I and Phase II.
Central Valley Improvement Act Goals	
Section 3402 (a), (b), and (c); Section 3406 (b) (1) Anadromous Fish Restoration Program	• Restore juvenile salmon rearing habitat in the Delta.

4. Previous Recipients of CALFED Program or CVPIA Funding

CALFED Project #	Title	Primary Contractor
99-B189	Inundation of a section of the Yolo Bypass to restore Sacramento splittail and to support a suite of other anadromous and native species in dry years	NHI
99-B166	Focused action to develop ecologically-based hydrologic models and water management strategies in the San Joaquin Basin	NHI
01-N32	Marsh Creek Watershed Stewardship Project	NHI
11332-0-J001	Introduced Spartan Eradication Project	Coastal Conservancy
B81642	Hamilton Wetland Restoration Project	Coastal Conservancy

5. System-Wide Ecosystem Benefits

The ecosystem-wide benefits of this project will be both physical and knowledge-based. The sheer size of this project will probably have a measurable, if not major, impact on primary productivity as well as spawning and rearing success of several native fish. The learning opportunities presented by the site will yield important information for managing the Delta and restoring more tidal marsh in the future.

6. Additional Information for Proposals Containing Land Acquisition

This proposal conforms with all five of the criteria outlined for private land acquisition.

Willing Seller
The three landowner families have longstanding ties to the Dutch Slough, the Delta, and the Oakley community. Two of the landowner families have rich historical ties to the Dutch Slough dating back 100–150 years. The landowners are co-applicants in this Dutch Slough Tidal Marsh Restoration Project proposal and have devoted substantial energy and resources to working with the local community to assure local support for this project.

Consistent with City General Plan or Evidence of Local Support
The property is outside of the Delta Primary Zone and the jurisdiction of the Delta Protection Commission. The City of Oakley recently incorporated and is currently in the process of developing a general plan. The City is currently considering two options for the area: 1) open space and 2) urban development. The City and the landowners support this project, and if approved by CALFED this summer, the general plan would be consistent with the proposed project. However, the landowners will continue to protect their development rights until there is a purchase agreement.

Prime Farmland
The Dutch Slough property is not designated prime farmland by any entity. The Dutch Slough property was designated for mixed-use development in the Contra Costa County General Plan in 1991, which permits approximately 4,500–6,100 residential units and other development to be constructed on the larger 1,539 acres, which includes the entire Dutch Slough Restoration Project area. The Dutch Slough property remains inside the County's urban limit line. Residential development around Dutch Slough has already occurred or is imminent, and the landowners have already secured a verified delineation from the Army Corps of Engineers covering 2 of the 3 properties. This delineation identifies less than 45 gross acres of wetlands.

Ecological Opportunities
As discussed above in the problem statement and justification section, the property is a one-of-a-kind opportunity for tidal marsh restoration consistent with meeting CALFED goals.

Time Sensitive
If CALFED does not grant acquisition funds, the Dutch Slough properties will be immediately sold for development. It is no longer feasible for the landowners to continue dairy and grazing operations at Dutch Slough, and thus, they have expended substantial sums to study and successfully secure non-agricultural development entitlements on the Dutch Slough property over the last decade, which they will exercise if CALFED does not fund this application. By joining in this application, the landowner families fully preserve their vested development rights in the recorded Development Agreements with Contra Costa County, recorded on January 17, 1997.

C. Qualifications

The **California Coastal Conservancy** was created by the State Legislature in 1976 to protect, restore, and enhance coastal resources. The San Francisco Bay Area Conservancy Program was established within the Coastal Conservancy by the Legislature in 1997. The Conservancy has taken the lead in developing innovative approaches to wetlands restoration throughout the state, including: Sonoma Baylands, Hamilton Airfield, and Arcata Marsh projects. The Conservancy's team for the Dutch Slough Restoration Project includes Nadine Hitchcock, Program Manager; Mary Small, Project Manager; Marcia Grimm, Staff Counsel; Sam Schuchat, Executive Officer; and the support of the accounting, contracts, and clerical staff of the Conservancy.

