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Enhancement Alternatives for the Ocean Meadows Golf Course Site
Goleta, California

A Group Project submitted in partial satisfaction of the requirements for the degree of Master's in Environmental Science and Management
for the
Donald Bren School of Environmental Science and Management

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June, 2000

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The mission of the Donald Bren School of Environmental Science and Management is to produce professionals who will devote their unique skills to the diagnosis, assessment, mitigation, prevention, and remedy of the environmental problems of today and the future. A guiding principal of the School requires quantitative training in more than one discipline and an awareness of the physical, biological, social, political, and economic consequences that arise with environmental management and science decisions.

The Group Project is required of all students in the Masters of Environmental Science and Management (MESM) Program. It is a three-quarter activity in which small groups of students conduct focused, inter-disciplinary research on the scientific, management, and policy dimensions of a specific environmental issue. This Final Group Project Report is authored by MESM students and has been reviewed and approved by:

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June, 2000

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Abstract

This project sought to evaluate the potential *enhancement and restoration alternatives for the Ocean Meadows Golf Course site*. Following extensive research, five Enhancement Alternatives were chosen to encompass the realistic spectrum of enhancement scenarios for the site, given the constraints of current social, political, and economic conditions. The gradient of alternatives ranged from a Green Golf Course Alternative, which expands current riparian corridors while allowing for the persistence of the golf course as a private business; to the Full Estuarine Wetlands Alternative, which recreates the maximum possible cover of historic wetlands.

The Enhancement Alternatives sought to increase ecosystem conditions or functions that were historically associated with a historic Reference Condition. Each Alternative was individually evaluated based on a suite of biologic, hydrologic, and economic characteristics. A Geographic Information System (GIS) was used to create potential habitat designs that maximized the enhancement goals of each alternative. The success of each Enhancement Alternatives was gauged by monitoring the improvement of several *ecosystem indicators*, which characterized a selected suite of critical ecosystem components. A final comparative analysis of the five alternatives was done to determine their relative cost-effectiveness.

Acknowledgements

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Executive Summary

Devereux Slough is an impounded coastal lagoon in Santa Barbara County, California. Like most Southern California wetland systems, the Devereux system has been severely degraded as a result of agricultural development and urbanization. Currently, the Slough covers less than half its historic range. While the lower Slough is protected as a portion of the Coal Oil Point Reserve, the historic upper Slough was drained and filled in 1967 to create the 70-acre Ocean Meadows Golf Course. Devereux Creek bisects the course and has been partially filled, probably as a result of upland development. During winter storms, water often overflows the creek banks, rendering the golf course unplayable for days to weeks at a time.

A number of stakeholders, including the University of California, Santa Barbara, the Southern California Wetlands Recovery Project, and the Audubon Society, have expressed an interest in acquiring the golf course property and restoring wetland conditions to the site. This project investigates the feasibility of restoration and enhancement of the Ocean Meadows Golf Course site.

Five site management alternatives were selected for detailed analysis after consideration of best available research, relevant case studies, socio-political constraints and the interests of project stakeholders. These alternatives represent a gradient of actions designed to rehabilitate ecosystem functions or conditions formerly present at the site:

No Action Alternative: the golf course remains unchanged;
Greener Golf Course Alternative: the riparian zones are expanded, upland habitat is increased;
Palustrine Alternative: the golf course is replaced with freshwater marsh habitat;

Partial Estuarine Alternative: the golf course is replaced with a combination of freshwater and estuarine marsh, expanded from the lower Slough;

Full Estuarine Alternative: the golf course is replaced with expanded estuarine conditions.

The final three alternatives, if implemented, would double the wetland area of the Devereux Slough system.

We examined a suite of ecosystem indicators to evaluate the benefits associated with enhancement activities. These indicators include changes in hydrological conditions, increase in native habitat types associated with former conditions, and benefits to selected plant and animal species of special concern.

Our analysis highlights the varied costs and benefits associated with each alternative. For example, returning the site as closely as possible to historic conditions under the full estuarine alternative is the most expensive option. However, the greatest species diversity is achieved under the partial estuarine alternative, while the palustrine alternative has the lowest cost per acre of wetland created.

This document is meant to be a management tool for future enhancement projects at the site regardless of stakeholder ownership. Thus, we do not recommend a specific alternative for implementation. Rather, we provide the information necessary for future decision-making at the site.

1.0 Introduction

1.1 The Setting

Coastal wetlands are recognized as one of the most endangered habitat types in California. Despite providing a range of social, economical, and biological benefits including water quality improvement, flood control, spawning nurseries, food chain support, nutrient cycling, pollution control, wildlife habitat, and recreation (Ferren et al., 1987; Sather and Smith, 1984; Zedler, 1982), an estimated 95% of California's coastal wetlands have been lost to development. The wetlands of Goleta Valley, a fast-growing community in Southern California, have not been exempted from this trend. The area contains several wetland systems, all of which are severely degraded (SCWRP, 1999). Our study concentrates on the Devereux Slough system (Figure 1-1). Devereux Slough is representative of many Southern California wetlands that occur at the mouths of watersheds; it is a seasonally flooded lagoon influenced by both tidal and freshwater input (Howald, 1985). Today the Slough is less than one half its former size, and has become a heavily fragmented and isolated system due to urban encroachment (Ferren et al., 1987).

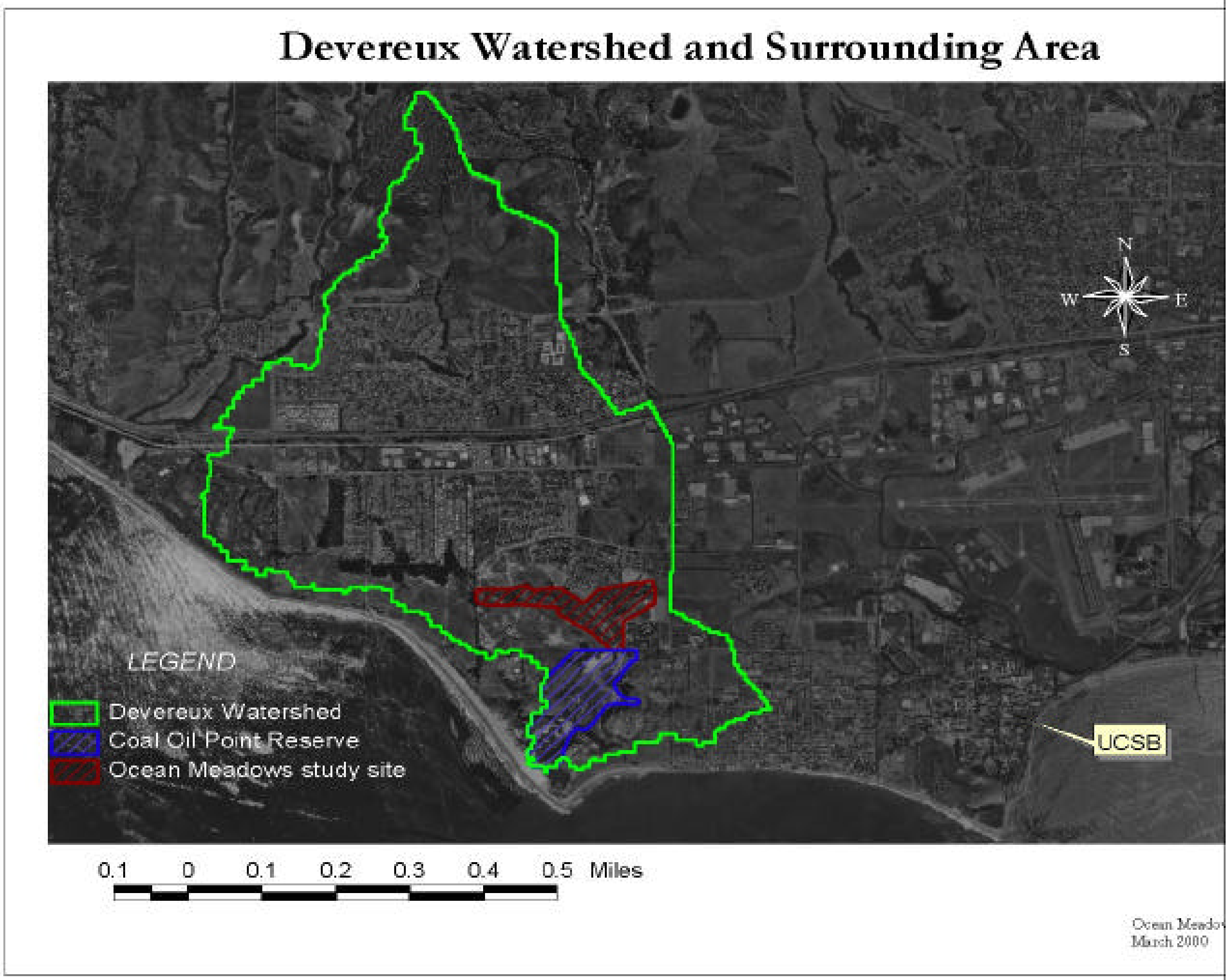
1.2 The Problem

The lower portion of Devereux Slough is protected within the Coal Oil Point Reserve (COPR), part of the University of California's Natural Reserve System. The northern half of the slough, former upper Devereux Slough, was filled in 1967 to create the 70-acre Ocean Meadows Golf Course (Figure 1-1). Today, the nine-hole course suffers economically due to periodic flooding that renders the course unplayable for several days following even moderate rain events. The incessant flooding problems and the resulting economic strains on the golf course (Hererra, personal communication) have spurred speculation that the site may be a prime location for wetlands restoration or mitigation (LSA, 1985).

1.3 The Political Climate

As early as 1985, stakeholders proposed habitat enhancements to the upper Devereux Slough (LSA, 1985). Subsequently, several organizations have expressed interest in acquiring the golf course for restoration, including the County of Santa Barbara, the Audubon Society, the U.S. Fish and Wildlife Service, and Southern California Wetlands Recovery Project. However, acquisition of the golf course may be particularly important for the University of California, Santa Barbara (UCSB). Presently, UCSB is under pressure to expand its University-owned housing system in order to recruit faculty and avoid putting undue demand on the local housing market (NCAG, 1999). In 1994 UCSB acquired much of the property immediately surrounding the golf course and the Slough as a potential site for the housing expansion. The North Campus, as the purchased property is called, consists of three parcels that lie north, south and east of the golf course (Figure 1-2). The proposed development gathered attention from campus constituencies as well as local citizens groups concerned with the loss of open space, especially on the South parcel. UCSB created a group to address the community's concerns, the North Campus Advisory Group. In November 1999 the group recommended delaying development on the South parcel while proceeding with development the North and East parcels (NCAG, 1999).

Figure 1-1


Devereux Watershed and Surrounding Area
N
W
E
S
LEGEND
Devereux Watershed
Coal Oil Point Reserve
Ocean Meadows study site
UCSB
0.1 0 0.1 0.2 0.3 0.4 0.5 Miles
March 2000

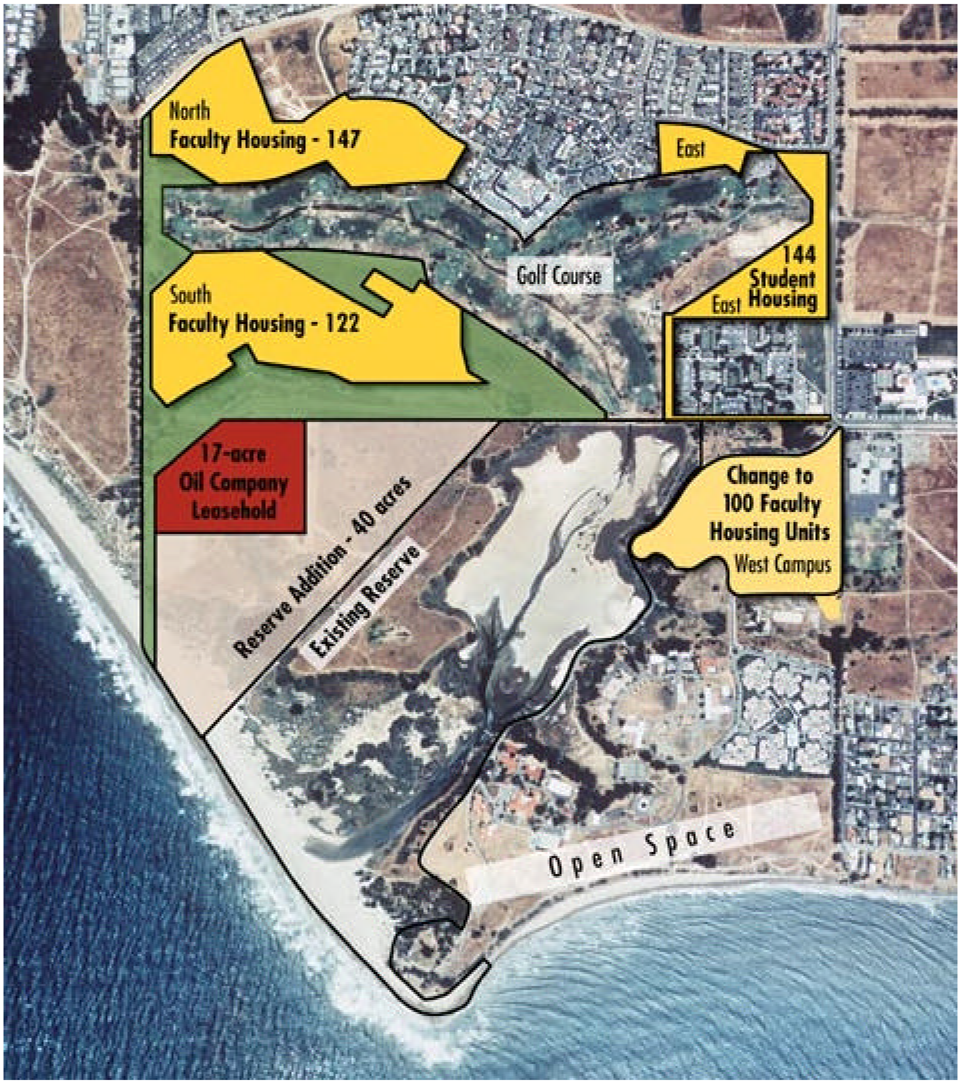


Figure 1-2: Proposed University development around Ocean Meadows Golf Course (Wallace, Roberts and Todd, 1997).

Construction of the North Campus project will probably require mitigation measures, which could be accomplished through restoration or enhancement of the golf course property. However, many development issues remain unresolved, and no agreement regarding the site has been reached at this time.

1.4 Ocean Meadows Golf Course Site Enhancement Project

Given the political climate described above, the Project members decided to create a document that would define a range of restoration alternatives for the site that will remain relevant in any political outcome. The alternatives for enhancement and restoration fall into two categories:

1) ownership of the golf course does not change, and the golf course remains; or

2) ownership of the golf course changes, and the course is removed.

Based on rigorous selection criteria outlined in Section 3.2, four management alternatives were chosen to encompass the realistic enhancement scenarios given current social, political, and economic constraints. The spectrum of alternatives ranges from a Green Golf Course Alternative, which expands the current riparian corridor on the site while allowing the golf course to continue as a private business, to the Full Estuarine Alternative, which restores the maximum possible extent of historical estuarine habitat to the site. We will contrast these alternatives with a No Action Alternative, a baseline evaluation of the golf course as it functions currently. A brief description of each management alternative is given in Table 1-1 below.

TABLE 1-1: Five Restoration and Enhancement Management Alternatives	
Alternative Name	**Primary Characteristics**
No Action	Baseline description of biological, hydrological, and managerial conditions of the current site.
Green Golf Course	Expansion of riparian corridor to increase habitat for birds and small mammals, while improving the flood control for the golf course.
Palustrine Wetland	Freshwater wetlands enhancement. Returns many hydrological and ecological functions associated with historic conditions while allowing access road to remain

	in place.
Partial Estuarine Wetland	Restoration of the site through returning tidal influence to lower elevations of the site while creating palustrine habitats in the higher elevations, a partial restoration of estuarine wetlands that were historically present at the site. The access road will be replaced with a bridge overpass.
Full Estuarine Wetland	Full restoration of the site, limited by recent urban developments. Maximum feasible recreation of historic estuarine wetland. The access road will be replaced with a bridge overpass.

These alternatives were selected as a set of graduated enhancement alternatives; the first alternative requires the least disruption from the current state of the site, but is the least similar to its historic configuration. The final alternative requires the greatest amount of disruption, but returns the site as much as possible to its former conditions (Figure 1-3). For example, we did not consider restoration of the entire former extent of the Slough, as this would require removal of hundreds of homes built on former Slough lands. In addition, we did not consider an enhancement plan to bring regular tidal action into the slough, as this was not the original tidal regime of the system (Appendix G). We will not recommend one of these alternatives as the optimal restoration choice, but rather present them on a continuum of increasing effort that approaches the former conditions of the system.

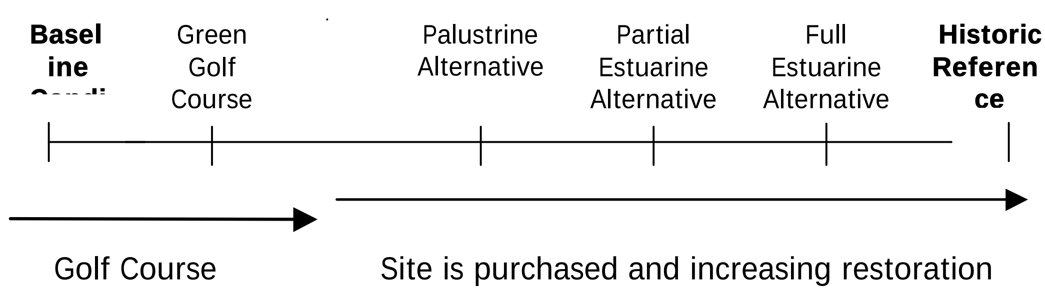


Figure 1-3: Gradient of Restoration and Enhancement Alternatives

1.5 Historic Reference Condition

Each alternative strives to restore some of the form and function of the historical Devereux system. To guide the design of the alternatives we defined a historic reference condition as the ideal, if unreachable, restoration target. The reference condition is based on the first habitat map of the site from 1871 (see Figure A-2 in Appendix A) and the first aerial photograph of the site in 1928 (Figure A-4), both of which depict the Slough as a large impounded lagoon surrounded by coastal grasslands. Appendix A further details the history of Devereux Slough. The reference illustrations indicate that the upper Slough rested partially on the present site of the Ocean Meadows Golf Course, but also extended well up into present-day Devereux creek, Phelps creek and out east toward Goleta Slough. The mouth of the Slough is depicted as closed in these illustrations. The water impounded in the Slough probably exhibited a saline gradient from the tidally influenced lower Slough to the runoff influenced upper Slough, although the gradient surely varied strongly with the season.

The dominant vegetation associations that directly surrounded the Slough probably fell into estuarine emergent and transition habitat types, while the Slough bed was probably dominated by estuarine aquatic bed species. The upper reaches of the system, however, which were more influenced by freshwater runoff (Ferren and Thomas, 1995), probably exhibited some palustrine emergent and palustrine scrub shrub vegetation associations.

1.6 Guiding Principle for Alternative Design

The guiding principle for the enhancement alternatives states that they are designed to rehabilitate or enhance ecosystem functions or conditions present within the historic reference condition. The term 'rehabilitate' is defined as an attempt to restore elements of structure of function to an ecological system without necessarily attempting complete historic restoration (Meffe, 1994). A reference condition will be used as the historic marker, which was the condition of the site in the late nineteenth century. Thus, the four enhancement alternatives were designed to either (1) bring back or increase habitat types present within the historic reference condition, or (2) improve or restore the functionality of an ecosystem component historically active in the historic reference condition.

The guiding principle shapes the alternatives by determining what habitat types, or ecosystem functions can be considered as potential enhancement options. For example, two of the management alternatives seek to expand palustrine wetland habitat, even though it may not have historically occurred directly on the site, because it played an important role in the historic reference condition's ecosystem dynamics (Ferren, personal communication). Similarly, the Green Golf Course Alternative can be considered enhancement because it not only increases habitat that has been lost from the historic reference condition, but also improves functions such as flood control and sediment trapping that were historically associated with it. Although several of our plans prescribe planting native plant species, we assume that some species benefiting from enhancement will recolonize the site without reintroduction.

1.7 Project Deliverables

The goal of the project is to create and analyze four enhancement alternatives that help guide management decisions for any stakeholders wishing to restore the site toward its former conditions. This document is an initial planning tool; it may serve to reduce the cost of preparing plans for each enhancement alternative.

In addition to the four management plans, this report synthesizes the information available about the Ocean Meadows site, including a Geographic Information System (GIS) of the site. It also provides a rough estimate of the costs and benefits associated with enhancement activities. This qualification will allow stakeholders to determine the best restoration alternative to serve their objectives

2.0 Site Description

2.1 Overview

Devereux Slough is an impounded coastal lagoon that opens to tidal flushing only following extreme storm events. Maps drawn before 1860 indicate that Devereux was closed to regular tidal flushing. (Figures A-1 and A-2 in Appendix A). Large-scale agricultural development began in the watershed during Spanish and Mexican rule and exacerbated loss of native vegetation and increased siltation in coastal estuaries (CSWRCB, 1977). Commercial development in the area began in the early 20th century.

Two artificial structures in Devereux Slough are of note to this project. The first is an east-west access road constructed in the 1920s, which bisected the slough and inhibited tidal influence in the Slough's northern reaches. The second significant development is Ocean Meadows Golf Course, constructed immediately north of the access road in 1967. Developers drained, filled and raised the upper portion of the slough to create the 70-acre course, which consists of nine holes, a clubhouse and a driving range. The golf course site is no longer affected by tidal flow, although the lower Slough experiences muted tidal flow with only occasional breaching of the berm separating the lagoon from the Pacific Ocean.

Three creeks drain the course, providing thin bands of riparian habitat. Sedimentation from upland development has partially filled these creeks. Although they are often dry in the summer, water from large winter storms often overflows the creeks' banks. The course is bounded to the north by residential development, to the east by the partially developed UCSB West Campus, to the west by coastal mesa grasslands, and to the south by Devereux Slough, part of the University's Coal Oil Point Reserve (Figure 1-2).

2.2 Characteristics of the Watershed

The Devereux watershed covers an area of about 2000 acres and ranges in elevation from sea level to 580 feet (Ferren et al., 1987). The Ocean Meadows Golf Course lies in the lower extent of the watershed (Figure 1-1). Devereux Creek, carrying about 750-acre feet of water per year from the higher elevations (Davis et al., 1990), runs through the golf course before discharging its contents into lower Devereux Slough. As of 1998, sixty three percent of the watershed had been developed. The remaining 37% of the watershed is undeveloped open space and agricultural fields (Carey et al., 1998). Of the developed lands, 31% is residential, 9% commercial and industrial, and 11% is road network.

The Devereux Watershed is a part of the Transverse Range Geomorphic Province of Southern California. The region is unusual in California due to the east-west trend of the Transverse Range, a series of mountain ranges that include the Santa Ynez Mountains and the Channel Islands, which is unlike the north-south trend of most of California's ranges. The Santa Ynez Mountains climb to 4,298 feet in elevation at Santa Ynez peak, and consist of hard sands and shales that originated in the Cretaceous Age (oldest) through the Miocene Age (youngest) (Ferren and Thomas, 1995). The Devereux Watershed slopes southward from these mountains, first steeply (about 33%) in the upper elevations, then moderately through the coastal foothills down to gently sloping (5%) alluvial plains fronting the coast (Carey et al., 1998).

2.3 Geology of the Site

The slough bed itself, overlaying the More Fault system, consists of Holocene sediments overlaying an older Pleistocene canyon system. The sediments are up to 45 feet deep, and probably were deposited during an episode of high sea levels during the

Holocene (Ferren and Thomas, 1995). Consistent coastal uplift along the east-west running More Ranch fault system for the past 6000 years may have substantially altered the shape of the shoreline at the slough mouth.

2.4 Soils

The Aquent soils of the original Devereux Slough consisted of a 30 to 75 cm layer of fine sandy loams with poor and very poor draining capacities. Ringing the slough were Conception soils on slopes ranging from 0-30% which were also comprised of fine sandy loams. In 1967, however, a parcel directly northwest of the lower slough was scraped, and the resulting fill was deposited on the remaining upper slough in order to raise the site for construction of the golf course. As a consequence, the entire site is covered with a layer of fill from 6 to 10 feet deep. Much of the soil surrounding the site today consists of cut and fill, while the soils of the lower slough and adjacent lands remain relatively intact (Ferren and Thomas, 1995).

2.5 Climate

The Devereux Watershed lies within the Southern California Mediterranean Climactic Region (NOAA, 2000), characterized by wet, mild winters and relatively dry, warm summers. Because of the Slough's proximity to the ocean, temperatures fall within a narrow range and rarely reach above 100°F or below freezing. Most of the year's precipitation falls during the winter months of November through April generally from northwest originating storms; summer rain is infrequent and usually comes from short-lived tropical storms. The slough does receive some early summer moisture, however, in the form of morning fog.

Temperature and precipitation have been recorded daily at the Santa Barbara Municipal Airport, five miles west of Deveruex

Slough, since 1931. The airport is at a similar elevation and distance from the ocean as the slough, and conditions recorded there may be used to approximate weather conditions at the study site. A comparison of monthly mean temperatures at the airport for the years 1961 to 1990 shows a high mean of 75°F for August and a low mean of 40°F for January, a difference of 15°F between the warmest and coolest months. This narrow temperature range is fairly constant when compared to earlier time periods (Ferren, 1987). The overall average temperature from the years 1961 to 1990 was 59°F.