Nadine Hitchcock, Program Manager for the San Francisco Bay Conservancy Program, will oversee the Conservancy's role in this project, including project management, interagency coordination, environmental compliance, and contractor selection and oversight. Ms. Hitchcock has over 17 years experience managing projects with the Conservancy, and 5 previous years experience with the Coastal Commission. Along with overall management of the Bay Program, she has managed or supervised several large-scale projects, including the Napa River Flood Control Project, the San Francisco Bay Joint Venture, the Napa-Sonoma Marsh Project, the Introduced Spartina Eradication Project, and the Regional Wetlands

Monitoring Plan. Ms. Small, who will assist with project management, has a master's degree in Environmental Planning. During the past four years, she has managed restoration and public access projects at the Coastal Conservancy and the Tahoe Conservancy. She also taught Geographic Information Systems at the Lake Tahoe Community College.

The **Conservation Fund** is a national nonprofit 501(c)(3) organization dedicated to preserving America's land legacy by acquiring and protecting open space, wildlife habitat, and historic sites throughout the nation. **Nancy Schaefer**, Director, California Office, will oversee all aspects of the acquisition process including securing a purchase contract, completing due diligence requirements, securing matching acquisition funding, and assisting with the development of local and state support. Prior to opening the Conservation Fund's California Office in 1999, Ms. Schaefer had thirteen years of experience in developing land protection programs throughout California. Ms. Schaefer founded and coordinated the San Francisco Bay Joint Venture where her responsibilities included identifying and securing critical wetland habitat, creating public/private partnerships to ensure the restoration, enhancement and permanent stewardship of these properties, securing funding to accomplish these goals, and raising operating funds. Ms. Schaefer also worked at the Trust for Public Land, where she managed the Trust's Wetlands Protection Program and served on the board on the Central Valley Habitat Joint Venture. Nancy is a founding member and officer of the Muir Heritage Land Trust. Ms. Schaefer holds a B.S. in Forest Science from the University of New Hampshire (1980) and an MBA from California State University, Sacramento (1987).

For over a decade the **Natural Heritage Institute** has applied state-of-the-art science and law to resolve complex environmental problems, particularly in the Bay-Delta arena. NHI was an original signatory to the Bay-Delta Accord that precipitated the CALFED program and has contributed significantly to the development of several CALFED programs. NHI Restoration Ecologist, **John Cain, M.L.A**., has over twelve years of experience in the field of stream and river restoration. He was a member of the technical committee overseeing restoration of Rush and Lee Vining Creeks in the Mono Basin and currently serves as a lead member of the technical committee developing a restoration plan for the San Joaquin River. **Dr. Elizabeth Soderstrom**, **Ph.D.,** has extensive experience in water resources management and adaptive management in the international and domestic arenas. **Richard P. Walkling**, **M.L.A.,** is an environmental planner who focuses on water management and environmental restoration. He has designed restoration plans for alluvial streams in California and for subsided islands in the Sacramento-San Joaquin Delta. **Sarah Beamish, M.E.M.**, has a graduate degree in wetland ecology and restoration.

Responsibilities of Partners.
The Conservation Fund will manage acquisition of the property and the transfer to DWR to act as the long-term landowner. The Coastal Conservancy will serve as fiscal administrator of the grant and will manage Phase 2 – Project Planning. DWR will own the property and will manage Phase 3 – Implementation of Restoration. The Natural Heritage Institute will provide technical assistance and help facilitate project planning.

There are no known conflicts of interest or issues related to meeting the proposed budget or schedule.

D. Cost

1. Budget

The total budget with cost share dollars is cash contribution is $36,089,178 and detailed in table 5. The total request to CALFED is $25,889,178 and is broken down annually in form 6 as requested by CALFED. The Coastal Conservancy is providing a $10,050,000 cost share that will fund $5,000,000 of the acquisition cost, early phases of planning, and all of construction during the 4th year of the project.

2. Cost-Sharing

The project applicants have secured are working to secure approximately $20 million in cost-share from the landowners and the Coastal Conservancy. An MIA appraisal, approved by the Department of General Services, valued the property at $38 million. A separate appraisal established the value at $44 million. There is preliminary agreement on a purchase price of $28 million, which amounts to approximately a $10 million cost-share by the landowners. The Coastal Conservancy is proposed to contribute $10 million toward the acquisition and planning costs.

Additional cost-sharing may be available from the Natural Resource Conservation District (NRCS) and the Department of Water Resources. The project partners are optimistic that an additional $2 million may be made available through the NRCS's Wetland Reserve Program to help cover acquisition costs. Additional in-kind cost sharing may be provided by DWR in the form of technical assistance and hydrodynamic modeling.

E. Local Involvement

As the Selection Panel is aware, there was initial local opposition to this proposed restoration project both by the City Council and by some members of the community. The project co-applicants have argued and continued to maintain that the project offers significant benefits to the community and can be implemented to create a regional recreational attraction with educational, recreational, and economic benefits. Over the past nine months, there have been several public meetings in Oakley to discuss this proposal and scores of additional meetings or conversations with individuals or Council members about the project. More than 200 people attended the April 8, 2002 Oakley City Council meeting. Approximately 20 people testified in favor of the project while only a handful opposed it. On May 6, 2002, the City Council voted to send in a letter of support for the project.

Table 5: Summary Budget and Cost Share

		Total Budget	CALFED	SCC	Notes and Other Sources
Phase I					
	Acquisition	$28,000,000	$23,000,000	$5,000,000	potentially $2 million from NRCS wetland
	Site Preparation	$100,000	$100,000		
	Site Mgt	$450,000	$450,000		
Phase II					
2A.	Constraints & Opportunities, Finalize	$25,000		$25,000	
2B.	Collect baseline data, Adaptive				
	Adaptive Management Working	$150,000	$50,000	$100,000	
	Monitoring Plan	$25,000		$25,000	
	Collect Data (one time data)				
	Bathymetry of Sloughs	$35,000		$35,000	
	Wetlands Delineation - Gilbert	$10,000		$10,000	
	Vegetation Mapping - all property	$20,000		$20,000	
	Mercury - sediment cores	$30,000		$30,000	
	Biological survey	$100,000	$100,000		
	Collect Data (ongoing data				
	Groundwater monitoring	$60,000	$60,000		based on $20,000/year for 3 years
	Methylmercury	$210,000	$210,000		based on $70,000/year for 3 years
	Fish (in sloughs)	$300,000	$300,000		based on $100,000/year for 3 years
	Dissolved organic carbon	$150,000	$150,000		based on $50,000/year for 3 years
2C	Coordinate Research Program	$30,000	$30,000		based on $10,000 for 3 years
2D	Public Access Master Plan	$150,000	$50,000		$50,000 - City of Oakley; $50,000 SCC grantto
2E	Develop and Analyze Alternatives				
	Develop Alternatives	$75,000	$75,000		
	Technical analysis of alternatives				
	hydrodynamic salinity modeling	$50,000			$50,000 - DWR
	flood control/canal over topping	$10,000	$10,000		
	groundwater seepage to canal	$30,000	$30,000		
	geomorphology and site evolution	$75,000	$75,000		
2F	Environmental Impact Analysis	$250,000	$250,000		
2G	Final Design	$150,000	$150,000		
2H	Regulatory Coordination	$50,000	$50,000		
Phase III					
3A	Levee Berms	$1,100,000		$1,100,000	$275,000
3B	Rough Grading	$2,800,000		$2,800,000	$700,000
3C	Vegetation	$800,000	$400,000	$400,000	
3D	Design and construction of stable	$25,000		$25,000	
3E	Monitoring				
	Groundwater monitoring	$40,000		$40,000	$20,000/year for two years
	Methylmercury	$140,000		$140,000	$70,000/year for two years
	Fish (in sloughs)	$200,000		$200,000	$100,000/year for two years
	Dissolved organic carbon	$100,000		$100,000	$50,000/year for two years
	Project Management				
	Year 1	$97,881	$97,881		
	Year 2	$83,573	$83,573		
	Year 3	$83,573	$83,573		
	Subtotals	$36,005,027	$25,805,027	$10,050,000	
	Overhead (3% CALFED grant, except	$84,151	$84,151		
	TOTAL	$36,089,178	$25,889,178	$10,050,000	note: $150,000 other matching funds:
					$50,000 DWR modelling
					$100,000 for public access master plan

The City Council and community's interest in this project is understandable given the significant potential effects on the City of Oakley. Concerns raised by the City Council and the community focused on three areas: fiscal impacts, community park, and the need for assurances about the long-term site management. In the initial proposal for the restoration of Dutch Slough, a long-term landowner was not identified because the co-applicants felt it was important that the City have input into what agency would be appropriate for that role. As indicated in the City's letter of support for this proposal, the City has expressed support for the Department of Water Resources to be the long-term landowner of the property.