Unlike temperature, rainfall is highly variable between seasons and between years. Eighty-six percent of the precipitation at the airport for the years 1961 to 1995 fell in the winter months of December to February, while only 14% fell in the summer months of June to August. In addition, the area experiences a considerable amount of interannual variability. For example, average annual precipitation during the years 1970 to 1975 was 13.25 inches, in comparison to an average annual precipitation of 21.4 inches between the years 1980 and 1985 (NWS, 2000). Higher rates of precipitation fall on the higher elevations of the watershed than on the study site. While the upper elevations of the watershed receive an average of over 20 inches per years, precipitation at the airport averages 16.2 inches per year (Stanley, 1985; NWS, 2000).

2.6 Hydrology

Three creeks and several storm ditches drain onto the Ocean Meadows Golf Course site, which overlays the west sub-basin of the Goleta groundwater basin. The largest drainage is Devereux creek entering at the western arm of the golf course. As Devereux creek runs southeast through the site it flows through a series of water-trap ponds and culverts. The capacity of these ponds is approximately 20.5 acre feet during winter floods, when the course is flooded to an average elevation of 8.5 to 9 feet above Mean Sea Level (MSL) (Lawrence,1983). During storm events the ponds progressively fill as the storm wave flows down the site, having the effect of reducing the flood wave peak and creating a sustained period of runoff. During low-to-normal flow periods all of the runoff leaving the site drains through a 36-inch corrugated metal pipe at the southern end of the site. The pipe runs underneath the low-water crossing of the access road, and has a capacity of approximately 100 cubic feet per second. When large storm events create discharge that exceeds this capacity, runoff flows over the road into the lower slough.

The Devereux lagoon is closed to tidal influence most of the year by a sand berm at the southern end of the lower slough . In the summer and fall net evaporation and reduced freshwater input to the lower slough creates hypersaline conditions. During these dry months water levels in the lower slough range from 3.5 to 4 feet MSL, just above the incised channel, with a volume of approximately 50 acre feet. Winter storms flood the basin to 8 feet MSL at the berm before the runoff breaches the berm and opens the slough to the ocean. Before the berm breaches, at 7 feet MSL, the lower slough holds approximately 170 acre feet, while after the berm breaches the basin drains quickly. The length of time that the berm remains open, exposing the slough to tidal influence, depends on tidal height and beach dynamics at the time of breakout. During high tides and or strong storm surge events only a small channel forms, allowing reformation of the sand berm in just a few days. If the breakout occurs at a low tide a large channel is formed, which allows the slough to remain open for several weeks.

Consequently, the tidal regime is a complex and stochastic process. As the amount and intensity of rainfall in the region is highly variable from year to year there is high variation in the timing and amount of breakout. During the 40-year period from 1942 to 1982 the runoff reached a sufficient level to cause breaching 37 out of 40 years. The average breakout date was

January 11th, with a standard deviation of 37 days (Lawrence, 1983). Several hydrological models exist for this watershed (Davis et al., 1990; de la Garza and Ryan, 1998). Davis et al. (1990) modeled runoff as a function of soil type and land cover type , they predicted an average annual runoff of 737-acre feet under 1990 conditions. Using 1930 land use conditions, the model predicts an annual runoff of 558 acre feet, suggesting that recent land use changes in the watershed have caused a 32% runoff increase.

2.7 Sediment

Creeks draining the Santa Ynez Mountains in the upper reaches of the watershed carry high levels of sediments through the foothills and alluvial plains to the ocean. Most of the sediment is brought down by large winter storms, and accumulates in the lowest elevations of the watershed. When the berm of the Devereux Slough system is broken, floodwaters scour the bed of the slough and carry sediments to sea. Subsequent tidal activity in the slough causes additional scouring and sediment removal.

Residential, commercial, and agricultural development may have increased the amount of sediment reaching the alluvial plain, which accumulates just above the golf course in a large riparian area. Santa Barbara County flood control removes approximately 7-acre feet of sediments every 3 to 5 years at this site, and places the sediments on nearby mesas. Sedimentation of the lower slough has increased due to sandy runoff from the scraped south parcel, creating a fan delta in the north west corner of the slough. Between 1967 and 1985 this sediment delta displaced 6.5% of the basin volume at 6.5 feet MSL. Since 1985 the growth of the delta has been slowed or arrested by sediment management berms and ditches constructed on the south parcel.

2.8 Water Quality

Urban and agricultural runoff contributes to relatively high pollutant levels in the wetlands: slough waters include high levels of suspended solids, toxic metals, nitrogen, and phosphorus (Ferren et al., 1987). De la Garza and Ryan (1998) modeled water quality of the watershed, and found that pollutant levels may exceed EPA water quality standards.

3.0 Methods

This section contains an overview of the methods used in this project. Full details can be found in the Appendices in the back of the report.

3.1 Documentation

This document contains numerous references to white papers and fewer references to primary sources. Although we conducted extensive literature searches for information relating to impounded coastal lagoons in Southern California and the Devereux Slough system specifically, we found that little to no peer reviewed documentation. Thus, we consulted extensively with local experts knowledgeable about the site. See the Bibliography for a list of the experts referenced.

3.2 Selection and Design of Alternatives

Throughout the initial phase of this project we considered the potential management alternatives for the restoration and enhancement of the site. From all the possible management scenarios, five alternatives were selected that represented the reasonable restoration and enhancement management alternatives given current social, economic, and political constraints (Table 1-1). The spectrum of alternatives (Figure 1-4) ranged from a Green Golf Course Alternative, which expands current riparian corridors while allowing for the persistence of the golf course as a private business; to the Full Estuarine Wetlands Alternative, which recreates the maximum possible cover of historic wetlands. As noted above, there is a bifurcation in the alternatives in that two alternatives allow for the maintenance of the golf course as an active business, while three alternatives entail the purchase and restoration of the site. It is important to note that full restoration of the historic upper Slough area was deemed impossible, given the urban development located nearby (Figure 1-1). These Five Alternatives were selected based upon a thorough investigation of:

1) Current research
2) Relevant case studies
3) Expert opinion
4) Publicly stated interests of key stakeholder
5) The socio-political climate
6) Physical limitations due to recent urban expansion and development
7) Economic constraints

We initially examined five enhancement alternatives from the range of all possible management options based on the suggestions and visions of stakeholders and a review of historic maps. From further in-depth investigations of historic information we decided not to persue a fully-tidal alternative (See Appendix G for more detail). We determined, based on further discussion with stakeholders and review of case-studies and published research, the appropriate landscape and species associated with each alternative. We created a vision of several possible configurations of each alternative that consisted of habitat distributions displayed by a GIS and lists of species associated with each habitat type. We adjusted our vision of each alternative throuought the process with continued discussion with stakeholders. Upon further examiniation we found that the range of habitat configurations designed for each alternative varied only slightly from each other and reduced the number of configurations within each alternative to one.

3.3 Wetlands Classification System

Four of the Five Alternatives will create new, or expand existing, wetland habitat. Based on the Cowardin et al. (1979) Wetlands

Classification System, eight wetlands *habitat types* are defined and described for this project, all of which were historically associated with the historic reference condition. Each habitat type belongs to one of two major wetland systems, estuarine and palustrine, and brief description of the habitat types is given in Table 3-1. A more complete description of the habitat types will be given in Appendix B, which includes the following specific data.

1) Definitions and characteristics of wetland habitat
2) Description of the Cowardin et al. (1979) *Wetlands Classification System*
3) Detailed descriptions of the eight wetland habitat types used referenced within this report
4) Characteristic plant species associated with each habitat type

TABLE 3-1: Key Characteristics of Habitat Types Included in Enhancement Alternatives at The Upper Devereux Slough Study Site (Cowardin et al., 1979; Ferren et al., 1987; Ferren et al., 1996b). *See Appendix B for associated plant species.

Wetland Habitat Type	Characteristic/ Dominant Vegetation	Water Regime*
Estuarine aquatic bed	Submerged Rooted vascular; (e.g. *Ruppia maritima*)	Seasonally flooded
Persistent estuarine emergent	Persistent emergent hydrophytes (e.g. *Salicornia virginica*, *Distichlis spicata*)	Irregulary exposed/ irregularly flooded or seasonally flooded (estuarine)
Nonpersistent estuarine emergent	Nonpersistent emergent hydrophytes (e.g. *Lasthenia glabrata ssp. coulteri*)	Irregularly or seasonally flooded (estuarine)
Transitional (estuarine/ palustrine)	Estuarine and palustrine emergent hydrophytes (e.g. *Hordeum depressum*)	Irregularly or seasonally flooded
Persistent palustrine emergent	Persistent emergent hydrophytes (e.g. *Scirpus californicus*)	Seasonally or semipermanently flooded
Nonpersistent palustrine emergent	Nonpersistent emergent hydrophytes *(e.g. Gnaphalium palustre)*	Seasonally flooded/ saturated

Palustrine forested wetland	Mixed deciduous and evergreen woody vegetation greater than 18 feet tall (e.g. *Salix lasiolepis, Baccharis salicifolia*)	Seasonally flooded/ saturated
Palustrine scrub- shrub wetland	Mixed deciduous and evergreen woody vegetation less than 18 feet tall *(e.g. Baccharis pilularis*)	Intermittently flooded, temporarily flooded, or saturated

3.4 Species of Special Concern

3.4.1 Plant Species of Special Concern

The Devereux Slough consists of valuable estuarine habitat in southern California (Ferren, personal communication), 95% of which has already been destroyed by urban and agricultural expansion (Zedler, 1994). The Devereux Slough is located near the geographic limit, both north and south, of many flora species. The Slough also exhibits extreme variations in salinity levels over the course of a year, creating a hostile and unique environment that is only tolerated by several halophytic floras.

Along with these natural, extreme qualities of the Slough, it also has experienced extensive development and human pressures over the past 50 years (Davis et al., 1990). Many local plant and animal species have declined as a result of the combined forces of rare habitat and human pressures within the watershed (Ferren, personal communication). Habitat loss, which occurred primarily because of the construction of the Ocean Meadows Golf Course (Ferren, Personal Communication), resulted in the decline or extirpation of many upper marsh plant species. These species occupied transition zone areas characteristic of high estuarine deltas, frequently flooded areas where concentration of salts occurred (Ferren, personal communication). Other upland plants have also been depleted or extirpated from the watershed due to encroaching human development.

The proposed enhancement alternatives will create estuarine, palustrine and scrub shrub wetland habitat currently rare in the Devereux Watershed. These habitats have associated species designated as *species of special concern* (see requirements below). There is no guarantee that the restoration of degraded habitat types will allow a particular species of special concern to return or increase its population size, but restoration significantly improves that possibility (Sandoval, personal communication). Therefore, when an alternative creates the habitats detailed in the Methods section, it will be assumed that the *species of special concern* associated with that habitat will benefit. Although this is not an exact process, it provides a heuristic for determining what habitat types will benefit local, important species (Noss, 1997). All the species listed below were based on extensive discussions with Ferren (1999). Plants located in the Devereux Slough will be defined as a *species of special concern* for the following reasons.

1) A formerly widespread species within the site and watershed that is currently rare or extirpated within the site and watershed. Rarity is determined if the flora is listed as rare or endangered federally, statewide, or by conservation groups.
2) A species that provides critical resources for an animal species of special concern (see below).
3) A species that is at its southern or northern limit at the Devereux Slough.
4) A species listed as a species of special concern by a recognized federal, state, or local agency.

A more complete description of the plant species of special concern is provided in Appendix C. A brief list of the selected plant species of special concern follows in Table 3-3.

Table 3-3: Plant Species of Special Concern *Page 1 of 2*			
Plant Species Name	**Associated Habitat Type**	**Primary Reason For Inclusion in this List**	**Federal, State, or Local Listing Agency**
Arthrocnemum subterminale (=Salicornia subterminales)	Transitional (estuarine/ palustrine hybrid); Palustrine emergent wetland-persistent	Formally Widespread Upper Marsh Species	Regionally rare (City of Santa Barbara, 1997); Devereux Slough species of special concern (Ferren, 1990).
Hordeum depessum	Transitional (estuarine/ palustrine hybrid); Palustrine emergent wetland-nonpersistent	Formally Widespread Upper Marsh Species	Regionally rare (City of Santa Barbara, 1997); Devereux Slough species of special concern (Ferren, 1990).
Suaeda calceoliformis	Transitional community (estuarine/ palustrine hybrid); Palustrine emergent wetland-nonpersistent	Formally Widespread Upper Marsh Species	Regionally rare (City of Santa Barbara, 1997); Devereux Slough species of

			special concern (Ferren, 1990).
Distichilis spicata	Estuarine emergent wetland-persistent; Transitional community; Palustrine emergent wetland-persistent	Provide Resources for Species of Species Concern	
Salicornia virginica	Estuarine emergent wetland – persistent; Transition	Provide Resources for Species of Species Concern	
Ruppia maritimae	Estuarine aquatic bed	Provide Resources for Species of Species Concern	

Table 3-3: Plant Species of Special Concern *Page 2 of 2*			
Plant Species Name	**Associated Habitat Type**	**Primary Reason For Inclusion in this List**	**Federal, State, or Local Listing Agency**
Isocoma menziesii var vernonioides	Palustrine scrub shrub wetland	Provide Resources for Species of Species Concern	
Euthamia occidentalis	Palustrine emergent wetland-persistent	Provide Resources for Species of Species Concern	
Hemizonia parryi ssp. Australis	Palustrine emergent wetland-nonpersistent	Species at Northern Limit	Federal Species of Concern; CNPS rare, endangered, or threatened (Wallace Roberts and Todd, 1997).
Stephanomeria elata	Estuarine emergent wetland-nonpersistent	Species at Southern Limit	Devereux Slough species of special concern (Ferren 1990)
Lasthenia glabrata ssp. Coulteri	Estuarine emergent wetland-nonpersistent; Palustrine emergent	High Probability of Existing Historically in Watershed	Regionally rare (City of Santa Barbara, 1997);

	wetland-nonpersistent		Devereux Slough species of special concern

3.4.2 Animal Species of Special Concern

The designation *Animal Species of Special Concern* in this document is intended to refer to insect, bird, and mammal species that are:

1) legally protected species (threatened or endangered) under state and federal Endangered Species Acts;
2) species of special concern to the U.S. Fish and Wildlife Service and/or the California Department of Fish and Game, and;
3) species considered to be regionally rare or important according to local biologists or local ecosystem management documents (e.g., Goleta Slough Ecosystem Management Plan).

For the purposes of this document, *Animal Species of Special Concern* are further identified as Species of Federal, State, or Local Concern that:

1) are known to occur in the vicinity of the study site (Devereux Slough/ West Campus area) or in the Goleta Slough Ecosystem, and
2) would potentially benefit from the expansion or creation of any one or more wetland habitat type(s) at the study site.

The selected animal species are listed below in Tables 3-4, 3-5, 3-6 and described in more detail in Appendix C.

Table 3-4: Insect Species of Special Concern That May Benefit From Creation or Expansion of Wetland Habitat Types at the Study Site (Sources: Sandoval, 1999; CERES, 1999; City of Santa Barbara, 1997; Zedler, 1982; Wallace Roberts and Todd, 1997)			
Scientific name	**Common Name**	**Status**	**Associated habitat type(s)**
Panoquina errans	Salt Marsh Wandering Skipper	Species of Federal and Local Concern	Palustrine emergent wetland (persistent); Estuarine emergent wetland (persistent); Transitional (estuarine/ palustrine hybrid)
Cincindela hirticollis gravida	Sandy Beach Tiger Beetle	Species of Federal Concern	Estuarine emergent wetland (nonpersistent); Transitional (estuarine/ palustrine hybrid)
Brephidium exillis	Pygmy Blue Butterfly	Species of Local Concern	Palustrine emergent wetland (persistent); Estuarine emergent wetland (nonpersistent)

Table 3-5: Bird Species of Special Concern That May Benefit From Creation or Expansion of Wetland Habitat Types at the Study Site (Sources: Holmgren, 1999; CERES 1999; City of Santa Barbara, 1997; Wallace Roberts and Todd, 1997; Udvardy and Farrand, 1994)
Page 1 of 2

Scientific Name	Common Name	Status	Associated habitat type(s)
Agelaius tricolor	Tricolored Blackbird	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent)
Plegadis chihi	White-faced Ibis	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent)
Asio flammeus	Short Eared Owl	Species of Federal, State, and Local Concern	Palustrine scrub shrub wetland; Palustrine forested wetland
Botaurus lengtginosus	American Bittern	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent); Estuarine emergent wetland (persistent); Transitional (estuarine/ palustrine hybrid)
Circus cyaneus	Northern Harrier	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent); Palustrine scrub shrub wetland
Athene cunicularia hypugea	Western Burrowing Owl	Species of Federal, State, and Local Concern	Palustrine scrub shrub wetland
Elanus caeruleus	White- tailed kite	Species of Federal, State, and Local	Estuarine emergent wetland (persistent); Palustrine emergent

		Concern (Protected in Santa Barbara County)	wetland (persistent); Palustrine forested wetland
Ixobrychus exilis	Least Bittern	Species of Federal and State Concern	Palustrine emergent wetlands (persistent); Estuarine emergent wetlands (persistent)
Accipiter cooperi	Cooper's Hawk	Species of Federal and State Concern	Palustrine forested wetland; Palustrine scrub shrub wetland

Table 3-5: Bird Species of Special Concern That May Benefit From Creation or Expansion of Wetland Habitat Types at the Site (Sources: Holmgren, 1999; CERES 1999; City of Santa Barbara, 1997; Wallace Roberts and Todd, 1997; Udvardy and Farrand, 1994) *Page 2 of 2*

Scientific Name	Common Name	Status	Associated habitat type(s)
Empidonax traillii brewsteri	Little (Brewster's) willow flycatcher	Species of Federal and State Concern	Palustrine forested wetland; Palustrine scrub shrub wetland (willows)
Falco peregrinus anatum	Peregrine Falcon	Species of Federal and State Concern	Palustrine emergent wetland (persistent); Palustrine forested wetland
Accipiter striatus	Sharp-shinned hawk	Species of Federal and State Concern	Palustrine forested wetland; Palustrine emergent wetland (persistent)
Numenius americanus	Long- billed curlew	Species of Federal and State Concern	Estuarine emergent wetland (persistent and nonpersistent)
Lanius ludovicianus	Loggerhead shrike	Species of Federal and State Concern	Palustrine scrub shrub wetland; Palustrine forested wetland

Icteria virens	Yellow-breasted Chat	Species of State and Local Concern	Palustrine forested wetland; Palustrine scrub shrub wetland (willows); Palustrine emergent wetland (persistent)
Dendroica petechia	Yellow warbler	Species of State and Local concern	Palustrine forested wetland; Palustrine scrub shrub wetland
Grus canadensis	Sandhill crane	Species of Federal Concern	Palustrine emergent wetland (persistent)
Passerculus sandwichensis beldingi	Belding's Savannah Sparrow	Species of State Concern	Palustrine emergent wetland (persistent); Estuarine emergent wetland (persistent); Transitional (estuarine/ palustrine hybrid)
Laterallus jamaicensis coturniculus	California black rail	Species of State Concern	Palustrine emergent wetland (persistent); Estuarine emergent wetland (persistent); Transitional (estuarine/ palustrine hybrid)

Table 3-6: Mammal Species of Special Concern That May Benefit From Creation or Expansion of Wetland Habitat Types at the Study Site (Sources: Holmgren, 1999; City of Santa Barbara, 1997; Wallace Roberts and Todd, 1997)

Scientific name	Common Name	Status	Associated habitat type(s)
Lepus californicus benettii	San Diego black- tailed jackrabbit	Species of Federal and State Concern	Palustrine scrub shrub wetland
Reithrodontomys megalotis limicola	Southern salt marsh harvest mouse	Species of Federal and State Concern	Estuarine emergent wetland (persistent); Transitional (estuarine/

			palustrine hybrid)
Neotoma fuscipes	Dusky-footed wood rat	Species of Local Concern	Palustrine forested wetland
Antrozous pallidus	Pallid bat	Species of State concern	Palustrine forested wetland

3.5 Geographical Information System

We used an existing GIS database of the Devereux watershed as a source of geographic information for our study site and as a backdrop for creating the enhancement alternatives (source: Mark de la Garza, Watershed Environmental, 1999). Included in the database were an aerial photo and a Digital Elevation Model (DEM) of 3-meter resolution. See Appendix D for a detailed description of the GIS Methods employed throughout the project.

For each enhancement alternative, we mapped out a mosaic of wetland habitat types estimated to result from implementation of the alternative. An elevation surface of future conditions for the created habitat mosaics was generated for each alternative (with the exception of the Green Golf Course alternative; see Appendix D for details). We then created a data layer of difference in elevation (between current and future conditions) across the study site in order to calculate the amount of minimum soil volume removal necessary for each alternative. The data created through this process is intended to be utilized only as a tool to analyze cost differences between the alternatives, and is not intended to be a robust estimate of actual soil volume necessary to achieve certain hydrologic conditions at the study site.

The GIS maps were used to design the habitat mosaic map for each of the alternatives. The location, type and extent of each specific habitat type was determined by the elevations of the GIS derived maps. The habitat types associated with the given elevations were defined by the parameters outlined in the Wetlands Classification System (Appendix B). The habitat mosaics are bounded in accuracy by the limitations of the DEM (Appendix D), but they provide a conceptual model of how the habitats would be spatially distributed relative to each other, as defined by the given elevation and salinity levels.

The water holding capacity of the study site was generated for each alternative (with the exception of Green Golf Course) using the created elevation surfaces layers and based on current conditions of the site provided by Lawrence (1983). A detailed description of the water holding capacity calculations is given in Appendix D.

3.6 Project Costs

The largest costs of enhancing the site are:

1) Land acquisition
2) Soil removal
3) Re-vegetation
4) Bridge construction

Only three of the five alternatives require acquisition of the site, so these plans will be substantially more expensive than plans that retain the golf course as a viable business. However, currently we have no estimate of the value of the site, so we are not including the cost of acquisition in summing the cost of converting the site. The details of obtaining cost estimates may be found in Appendix E.

Estimates for the cost of soil removal were determined after extensive analysis of other local restoration projects, and communication with local experts. This information was used to formulate an estimate value for the *cost per cubic yard of soil moved*. For a detailed outline of these calculations see Appendix E.

Costs for revegetation of the site through hydroseeding and hand planting from containers were calculated for each enhancement alternative. Appendix I provides a complete list of native plants included in revegetation of wetland habitat at study site, arranged according to planting method. Details of methods for calculating revegetation costs are provided in Appendix E.

Since hydroseeding is less expensive than hand planting from containers, this method was used in calculating costs for species available from S & S Seeds, a native seed supplier in Carpinteria, California. S & S Seeds estimated the cost of supplying native seeds of species selected to be established at the study site by hydroseeding. The remaining species proposed for inclusion in revegetation of the site were included in cost calculations of hand planting from containers, using approximate spacing distances between plants.

3.6.1 Reducing Costs

It is important to note that the cost values associated with the enhancement alternatives can be lowered in a variety of ways. The three most obvious techniques that could be employed to reduce costs are as follows.

1) Dispose dredged soil on site, instead of paying to have it removed.
2) Use volunteers for plantings.
3) Use conservation easements to facilitate site restoration.

These three techniques are examples of how costs associated with the enhancement alternatives can be reduced. This is obviously not an exhaustive list, and is meant only as a guide for cost reduction possibilities.

3.7 Analysis of the Alternatives

The five alternatives are compared using the data generated for expected acreage and number of wetland habitat types, native plant diversity, plant and animal species of special concern, water holding capacity, and construction and revegetation costs. The alternatives are compared in table format and discussed qualitatively in the Analysis Section.

4.0 Alternatives

The Five Alternatives will be outlined in detail in the following sections. The Alternatives will be presented in the order of least impact of change, to the alternative that requires the most extensive alterations (Figure 1-4).

The following two management alternatives assume that the Ocean Meadows Golf Course remains as a viable business. The first is a baseline description of the site as it exists under current management. The second outlines a plan for expanding the riparian corridor within the site for the benefit of both golf course management and local wildlife.

4.1 No Action Alternative

4.1.1 Introduction

4.1.1.1 Historical Justification

Evaluating the benefits of the proposed restoration and enhancement alternatives requires an examination of current management practices to establish a "baseline condition." In the No Action Alternative, existing conditions and trends of the study site as a golf course will be described in detail. Leopold et al. (1971) stresses the need for a baseline site evaluation in decision frameworks for projects that include environmental impacts. They call for an "environmental characterization report prior to initiation of action" which describes conditions and characteristics of the existing environment with sufficient breadth, but including "only such details as are needed for evaluating the environmental impact." In this way, the No Action Alternative may be directly compared to other management alternatives to determine their restoration value.

Ocean Meadows Golf Course is a low-priced nine-hole course that provides open space recreation to about 100,000 golfers per year from the growing community of Goleta. It serves as an impoundment basin for precipitation from large winter storms (Wallace Roberts and Todd, 1997), and as a corridor for some species of birds and mammals (Holmgren, personal communication). Although golf course managers promote the site as a "park-like oasis" for wildlife (Cappon, 2000), enhancement and restoration options would create a richer natural community for locally rare and expatriated species (Holmgren, personal communication).

4.1.2 Details of the Alternative

4.1.2.1 Habitat Types

The Ocean Meadows Golf Course site is transected by three drainages: Devereux Creek from the west, Phelps Creek from the north and an unnamed ditch that drains the eastern arm of the course (Figure 4-1). The three drainages total 1,700 feet in length and are, on average, six feet wide. They are traversed by eight bridges, and are piped through culverts in seven places throughout the course.

Course managers have also created three small shallow ponds on the site. Each pond is less than two feet deep, less than six feet across and is rimmed by palustrine emergent persistent vegetation. Exotic grasses cover over 99% of the course and palustrine emergent vegetation occupies less than 1% of the course, occurring near drainages and constructed pools (Table 4-1).