The significant effort that has gone into building public support for this project has also laid an excellent foundation for planning restoration and public access on the site. Preliminary documents outlining the points of agreement have been drafted and would become Memorandum of Understanding (MOU) between the City and the co-applicants. These MOU have not been finalized, pending a funding decision from CALFED.

Local Groups
The project is supported by numerous local groups including: the Delta Science Center, the Delta Chapter of the Sierra Club, the Mt. Diablo Chapter of the Audubon Society, the Federation of Flyfishers, Save The Bay, and Greenbelt Alliance. Hundreds of local citizens have signed petitions supporting the project.

Public Outreach and Benefits
The Dutch Slough restoration site is located on the edge of the Bay Area metropolis and will be adjacent to a regional trail and community park. The site is next to the East Bay Regional Park District's Big Break Regional shoreline and the proposed location of the $10 million Delta Science Center. The site is also located on the heavily used Marsh Creek Regional Trail.

Third Party Impacts
No unavoidable third party impacts have been identified in conjunction with habitat restoration at Dutch Slough.

F. <u>Compliance with Standard Terms and Conditions</u>

The Coastal Conservancy is agreeable to, and able to comply with the Terms and Conditions for State Funds as described in the 2002 Proposal Solicitation Package Attachment D, except as follows: (1) the Conservancy would revise or exclude Paragraph 11, requiring it to indemnify, defend, and save harmless the State because the Conservancy is itself an agency of the State; (2) the Conservancy would exclude Paragraph 12, because agents and employees of the Conservancy are, in fact, officers and employees or agents of the State of California.

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Birds
American Avocet
American Bittern
American Coot
American Crow
American Goldfinch
American Kestrel
American Pipit
American Robin
American White Pelican
American Wigeon
Anna's Hummingbird
Ash-Throated Flycatcher
Bank Swallow
Barn Owl
Barn Swallow
Belted Kingfisher
Bewick's Wren
Black Phoebe
Black Rail
Black Tern
Black-Bellied Plover
Black-Crowned Night-Heron
Black-Headed Grosbeak
Black-Necked Stilt
Blue Grosbeak
Bonaparte's Gull
Brandt's Cormorant
Brewer's Blackbird
Brown-Headed Cowbird
Bufflehead
Bullock's Oriole
Bushtit
California Black rail
California Gull
Canvasback
Caspian Tern
Cattle Egret
Cedar Waxwing
Cinnamon Teal
Cliff Swallow
Common Goldeneye
Common Merganser
Common Moorhen
Common Raven
Common Snipe
Common Yellowthroat
Cooper's Hawk
Double-Crested Cormorant
Downy Woodpecker
Dunlin
Eared Grebe
European Starling
Forster's Tern
Fox Sparrow
Gadwall
Glaucous-Winged Gull
Golden-Crowned Sparrow
Great Blue Heron
Great Egret
Great Horned Owl
Greater Scaup
Greater Yellowlegs
Green Heron
Green-Winged Teal
Hermit Thrush
Herring Gull
Hooded Merganser
Hooded Oriole
Horned Grebe
Horned Lark
House Finch
House Sparrow
House Wren
Killdeer
Lark Sparrow
Least Sandpiper
Least Tern
Lesser Scaup
Lesser Yellowlegs
Lincoln's Sparrow
Loggerhead Shrike
Long-Billed Curlew
Long-billed Dowitcher
Mallard
Marbled Godwit
Marsh Wren
Mew Gull
Mourning Dove
N. Rough-Winged Swallow
Northern Flicker
Northern Harrier
Northern Mockingbird
Northern Rough-Wing Swallow
Northern Shoveler
Nuttall's Woodpecker
Orange-Crowned Warbler
Osprey
Pied-Billed Grebe
Red-Necked Phalarope
Red-Shouldered Hawk
Red-Tailed Hawk
Red-Winged Blackbird
Ring-Billed Gull
Ring-Necked Pheasant
Rock Dove
Ruby-Crowned Kinglet
Sandhill Crane
Savannah Sparrow
Say's Phoebe
Scrub Jay
Sharp-Shinned Hawk
Snowy Egret
Song Sparrow
Sora
Spotted Sandpiper
Spotted Towhee
Swainson's Hawk
Thayer's Gull
Tree Swallow
Turkey Vulture
Violet–Green Swallow
Virginia Rail
Western Kingbird
Western Meadowlark
Western Sandpiper
Western Scrub-Jay
Western Tanager
Western/Clark's Grebe
Whimbrel
White-Crowned Sparrow
White-Faced Ibis
White-Tailed Kite
White-Throated Swift
Willet
Willow Flycatcher
Wilson's Warbler
Wood Duck
Yellow Warbler
Yellow-Breasted Chat
Yellow-Headed Blackbird

Reptiles and Amphibians
Western Pond turtle
Red-legged Frog (upper Marsh Creek)
Silvery Legless Lizard
Alameda Whip Snake
Western Fence Lizard

Mammals
Beaver
California Ground Squirrel
Coyote
Gray Fox
Opossum
Striped Skunk
River Otter

Appendix 2: Mercury Methylation

During the last decade several studies have evaluated the sources, concentrations, and fate of mercury in the Marsh Creek watershed, Big Break, and Delta waters near the Dutch Slough site. There is an abandoned mercury mine on Marsh Creek 30 miles upstream from the Dutch Slough site. A three-year study of mercury concentrations in fish and macroinvertebrates in the Marsh Creek watershed found that levels of methylmercury in lower Marsh Creek were significantly lower than levels in upper Marsh Creek and hypothesized that the transport of mercury downstream from the mine was significantly impeded by the Marsh Creek reservoir (Slotton et al., 1998). The authors caution, however, that the number of samples from lower Marsh Creek was not sufficient to characterize long-term trend and that future pulses of mercury from upstream could be triggered by large storm events.

Historical geomorphic analysis suggests that Marsh Creek (NHI, 2002) may not have historically deposited mercury at Big Break. Soil and geologic maps indicate that the dominant course of Marsh Creek during the Holocene has been toward Discovery Bay to the east (SCS, 1977; USGS, 1994). By the late nineteenth century, the Marsh Creek channel had assumed its current alignment but maps from that era show the channel as discontinuous, interrupted by the sandy dune soils two miles upstream of the its current mouth (State Geologic and US Surveys, 1871; McMahon,1908). Early USGS maps and flooding records indicate that Marsh Creek, due to its complex and avulsing pattern near Brentwood, spilled most of its flood waters overbank, depositing the bulk of sediments and water along the channel rather than conveying it to Big Break (Contra Costa County, 1953). Marsh Creek did not flow directly to Big Break until flood control channel improvements were implemented in 1962, only a few years before the Marsh Creek reservoir was completed. Evidence from Slotton et al. (1998) indicates that the reservoir now captures the vast majority of the stream's mercury load.

A CALFED funded assessment of methylmercury distribution, production, and bioaccumulation in the Delta measured low levels of mercury at the mouth of Marsh Creek and in Franks Tract and Sand Mound Slough (near Dutch Slough) relative to other sites in the Delta (Suchanekl, et al. 1999). The study concluded that mercury levels in the Central Delta were relatively low compared to upstream locations where tributaries enter the Delta along its northern, eastern, and southern periphery. Big Break and the mouth of Marsh Creek were about average for the Central Delta. Mercury concentrations in largemouth bass and white catfish from the Delta were also lower than concentrations from the same species sampled in the Sacramento and San Joaquin Rivers (Davis et al. 2002).

Even if Marsh Creek did deliver significant quantities of mercury to Big Break over the last century and a half, a network of levees and berms would have prevented sediment (and mercury) deposition on the Dutch Slough properties, which are surrounded by levees on the north and west edges. Berms associated with the railroad grade and the Contra Costa Canal both ponded and diverted Marsh Creek floodwaters away from the properties eastward toward the vicinity of Knightson (Contra Costa County Flood Control and Water Conservation District 1953).