Table 4-1 Habitats of the Ocean Meadows Golf Course

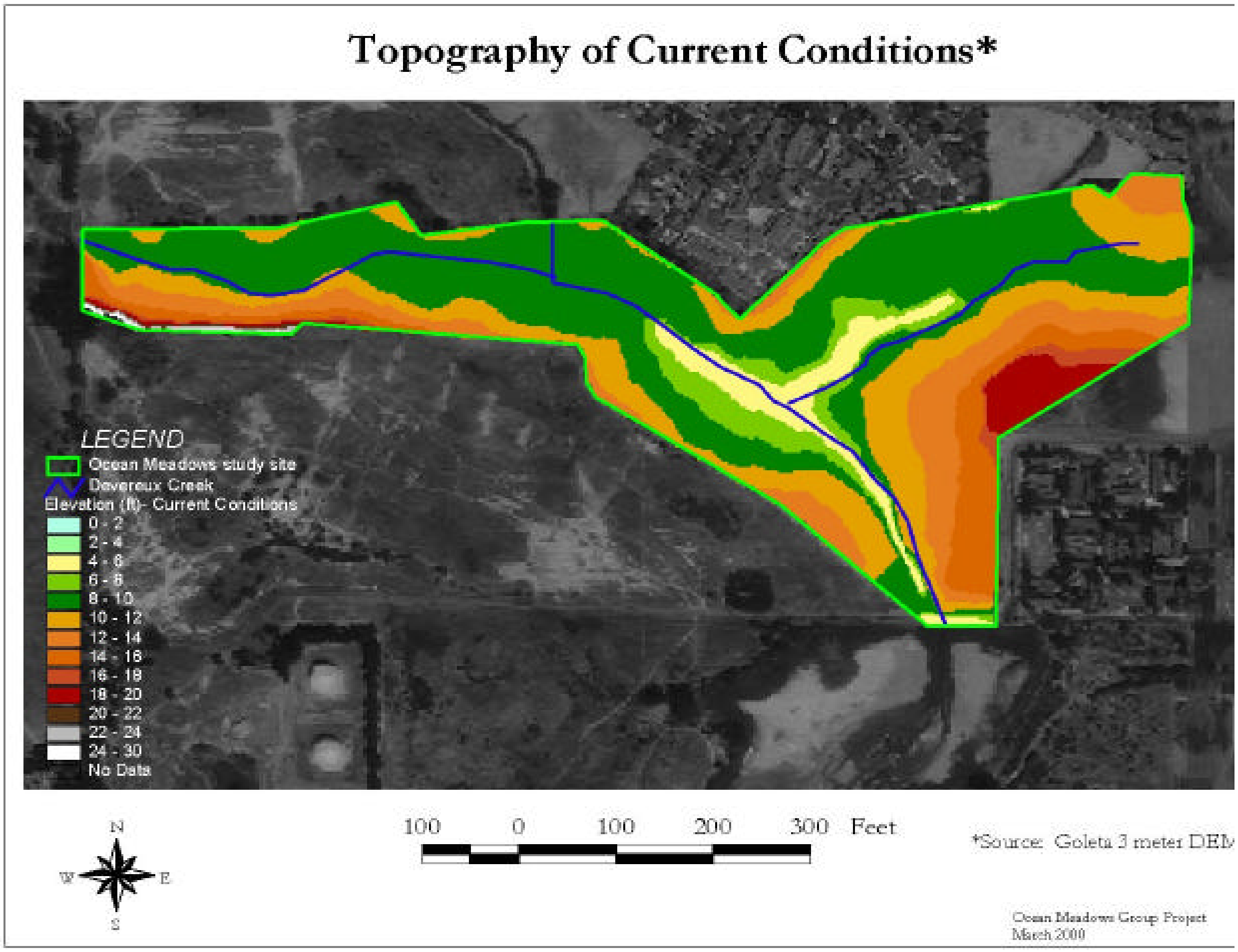
Habitat	Vegetation Type	Number of	Notes

Table 4-1 Habitats of the Ocean Meadows Golf Course			
Type		**Acres**	
Greens and Fairways	Exotic grasses, exotic and native trees	70 acres	
Drainages	Palustrine Persistent Emergent	Less than 1 acre	3 drainages, traversed by 8 bridges and piped through 7 culverts
Artificial Ponds	Palustrine Persistent Emergent	Less than 1 acre	3 shallow ponds, less than 6 ' diameterby 2 ' deep

Site elevation ranges from roughly five feet in the drainages to roughly fifteen feet at some of margins. Figure 4-1 illustrates an approximate distribution of these elevations.

Two factors lead us to believe that the soils of the golf course are saline, although no direct tests were performed. First, saline-tolerant plants such as salt grass (*Distichilis spicata*) and pickleweed (*Salicornia virginica*) are common on the margins of the entire course. Also, three live oak (*Quercus agrifolia*) trees recently planted on the southern end of the course are either failing or dead, which may be attributed to soil increasing in salinity toward the southern end of the course.

Figure 4-1


Topography of Current Conditions*
LEGEND
Ocean Meadows study site
Devereux Creek
Elevation (ft)- Current Conditions
0 - 2
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
12 - 14
14 - 16
16 - 18
18 - 20
20 - 22
22 - 24
24 - 30
No Data
N
W
E
S
100
0
100
200
300
Feet
*Source: Goleta 3 meter DEM
Ocean Meadows Group Project
March 2000

4.1.2.2 Ecosystem Indicators—Hydrology

Under the No Action Alternative, hydrological conditions will remain unchanged as described in Appendix A. Large winter storms have the potential to flood the majority of the golf course, making the area unplayable. Lawrence (1983) estimates the water holding capacity of the course at 20 acre feet of water during a storm event where the depth was 1.5 feet above the creek bed. During such storm events, water accumulates primarily in the trap ponds that form behind the successive cart roads over the creek.

Flooding is largely a result of sedimentation on the course. Without improvements to the site, sediment will continue to accumulate above the golf course and will require removal by the County. Since the 1920s, runoff has increased by approximately 32% (Davis et al., 1990). This trend will probably continue with further development in the watershed (Davis et al., 1990), including construction of University housing on the parcels surrounding the golf course and additional residential and commercial development in the watershed. De la Garza and Ryan (1998) showed that potential water pollutants draining off the watershed (such as copper, diaznon, lead, nitrate, oil, grease, phosphorus, suspended solids, and zinc) would increase only a barely measurable 1-5% if the University's housing projects develop as planned.

Wetland vegetation in the golf course area and in the lower slough may remediate pollutants from the upper watershed. Although thorough studies of coastal contamination due to pollutants from this watershed exist, other studies have shown that metals, nutrients, and biological pathogens can be stored, utilized, or transformed by wetland vegetation (De Laney, 1995; Gearhart, 1992). *Scirpus* and *Typha* species are often planted in constructed wetlands to lower pollution levels (Gersberg et al., 1984). Species of these genera currently exist on the site, and will continue to provide some pollution control even if no habitat improvements are undertaken.

4.1.2.3 Area of Native Habitat Types

Bullrush (*Scirpus spp*.) is the most prevalent plant species in the site's drainages and ponds, however willows (*Salix spp*.) and Coyote Brush (*Baccharis pilullais*) are also common along the edges of the habitat. Non-native lawn grasses dominate the greens and fairways. However, course managers have also planted native and non-native trees throughout the course, such as pine, sycamore, juniper and palm species (Table 4-2). A few opportunistic native and exotic plant species grow at the edges of the greens (Table 4-2). In addition, two rare plants are found on the site's uplands: *Hemizonia parrii var australis*, an endangered tarplant (Coon et al., 1999), and *Hordeum depressum*, a locally rare barley (Coon et al., 1999).

Table 4-2: Native and Non-native Trees and Herbaceous Plants at the Golf Course Site

Species	Common Name	Status
Quercus agrifolia	Coastal Live Oak	Native
Platanus spp	Sycamore	Native and non-native species
Pinus spp.	Pine species	Non-native
Juniperius ssp.	Juniper species	Non-native
Callistemon salignus	Bottlebrush	Non-native
Eucalyptus spp.	Eucalypus Species	Non-native
Salicornia virginica	Pickleweed	Native
Distichilis spicata	Salt grass	Native
Plantago spp.	Plantago	Native
Potentilla sp.	Cinquefoil	Native
Erodium sp.	Crane Bill Geranium	Non-native

Trifolium spp,	Clover	Native
Foeniculum vulgare	Fennel	Non-native

4.1.2.4 Animal Use of Golf Course Habitat

Most of the vertebrate species listed as inhabiting the golf course also utilize the palustrine emergent habitats, particularly the waterfowl, blackbirds and tree frogs. However, some birds and mammals may use the open space for breeding, shelter, travel and foraging (Holmgren, personal communication). Holmgren (personal communication) reports several bird species commonly perch on golf course trees (Table 4-3). He also predicts that many mammals, such as coyotes, foxes, rabbits and small rodents may cross the course at night, moving from Phelps's ditch to the lower Devereux Slough. In addition to birds and mammals, pacific tree frogs (*Hyla pacifica*) and western toads (*Bufo boreas*) are found on site. Other vertebrates may inhabit the site; however, no systematic survey has been conducted (Holmgren, personal communication).

Table 4-3: Bird Species Recently Observed at the Golf Course Site

Species	Common Name	Status
Buteo lineatus	Red-shouldered Hawk	Federally Protected
Buteo jamaicensis	Red-tailed Hawk	Federally Protected
Falco peregrinis	Peregrine Falcon	Federally Endangered
Elanus caeruleus	White-tailed Kite	Federally Protected
Passerculus sandwichensis beldingi	Belding's savannah sparrow	Federally Endangered
Melospiza melodia	Song Sparrow	None
Cistothorus palustris	Marsh Wren	None
Mimus polyglottos	Northern Mockingbird	None
Ardea herodias	Great Blue Heron	None
Caserodius albus	Great Egret	None
Charadrius vociferus	Killdeer	None
Colaptes auratus	Northern Flicker	None

Sayornis nigricans	Black Phoebe	None
Sialia mexicana	Western Bluebird	None
Euphagus cyanocephalus	Brewer's Blackbird	None
Agelaius phoeniceus	Red-winged Blackbird	None
Zonotrichia leucophrys	White-crowned Sparrow	None
Tyrannus vociferans	Cassin's Kingbird	None
Porzana carolina	Sora	None
Corvus brachyrhychos	American Crow	None
Larus californicus	California Gull	None
Branta canadensis	Canada Goose	None
Anas platyrhynchos	Mallard Duck	None
Fulica americana	American Coot	None

4.1.2.5 Costs

One impact commonly associated with golf courses is runoff with high concentrations of fertilizers, herbicides and watering. However, one recent study of 36 golf courses across North America showed that golf course runoff did not significantly affect water quality (Cohen et al., 1997). Most wells proximate to the courses studied did not exceed the maximum levels of nitrates recommended by the National Health Advisory Board. For the 3.6% of the wells sampled that did exceed this maximum, the authors concluded that the high nitrate concentrations were due to agricultural fertilizers.

Devereux Creek does not seem to be impacted from golf course runoff. A 1999 County assessment of the water quality of local creeks found that water leaving the golf course was of average quality. In addition, Ocean Meadows Golf Course uses substantially less pesticide chemicals than the two other courses in the watershed (County Records, 1995 –1999). Overall, Devereux Creek does not seem to be significantly impacted from chemicals applied to the Ocean Meadows Golf Course.

4.2 Green Golf Course Alternative

4.2.1 Introduction

4.2.1.1 Historical Justification

The proximity of the Ocean Meadows Golf Course to Coal Oil Point Reserve affords the golf course an opportunity to perform critical ecosystem services that were active in the historic reference condition, while still remaining an active, private golf course facility. The Green Golf Course Alternative would enhance the health of the site and adjacent reserve while improving the aesthetic and functional value of the golf course. It also coincides with the golf course's publicly stated goal of protecting riparian corridor species (Cappon, 2000).

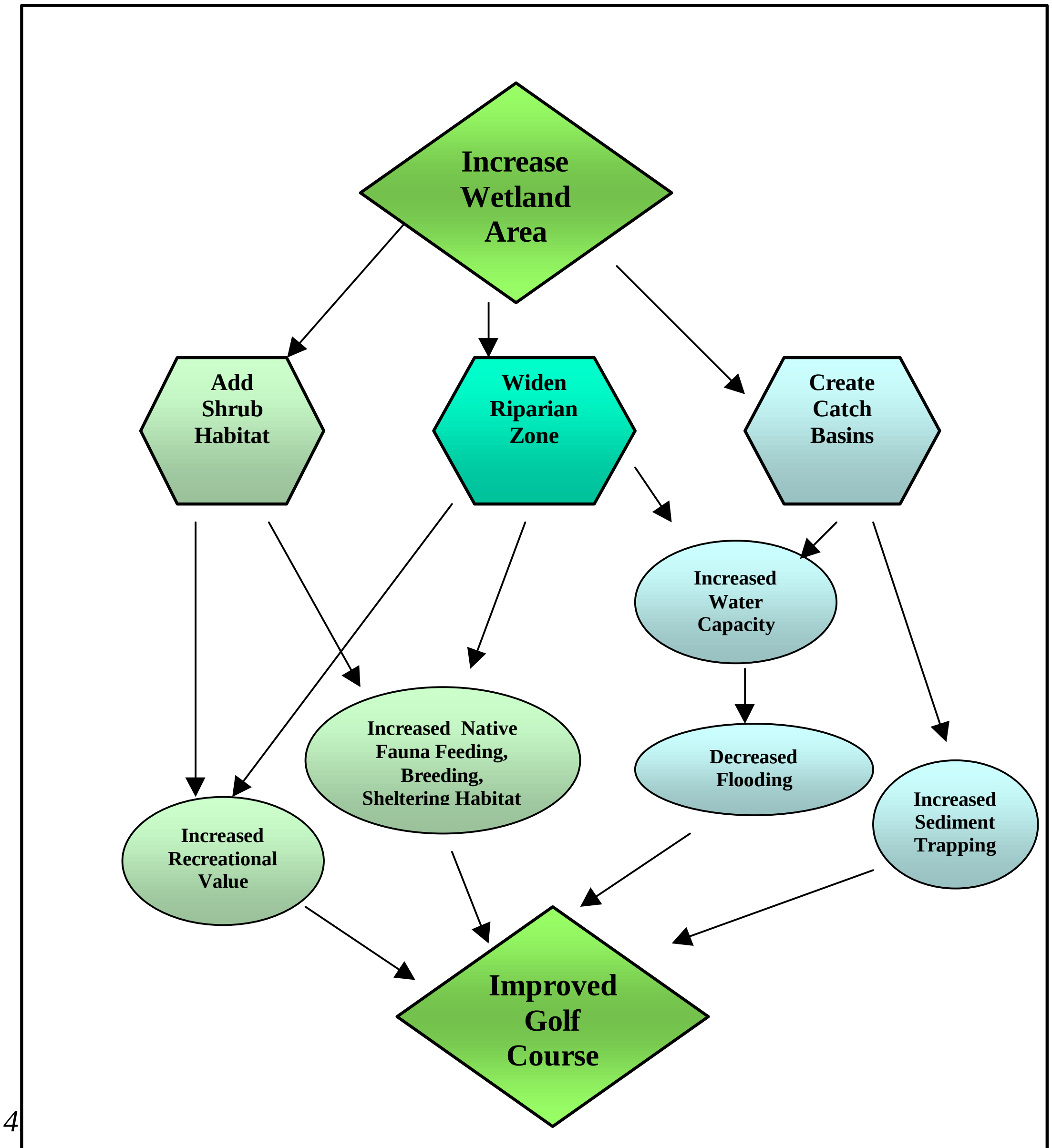
In accordance with the Guiding Principle for Alternative Design of this report (Section 1.5), the Green Golf Course Alternative would restore ecosystem functions or conditions associated with the historic reference condition. This alternative increases riparian palustrine emergent persistent wetlands, thereby enhancing a severely degraded habitat. Expansion of the Ocean Meadows Golf Course riparian corridor would benefit breeding bird, mammal, and reptile populations by increasing invertebrate resources (Holmgren, personal communication). This alternative also includes upland scrub shrub wetland to the site, which plays a critical role in the dynamics of the adjacent Devereux Slough estuarine habitat, providing key feeding habitat for many estuarine invertebrates (Sandoval, personal communication).

4.2.1.2 Design Description of Objectives

Concisely, the goals of the Green Golf Course Alternative for the Ocean Meadows Golf Course are:

1) To expand the current riparian wetland habitat on the course by over 100%, create seasonal ponds, and install small islands of scrub shrub wetlands in out-of-play areas.
2) To improve the rate at which water flows through those riparian zones, and to provide improved water retention facilities to alleviate flooding and sediment problems.

Ocean Meadows Golf Course managers are willing to consider implementing the Green Golf Course Alternative because they wish to improve the riparian habitat and draining capabilities of the site.



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The creeks on the golf course would be widened to three times their current size. This general expansion objective will be limited where: (1) it negatively affects the playability of golf; (2) it is blocked by trees or other permanent obstacles; or (3) at management discretion. Therefore, the goal is to enlarge the riparian corridor by seven feet on each side (Herrera, personal communication), but the actual expansion will probably be less.

The created waterways will have a sloped bank equivalent or slightly more gentle than the current system.

We recommend that seven of eight drainage pipe blockages in the riparian corridor be removed during the expansion. The outflow of Devereux Creek from the golf course will be left unchanged, since the outlet pipe is not owned by the golf course and therefore has no direct relevance to this alternative. Currently, the pipes on the golf course in the riparian corridor are causing a back up of water during times of heavy flow, until the water overflows into the next section of the creek (Lawrence, 1983). This limits one of the two expressed goals of Ocean Meadows Golf Course managers (Herrera, personal communcication): to increase water flow rates through the course. At present, six of the blockages allow maintenance carts to cross the creek but have no impact on the movement of golfers. The largest blockage at the junction of the Devereux Creek and the east arm creek-way should remain because of its large size and its important location on the golf course. We also recommend removing the blockage area used by golfers at the west end of the west arm, to be replaced with a bridge. The two current bridges crossing the creek will need to be expanded. One other bridge may need to be put in, possibly near the junction of Devereux Creek and Phelps Ditch, to allow easy maintenance access to any point on the course. A summary of these recommendations appears in Table 4-4.

Table 4-4: Golf Course Structures Impacting Site Drainages		
Location	**Structure Description**	**Recommendation**
Junction of Devereux Creek and Devereux Slough	Outlet Drainage of Devereux Creek	Leave current structure in place because it is not owned by golf course.
Junction of east-arm Creek-way and Devereux Creek	15-25m underground drainage pipe between creeks	Leave in because of its size and the over-traffic it receives by golfers
West end of west-arm	Dirt blockage walkway for golfers, with underground drainage pipe	Remove and replace with bridge.
Six to eight locations on course of underground drainages	Dirt blockage driveway for maintenance crew, with underground drainage pipe for water flow	Remove and replace with one or two, well placed bridges
Two bridges currently used	Two bridges, one used by golfers, the other by maintenance crews	Expand bridges

A large portion of the plants in the creeks would be removed and the beds dredged to remove excessive sediment buildup. New palustrine emergent persistent species would be planted to replace the removed bulrushes. Islands of inter-spaced plant habitat would be established to insure the water moving through the course was flowing through a natural environment. Buffer zones of native shrubs and grasses could be established around the creeks. Thus, the expansion of the course's riparian zone would:

1) Increase the total area of riparian creek wetland acreage
2) Increase native floral species diversity

3) Enlarge the buffer zone between the golf course and the creeks
4) Improve the quality and overall area of feeding habitat for birds by making the waterways more accessible
5) More closely mimic slough habitat by creating wider, flatter waterways
6) Increase the rate at which water flows through the riparian corridors
7) Remove some of the drainage pipe blockages that currently cause flow back-up

4.2.1.4 Palustrine Ponds and Catch Basin Reservoirs

In addition to riparian zone expansion, five catch basins would be created to: (1) provide open water and palustrine emergent habitat; (2) to catch incoming sediment; and (3) store excess water. Basins (see below for specified dimensions) will be dug below the elevation of the creek waterway. The inlet and outlet flow channels will be above the bottom of the basins, allowing water to accumulate for a greater duration during the wet season. These basins will be seasonal and will not require artificial impervious layers or extensive soil removal during construction.

The two larger basins would be relatively medium-to-large size reservoirs designed to hold water that has backed up at the culvert outlet into the Devereux Slough and at the underground pipe located at the junction of Devereux Creek and the west arm creek-way. Their locations are designed primarily for flood control, because water often backs up at the exit culvert from the golf course and at the junction mentioned above. The two reservoir basins would be relatively large, particularly the one near the Devereux Slough, and situated in locations that could be easily accessed by the heavy machinery needed to dredge them. These would still provide wetland habitat; their seasonal characteristic would limit their attractiveness to pest birds, such as coots, which have caused problems with other local golf courses (Lawyer, personal communication).

The three other basins would be smaller and shallower, and although they would provide some flood control and sediment trapping, their primary function would be to provide palustrine habitat for many bird and insect species.

The combined effects of the newly provided habitat (as with the two reservoir basins) would:

1) Increase the amount of seasonal wetland in the area
2) Increase the duration of seasonal water inundation in the area
3) Provide habitat for water-loving birds
4) Increase the aesthetic value of the golf course by attracting a diverse array of wildlife
5) Increase water retention in reservoir basins

4.2.1.4.1 Aeration System for Ponds

Although Ocean Meadows Golf Course uses legally acceptable levels of pesticides or fertilizers (Santa Barbara County Agricultural Commission), there is evidence of upstream sites containing excessive nutrient loadings (Lawyer, personal communication). Excessive loading of nutrients into the golf course, along with fertilizers used on the golf course, may catalyze large algal blooms in the open water ponds when there is standing water (Lawyer, personal communication). Excessive algal blooms can give off an offensive odor, be visually unpleasant, have deleterious impacts on native species, and promote pest or infectious insects.

An aeration system can solve these problems if they become excessive. An inexpensive, useful aeration technology is *forced air aeration* (Lawyer, personal communication). A *forced-air* hose is run to the bottom of the pond, where a diffuser breaks the air down into extremely small bubbles. The column of bubbles lifts bottom waters, devoid of oxygen, to the surface. The result is a constant turnover of the water column, maintaining oxygen at the depth (Aquatic Systems Inc., 1999).

4.2.1.5 Scrub Shrub Habitat in Out-of-Play Areas

As a third major component of the greener golf course alternative, out of play areas would be planted with drought and flood resistant scrub shrub wetland species that would receive little or no irrigation. These new plants would not diminish the playability of the golf course, and would add aesthetic value by flowering in the summer and late fall, and attracting local birds, invertebrates, and small mammals. It also provides critical resources to many invertebrates in the adjacent estuary (Williard and Hiller, 1990). The shrubs would be put in with a cost-effective mixture of hydro seeding and nascent shrub plantings. The genetic strains with these mixes, as with all the native inputs, would be of the local variety.

4.2.1.6 Integrated Pest Management

There have not been any studies that correlated use of chemicals by the Ocean Meadows Golf Course to negative impacts on local water quality. However, a national trend suggests very little water quality contamination can be attributed to golf course pesticide use (Horsley, 1998). In a national study, few study sites near 13,000 golf courses in the United States were found to be have detectable concentrations of pesticides (Cohen, 1998). More research is strongly suggested, but until that time an acceptable use of chemicals in relation to local water quality will be assumed.

However, should future research indicate that pesticide use on the Ocean Meadows Golf Course detrimentally affected local water quality, we suggest use of integrated pest management (IPM). Many golf courses have cut down on pesticide, herbicide and chemical fertilizer use by using natural fertilizers and implementing an IPM system, which attempts to minimize pest attacks, by using more natural techniques than the traditional application of chemicals.

The key to an IPM is often the creation of native area "bio-islands," designed to attract beneficial insect and animal species, reduce water consumption and to add aesthetic value to the golf course (Ostenkowski, 1999). The proliferation of wildflowers, flowering shrubs and trees provides a unique visual backdrop for a golf course, while supporting shelter, food and nesting habitat for a number of beneficial insects, birds, frogs, and garter snakes. The beneficial species reduce the need for pesticides, herbicides and fertilizers to be used on the golf course because they prey upon, or parasitize, golf course pest species. Increased predator presence decreases pest population stability and is particularly effective at eliminating large blooms of pest populations (Ostenkowski, 1999).

Natural substances, such as garlic, can be very effective at discouraging pest foraging when they are applied at the proper dosages. These deterrents are attractive because they do not deleteriously affect the local environment, and an application license is not needed to purchase or use them. On a different tact, barriers of native areas provide a disruption to monospecific stretches of golf course grasses. These barriers inhibit the proliferation of pest outbreaks across the golf course.

Additionally, using natural fertilizer applications, such as seaweed mixtures or rock mineral dust, can improve the health of golf course vegetation without using synthesized fertilizers.

4.2.2 Details of the Alternative

4.2.2.1 Habitat Types

Table 4-5: Wetland Habitat Created Under the Greener Golf Course Alternative	
Habitat Type	**Acreage Created**
Palustrine emergent wetland: persistent	2 acres
Palustrine scrub shrub wetland: mixed	2 acres

4.2.2.2 Habitat Mosaic Map

The Habitat Mosaic Map (Figure 4-3) illustrates the design of the expanded riparian corridor, catch basins, and scrub shrub zones. The location, area extent, and characteristics of these habitat types are *potential landscape designs*, based on the best available research. Final arrangement of the extent and pattern of the habitat types will be determined in the future by the owner of Ocean Meadows Golf Course.

4.2.2.3 Ecosystem Indicators –Hydrology

Plans for the green golf course involve some hydrological changes including removal of dirt roads bisecting the creek in several locations. At these creek intersections, small diameter pipes carry discharge under the roads. The pipes slow water flow and cause overflow during even moderate rain events. High flow volumes in the creek overcome the first small pipe in the upper portion of the golf course, causing a pond to form up to the level where the blockage is bypassed by water. As flows continue to increase during a storm event, overflow occurs at each culvert down the length of the creek, creating a series of ponds and localized flooding down the golf course. Removal of these culverts will stop this from occurring, allowing water to move through the site more quickly.

Figure 4-3


Green Golf Course Alternative
Distribution of Habitat Types
LEGEND
Seasonal palustrine emergent pond
Palustrine emergent persistant
Ocean Meadow Study Site
Palustrine Scrub Shrub Wetland
100 0 100 200 300 Feet
N
W
E
S

4.2.2.3.1 Catch Basins

The seasonal catch basin ponds mimic the hydrologic regime or pattern of the adjacent Devereux Slough, filling up and retaining water during the wet months, and drying up during the summer drought

The catch basins are a key component of the Green Golf Course Alternative because they provide water and sediment retention capabilities not currently present at the Ocean Meadows Golf Course (Herrera, personal communication). The two larger reservoir basins, in particular, are situated in areas previously prone to local flooding (Lawrence, 1983), and will provide a retention basin for backed up water, thereby slowing the rate at which water overflows the riparian corridor and floods the course. Sediment has also been a persistent problem for the golf course because it clogs up flow within the riparian corridors and drops out of floodwaters onto the course playing areas during flood events. The catch basins should alleviate the first problem by removing and storing incoming sediment that can later be dredged. However, they may have little impact on the sediment dropped during large flood events, common in Santa Barbara winter rain season, likely to overwhelm any flood retention capabilities associated with the Green Golf Course Alternative.

The catch ponds will provide water retention capacity in lower areas, decreasing flooding onto playing areas. A large pond will be created just above a 45-foot underground pipe that will be left in place to connect drainages in the eastern arm of the golf course to drainages in the western arm. This pond will reduce flooding by providing water retention capacity above the culvert. Another large pond will be created at the bottom of the golf course just above the culvert that drains Devereux creek into the lower slough. This pond will allow for some water storage capacity for periods of high flow when the drainage pipe is overcome, or the lower slough is at high water just prior to break out. This may reduce impacts from low to moderate flood events that currently overtax the small stream corridor, causing flooding on golf course. After alteration according to the green golf course plan, the site will hold 4-acre feet of water with the water level at 9-ft MSL, 1.5 feet above creek bottom.

In addition, under the green golf course plan the riparian corridor will be widened and the amount of wetland vegetation will be increased. This small increase may have a positive effect on water quality, through vegetation-mediated removal of pollutants (Orie, 1990). The increase in wetland area and the creation of ponds may alleviate some sediment accumulation into the lower slough, although currently this does not appear to be a problem.

4.2.2.4 Ecosystem Indicators - Ecology

The following ecological indicators (see Methods) will be used to ascertain the value and viability of the proposed ecosystem rehabilitation based on the Guiding Principle. These indicators are meant to offer a measure of how "improved" the ecosystem will be after implementation of the alternative.

This alternative would create the following vegetation habitat types (see Methods), as defined by Cowardwin et al. (1979).

1) Palustrine emergent wetland: persistent
2) Palustrine scrub shrub wetland: mixed deciduous evergreen

The resultant diversity of plant species would be much higher than within the current system, which is dominated by bulrush reeds (*Scirpus* spp.). The goal of the plant mosaic would be to mimic local native creeks to maximize the wetland benefits for key bird, mammalian, and insect species. Once the grasses and shrubs were established their upkeep should be minimal, and they will provide perpetual, natural habitat islands within the golf course.

<u>4.2.2.4.1 Enhance Habitat for Species of Special Concern</u>

The expansion of the Ocean Meadows Golf Course riparian corridor has been cited as potentially the most beneficial *per area* restoration option for Devereux Slough because of the large positive effect it would have on resident avian and vertebrate species, including species of special concern (Holmgren, personal communication). This habitat supports seldom seen and sensitive birds, and the expansion of riparian habitats would provide increased invertebrate resources and improved breeding bird, mammal, and reptile populations (Ostenkowski, 1999). The diversity of plant species would also be much higher than the current system, which is dominated by bulrush reeds (*Scirpus* spp).

Upland scrub shrub wetland would be added, habitat which plays a critical role in the dynamics of the adjacent Devereux Slough estuarine habitat. The scrub shrub zones would restore severely degraded upland that provides key feeding habitat for many estuarine invertebrates (Sandoval, personal communication). The expanded wetland habitats would increase the existing native floral diversity, while supporting shelter, food and nesting habitat for a number of beneficial insects and birds (Ostenkowski, 1999).

Table 4-6: Animal Species of Special Concern That May Benefit From Creation or Expansion of Wetland Habitat Types Included in The Greener Golf Course Alternative ***Page 1 of 2***			
Scientific name	**Common Name**	**Status**	**Associated habitat type(s)**
Panoquina errans	Salt Marsh Wandering Skipper	Species of Federal and Local Concern	Palustrine emergent wetland (persistent)
Brephidium exillis	Pygmy Blue Butterfly	Species of Local Concern	Palustrine emergent wetland (persistent)
Agelaius tricolor	Tricolored Blackbird	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent)
Plegadis chihi	White-faced Ibis	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent)
Asio flammeus	Short Eared Owl	Species of Federal, State, and Local Concern	Palustrine scrub shrub wetland
Botaurus lengtginosus	American Bittern	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent)
Circus cyaneus	Northern Harrier	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent); Palustrine scrub shrub wetland
Athene cunicularia hypugea	Western Burrowing Owl	Species of Federal, State, and Local Concern	Palustrine scrub shrub wetland
Elanus caeruleus	White- tailed kite	Species of Federal, State, and Local Concern (Protected in Santa Barbara	Palustrine emergent wetland (persistent)

		County)	
Ixobrychus exilis	Least Bittern	Species of Federal and State Concern	Palustrine emergent wetland (persistent)

Table 4-6: Animal Species of Special Concern that may benefit from creation or expansion of wetland habitat types included in the Greener Golf Course Alternative ***Page 2 of 2***			
Scientific name	**Common Name**	**Status**	**Associated habitat type(s)**
Accipter cooperii	Cooper's Hawk	Species of Federal and State Concern	Palustrine scrub shrub wetland
Empidonax traillii brewsteri	Little (Brewster's) willow flycatcher	Species of Federal and State Concern	Palustrine scrub shrub wetland
Falco peregrinus anatum	Peregrine Falcon	Species of Federal and State Concern	Palustrine emergent wetland (persistent)
Pandion haliaetus	Osprey	Species of Federal and State Concern	Palustrine emergent wetland
Accipiter striatus	Sharp-shinned hawk	Species of Federal and State Concern	Palustrine emergent wetland (persistent)
Lanius ludovicianus	Loggerhead shrike	Species of Federal and State Concern	Palustrine scrub shrub wetland
Icteria virens	Yellow-breasted Chat	Species of State and Local Concern	Palustrine scrub shrub wetland; Palustrine emergent wetland (persistent)
Dendroica petechia	Yellow warbler	Species of State and Local concern	Palustrine scrub shrub wetland
Grus canadensis	Sandhill crane	Species of Federal Concern	Palustrine emergent wetland (persistent)
Passerculus sandwichensis beldingi	Belding's Savannah Sparrow	Species of State Concern	Palustrine emergent wetland (persistent)
Laterallus jamaicensis coturniculus	California black rail	Species of State Concern	Palustrine emergent wetland (persistent)
Eremophila alpestris	Coast horned lark	Species of Local Concern	Palustrine scrub shrub wetland

actia			
Rallus limacola	Virginia Rail	Species of Local Concern	Palustrine emergent wetland (persistent)
Lepus californicus benettii	San Diego black- tailed jackrabbit	Species of Federal and State Concern	Palustrine scrub shrub wetland

4.2.2.4.2 Importance of Riparian Habitat

Despite covering less than 0.5% of the stateˈs total land area, riparian habitat corridors are recognized as being critical to the functioning and integrity of almost all of Californianˈs natural ecosystems (Smith, 1977). Riparian sites are acknowledged as the single most important habitat for California land-birds, and their conservation is critical to the health of many neo-tropical migrant and resident California bird species. These habitats provide essential breeding, feeding, sheltering, over-wintering, and migration resting habitat for countless local and migrant bird species. As a result, DeSante and George (1994) suggest that riparian habitat degradation is the driving factor behind the population declines in western North America land-bird species (DeSante and George, 1994).

4.2.2.4.3 Importance of Scrub Shrub Habitat

Ocean Meadows Golf Course could also provide critical upland scrub shrub wetland habitat in out-of-play areas. This upland shrub, late flowering, community would help complete the Coal Oil Point Reserve estuarine ecosystem (Williard and Hiller, 1990) by returning some upland habitat that has been heavily degraded over the last 50 years (Davis et al., 1990). Such habitat provides rare upland shrub habitat for many invertebrate and small bird species in the adjacent Coal Oil Point Reserve (Sandoval, personal communication), including the federally endangered Salt Marsh Wandering Skipper (*Panoquina errans).*

4.2.2.4.4 Importance of Catch Basins

Seasonality would eliminate many of the pest related problems other golf courses have had with permanent standing water (Lawyer, personal communication), but it would still attract some open water loving birds (as does the adjacent Devereux Slough) which might become pests at high densities (Hamilton, 1999). The ponds will provide similar ecological benefits to avian species as the adjacent slough, although the vegetation composition will be very different, so these similarities may be limited. More likely they will provide similar Palustrine habitat to that found in the region, or in nearby riparian corridors. However, since the ponds may be aerated and occasionally dredged of sediment, their ecological value may not be significant (Lawyer, personal communication).

4.2.2.5 Construction Activities

1) *Widening creeks* – widening the riparian zone to three times the current size.

2) *Creation of catch basins* – five catch basins (three small sized ponds and two larger reservoirs) will be created at several locations on the golf course.

3) *Install forced-air aeration system* – input aeration system for three catch basins, to be used as needed to eliminate algal blooms.

4) *Removing vegetation from creeks and catch basins* – the riparian corridors and catch basins will need to be removed of vegetation approximately every 1-3 years to remove any excessive build-up in sediment load. This will entail removing some or all of the plant species in various parts of the Golf Course.

5) *Input of small bridges* – Two to four bridges may be needed to allow golf carts or maintenance crews to cross over areas of the riparian corridor will need to be built or expanded.

6) *Acquiring and planting the required plant seed mixes or shrubs for two habitat types* – this will be determined by our general mode (Appendix E).

4.2.2.6 Costs

4.2.2.6.1 Land Acquisition

The implementation of the Green Golf Course Alternative does not require the purchase of the site. The current owner is interested in implementing this plan.

4.2.2.6.2 Excavation and Removal of Fill

We estimate that the cost of excavating and relocating 52,000 yds^3 of soil, at a unit cost of between $5 and $15, to be between $260,000 and $780,000.

Table 4-7: Volume of Soil to be Moved Under the Green Golf Course Alternative

Depth (feet)	Acres	Volume (yd^3)	Cost at $15 / yd^3 *
Catch Basins	1.6	5,987	90,000
Riparian Corridor	0.6	46,009	690,000
Total	*2.2*	51,996	780,000

* rounded to nearest $1,000

4.2.2.6.3 Revegetation

Appendix E describes in detail the methods employed to calculate costs of revegetation.

Hydroseeding

As seen in Table 4-8 below, it will cost approximately $5, 000 to revegetate by hydroseed 2.2 acres of palustrine emergent wetland (persistent) and $8,000 to hydroseed 2.4 acres of palustrine scrub shrub wetland. The total cost associated with securing native seed for creation of wetland habitat in the green golf course alternative is $13,000.

Hand Planting (from containers)

Planting from container is estimated to cost a total of $7- 10/ plant (Hubbard, personal communication). This estimate includes all costs associated with hand planting, including pucrchasing or growing and labor. For the purposes of comparing between alternatives, an estimate of $7/ plant was used in calculating costs.

For the Green Golf Course Alternative, 10 species associated with palustrine emergent wetland (persistent) and 8 species associated with palustrine scrub shrub wetland are recommended to be established by hand planting (see Appendix I). It would cost approximately $313,000 to plant about 44,800 plants included in this alternative.

Table 4-8: Total Number of Container Plants Included in Revegetation Cost Estimates for the Green Golf Course Alternative				
Habitat type	**Acres**	**Feet ^{2}**	**Spacing**	**Estimated # plants**
Palustrine emergent wetland (persistent)	2.2	95,832	3.5'	27,381
Palustrine scrub shrub wetland	2.4	104,544	6'	17,424
TOTAL plants				44,805
Cost for planting from containers (@ $7/plant)*				$314,000

* rounded to nearest $1,000

4.2.2.6.4 Bridge Construction

Implementation of this alternative does not require the removal of the culvert that currently exists between the slough and the golf course. But two small bridges may need to be constructed to allow golf course personnel to freely access all areas of the course.

4.2.2.6.5 Summary of Costs

Table 4-9: Summary of Costs for the Green Golf Course Alternative				
Item	**Unit**	**Cost per Unit**	**# of Units**	**Total Cost***
Revegetation (hand planting)	Plants	$7	44,800	$314,000
Revegetation (hydroseeding)*	-	-	-	$13,000
Small bridge construction	1 bridge	$10,000	3	$30,000
Purchase Forced-air aerator	1 aerator	$4,000	1	$4,000

Excavation and removal of fill	cubic yard	$15	52,000	$780,000
Total Cost				**$1,140,000**

* rounded to nearest $1,000

The following three management alternatives assume that the site is acquired for restoration to a wetland condition. The three are presented in the order in the ascending degree to which they return the site to the historic reference condition. All greatly enhance conditions and functions associated with the historic reference condition, but they differ in how closely they mimic the estuarine wetlands that were historically located at the site.

4.3 Palustrine Alternative

4.3.1 Introduction

The acreage of palustrine wetlands in California has decreased dramatically since the turn of the century due to drainage and conversion to other uses, primarily agriculture (Gilmer et al., 1982). In Santa Barbara County specifically, palustrine wetlands have been destroyed to make way for urban and agricultural development. As a result, many of the remaining palustrine habitats in nearby Goleta Slough support rare assemblages of native species, particularly those of wet haline soils, and therefore are of regional significance (City of Santa Barbara, 1997).

4.3.1.1 Historical Justification

The Palustrine Alternative will enhance the site by returning many biologic and hydrologic functions that mimic those associated with the historic reference condition (Ferren, personal communication). The large increase in wetland habitat (Table 4-13) would improve the feeding, breeding and sheltering habitat of many local bird and small mammal species (Holmgren, personal communication, 1999). Connectivity between local estuarine and upland habitats would be enhanced, potentially benefiting local invertebrate species (Sandoval, personal communication; Ferren, personal communication).

4.3.1.2 Description of alternative

The palustrine alternative will support palustrine emergent wetland characterized by persistent vegetation (i.e., freshwater marsh) in the areas surrounding the creek corridor. Palustrine emergent wetlands, dominated by non-persistent vegetation, will be created in the slightly higher elevations adjacent to persistent emergent wetland areas. Forested wetland habitat dominated by arroyo willows (*Salix lasiolepis*) will be created adjacent to persistent emergent wetlands on the northern margin of the study site. Scrub shrub wetlands will be created on the higher elevations (greater than 12 feet MSL) of the southwest edge of the study site and along the southeastern edge of the site. Refer to the description of mosaic of habitat types below (in section 4.3.2.1.2) for more details.

4.3.2 Details of the Alternative

4.3.2.1 Habitat Types

4.3.2.1.1 Acreage

As shown in the chart below, this alternative will create of about 70 acres of palustrine wetland habitat: approximately 48 acres of palustrine emergent wetlands, 12 acres of forested wetland, and 10 acres of scrub-shrub wetland. Calculations of percent cover of each wetland habitat type in the study site, also provided in the chart below, assumes the golf course is 70 acres, as given in the GIS data for the study site. The majority of the study site will consist of palustrine emergent wetlands (68% total: 52% persistent and 16% nonpersistent). Approximately 22 acres of scrub shrub and forested wetland will buffer freshwater marsh and vernal wetland areas from surrounding land use.

Table 4-10: Coverage of Native Habitat Types Associated With the Historic Reference Condition Under the Palustrine Alternative.

Palustrine Alternative	m^2	feet ^{2}	Acres	Percent Cover*
Total Palustrine Wetlands	286,000	3,100,000	70	100
Total Palustrine emergent	194,000	2,100,000	48	67

wetlands				
Persistent	146,000	1,600,000	37	52
Nonpersistent	43,000	476,000	11	15
Palustrine forested wetlands	48,000	529,000	12	17
Palustrine scrub-shrub wetlands	42,000	465,000	11	15

* Percent coverage of the Ocean Meadows Golf Course site.

4.3.2.1.2 Distributions

The distribution of palustrine wetland habitat is displayed in the map of the palustrine alternative Figure 4-4. In addition, potential elevation ranges of future conditions for this alternative are provided in Figure 4-5.

4.3.2.1.3 Description of mosaic of habitat types

Low elevations in the areas surrounding the creek corridor (mostly 7-9 feet MSL) support palustrine emergent wetland characterized by persistent vegetation (freshwater marsh). Nonpersistent palustrine emergent wetlands will be created in the slightly higher elevations (9- 12 feet MSL) adjacent to persistent emergent wetland areas.

Persistent emergent wetland vegetation zones typically occur as a series of concentric rings that reflect the relative depth and duration of flooding (Kramer, 1988). However, vegetation zones may be present in a patchy configuration rather than the classic concentric ring pattern if the bottom of the wetland is very uneven (Millar, 1976). Some emergent vegetation, such as spikerush (*Eleocharus* spp.) and cattail (*Typha* spp.), will colonize areas that are permanently or semi-permanently flooded (6 to 20 inches). Other emergents, including the sedges (*Cyperus* spp.; *Carex* spp.), will colonize more shallow areas that are seasonally to permanently flooded up to 15 inches in depth (Hammer, 1997). The different zones of emergent vegetation in created wetlands were not mapped to this detail, but it is expected that persistent emergents will recolonize areas of the created palustrine wetlands according to the depth and duration of flooding.

Figure 4-4

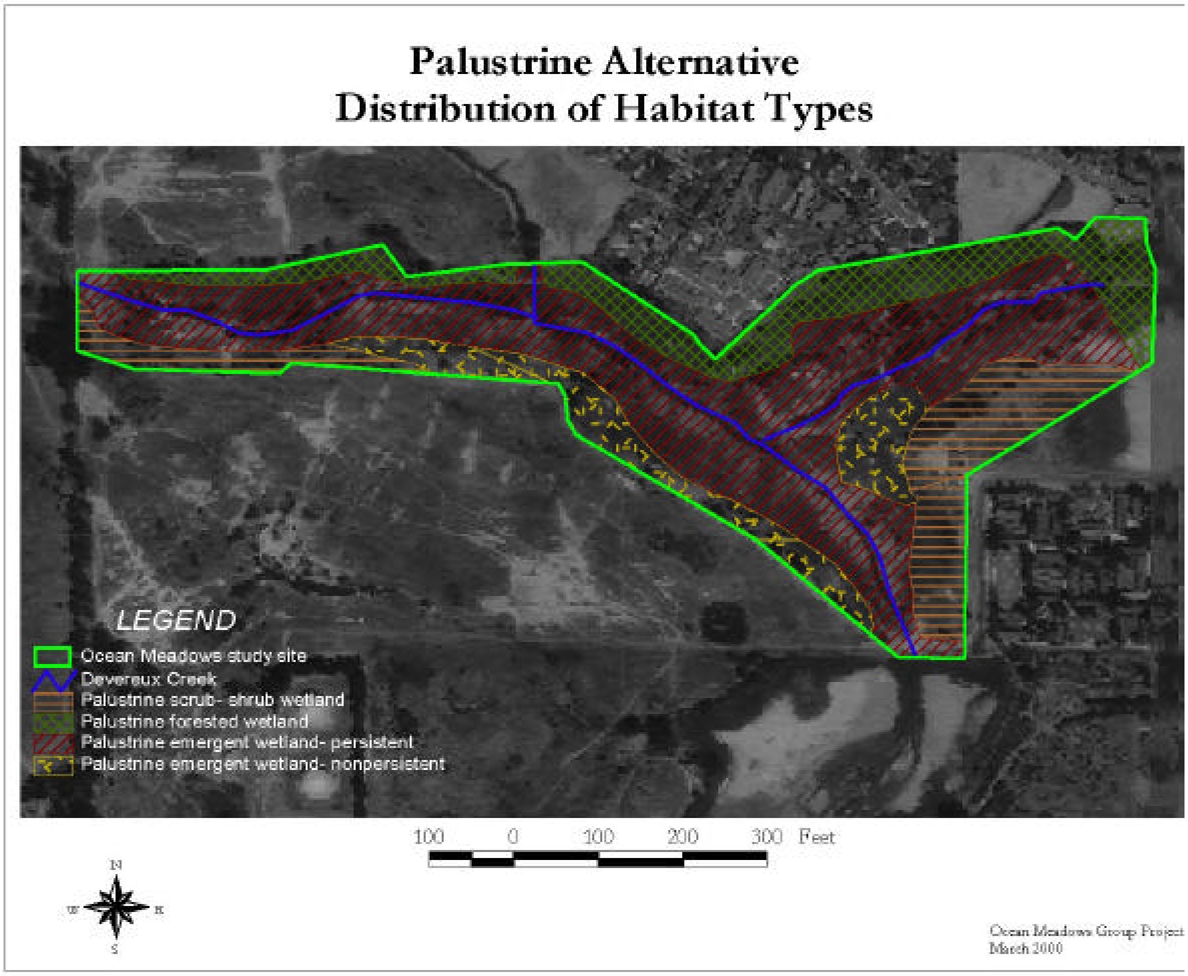
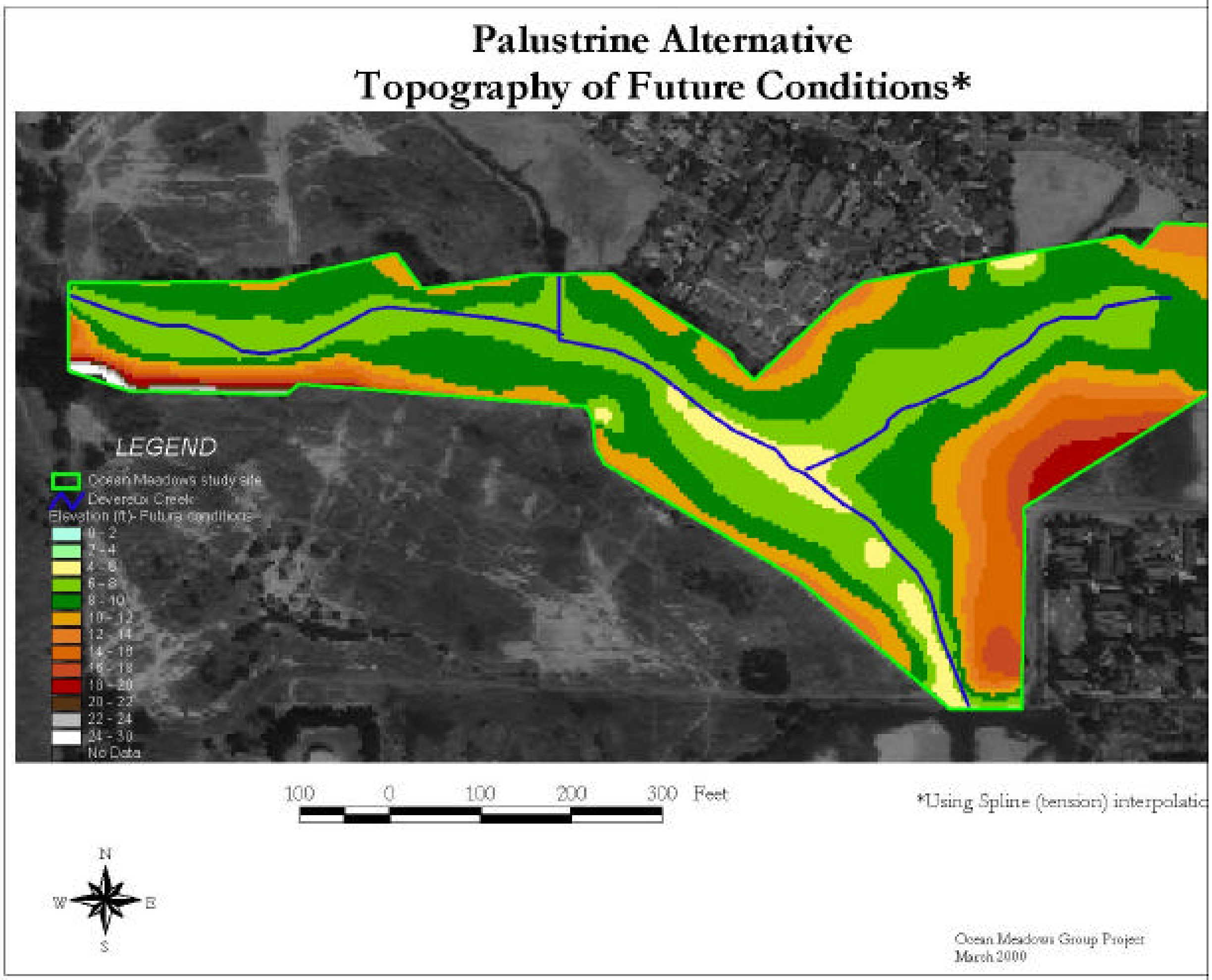

Palustrine Alternative
Distribution of Habitat Types
LEGEND
Ocean Meadows study site
Devereux Creek
Palustrine scrub- shrub wetland
Palustrine forested wetland
Palustrine emergent wetland- persistent
Palustrine emergent wetland- nonpersistent
100 0 100 200 300 Feet
N
S
Ocean Meadows Group Project
March 2000

Figure 4-5


Palustrine Alternative
Topography of Future Conditions*
LEGEND
Ocean Meadows study site
Devereux Creek
Elevation (ft)- Future conditions
0 - 2
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
12 - 14
14 - 16
16 - 18
18 - 20
20 - 22
22 - 24
24 - 30
No Data
100 0 100 200 300 Feet
*Using Spline (tension) interpolatic
N
W
E
S
Ocean Meadows Group Project
March 2000

Forested wetland habitat dominated by arroyo willows (*Salix lasiolepis*) will occur adjacent to persistent emergent wetlands on the upper margin of the study site, generally in seasonally flooded or saturated areas above elevations of 9 feet MSL. Scrub shrub wetlands will be created on the higher elevations (greater than 12 feet MSL) of the southwest edge of the study site and along the southeastern edge of the site. Scrub shrub habitat will also be created adjacent to emergent (nonpersistent or persistent) wetlands in areas that are expected to be intermittently or temporarily flooded/ saturated.