Appendix 3: Dissolved Organic Carbons

Improving drinking water quality and increasing ecosystem productivity are central goals of the CALFED program (CALFED, 2001), but there may be conflicts between ecosystem restoration projects that increase dissolved organic carbon (DOC) and CALFED's drinking water quality goals. The Dutch Slough project will serve as an excellent opportunity for measuring the effect of tidal marsh restoration on the quantity and quality of DOC in the Delta and its impact on drinking water quality. Dissolved organic carbons provide nutrients that can benefit the ecosystem by enhancing productivity (Jassby et al. 1993), but when disinfected with chlorine, chloramine, or ozone as part of the drinking water treatment process, they can be harmful to human health (California Department of Water Resources 1994). Current land uses in the Delta and its watershed currently provide significant inputs of dissolved organic carbons to Delta waters (Amy et al. 1990*)*. Some forms of DOC play an important role in the formation of a variety of chemicals referred to as disinfection byproducts (DBPs), which are suspected carcinogens. These compounds are formed when water is disinfected in drinking water treatment plants. There are various forms of DOC, and some of them are more prone to forming DBPs than others (Fram 1999).

Tidal marsh restoration in the Delta will create DOC, but it is unclear whether they will create more or less harmful DOC than already exists (Brown, draft). The net impact of restoring farmlands to wetlands is unclear. Depending on the type of restored wetland and a variety of factors including soil, location, and hydrodynamics, the restored wetland may create more or less reactive DOC than the agricultural land it replaced. A review of Jassby et al. (1993) indicates that restored tidal wetlands will export organic carbon to adjacent deep-water habitats, but is unclear how much will be exported or whether it will significantly increase formation of DPBs. Some fraction of the DOC exported from tidal wetlands will likely be very reactive in formation of DPBs, but it is uncertain how large this source amount and reactivity would be compared to other sources of DOC. The amount and types of DOC created by a particular wetland restoration project may vary depending on construction methods used to restore the wetland. Agriculture land opened to tidal action for wetland restoration might export more organic carbon than agricultural land that is covered with clean dredge spoils as part of project construction. Agricultural lands and restored wetlands in the western Delta, downstream of pumps that divert water from the Delta, may be a smaller source of DOC in drinking water than lands near the pumps. The Dutch Slough Project has been designed to address these issues and quantify the production of DOC.

The effect of DOC on drinking water quality depends on the drinking water treatment method. Drinking water treatment methods that depend solely on chlorine are more likely to result in production of trihalomethanes, forms of disinfectant byproducts that are regulated by the U.S. Environmental Protection Agency. The Contra Costa Water District relies largely on ozone disinfection, a process that significantly reduces the production of trihalomethanes, but can cause the formation of bromate, a different regulated DBP. The district does, however, utilize chloromine to treat residual carbon resulting in some potential trihalomethane formation (Gartrell, pers com, 2002). Since the Dutch Slough project is in close proximity to Rock Slough, one of the main drinking water intakes for the Contra Costa Water District, any additional DOC created as a result of the Dutch Slough project is a concern for the District (Gartrell, pers com, 2002).

As with other tidal marsh restoration projects, it is unclear whether the Dutch Slough project will result in increased DOC from existing conditions. Currently the land is managed for a dairy operation and irrigated pasture. Irrigation drainage water from these operations may presently be contributing large quantities of DOC and other potentially harmful constituents, such as nitrates, to Delta waters. Before implementation of the project, the project team will work with regulatory agencies, CALFED, and research scientists to measure existing levels of DOC discharge from the site and to identify restoration design strategies to reduce DOC export from the site.

During and after project implementation, the project team will collaborate with CALFED funded researchers to monitor levels of DOC and other nutrients after the site has been restored to tidal marsh. If the site does increase levels of DOC that adversely affect drinking water quality, the project partners will work with the CALFED program to appropriately identify mitigation measures. The CALFED BDPAC drinking water subcommittee is currently working on a mitigation framework that could facilitate mitigation of all CALFED sponsored projects that might impact drinking water quality, including water supply enhancement and ecosystem restoration projects (Gartrell, pers com, 2002). Under such a framework, the CALFED program would fund water quality improvement projects to more than offset the potentially adverse effects of other projects to ensure that the CALFED Bay-Delta Program can meet its goal of continuous improvement in drinking water quality. The Contra Costa Water District has suggested that funding to implement the CALFED Rock Slough and Old River Water Quality Improvement Projects or to line the Contra Costa Canal might be appropriate mitigation measures for projects that harm Contra Costa drinking water quality (Gartrell, pers com, 2002). The project partners anticipate that this sort of global mitigation program would be the most appropriate vehicle for resolving conflicts that are likely to arise from implementation of the CALFED program.