The palustrine alternative entails wetland creation given the existence of the access road to the north of lower Devereux Slough, which precludes the movement of estuarine water into the study site. The distribution of palustrine wetlands for this alternative is partially based on the assumption that there is one-way flow of water from the golf course to the Slough through the current culvert. However, if there is some input of saline water into the study site, a transition zone of estuarine/ palustrine hybrid wetlands will support species with an affinity for saline water. Brackish conditions currently occur on the study site due to the leaching of salts from the soil; thus, plant species more typically associated with estuarine systems are included in the palustrine alternative.

4.3.2.2 Ecosystem Indicators - Hydrology

Under the palustrine alternative, riparian areas will be expanded to cover most of the site, and all blockages in the creek will be removed. Although the main creek elevation will remain the same, soil removal along the banks of the creeks will widen the riparian areas to allow for palustrine emergent and non-emergent wetland. The road and culvert block will remain at the lower end of the golf course, effectively removing the tidal influence above it.

This habitat will allow for natural flooding of this area, attenuating water and sediment waves. With a water level of +9 MSL, the site will hold 56-acre feet of water. The large amount of riparian area and vegetation will slow incoming water and sediments from flooding events will deposit throughout the system. Sediments will eventually reach the lower slough but at a slower rate. As recent models have shown, runoff in the watershed has increased and become more flashy, due to increased development of the watershed (Davis et al., 1990). The construction of this palustrine wetland should moderate the flashiness of these storm events by slowing and storing some of the flood wave. In addition, sediments will be trapped and stabilized by the increased coverage of vascular wetland plants (Adam, 1990).

Artificial wetlands are often used in wastewater treatment to lower levels of nutrients, toxicants, and viruses. For example, *Scirpus* and *Typha* species, which are included in the proposed revegetation plans for this alternative, are often used in constructed wetlands to successfully lower pollution levels (Gersberg et al., 1984). Consequently, given the increases in water holding time and the increased amount of wetland vegetation planned for this alternative, we expect the site to provide higher levels of metal sequestration, nutrient removal, and pollutant degradation than it does presently. This may help to alleviate coastal pollution problems from future development in the watershed.

4.3.2.3 Ecosystem Indicators - Ecology

Fresh emergent wetlands are among the most productive wildlife habitats in California. They provide food, cover, and water for more than 160 species of birds (U.S. Comptroller General, 1976), and numerous mammals, reptiles, and amphibians. Freshwater marshes which hold water year round, seasonally, or following heavy rains often support "luxuriant" marsh vegetation, collectively an important resource for waterfowl nesting (Hammer, 1997). Seasonal wetlands often provide important habitat for migratory waterfowl during the winter and spring months (Josselyn et al., 1990). Marsh emergents generally support abundant insect populations and provide critical cover and protection from the weather and predators (Hammer, 1997).

4.3.2.3.1 Habitat for species of special concern

The palustrine alternative will provide and/or enhance habitat for many species of special concern, including those highlighted below.

Table 4-11: Plant Species of Special Concern That May Benefit From Creation or Expansion of Palustrine Wetland Habitat Types at the Study Site		
Scientific Name	**Common Name**	**Associated Palustrine wetland habitat type(s)**
Arthrocnemum subterminale	Parish's glasswort	Persistent emergent wetland
Lasthenia glabrata ssp. Coulteri	Coulter's goldfields	Nonpersistent emergent wetland
Hemizonia parryi ssp australis	Southern tarplant	Nonpersistent emergent wetland
Suaeda calceoliformis	Horned seablite	Nonpersistent emergent wetland
Hordeum depressum	Alkali barley	Nonpersistent emergent wetland

Table 4-12: Animal Species of Special Concern That May Benefit From Creation or Expansion of Wetland Habitat Types Included in the Palustrine Alternative *Page 1 of 2*			
Scientific name	**Common Name**	**Status**	**Associated habitat type(s)**
Panoquina errans	Salt Marsh Wandering Skipper	Species of Federal and Local Concern	Palustrine emergent wetland (persistent)
Brephidium exillis	Pygmy Blue Butterfly	Species of Local Concern	Palustrine emergent wetland (persistent)
Agelaius tricolor	Tricolored Blackbird	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent)
Plegadis chihi	White-faced Ibis	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent)
Asio Flammeus	Short Eared Owl	Species of Federal, State, and Local Concern	Palustrine scrub shrub wetland; Palustrine forested wetland
Botaurus lengtginosus	American Bittern	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent)
Circus cyaneus	Northern Harrier	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent); Palustrine scrub shrub wetland
Athene	Western	Species of	Palustrine scrub shrub

cunicularia hypugea	Burrowing Owl	Federal, State, and Local Concern	wetland
Elanus caeruleus	White- tailed kite	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent); Palustrine forested wetland
Ixobrychus exilis	Least Bittern	Species of Federal and State Concern	Palustrine emergent wetlands (persistent)
Accipiter cooperi	Cooper's Hawk	Species of Federal and State Concern	Palustrine forested wetland; Palustrine scrub shrub wetland
Empidonax traillii brewsteri	Little (Brewster's) willow flycatcher	Species of Federal and State Concern	Palustrine forested wetland; Palustrine scrub shrub wetland

Table 4-12: Animal Species of Special Concern That May Benefit From Creation or Expansion of Wetland Habitat Types Included in the Palustrine Alternative
Page 2 of 2

Scientific name	Common Name	Status	Associated habitat type(s)
Falco peregrinus anatum	Peregrine Falcon	Species of Federal and State Concern	Palustrine emergent wetland (persistent); Palustrine forested wetland
Pandion haliaetus	Osprey	Species of Federal and State Concern	Palustrine emergent wetland
Accipiter striatus	Sharp-shinned hawk	Species of Federal and State Concern	Palustrine forested wetland; Palustrine emergent wetland (persistent)

Lanius ludovicianus	Loggerhead shrike	Species of Federal and State Concern	Palustrine scrub shrub wetland; Palustrine forested wetland
Icteria virens	Yellow-breasted Chat	Species of State and Local Concern	Palustrine forested wetland; Palustrine scrub shrub wetland; Palustrine emergent wetland (persistent)
Dendroica petechia	Yellow warbler	Species of State and Local concern	Palustrine forested wetland; Palustrine scrub shrub wetland
Grus canadensis	Sandhill crane	Species of Federal Concern	Palustrine emergent wetland (persistent)
Passerculus sandwichensis beldingi	Belding's Savannah Sparrow	Species of State Concern	Palustrine emergent wetland (persistent)
Laterallus jamaicensis	California black rail	Species of State Concern	Palustrine emergent wetland (persistent)
Progne subis	Purple martin	Species of State Concern	Palustrine forested wetland
Eremophila alpestris actia	Coast horned lark	Species of Local Concern	Palustrine scrub shrub wetland
Rallus limacola	Virginia Rail	Species of Local Concern	Palustrine emergent wetland (persistent)
Lepus californicus benettii	San Diego black- tailed jackrabbit	Species of Federal and State Concern	Palustrine scrub shrub wetland
Neotoma fuscipes	Dusky-footed wood rat	Species of Local Concern	Palustrine forested wetland
Antrozous pallidus	Pallid bat	Species of State concern	Palustrine forested wetland

4.3.2.3.2 Area of habitat types associated with the Historic Reference Condition

This alternative will increase the acreage of native vegetation associations that occur in the palustrine wetland system, specifically native hydrophytes associated with freshwater and brackish environments.

The area of vegetated wetlands resulting from this alternative was compared with the current wetland acreage of the Devereux Slough. Wetlands and associated vegetation of Lower Devereux slough were mapped by Ferren et al. (1987). Acreage and percent cover of the lower slough area are provided for each palustrine wetland habitat type (except for nonpersistent emergent) in the table below. Nonpersistent palustrine emergent wetlands occur at lower Devereux, but this type of vegetation is restricted to narrow bands on margins of dune wetlands and could not be mapped.

Under the palustrine alternative, the total Devereux Slough area (upper and lower) will be comprised of about 59% palustrine wetland habitat, as compared to the 17% palustrine wetlands that currently occurs in the lower Devereux Slough. Additionally, freshwater marsh (palustrine emergent) habitat will increase from about 6% in the lower slough to about 37% in the Devereux slough area resulting from wetland creation. Scrub shrub wetlands will increase from the less than one acre that currently occurs in the lower slough to about 8% in the larger slough area.

Table 4-13: Areas of Native Habitat Associated With the Historic Reference Condition Created Under the Palustrine Alternative					
	Lower Devereux Slough system (Ferren et al., 1987)		**Proposed Wetland Creation at Upper slough**	**Total wetlands, Devereux Slough (upper and lower)**	
Wetland Type	Area (acres)	% Cover of lower slough	Area (acres)	Area (acres)	% Cover of upper and lower slough area
Total Wetlands	70	nearly 100	70	140	100
Total palustrine wetlands	12	17	70	83	59
Total palustrine emergent wetlands	4	6	48	52	37
Persistent	4	6	40	41	29
Non persistent	-	-	11	11	8
Palustrine forested wetlands	7	11	12	19	14
Palustrine scrub shrub wetlands	less than 1	less than 1	11	11	8

4.3.2.4 Construction Activities

To create the above-mentioned wetlands, many structural changes (summarized below) will need to occur at the study site.

Table 4-14: Actions Necessary for Creation of Palustrine Wetland Habitat at the Study Site
Acquisition of golf course
Removal of site fill
Removal of artificial structures such as dirt roads/ blockages, which currently bisect the creek in several locations, and associated underground drainage pipes
Removal of 15- 25 meter underground drainage pipe at the junction of the west- arm creek- way and Devereux Creek
Removal of two bridges used by golfers and maintenance crews
Removal of large non- native trees and other exotic vegetation
*Removal and grading of soil to achieve desired topography (see map and description below)
*Revegetation of the site by hydroseeding, planting from containers, and transplantation of cuttings

4.3.2.4.1 Creation of wetlands

For the Palustrine Alternative, elevation will generally need to be lowered from the current elevation to 7 to 9 or 10 feet MSL, as seen on the topography of future conditions (Figure 4-5). In areas that show a lower elevation (about 4- 7 feet MSL) in the DEM of current conditions, no soil removal was assumed, and these areas were not included in the soil volume calculations. An artifact of interpolation for future conditions from elevation points is that some cells are higher in elevation than current conditions. In these areas, it is assumed that topography will not change significantly and these cells were not included in the soil removal calculations.

Forested wetlands will extend above 9 feet MSL and slope up to the boundary of the site; some earth moving will be necessary to achieve this range of elevation. Additional soil removal and grading will be implemented to achieve a rise in elevation to scrub shrub habitats, which begin about 12 feet MSL in this alternative. In total, approximately 58 acres of the study site will require soil removal of a depth ranging from 0 to 8 feet (see chart below).

By implementing methods outlined in the methods section of this report, the total volume of soil to be removed in order to achieve the elevation ranges under future conditions was calculated at 461,000 yd^3 (see Table 4-16).

Table 4-15: Volume of Soil to be Moved Under the Palustrine Alternative			
Depth (feet)	**Acres**	**Volume (yd^3)***	**Cost at $15/ yd^3***
0-2	40	195,000	2,918,000
2 to 4	17	248,000	3,717,000
4 to 6	1	18,000	275,000
6 to 8	Less than 1	less than 1,000	3,000
Total	**58**	**461,000**	**6,913,000**

* rounded to nearest $1,000

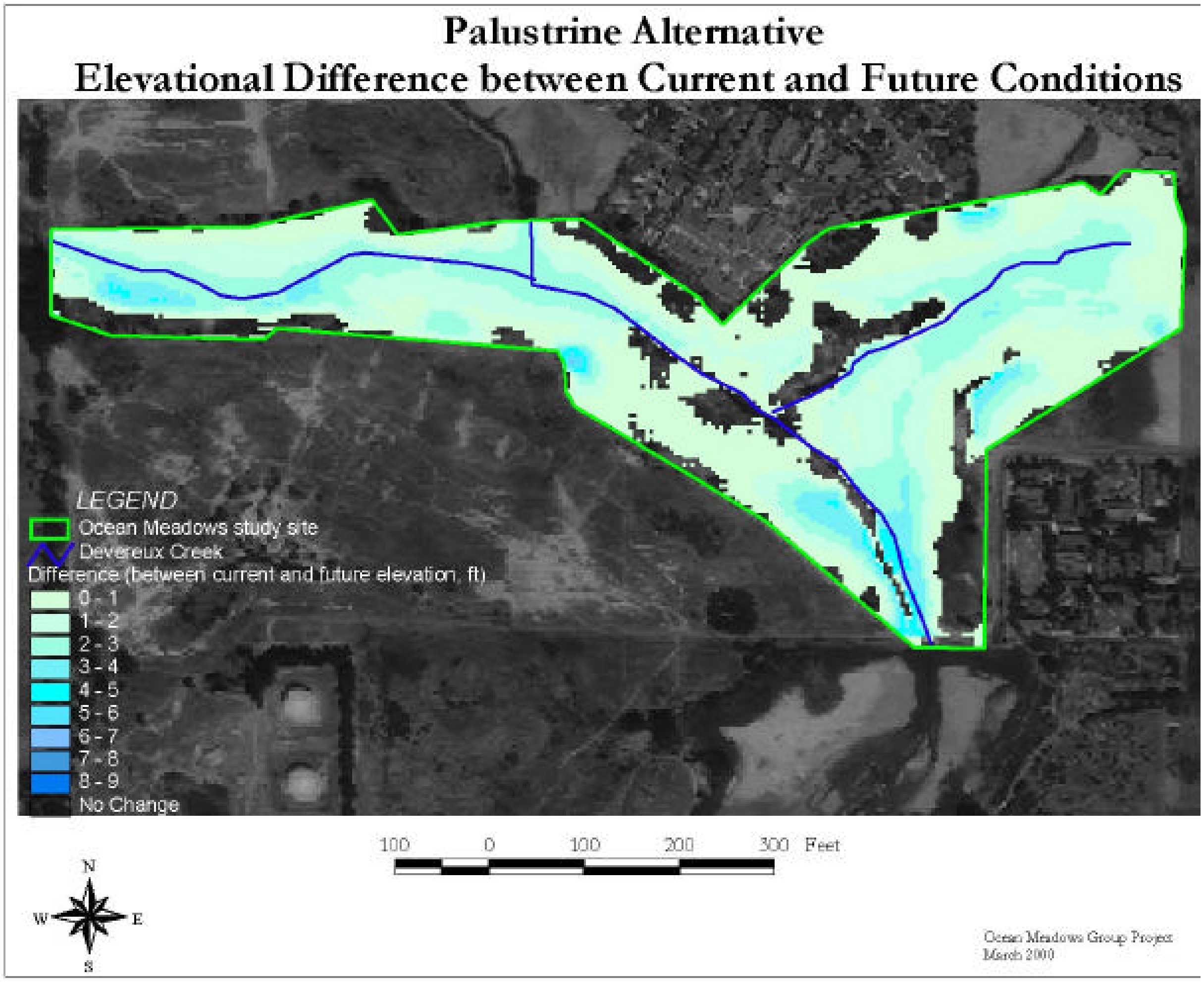
4.3.2.4.2 Comparison of habitat type variation within palustrine alternative

The distribution of vegetation zones within emergent wetlands (Figure 4-1) is an example freshwater wetland design, given current social, economical, and political constraints. In order to gauge the validity of this design, a sensitivity test was applied, evaluating the importance of distribution and amount of freshwater habitat types in the palustrine alternative in determining costs. The acreage and distribution of nonpersistent and persistent emergent wetland was varied to determine if this would result in a substantial change in the amount of soil removal necessary to achieve future conditions. The variation consisted primarily of an elevation gradient that more closely followed the current topography of the site and created of a greater amount of nonpersistent (relative to persistent) emergent wetland. Buffer areas of forested and scrub shrub wetlands remained the same.

As Table 4-17 shows, when the amount of nonpersistent emergent wetland is increased by about 5% and acreage of persistent emergent wetland is concurrently decreased by about 7%, the amount of soil to be removed decreases by about 2%. This change results in a 1% decrease in costs associated with soil removal (assuming $15/ yd^3$). This analysis yielded only minimal changes in the amount of soil removed: a 2% decrease resulted in cost reductions of only 1%. In fact, variations were so slight they could be attributed to rounding errors inherent in the calculations.

Table 4-16: Comparison of the Palustrine Alternative and a Variation of the Alternative in Terms of Distribution of Emergent Wetland Types				
	Persistent Emergent Wetlands	Nonpersistent Emergent Wetlands	Estimated Volume of soil removal (yd^3)	Estimated Cost for soil removal (at $15/ yd^3)
Palustrine Alternative	37 acres	11 acres	461,000	6,900,000
Variation of Alternative	32 acres	15 acres	453,000	6,800,000
% Change between alternatives	- 8%	+ 6%	- 2%	- 1%

Figure 4-6


Palustrine Alternative
Elevational Difference between Current and Future Conditions
LEGEND
Ocean Meadows study site
Devereux Creek
Difference (between current and future elevation, ft)
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
No Change
100 0 100 200 300 Feet
N
W
E
S
Ocean Meadows Group Project
March 2000

4.3.2.4.3 Hydroseeding/ planting of native species

Native plants will be established by planting from containers, cuttings, or through hydroseeding methods. In addition, some plants will likely recolonize the created habitats with little human intervention. The specific method for each plant that we used for calculation of costs is indicated in the extensive list of native species provided in Appendix I.

4.3.2.5 Costs

4.3.2.5.1 Land Acquisition

Since the current owner wishes to maintain the site as a golf course, the study site will have to be purchased prior to beginning any of the restoration alternatives. Estimates from within the Santa Barbara Community have provided a range of values that vary widely. As a result, the only estimate that we can make, with any level of certainty, is that the study site will likely cost less than $10 million.

4.3.2.5.2 Excavation and Removal of Fill

We estimate that the cost of excavating and relocating 460,000 yds^3 of soil, at a unit cost of between $5 and $15, to be between $2.3 million and $6.9 million. The large range in the unit cost values is the result of three main mitigating factors. First, the cost of transporting fill material is strongly dependent upon the distance of the relocation site from the excavation site. These unit costs are further complicated by the common practice of selling the fill material to local contractors. In these instances, the purchasing contractor will usually also arrange for the material to be transported off-site. Lastly, the water content of the soil can also have an effect upon the cost of excavation and removal. This is particularly relevant to this site where we will be digging in an area where the water table is predicted to be relatively shallow.

4.3.2.5.3 Revegetation

Appendix I describes in detail the methods employed to calculate costs of revegetation.

Hydroseeding
Approximately 40 acres of palustrine emergent wetland (persistent), 11 acres of palustrine emergent wetland (nonpersistent) and 11 acres of palustrine scrub shrub wetland will be revegetated by hydroseeding.

Hand Planting (from containers)
Planting from container is estimated to cost a total of $7- 10/ plant (Hubbard, personal communication). This estimate includes all costs associated with hand planting, including purchasing or growing and labor. For the purposes of comparing between alternatives, an estimate of $7/ plant was used in calculating costs. It would cost approximately $5,055,000 to plant about 722,000 plants included in the Palustrine Alternative (See table 4-17 below).

Table 4-17: Containerized Planting Reqirements Under the Palustrine Alternative

Habitat type	Acres	Feet ^{2}*	Spacing	Estimated No. of Plants*	Species Planted from Containers
Palustrine emergent wetland (persistent)	40	1,608,000	3.5'	459,000	10
Palustrine emergent wetland (nonpersistent)	11	476,000	3'	159,000	8
Palustrine forested wetland	12	529,000	20'	26,000	9
Palustrine scrub shrub wetland	11	465,000	6'	78,000	8
TOTAL plants: Palustrine				**722,000**	
Cost for planting from containers (@ $7/plant):				**$5,055,000***	

* rounded to nearest $1,000

4.3.2.5.4 Summary of Costs

Table 4-18: Summary of Costs for the Palustrine Alternative				
Item	**Unit**	**Cost per Unit**	**# of Units**	**Total Cost***
Revegetation (hand planting)	Plants	$7	722,000	$5,055,000
Revegetation (hydroseeding)	-	-	-	$160,000
Excavation and removal of fill	cubic yard	$15	461,000	$6,900,000
Total Cost				**$12,115,000**

* rounded to nearest $1,000

4.4 Partial Estuarine Option

4.4.1 Introduction

We present two alternatives by which the estuarine habitat historically located on the site can be re-established: (1) restoration of partial estuarine conditions; and (2) restoration of full estuarine conditions. Since both alternatives have similar historic justification for restoration, there will be some repetition between the plans. The full estuarine alternative would extend current conditions at the Devereux Slough through the area occupied by Ocean Meadows Golf Course. This alternative represents the maximum possible restoration of historical estuarine conditions to the site, given current residential development. Conversely, the partial estuarine alternative would only partially extend the present range of the Slough through the site, but would also expand palustrine conditions that currently exist there. In this way the partial estuarine alternative is a compromise between the full estuarine alternative and the palustrine alternative.

Morrison et al. (1994) argue that restored conditions at a site should be based on evaluation of past biophysical dynamics and associated floral and faunal communities, which in the Devereux watershed include documented estuarine conditions. Zedler (1996a) calls for the expansion of current communities rather than adding new habitat types. Moreover, Zedler (1996b) further contends that the greatest regional need in Southern California is for salt marsh and intertidal flat restoration, given that coastal wetlands are critical to long-term flyway support. These objectives would be met under the partial estuarine alternative. Finally, Ferren et al. (1987) cite restoration of both palustrine and estuarine habitats near Devereux Slough as a primary goal for the site in order to preserve the unique mix of habitats found therein.

4.4.1.1 Historical Justification

Historic representations of the watershed (Figure 1-6) indicate that estuarine conditions extended well north of the current Slough. Implementation of the partial estuarine alternative will contribute to restoring ecological and hydrologic conditions associated with the historic reference condition.

4.4.1.2 Description of the Alternative

The partial estuarine alternative necessitates removal of the east-west road dividing the upper and lower Slough. Other requirements include, but are not limited to, the following:

1) acquisition of the golf course;
2) removal of course structures such as tee boxes, culverts, etc.;
3) removal of large trees, including both native and exotic;
4) gradation of soils to create conditions that will support wetland species; and
5) revegetation of the site with wetland plants through both hydroseeding and direct planting.

The partial estuarine alternative creates a mosaic of eight habitat types. It expands the estuarine conditions of the lower Slough northward through portions of the golf course site at elevations ranging from 0-6 feet MSL. Palustrine conditions are created in higher elevations in the upper reaches of the golf course site, at elevations of 8-10 feet MSL. In addition to transition zones between estuarine and palustrine communities, this alternative includes a number of buffer areas of palustrine forested and palustrine scrub shrub habitats on the eastern, western and northern borders of the site. Elevations for these buffer zones range from 8-20 feet MSL.

4.4.2 Details of the Alternative

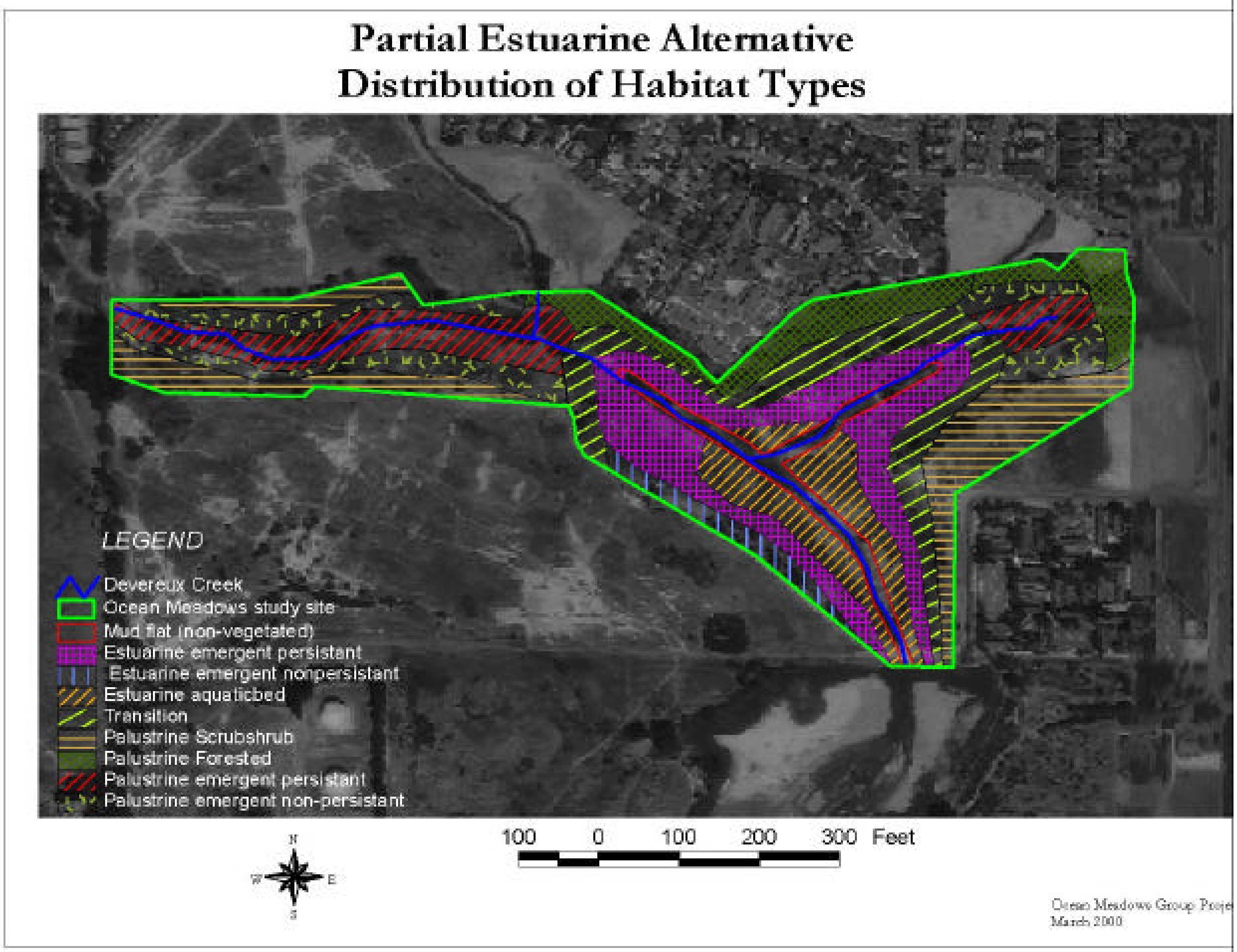
4.4.2.1 Habitat Types

4.4.2.1.1 Acreage

The partial estuarine alternative is a gradation between the palustrine alternative and full estuarine conditions. The constructed mosaic will include eight habitat types, not including the main Devereux Creek channel. Table 4-21 describes each of these habitat types. Of the 70 acres at the site, estuarine wetlands account for approximately 25% of the total cover, palustrine wetlands account for approximately 20% of the total cover and buffer zones (palustrine forested wetlands and palustrine scrub shrub wetlands) account for approximately 27% of the total cover.

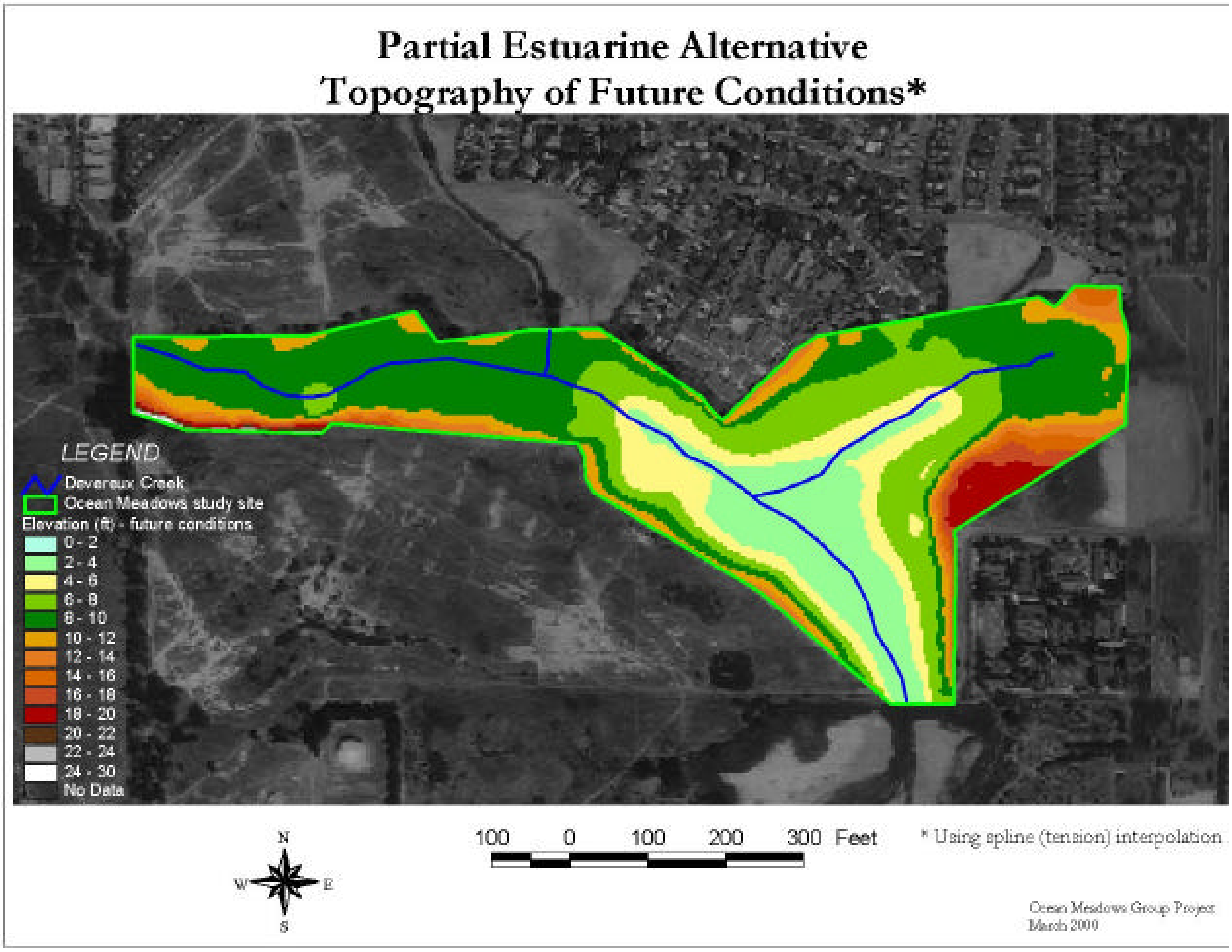
Table 4-19: Habitat Coverage for the Partial Estuarine Scenario				
Partial Estuarine Alternative	**m^2**	**$feet^2$**	**Acres**	**% Cover***
Total Wetlands	283,000	3,049,000	70	100
Estuarine Aquatic bed	26,000	291,000	7	10
Total Estuarine emergent wetlands	70,000	753,000	17	25
Persistent	36,000	400,000	9	13
Nonpersistent	32,000	353,000	8	12
Transition	37,000	407,000	9	13
Total Palustrine emergent wetlands	57,000	614,000	14	20
Persistent	49,000	536,000	12	18
Nonpersistent	7,000	78,000	2	3
Palustrine forested wetlands	29,00	322,000	7	11
Palustrine scrub-shrub wetlands	46,000	502,000	12	16

Figure 4-7



Partial Estuarine Alternative
Distribution of Habitat Types
LEGEND
Devereux Creek
Ocean Meadows study site
Mud flat (non-vegetated)
Estuarine emergent persistant
Estuarine emergent nonpersistant
Estuarine aquaticbed
Transition
Palustrine Scrubshrub
Palustrine Forested
Palustrine emergent persistant
Palustrine emergent non-persistant
100 0 100 200 300 Feet
N
W
E
S
Ocean Meadows Group Proje
March 2000

Figure 4-8


Partial Estuarine Alternative
Topography of Future Conditions*
LEGEND
Devereux Creek
Ocean Meadows study site
Elevation (ft) - future conditions
0 - 2
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
12 - 14
14 - 16
16 - 18
18 - 20
20 - 22
22 - 24
24 - 30
No Data
N
W
E
S
100 0 100 200 300 Feet
* Using spline (tension) interpolation
Ocean Meadows Group Project
March 2000

4.4.2.1.2 Distributions

Figure 4-8 illustrates the distribution of habitats for the partial estuarine scenario. Habitats were designed based on historic coverage and current topography and hydrology. Figures 4-1, 4-9, and 4-11 detail current elevation at the site, elevations for restoration activities, and changes in elevation from pre- to post-restoration.

4.4.2.1.3 Description

Estuarine conditions dominate the southern end of the site, adjacent to the Lower Slough. Estuarine aquatic bed, characterized by *Ruppia maritima*, surrounds the main channel of the system, while estuarine emergent persistent habitat, dominated by *Salicornia virginica*, borders the land-ward edge of the aquatic bed. The system gradually progresses northward through transitional habitat, which provides the necessary buffer between estuarine and palustrine habitats, to the palustrine wetlands. And, as mentioned above, buffer zones ring the system on its outer edges. One exception is the southwestern portion of the golf course site, where estuarine emergent non-persistent habitat and transitional habitat extend to the borders of the site. Buffer zones are not thought to be necessary here because of the habitat composition, and likely future management practices of the adjacent lands (NCAG, 1999). This design of this system generally follows from lower elevations estuarine habitats in the southern portion of the site and surrounding the creek beds to higher elevation palustrine and transitional communities.

4.4.2.2 Ecosystem Indicators-- Hydrology

Under the partial estuarine alternative the tidal blockage will be removed from the bottom of the golf course and the lower portion of the golf course will be dredged extensively to create estuarine habitat contiguous with the lower slough at elevations consistent with the lower slough. This will have the effect of enlarging the lower slough basin and increasing the amount of water required to fill it. Given a water level of +8 feet MSL breaching elevation, the site would impound 90-acre feet of water. Currently the lower slough has a volume of 171-acre feet at +7 feet MSL (Davis et al., 1990).

The remaining upper portions of the golf course site will be enhanced with palustrine habitat, forming a large riparian area similar to the palustrine alternative. Attenuation of water and sediment will occur as in the freshwater alternative but at a smaller scale, as there will be less palustrine habitat. The same will be true with nutrient and pollution removal: filtration will occur as in the palustrine plan, but with a lower residence time and less vegetation before flows reach the enlarged slough. In addition, estuarine plants may remove metals, toxics, and nutrients (Zedler, 1996b), decreasing the amount of pollution reaching the slough and ocean.

4.4.2.3 Ecosystem Indicators-- Ecology

4.4.2.3.1 Habitat for species of special concern

All of the habitat types supporting species of special concern will be created under this scenario. Thus, the habitat provided for species of special concern are listed in Tables 4-22 and 4-23:

Table 4-20: Plant Species of Special Concern Associated with the Partial Estuarine Alternative

Species Name	Common Name
Ruppia maritima	Ditchgrass
Salicornia virginica	Pickleweed
Distichilis spicata	Coastal Saltgrass

Stephanomeria elata	
Lasthenia glabrata ssp. Coulter	Coutler's Goldfields
Suaeda clceoliformis	Horned Seablite
Hordeum depressum	Alkali Barley
Hemizonia parryi ssp. Australis	Southern Tarplant
Arthrocnemum subterminale	Parish Glasswort
Eurhamia occidentalis	Western Goldenrod
Isocoma menziesii var vernonioides	Coast Goldenbrush

Table 4-21: Animal Species of Special Concern That May Benefit From Creation or Expansion of Wetland Habitat Types Included in the Partial Estuarine Alternative *Page 1 of 3*			
Scientific name	**Common Name**	**Status**	**Associated habitat type(s)**
Panoquina errans	Salt Marsh Wandering Skipper	Species of Federal and Local Concern	Palustrine emergent wetland (persistent); Estuarine emergent wetland (persistent); Transitional (estuarine/ palustrine hybrid)
Cincindela hirticollis gravida	Sandy Beach Tiger Beetle	Species of Federal Concern	Estuarine emergent wetland (nonpersistent); Transitional (estuarine/ palustrine hybrid)
Brephidium exillis	Pygmy Blue Butterfly	Species of Local Concern	Palustrine emergent wetland (persistent); Estuarine emergent wetland (nonpersistent)
Agelaius tricolor	Tricolored Blackbird	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent)
Plegadis chihi	White-faced Ibis	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent)
Asio Flammeus	Short Eared Owl	Species of Federal, State, and Local Concern	Palustrine scrub shrub wetland; Palustrine forested wetland
Botaurus lengtginosus	American Bittern	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent); Estuarine emergent wetland (persistent); Transitional community (estuarine/

			palustrine hybrid)
Circus cyaneus	Northern Harrier	Species of Federal, State, and Local Concern	Palustrine emergent wetland (persistent); Palustrine scrub shrub wetland
Athene cunicularia hypugea	Western Burrowing Owl	Species of Federal, State, and Local Concern	Palustrine scrub shrub wetland

Table 4-21: Animal Species of Special Concern That May Benefit From Creation or Expansion of Wetland Habitat Types Included in the Partial Estuarine Alternative *Page 2 of 3*			
Scientific name	**Common Name**	**Status**	**Associated habitat type(s)**
Elanus caeruleus	White- tailed kite	Species of Federal, State, and Local Concern (Protected in Santa Barbara County)	Estuarine emergent wetland (persistent); Palustrine emergent wetland (persistent); Palustrine forested wetland
Ixobrychus exilis	Least Bittern	Species of Federal and State Concern	Palustrine emergent wetland (persistent); Estuarine emergent wetland (persistent)
Accipiter cooperi	Cooper's Hawk	Species of Federal and State Concern	Palustrine forested wetland; Palustrine scrub shrub wetland
Empidonax traillii brewsteri	Little (Brewster's) willow flycatcher	Species of Federal and State Concern	Palustrine forested wetland; Palustrine scrub shrub wetland
Falco peregrinus anatum	Peregrine Falcon	Species of Federal and State Concern	Palustrine emergent wetland (persistent); Palustrine forested wetland
Pandion haliaetus	Osprey	Species of Federal and State Concern	Estuarine emergent wetland; Palustrine emergent wetland
Accipiter striatus	Sharp-shinned hawk	Species of Federal and State Concern	Palustrine forested wetland; Palustrine emergent wetland (persistent)

Numenius americanus	Long- billed curlew	Species of Federal and State Concern	Estuarine emergent wetland (persistent and nonpersistent)
Lanius ludovicianus	Loggerhead shrike	Species of Federal and State Concern	Palustrine scrub shrub wetland; Palustrine forested wetland
Icteria virens	Yellow-breasted Chat	Species of State and Local Concern	Palustrine forested wetland; Palustrine scrub shrub wetland; Palustrine emergent wetland (persistent)
Dendroica petechia	Yellow warbler	Species of State and Local concern	Palustrine forested wetland; Palustrine scrub shrub wetland
Grus canadensis	Sandhill crane	Species of Federal Concern	Palustrine emergent wetland (persistent)

Table 4-21: Animal Species of Special Concern That May Benefit From Creation or Expansion of Wetland Habitat Types Included in the Partial Estuarine Alternative *Page 3 of 3*			
Scientific name	**Common Name**	**Status**	**Associated habitat type(s)**
Passerculus sandwichensis beldingi	Belding ’s Savannah Sparrow	Species of State Concern	Palustrine emergent wetland (Persistent); Estuarine emergent wetland (Persistent) Transitional (estuarine/ palustrine hybrid)
Laterallus jamaicensis coturniculus	California black rail	Species of State Concern	Palustrine emergent wetland (persistent); Estuarine emergent wetland (persistent); Transitional (estuarine/ palustrine hybrid)
Progne subis	Purple martin	Species of State Concern	Palustrine forested wetland
Eremophila alpestris actia	Coast horned lark	Species of Local Concern	Palustrine scrub shrub wetland
Rallus limacola	Virginia Rail	Species of Local Concern	Palustrine emergent wetland (persistent); Estuarine emergent wetland (persistent)
Lepus californicus benettii	San Diego black- tailed jackrabbit	Species of Federal and State Concern	Palustrine scrub shrub wetland
Reithrodontomys megalotis limicola	Southern salt marsh harvest mouse	Species of Federal and State Concern	Estuarine emergent wetland (persistent); Transitional (estuarine/ palustrine hybrid)
Neotoma fuscipes	Dusky-footed wood rat	Species of Local Concern	Palustrine forested wetland

Antrozous pallidus	Pallid bat	Species of State concern	Palustrine forested wetland

4.4.2.3.2 Area of habitat types associated with the Historic Reference Condition

The increase in transitional and scrub shrub habitat associated with this alternative is especially important. First, it serves as a refuge for animals during high water events. Zedler (1996b) notes that Belding's savannah sparrow requires such refuge. Second, scrub shrub habitat links the upper and lower reaches of the marsh by supporting pollinators and other insects that enhance functionality of the marsh. These include members of Coleoptera, Diptera, Hymenoptera, and Lepidoptera (PERL, 1990).

It is important to note that this plan increases the coverage of pickleweed by approximately 24 acres, providing key support for Belding's savannah sparrow. Mid to upper marsh provides territorial males with singing perches, females with suitable nesting sites and materials, proximity to food supplies and disturbance buffers (PERL, 1990). Additionally, the increase in coverage of saltgrass benefits the wandering skipper, as its larvae are host specific on saltgrass (Zedler, 1996b).

A comparison of the area of vegetated wetlands resulting from this alternative was and the current wetland acreage of the Devereux Slough as mapped by Ferren et al. (1987) appears in Table 4-22. Acreage and percent cover of the total lower Slough area is provided for each wetland type to be created, except for palustrine emergent nonpersistent.

Table 4-22: Areas of Native Habitat Associated With the Historic Reference Condition Created Under the Partial Estuarine Alternative					
	Lower Devereux Slough system (Ferren et al., 1987)		Proposed Wetland Creation at Upper slough	Total wetlands, Devereux Slough (upper and lower)	
Wetland Type	Area (acres)	% Cover of lower slough	Area (acres)	Area (acres)	% Cover of upper and lower slough area
Total wetlands	70	almost 100	70	140	100
Total palustrine wetlands	12	17	33	45	32
Total palustrine emergent wetlands	4	6	14	18	13
Persistent	4	6	12	16	12
Nonpersistent	-	-	2	2	1
Palustrine forested wetlands	7	11	7	15	11
Palustrine scrub-shrub wetlands	less than 1	less than 1	11	12	9
Total estuarine wetlands	42	60	24	66	47
Estuarine aquatic bed	23	34	7	30	22

Total estuarine emergent wetlands	18	26	17	36	26
Persistent	18	26	9	41	29
Nonpersistent	less than 1	less than 1	8	11	8

4.4.2.4 Construction Activities

A list of construction activities associated with the partial estuarine alternative appears in Table 4-25.

Table 4-23: Construction Activities Required for Creation of Partial Estuarine Alternative
Acquisition of golf course
Removal of golf course greens and fill*
Removal of artificial structures such as dirt roads/blockages, which currently bisect the creek in several locations, and associated underground drainage pipes
Removal of 15-25 meter underground drainage pipe at the junction of the west-arm creekway and Devereux Creek
Removal of two bridges used by golfers and maintenance crews
Removal of large trees, both native and exotic
Removal and grading of soil materials to achieve desired topography
Removal of culverts and materials supporting the east-west road that divides the golf course and lower Slough*
Revegetation of the site by hydroseeding, planting from containers, and transplantation of cuttings*

*For purposes of comparison of alternatives, only the costs associated with soil removal and revegetation are included for this alternative.

4.4.2.5 Costs

4.4.2.5.1 Land Acquisition

Since the current owner has expressed his desires to maintain the site as a golf course, the study site will have to be purchased prior to beginning any of the restoration alternatives. At present we estimate the study site to be valued at less $10 million.

4.4.2.5.2 Excavation and Removal of Fill

We estimate that the cost of excavating and relocating 890,000 yds^3 of soil, at a unit cost of between $5 and $15, to be between $4.45 million and $13.35 million. For further influences on soil removal costs see section 4.3.2.5.2.

Table 4-24: Volume of Soil to be Moved Under the Partial Estuarine Alternative			
Depth (feet)	Acres	Volume (yd^3)*	cost at \$15/ yd^3*
0-2	33	161,000	2,421,000
2 to 4	15	225,000	3,374,000
4 to 6	8	203,000	3,040,000
6 to 8	7	232,000	3,473,000
8 to 10	1	61,000	909,000
10 to 12	less than 1	8,000	115,000
Total	**66**	**889,000**	**13,332,000**

* rounded to nearest $1,000

4.4.2.5.3 Revegetation

Appendix I describes in detail the methods employed to calculate costs of revegetation.

Hydroseeding
It will cost approximately $120,000 to revegetate the site by hydroseeding.

Hand Planting (from containers)
For the Partial Estuarine Alternative, 3 species associated with estuarine emergent wetland (persistent), 4 species associated with estuarine emergent wetland (nonpersistent), 9 species associated with transitional community, 10 species associated with palustrine emergent wetland (persistent), 8 species associated with palustrine emergent wetland (nonpersistent), 9 species associated with palustrine forested wetland, and 8 species associated with palustrine scrub shrub are recommended to be established by hand planting (see Appendix I).

Our planting estimate includes all costs associated with hand planting, including purchasing or growing and labor. For the purposes of comparing between alternatives, an estimate of $7/ plant was used in calculating costs.

It would cost approximately $4,662,000 to plant about 666,000 plants included in the Palustrine Alternative (See table 4-25 below). .

Figure 4-9

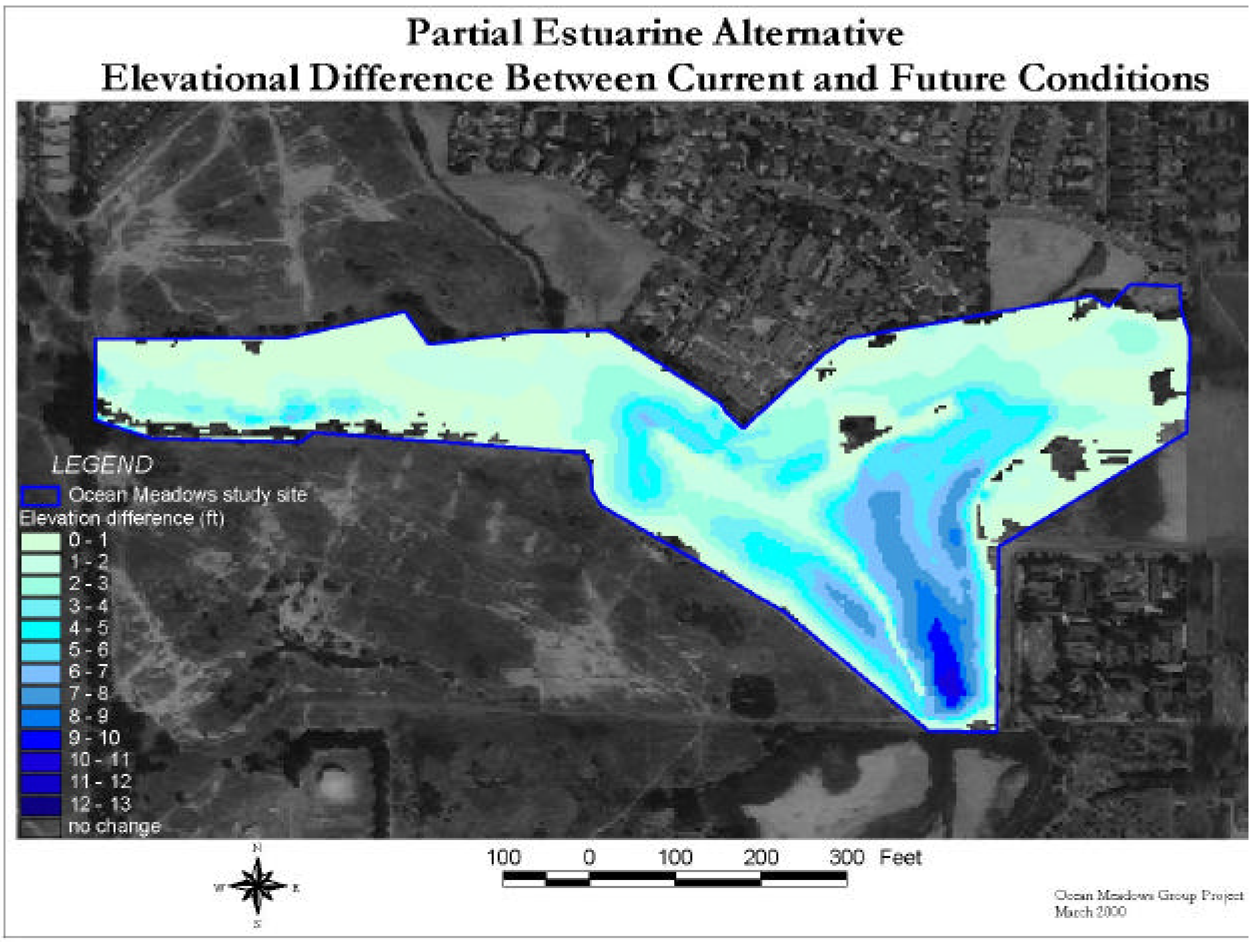

Partial Estuarine Alternative
Elevational Difference Between Current and Future Conditions
LEGEND
Ocean Meadows study site
Elevation difference (ft)
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
10 - 11
11 - 12
12 - 13
no change
100 0 100 200 300 Feet
Ocean Meadows Group Project
March 2000

Table 4-25: Containerized Planting Requirements Under the Partial Estuarine Alternative

Habitat type	Acres	Feet^2	Spacing	Estimated No. of Plants	Species Planted from Containers
Estuarine aquatic bed	7	291,000	-	0	0
Estuarine emergent wetland (persistent)	9	400,000	3'	133,000	3
Estuarine emergent wetland (nonpersistent)	8	353,000	3'	118,000	4
Transitional Community	9	407,000	3'	136,000	9
Palustrine emergent wetland (persistent)	12	536,000	3.5'	153,000	10
Palustrine emergent wetland (nonpersistent)	2	78,000	3'	26,000	8
Palustrine forested wetland	7	322,000	20'	16,000	9
Palustrine scrub shrub wetland	12	502,000	6'	84,000	8
TOTAL plants: Partial estuarine				**666,000**	

alternative *	
Cost for planting from containers (@ $7/plant)*	**$4,662,000**

* rounded to nearest $1,000

4.4.2.5.4 Bridge Construction

In order to increase the flow of water between the current Devereux Slough and the enhancement area, the culvert that currently exists there must be removed and replaced with a structure that allows for a greater exchange of materials between the two locations. Furthermore, it is recommended that the structure not be "hard bottom" as to allow for the greater movement of organisms across the structure. We expect that removal of the current structure and construction of a bridge with dimension of 60 feet. by 16 feet. to be approximately $150,000 to $350,000.

Table 4-26: Summary of Costs for Partial Estuarine Alternative

Item	Unit	Cost per Unit	# of Units	Total Cost*
Revegetation (hand planting)	plants	$7	666,000	$4,662,000
Revegetation (hydroseeding)*	-	-	-	$120,000
Culvert removal and Bridge cons.	1 bridge	$350,000	1	$350,000
Excavation and removal of fill	cubic yard	$15	889,000	$13,335,000
Total Cost				$18,467,000

* rounded to nearest $1,000

4.5 Full Estuarine Option

4.5.1 Introduction

Morrison et al. (1994) argue that restored conditions at a site should be based on evaluation of past biophysical dynamics and associated floral and faunal communities, which in the Devereux watershed include documented estuarine conditions. And Zedler (1996a) calls for the expansion of current communities rather than addition of new ecosystem types, especially in habitat remnants at smaller wetlands. Finally, Zedler (1996b) further contends that the greatest regional need in Southern California is for salt marsh and intertidal flat restoration, given that coastal wetlands may be more critical to long-term flyway support. Again, these objectives would be met under the full estuarine alternative.

4.5.1.1 Historical Justification

Much of the rationale, plans, effects and benefits described in the full estuarine alternativeare similar to information in the partial estuarine alternative. Both create or enhance many of the same habitat types. They also provide many of the same ecosystem benefits and functions that were associated with the historic reference condition. Each results in the return of historic estuarine habitat to the site.

Aerial photographs of the watershed (Figure 1-6) indicate that estuarine conditions extended well north of the current Slough, thereby encompassing the entire site. Implementation of the full estuarine alternative will contribute to restoring ecological and hydrologic conditions historically present at the site.

4.5.1.2 Descriptions

The full estuarine alternative necessitates the removal of the east-west road dividing the upper and lower Slough. Other requirements include, but are not limited to, the following:

1) acquisition of the golf course;
2) removal of course structures such as tee boxes, culverts, etc.;
3) removal of large trees, both native and exotic;
4) gradation of soils to create conditions supporting wetland species; and
5) revegetation of the site with wetland plants through both hydroseeding and plantings.

The full estuarine scenario creates a system of six habitat types, not including the main Devereux Creek channel. This alternative extends the conditions of the lower Slough through most of the golf course site. Estuarine aquatic bed, estuarine emergent persistent and transition habitat dominate the mosaic. Palustrine scrub shrub and palustrine forest habitats serve as buffers on the eastern, western and northern boundaries of the site. Elevations range from 0-6 feet MSL for the estuarine species, including the aquatic bed habitat, and from 6-16 feet MSL for the buffer zones.

4.5.2 Details of Alternative

4.5.2.1 Habitat Types

<u>4.5.2.1.1 Acreage</u>

The full estuarine alternative extends current estuarine conditions of the lower Slough through the golf course site. The set of habitats will include:

1) estuarine aquatic bed;
2) estuarine emergent persistent habitat;
3) estuarine emergent non-persistent habitat;
4) transition habitat;

5) palustrine scrub shrub;
6) palustrine forested.

Table 4-29 lists the cover of each habitat type.

Table 4-27: Habitat Coverage For Full Estuarine Scenario				
Full Estuarine Alternative	**m^2**	**$feet^2$**	**Acres**	**% Cover***
Total Wetlands	282,000	3,049,000	70	100
Estuarine aquatic bed	42,000	465,000	11	15
Total Estuarine emergent wetlands	90,000	967,000	22	32
Persistent	82,000	899,000	21	29
Nonpersistent	6,000	68,000	2	2
Transition	53,000	581,000	13	19
Palustrine forested wetlands	23,000	256,000	6	8
Palustrine scrub shrub wetlands	35,000	384,000	9	12

Of the 70-acre site, estuarine aquatic bed accounts for approximately 15% of the total cover, estuarine wetlands account for approximately 31% of the total cover and buffer zones account for approximately 21% of the total cover.

4.5.2.1.2 Distributions

Figure 4-10 illustrates the distribution of habitats for the full estuarine scenario. Habitats were designed based on historic coverage and current topography and hydrology. Additional details can be found in the Methods section. Figures 4-1, 4-11, and 4-13 detail current elevation at the site, elevations for restoration activities, and changes in elevation from pre- to post-restoration.

Figure 4-10

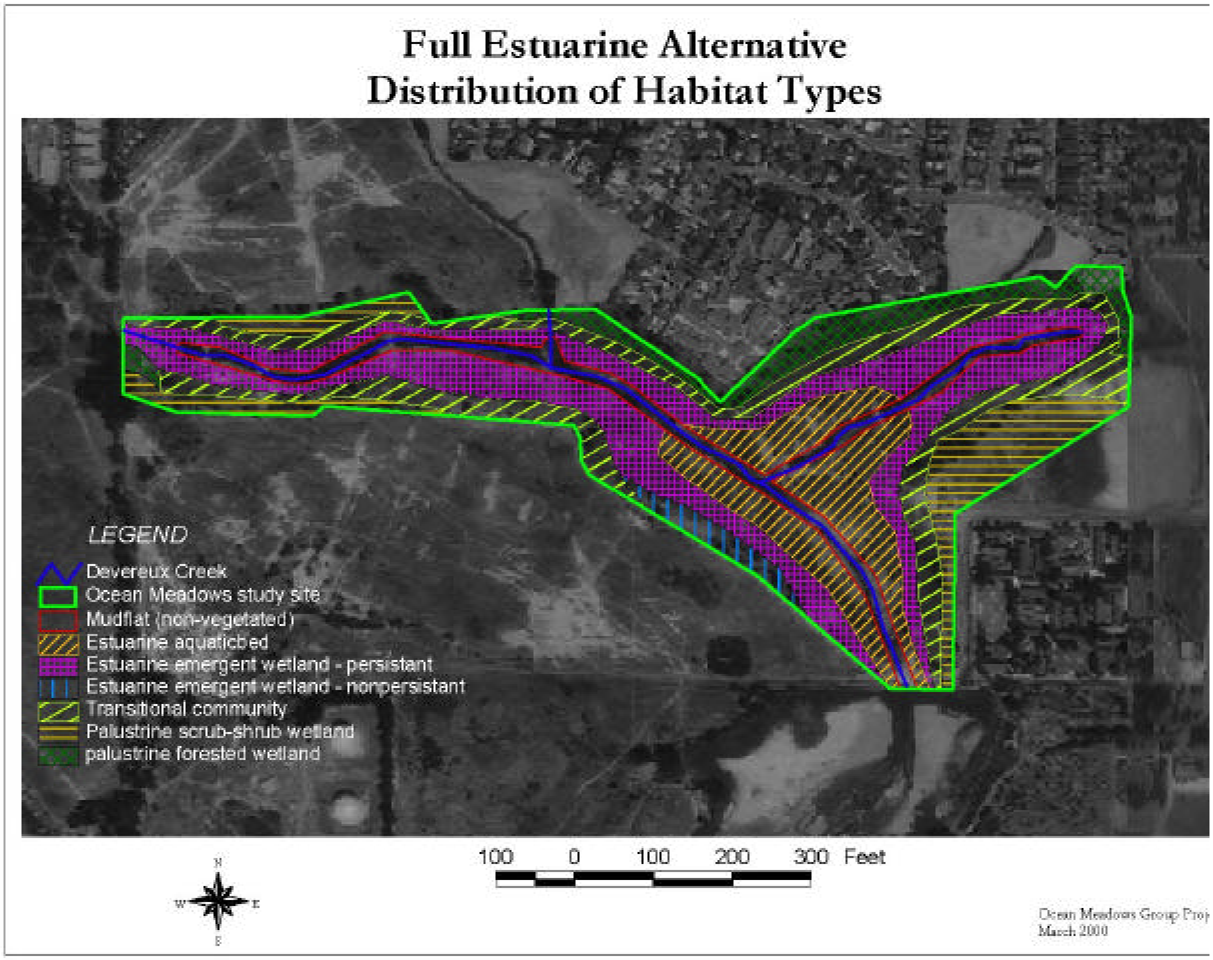
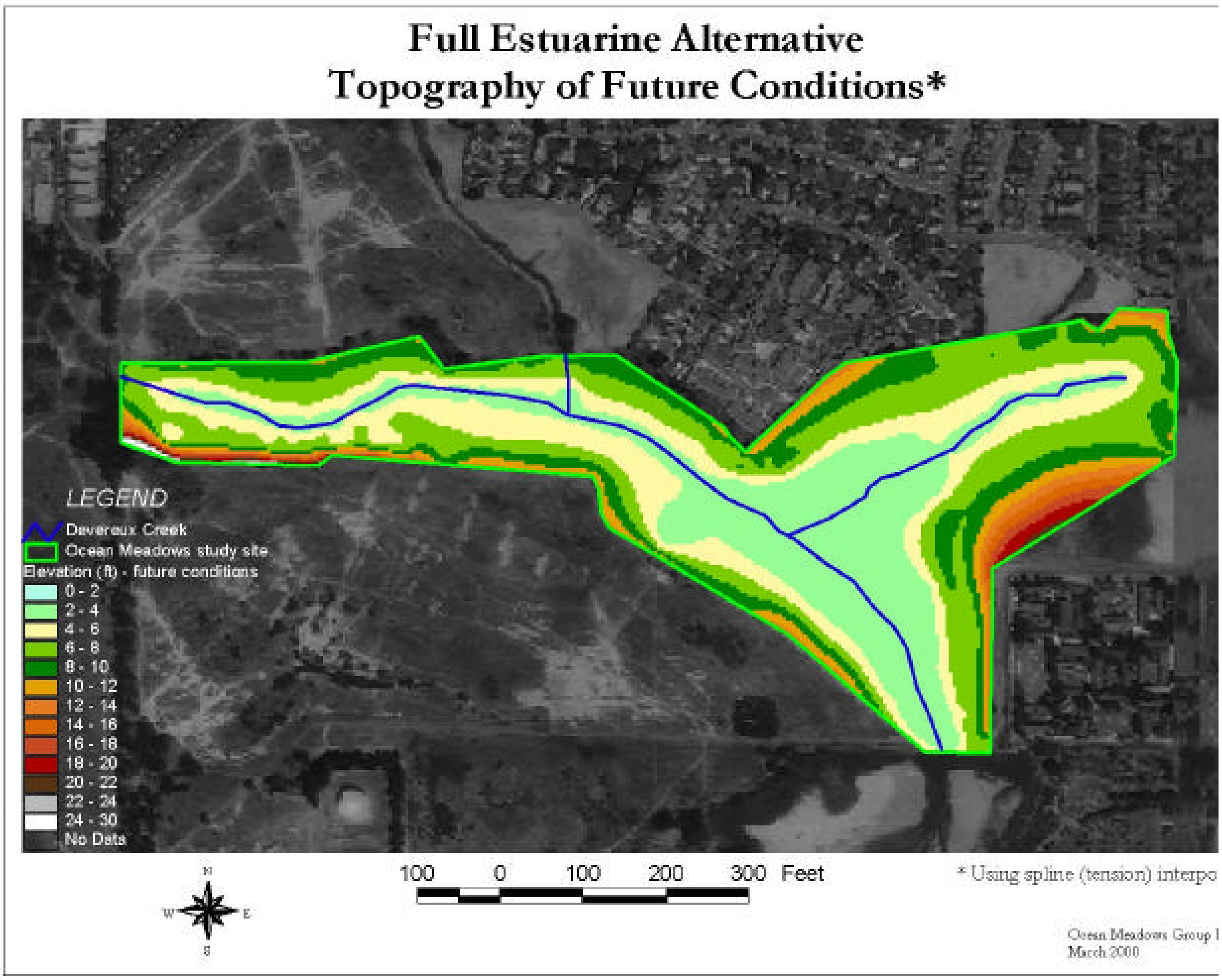

Full Estuarine Alternative
Distribution of Habitat Types
LEGEND
Devereux Creek
Ocean Meadows study site
Mudflat (non-vegetated)
Estuarine aquaticbed
Estuarine emergent wetland - persistant
Estuarine emergent wetland - nonpersistant
Transitional community
Palustrine scrub-shrub wetland
palustrine forested wetland
100 0 100 200 300 Feet
N
W
E
S
Ocean Meadows Group Proj
March 2000

Figure 4-11



Full Estuarine Alternative
Topography of Future Conditions*
LEGEND
Devereux Creek
Ocean Meadows study site
Elevation (ft) - future conditions
0 - 2
2 - 4
4 - 6
6 - 8
8 - 10
10 - 12
12 - 14
14 - 16
16 - 18
18 - 20
20 - 22
22 - 24
24 - 30
No Data
100 0 100 200 300 Feet
N
W
E
S
* Using spline (tension) interpo
Ocean Meadows Group I
March 2000

<u>4.5.2.1.3 Description</u>

Like the partial estuarine alternative, the full estuarine plan extends the habitats of the lower Slough up through the golf course site. As in the prior alternative, the estuarine aquatic bed habitat will be extended up the sides of the Devereux Creek channel. However in this alternative, it will also extend part way up both Devereux creek and the eastern drainage. Estuarine emergent persistent habitat will surround the aquatic bed and will also extend to the upper reaches of the two creeks, above 2 feet MSL. Transitional communities will extend outward from the estuarine emergent persistent habitat. Elevations follow natural patterns: lower in the southern portions of the site and near the channels, gradually increasing toward the edges of the site.

4.5.2.2 Ecosystem Indicators - Hydrology

The tidal blockage culvert at the southern end of the golf course will be removed under this alternative. Extensive dredging will remove most or all of the fill imported to create the golf course in 1967, adding a substantial amount of estuarine habitat to the lower slough and appreciably increasing its volume. At +8 feet MSL breaching level the site under this alternative will impound 156-acre feet of water. Currently at +7 feet MSL the lower slough holds 171-acre feet of water. This alternative may decrease berm breaching frequency, as more runoff will need to accumulate in order to reach the 8-foot MSL berm breaching height. A decrease in breaching frequency may compensate somewhat for higher discharge volumes and increased breaching frequency caused by increased levels of urbanization in the watershed (Davis et al., 1990).

Under the estuarine alternative, sediments may move directly into the larger slough system, and may deposit at the upper end. This process is dependent on the variable balance between sediment input, flood scouring, and tidal scouring. The majority of sediment carried by creeks in the watershed is a result of erosion during large storm events. During these high flood periods, sediment-rich runoff will move through the site and dump most of the sediment directly into the ocean. Therefore, the site under the full estuarine alternative should not accumulate a substantial amount of sediment.

Similarly, pollutants from the watershed will move directly into the larger estuarine system, with no palustrine component to filter and degrade pollutants. This larger estuarine system will have the potential to filter and degrade pollutants prior to export into the ocean (Zedler, 1996b).

4.5.2.3 Ecosystem Indicators - Ecology

4.5.2.3.1 Habitat for species of special concern

This plan includes creation and enhancement of estuarine habitats and palustrine scrub shrub habitats. Therefore, species of special concern that associate with these habitats will benefit from this scenario. Tables 4-30 and 4-31 list these species.

Table 4-28: Plant Species of Special Concern That May Benefit From Creation or Expansion of Wetland Habitat Types Included in the Full Estuarine Alternative

Species Name	Common Name
Ruppia maritima	Ditchgrass
Salicornia virginica	Pickleweed
Distichilis spicata	Coastal Saltgrass
Stephanomeria elata	
Lasthenia glabrata ssp. coulter	Coutler ș Goldfields

Hordeum depressum	Alkali Barley
Arthrocnemum subterminale	Parish Glasswort
Isocoma menziesii var vernonioides	Coast Goldenbrush

Table 4-29: Animal Species of Special Concern That May Benefit From Creation or Expansion of Wetland Habitat Types Included in the Full Estuarine Alternative *Page 1 of 2*			
Scientific name	**Common Name**	**Status**	**Associated habitat type(s)**
Panoquina errans	Salt Marsh Wandering Skipper	Species of Federal and Local Concern	Estuarine emergent wetland (persistent); Transitional (estuarine/ palustrine hybrid)
Cincindela hirticollis gravida	Sandy Beach Tiger Beetle	Species of Federal Concern	Estuarine emergent wetland (nonpersistent); Transitional (estuarine/ palustrine hybrid)
Brephidium exillis	Pygmy Blue Butterfly	Species of Local Concern	Estuarine emergent wetland (nonpersistent)
Asio Flammeus	Short Eared Owl	Species of Federal, State, and Local Concern	Palustrine scrub shrub wetland; Palustrine forested wetland
Botaurus lengtginosus	American Bittern	Species of Federal, State, and Local Concern	Estuarine emergent wetland (persistent); Transitional (estuarine/ palustrine hybrid)
Circus cyaneus	Northern Harrier	Species of Federal, State, and Local Concern	Palustrine scrub shrub wetland
Athene cunicularia hypugea	Western Burrowing Owl	Species of Federal, State, and Local Concern	Palustrine scrub shrub wetland
Elanus	White- tailed	Species of	Estuarine emergent

caeruleus	kite	Federal, State, and Local Concern (Protected in Santa Barbara County)	wetland (persistent); Palustrine forested wetland
Ixobrychus exilis	Least Bittern	Species of Federal and State Concern	Estuarine emergent wetlands (persistent)
Accipiter cooperi	Cooper’s Hawk	Species of Federal and State Concern	Palustrine forested wetland; Palustrine scrub shrub wetland
Empidonax traillii brewsteri	Little (Brewster’s) willow flycatcher	Species of Federal and State Concern	Palustrine forested wetland; Palustrine scrub shrub wetland

Table 4-29: Animal Species of Special Concern that may benefit from creation or expansion of wetland habitat types included in the Full Estuarine Alternative *Page 2 of 2*

Scientific name	Common Name	Status	Associated habitat type(s)
Falco peregrinus anatum	Peregrine Falcon	Species of Federal and State Concern	Palustrine forested wetland
Pandion haliaetus	Osprey	Species of Federal and State Concern	Estuarine emergent wetland
Accipiter striatus	Sharp-shinned hawk	Species of Federal and State Concern	Palustrine forested wetland
Numenius	Long- billed	Species of	Estuarine emergent wetland

americanus	curlew	Federal and State Concern	(persistent and nonpersistent)
Lanius ludovicianus	Loggerhead shrike	Species of Federal and State Concern	Palustrine scrub shrub wetland; Palustrine forested wetland
Icteria virens	Yellow-breasted Chat	Species of State and Local Concern	Palustrine forested wetland; Palustrine scrub shrub wetland (willows)
Dendroica petechia	Yellow warbler	Species of State and Local concern	Palustrine forested wetland; Palustrine scrub shrub wetland
Passerculus sandwichensis beldingi	Belding's Savannah Sparrow	Species of State Concern	Estuarine emergent wetland (persistent); Transitional (estuarine/ palustrine hybrid)
Laterallus jamaicensis coturniculus	California black rail	Species of State Concern	Estuarine emergent wetland (persistent); Transitional (estuarine/ palustrine hybrid)
Progne subis	Purple martin	Species of State Concern	Palustrine forested wetland
Eremophila alpestris actia	Coast horned lark	Species of Local Concern	Palustrine scrub shrub wetland
Rallus limacola	Virginia Rail	Species of Local Concern	Estuarine emergent wetland (persistent)
Lepus californicus benettii	San Diego black- tailed jackrabbit	Species of Federal and State Concern	Palustrine scrub shrub wetland

4.5.2.3.2 Area of native habitat types associated with the Historic Reference Condition

The increase in transitional and scrub-shrub habitat is especially important. First, it serves as a refuge for animals during high water events. Zedler (1996b) notes that Belding's savannah sparrow requires such refuge. Second, such habitat links the upper and lower reaches of the marsh by supporting pollinators and other insects that increase functionality of the marsh. These include members of Coleoptera, Diptera, Hymenoptera, and Lepidoptera (PERL, 1990).

A comparison of the area of vegetated wetlands resulting from this alternative and the current wetland acreage of the Devereux Slough as mapped by Ferren et al. (1987) appears in Table 4-32. Acreage and percent cover of the total lower Slough area is provided for each wetland type to be created, except for palustrine emergent nonpersistent, in the table below.

Table 4-30: Areas of native habitat associated with the Historic Reference Condition created under the Full Estuarine Alternative					
	Lower Devereux Slough system (Ferren et al., 1987)		Proposed Wetland Creation at Upper slough	Total wetlands, Devereux Slough (upper and lower)	
Wetland Type	Area (acres)	% Cover of lower slough	Area (acres)	Area (acres)	% Cover of upper and lower slough area
Total wetlands	70	nearly 100	70	140	100
Total palustrine wetlands	12	17	15	27	19
Palustrine forested wetlands	7	11	6	13	9
Palustrine scrub-shrub wetlands	less than 1	less than 1	8	9	7
Total estuarine wetlands	42	60	33	75	53
Estuarine aquatic bed	23	34	11	34	24
Total estuarine emergent wetlands	18	26	22	40	29
Persistent	18	26	21	38	28
Nonpersistent	less than 1	less than 1	2	2	2

4.5.2.4 Costs

A list of construction activities associated with the partial estuarine alternative appears in Table 4-33. Costs associated with the construction activities will be detailed below.

Table 4-31: Actions necessary for creation of full estuarine wetland habitat at the study site
Acquisition of golf course
Removal of golf course greens and fill
Removal of artificial structures such as dirt roads/blockages, which currently bisect the creek in several locations, and associated underground drainage pipes
Removal of 15-25 meter underground drainage pipe at the junction of the west-arm creekway and Devereux Creek
Removal of two bridges used by golfers and maintenance crews
Removal of large native and exotic
Removal and grading of soil materials to achieve desired topography (see Figure 4-13)
Removal of culverts and materials supporting the east-west road that divides the golf course and lower Slough
Revegetation of the site by hydroseeding, planting from containers, and transplantation of cuttings

4.5.2.4.1 Land Acquisition

Since the current owner has expressed his desires to maintain the site as a golf course, the study site will have to be purchased prior to beginning any of the restoration alternatives. At present, we estimate the value of the study site to be less than $10 million.

4.5.2.4.2 Excavation and Removal of Fill

We estimate that the cost of excavating and relocating 1,460,000 yds^3 of soil, at a unit cost of between $5 and $15, to be between $7.3 million and $21.9 million.

Figure 4-12

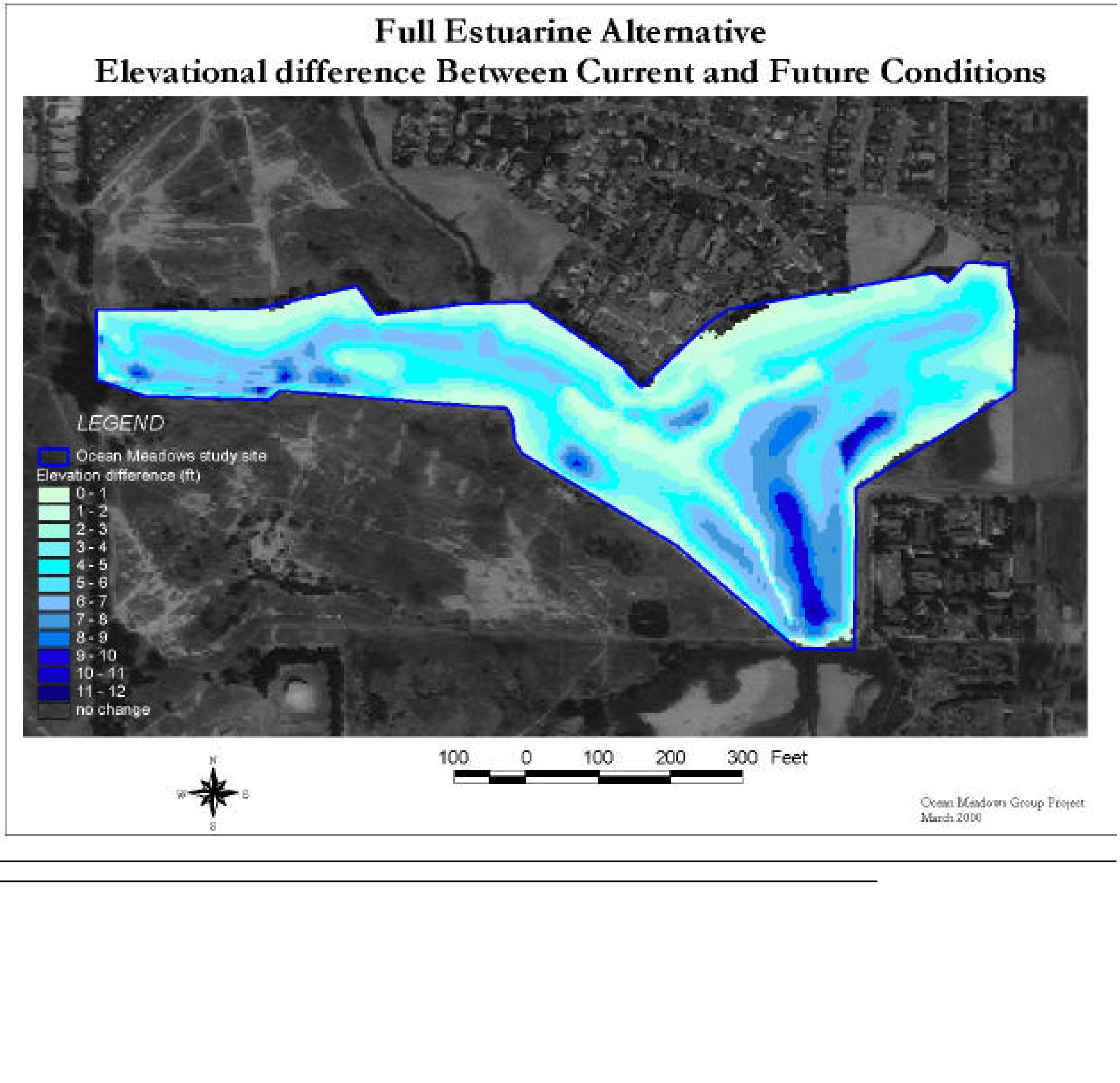

Full Estuarine Alternative
Elevational difference Between Current and Future Conditions
LEGEND
Ocean Meadows study site
Elevation difference (ft)
0 - 1
1 - 2
2 - 3
3 - 4
4 - 5
5 - 6
6 - 7
7 - 8
8 - 9
9 - 10
10 - 11
11 - 12
no change
100 0 100 200 300 Feet
N
W
E
S
Ocean Meadows Group Project
March 2000

Table 4-32: Volume of Soil to be Moved Under the Full Estuarine Alternative			
Depth (feet)	**Acres**	**volume (yd^3)***	**cost at $15/ yd^3***
0-2	13	61,000	913,000
2 to 4	20	286,000	4,290,000
4 to 6	19	450,000	6,745,000
6 to 8	15	500,000	7,507,000
8 to 10	3	150,000	2,251,000
10 to 12	less than 1	17,000	257,000
Total	**69**	**1,464,000**	**21,963,000**

* rounded to nearest $1,000

4.5.2.4.3 Revegetation

Appendix I describes in detail the methods employed to calculate costs of revegetation.

Hydroseeding

It will cost a total of approximately $127,300 to revegetate the site with seed.

Hand Planting (from containers)

Planting from container is estimated to cost a total of $7- 10/ plant (Hubbard, personal communication). This estimate includes all costs associated with hand planting, including purchasing or growing and labor. For the purposes of comparing between alternatives, an estimate of $7/ plant was used in calculating costs.

It would cost approximately $4,100,000 to plant about 593,000 plants included in the Full Estuarine Alternative (See Table 4-35 below).

Table 4-33: Containerized Planting Requirements Under the Full Estuarine Alternative					
Habitat type	**Acres**	**Feet²**	**Spacing**	**Estimated No. of Plants**	**Species Planted from Containers**
Estuarine aquatic bed	11	465,000	-	0	0
Estuarine emergent wetland (persistent)	21	899,000	3'	300,000	3
Estuarine emergent wetland (nonpersistent)	2	68,000	3'	23,000	4
Transitional Community	13	581,000	3'	194,000	9
Palustrine forested wetland	6	256,000	20'	13,000	9
Palustrine scrub shrub wetland	9	383,000	6'	64,000	8
TOTAL plants: Full estuarine alternative*				**593,000**	
Cost for planting from containers (@ $7/plant)*				**$4,148,000**	

* rounded to nearest $1,000

4.5.2.4.4 Bridge Construction

In order to increase the flow of water between the current Devereux Slough and the enhancement area, the culvert that currently exists there must be removed and replaced with a structure that allows for a greater exchange of materials between the two locations. This increase water flow will return tidally influenced water flows to the site, which are required to obtain the estuarine habitat types detailed above (Table 4-27). Furthermore, it is recommended that the structure not be "hard bottom" as to allow for the greater movement of organisms across the structure. We expect that removal of the current structure and construction of a bridge with dimension of 60 feet. by 16 feet. to be approximately $150,000 to $350,000.

4.5.2.4 Summary of Costs

Table 4-34: Summary of Costs for Full Estuarine Alternative				
Item	**Unit**	**Cost per Unit**	**# of Units**	**Total Cost**
Revegetation (hand planting)	plants	$7	593,000	$4,148,000
Revegetation (hydroseeding)*	-	-	-	$127,000
Culvert removal and Bridge cons.	1 bridge	$350,000	1	$350,000
Excavation and removal of fill	cubic yard	$15	1,464,000	$21,960,000
Total Cost				$26,585,000
Approximate Cost				$26,600,000

* See Appendix I for details of cost calculations based on species and habitat areas

5.0 Summary of Alternatives

5.1 Introduction

The goal of this analysis is to compare our four management enhancement alternatives based on a set of indicators. First the *matrix indicators* are presented in tabular form, which are a set of quantitative measures of key biologic, hydrologic, and economic components of the alternatives. These indicators have inherent errors associated with them (see section 3.0), but these are equally propagated throughout the alternatives, making the *relative* differences accurate. In addition, the pros and cons of implementation of each alternative are discussed.

5.2 Comparison of Alternatives

Table 5-1: Success Indicators and the associated values for each alternative.

	No Action	*Green Golf Course*	*Palustrine*	*Partial Estuarine*	*Full Estuarine*
Acreage in wetland habitat	0.25	2	70	70	70
Number of habitat types	1	2	4	8	6
# of native plant species	23	41	59	76	54
# of plant species of special concern	2	3	5	11	8
# of animal species of special concern*	5	24	27	30	27
Water holding capacity (acre feet)	0.47	4	56	90	156
# of users per year**	100,000	100,000	2,000	2,000	2,000
Cost (thousands of dollars)***	0	1,100	12,100	18,500	26,600
Cost per acre of restored area (thousands of dollars)	0	500	170	260	380

* The maximum number of species that could potentially colonize or utilize these habitat types

** Esimate (Herrera, 1999; NCAG, 1999; Ferren, 1997)

*** Upper cost range for each alternative, for comparative purposes

5.2.1 Description of Success Indicators

1) **Wetland Acreage**. This number represents the amount of acreage dedicated to wetland habitat types for each alternative. Only acreage of habitat types that are included in Cowardin et al.'s (1979) classification of Southern California Wetlands contribute to this number. It includes acreage of both palustrine and estuarine habitats, but does not include golf course greens or fairways.
2) **Number of Habitat Types**. This number represents the diversity of habitat types described in each alternative. Again, this includes all habitats described in Ferren's classification, but not golf course greens or fairways.
3) **Number of Native Plant Species**. This number represents the number of plant species identified as likely inhabitants of the site under alternate management strategies. The species lists that give rise to this number are not meant to be exhaustive, rather they are a representation of dominant vegetation associations that are planed for the site. This number is presented in the matrix for as a proxy for overall species diversity. Appendix I specifically outlines which native plants are expected to establish independently (without needing to be plants), will require hydroseeding, or must be hand planting. The cost associated with each technique is outlined in Appendix E.
4) **Number of Species of Special Concern**. This number represents the number of species likely to inhabit the site that are legally protected, or recognized to be locally rare, for each alternative.
5) **Water Holding Capacity**. This number is the quantity of acre-feet of water that the site can retain under each management plan, as calculated from the GIS representations of the site.

6) **Number of Users Per Year**. This number represents the number of people likely to visit the site, including golfers, wildlife watchers, school groups, researchers and general recreationists for each alternative. For the No Action and the Green Golf Course alternatives, we estimated current visitation to the site, and assumed that that number will not change. However, given the potential increases in housing immediately surrounding the golf course, visitation to the course may increase. Demand for golfing may also increase with the increase in local residents. For estimates of visitation for other uses we drew estimates from the Coal Oil Point Management Plan and the Carpenteria Salt Marsh Preserve Plan.
7) **Cost**. This number represents the capital cost of altering the site to resemble the initial conditions of each alternative *using the upper bound cost estimates*. It includes soil removal, road and bridge construction and placement of native vegetation. It does not include the cost of acquiring the site. These numbers are highly uncertain and are presented for relative comparison. Further details are provided in Appendix D.

5.3 Within-Alternative Analysis

5.3.1 Green Golf Course

The proximity of the Ocean Meadows Golf Course to the Coal Oil Point Reserve provides an opportunity for a private business and local environmental constituents to work together on a land use planning effort. The proposed green golf course alternative would enhance the ecosystem health of the site relative to the current conditions, while improving the aesthetic and functional value of the golf course. Expansion of the riparian corridor may be the most effective *per area* restoration option because of the large positive effect it would have on avian and vertebrate species (Holmgren, personal communication) and the low cost relative to the other enhancement alternatives. In return, the golf course as a buisness would benefit from improved water flow capacity and from increased sediment trapping in the newly created catch basin freshwater ponds. These alterations would help the golf course alleviate flooding problems associated with winter storms.

From an ecological standpoint, however, the green golf course has fewer benefits than the three restoration alternatives. The extent and quality of the created habitat, and the ecosystem functions those habitat types perform relative to the current condition, will be significantly less in the green golf course alternative. Additionally, the catch basins and widened riparian corridor will alleviate some flooding problems, but will by no means eradicate them, particularly during large winter storms.

For the green golf course alternative the wetland acreage increases by 2 acres, a large increase over the current acreage of 0.25 acres. The number of native plant species present almost doubles while the number of plant species of special concern may only increase by one species, from 2 to 3. The calculated water holding capacity increases by 700% to a volume of 4 acre feet. The gross number of users to the site is not expected to significantly change from the current conditions. However the golf course predicts that increased wildlife abundance may attract more customers (Cappon, 1999). The overall cost is the least expensive of all the restoration options at approximately 1 million dollars; however the cost per acre of restored areas is relatively high at 500,000 per acre.

While enhancement activities according to this alternative do not approach the extent of restoration possible at the site, it allows the golf course to continue to provide recreational benefits to the public and economic profit for the owners. For a small cost and minimal effort, large gains may be made for some species in the area as well as improving some of the hydrological conditions on the site.

5.3.2 Palustrine Wetlands

Historically the Ocean Meadows Golf Course site was part of a larger estuarine system that extended farther into the watershed. While increasing palustrine wetlands is not restoration, this would many conditions and functions associated with the historic reference condition.

Large amounts of the watershed have been developed with a subsequent alteration of hydrology, sedimentation, and water quality. Areas that were historically part of the Devereux Slough estuary have been converted into housing, roads, and the Ocean Meadows Golf Course. Given the large alterations made to the system, the palustrine alternative is attractive management option. It requires a relatively small amount of soil removal and dredging. The dredging that is involved widens the riparian and associated habitats, and removes and grades some of the site topography.

Palustrine wetland habitats have been significantly degraded and reduced along the South Coast of Southern California and in the Devereux Watershed. This plan would contribute to the creation and conservation of regionally important habitat. Palustrine habitat may also provide a connection between estuarine wetland habitat and upland habitat that has been lost to development, benefiting estuarine species such as the pygmy blue butterfly (Sandoval, personal communication).

This plan would restore the entire site to wetlands, and double the size of the current Devereux Slough system. The four created habitat types may support a toal of 59 native plant species, an increase of 157% over the estimated current number, and a 44% increase over the number that may be supported by the green golf course alternative. The number of plants of special concern may increase from 3 to 5 species, while we predict that the number of animal species of special concern may only increase from 24 to 27 species. The required dredging of the site results in a significantly improved water holding capacity, an expected 13-fold increase over the green golf course. The number of users per year is predicted to drop by approximately 98%, as is true for full and partial estuarine alternatives because of the removal of the golf course. The cost, $12,100,000, is substantially more than the green golf course, although when it is broken down by the cost per acre of habitat created it is the least expensive one out of all the alternatives, roughly $173,000 per acre. Approximately 71% of these costs are from soil removal.

Although this option does not restore the historic site condition, it is an attractive enhancement alternative because it is relatively inexpensive and it creates regionally and locally rare habitats. In addition, the site will perform many functions associated with the historic reference condition, such as improved water holding capacity, and feeding habitat for locally rare butterflies. With a relatively small amount of site alteration, this alternative creates a large amount of diversity in natural species and habitats. The small amount of dredging substantially reduces expenses, so that this plan is roughly half the cost of the next, more extensive, alternative. In addition, it is the least expensive option when the cost is normalized by the acreage of natural habitat created.

5.3.3 Partial Estuarine

This plan is a compromise between the full estuarine and palustrine alternatives. By removing the road/blockage at the lower end of the golf course, along with extensive dredging of the lower site, the lower Devereux Slough will be extended into the golf course site. Transition habitats blend into palustrine habitats at the upper edges of the site. This alternative results in the highest diversity of habitats, and subsequently the highest diversity of species. Given that portions of the original estuarine system are unrecoverable due to residential development, the idea of creating a reduced version of the original historic reference condition is attractive.

Restored wetlands cover the site in eight habitat types, as opposed to four habitat types for the palustrine alternative and the six habitat types of the full estuarine alternative. This plan also has the highest expected number of native plant species and native plant species of special concern, 76 native plants and eleven plant species of concern. The number of animal species of special concern is also expected to be the highest of all the alternatives at 30 species. There is expected to be a 61% increase in the water holding capacity over the palustrine plan, largely due to the extensive low lying areas that will be excavated for the estuarine portion. Currently the lower Slough within Coal Oil Point Reserve holds 171 acre feet of water at seven feet mean sea level elevation. Thus, this alternative greatly expands the estuarine basin. The $18,500,000 estimated cost is nearly double the palustrine alternative but is significantly less than the full estuarine option's cost of $26,600,000. The cost per acre is roughly 53% higher than the palustrine, for the same amount of created wetland habitat.

This plan is more ambitious, and goes farther towards a complete restoration or original estuarine habitats of the site than the palustrine alternative. It is more costly than the palustrine option but may create a higher diversity of habitats and species, creating a reduced version of the larger original estuarine system. Connecting the site with the lower slough greatly increases the size and connectivity of the whole system. This alternative follows Zedler's (1996a) recommendations to expand existing wetlands instead of creating new habitat types.

5.3.4 Full Estuarine

This plan calls for the maximum restoration of historical estuarine conditions to the site, as constrained by recent residential developments. The road between the site and the lower slough would be removed and extensive dredging of most or all of the golf course would lower the elevation of the site to expose groundwater. This would result in the expansion of estuarine habitats over the site, and would extend the current size of the Devereux Slough. The diversity of habitats and species is not expected to be as high as the under the partial estuarine plan, but each habitat type would have a much larger area across the site. The greatest benefit is that it doubles the estuarine system of the Coal Oil Point Reserve.

Six habitat types are represented in this plan, almost twice the number of habitat types created by the palustrine alternative, but two less than the number created by the partial estuarine alternative. The number of plant species is the lowest of the three full site alteration plans, although there areexpected to be 140% more plant species than are currently at the site. The number of both plant and animal species of special concern are lower than the partial estuarine plan. However, this alternative is expected to provide the largest water holding capacity at 156 acre feet, which is 3800% (38 times) more water than the site currently holds and a 73% increase over predicted capacitiy of the palustrine plan. This alternative would almost double the size of the lower slough system. At $26,600,000, this is the most costly plan, primarily because of the large amount of dredging and fill removal requireded for implementation. The cost per acre of restoration is also high, at $380 per acre.

This plan creates the maximum allowable restoration to historic estuarine conditions, creating large expanses of regionally and locally rare habitat. The size and scope of this plan would be extensive, with a proportionally large cost.

6.0 Discussion

6.1 Discussion of Results

The full estuarine alternative represents the best enhancement alternative given our guiding principle, which states the alternatives attempt to enhance or restore conditions or functions associated with the historic reference condition. The full estuarine alternative creates the maximum allowable extent of historic estuarine habitat as constrained by current residential development, and therefore best mimics the historic reference condition. It is the culmination of the restoration gradient associated with the site, but it comes at relatively large price.

The three other enhancement alternatives offer attractive compromises for site managers. The partial estuarine alternative creates a condensed version of all the habitat types associated with the historic reference condition. The palustrine alternative offers a relatively inexpensive way to restore wetlands to the entire site. Alternatively, the green golf course provides an excellent opportunity for the golf course owner and local environmental constituents to work together to create positive benefits for each. Therefore, each of these three alternatives do not fully restore the site to the extent it allows, but they do enhance conditions and functions associated with the historic reference condition at a lower economic cost.

6.3 Regional Context of Restoration

This section examines "regional restoration" as it relates to the enhancement of the Ocean Meadows Golf Course site. Key regional context questions are discussed. Additionally, a specific analysis of the problems associated with applying regional planning to the Ocean Meadows Golf Course site is given.

Zedler (1996a) notes that restoration and/or mitigation plans have been proposed for about half of Southern California's 29 coastal wetland systems. With so many projects planned, Zedler (1996a) argues that final design and implementation should be coordinated so that the resulting landscape contains an optimal mix of habitat types. Such an approach would maintain or increase species diversity (SCWRP, 1999) and would likely result in large habitat areas. Zedler (1996a) suggests that such larger systems support greater biodiversity. Moreover, regional restoration planning would provide opportunities to link adjacent habitats.

Connectivity of the habitat to be created must also be considered. Zedler (1996a) and Mazzotti and Morgenstern (1997) argue for the need to include upland habitat in any restoration plan. Upland habitats often support species that add to wetland ecosystem function but forage elsewhere, such as pollinators. Devereux Slough lacks upland habitat, hence it is not surprising to find that the system lacks pollinators (Cristina Sandoval, Coal Oil Point Reserve, *personal communication*). Therefore in addition to regional links between systems, there must be links between habitats within created systems as well.

In order to assess regional restoration compatibility for the enhancement of the Ocean Meadows Golf Course site, we will individually examine each habitat type associated with the enhancement alternatives, beginning with the estuarine alternatives. Several habitat types are common to both the palustrine and estuarine components, including palustrine forested wetland and palustrine scrub shrub. Since these habitat types will be created for each restoration alternative, their regional representation will not be discussed.

Salicornia virginica (pickleweed) dominates both Goleta Slough and Carpinteria Salt Marsh. Therefore, creation of a pickleweed-dominated habitat at Devereux (as proposed under the estuarine emergent wetland, persistent portion of the estuarine option) would provide for connectivity of the regional landscape but would not increase regional habitat diversity. However, the estuarine enhancement option at Devereux also calls for the expansion of estuarine aquatic bed (rooted vascular) habitat, dominated by *Ruppia maritima* (ditchgrass). Devereux Slough hosts the largest population of *Ruppia* known in southern California (Ferren et al., 1987). It is poorly represented at Goleta Slough, occurring only in seasonally flooded, dike marsh (City of Santa Barbara, 1997) and is not known to occur at Carpinteria Salt Marsh. Thus, extension of this habitat would increase regional habitat diversity. Finally, estuarine emergent wetland, non-persistent, occurs at Carpinteria Salt Marsh (Ferren et al., 1996).

Regional representation of palustrine habitat is much more rare. There is some palustrine habitat at Lake Los Carneros, in Goleta (Santa Barbara County Board of Supervisors, 1986), although it remains largely unquantified. While palustrine emergent non-persistent habitat exists at both Carpinteria Salt Marsh (Ferren et al., 1997) and Goleta Slough (City of Santa Barbara, 1997; Ferren et al., 1996), the Goleta Slough Management Plan calls for most of it to be removed. There is additional representation of this habitat at Mugu Lagoon in Ventura County and San Dieguito Lagoon in San Diego County (Ferren et al., 1996). Palustrine emergent persistent wetland is located regionally only at Vandenburg Air Force base. Hence, this habitat type has been identified as regionally rare (Wayne Ferren, UCSB Museum of Systematics and Ecology, *personal communication*). Thus, creation of a freshwater marsh would increase regional habitat diversity but would not increase connectivity of surrounding landscapes.

Favoring a particular enhancement option based on regional representation in the case of Devereux Slough appears to be inconclusive. In the end, it is a value judgment, based on whether regional restoration planning means improving connectivity with surrounding habitats or increasing the diversity of habitat representation. Zedler (1996a) uses both as regional criteria, but does not weigh one more heavily than the other. For example, as we have seen, palustrine persistent emergent wetlands are regionally rare, thus creation of this habitat type would improve regional diversity. But at the same time, this type of habitat would not improve regional connectivity.

In summary, regional restoration planning seeks to "describe an optimum mix of habitat types and sites to maintain species diversity in Southern California's coastal wetlands" (SCWRP, 1999). Thus, it provides resource managers with a goal. However, the current literature on regional planning does not prescribe a guide for that optimum mix. Hence, choosing habitat types to fit into a regional picture is largely a value judgment.

6.2 Recommendations for future research

The limited amount of biological data associated with the Devereux Slough system has made success rates difficult to quantify. This problem has been exacerbated by the scarcity of studies analyzing the success of restoration projects over time, or comparing the relative success of different restoration techniques.

There is a lack of data available on many critical ecosystem components that are necessary for a robust and systematic analysis and comparison. For example, it was impossible to determine the likelihood that an animal species of special concern would occupy a new habitat type because data for minimum patch size requirements were not available. In addition, it was not possible to predict whether a plant species of special concern would be able to successfully establish in a new habitat zone because soil assays are not available, and the physiological requirements of most of the plants are generally unknown. Therefore, habitat designs were primarily examination of similar restoration efforts and discussion with local experts; which made quantification of success difficult. As a result of this problem, a set of recommendations for future research will be given to help guide restoration research.

In order to help improve future restoration planning projects, we will recommend areas of future research that may facilitate the quantification of results and the predictability of success. The data that would be most useful for restoration planning are:

- ***Species dispersal rates*** – dispersal data would provide a means by which the likelihood of colonization could be quantified; and would give a measure of how connected the site is, for a given species, to other sites in the region.
- ***Minimum area requirements for species of special concern*** – these would allow predictions of how large a population the restored habitat could support.
- ***Demographic data, particularly for species of special concern*** – these would provide a better gauge of success for survival rates.
- ***Physiological constraints, particularly for species of special concern*** – these would allow some sites to be eliminated as implausible for certain important species.
- ***Water and soil chemical and nutrient assays*** – these may allow predictions of what species would be most likely to occupy a habitat type.
- ***Success rates for plantings*** – this information concerning the success rates of hydroseeding and hand planting native wetlands species would help make cost estimates more accurate.
- ***Review and comparison studies*** - studies that review the success of restoration techniques, and which compare the successes of different restoration projects are needed.
- ***Regional studies of the economic and social value of wetlands*** – although extremely difficult to quantify, these data could be used to justify or discourage the implementation of a costly enhancment project.

7.0 Summary

This project sought to design a suite of management alternatives for the restoration and enhancement of the Ocean Meadows Golf Course site, given the political climate outlined earlier in the report. The alternatives spanned the spectrum of reasonable restoration alternatives; ranging from a green golf course alternative, which widens the riparian corridor within the golf course, to the full estuarine alternative, which restores the maximum possible extent of historical estuarine habitat to the site. Creating a range of restoration alternatives provides a relevant management tool for any potential stakeholders with an interest in enhancing the site. Therefore, even though future management goals will vary between stakeholders, this document provides a template for restoration that will meet their needs and constraints.

Of the selected alternatives, three require the site to be purchased and altered significantly for restoration, while one allows for the continuation of the golf course as a private business. The alternatives were compared to a baseline, "no action" alternative that outlined conditions associated with the current management. The selection process for the alternatives was rigorous. It involved synthesizing current wetland research, relevant case studies, local expert opinion, stakeholder interests, economic constraints, hydrological constraints, and social constraints.

Once the alternatives were selected, a habitat mosaic was created for each alternative, based on our guiding principle, which states that the alternatives sought to rehabilitate or enhance functions or conditions associated with the historic reference condition. The reference condition was defined as the historic state of the Slough as of the end of the nineteenth century (Section 1.6), which marks the earliest known reliable records for the site. Habitat mosaic maps were designed for each alternative given a suite of biological, hydrological and economical parameters associated with its goal. The maps were created using an Arc/INFO Geographic Information System (GIS), which was based on an extrapolated local Digital Elevation Model (DEM). Linked to each habitat type was a list of plant and animal species that were known to occupy similar habitats with the region. Additional lists of plant and animal species of special concern were tabulated to provide a reference for the all key listed species that could accompany future restoration projects. The conceptual plan, or *vision model*, of the habitat mosaic maps of the alternatives are one of the primary products of this report. They provide a conceptual foundation for future planning decisions and designs.

The relative costs of each alternative were estimated using a range of techniques. Cost estimates for construction activities such as soil removal per cubic yard, disposal of removed soil, bridge construction of various sizes, hydro-seeding, hand planting, and other tasks were formulated by: interviewing local experts, comparing similar restoration construction costs, and from civil engineering texts. Errors inherent in the cost values are assumed to vary equally across the plans. Therefore the relative costs of the alternatives can be compared, even if the absolute cost values may be inaccurate. Despite errors, the given cost values are expected to be within an order of magnitude of the real cost.

The enhancement alternatives were analyzed based on a selected set of biological, hydrological, and economical indicators. The pros and cons of each alternative were first compared individually, and then the alternatives were graphical contrasted against each other using the indicators. Errors associated with the indicator values were acknowledged, and were a result of the limited quantitative data available for the site. Because of this scarcity of quantitative data for key restoration parameters, a list of recommendations for future research was compiled to help facilitate future restoration planning projects.

The analysis illustrates that enhancing the site to mimic the historic reference condition cost an increasingly large amount of money, as alternatives became more similar the historic conditions. The full estuarine alternative most closely mimics the historic reference condition, but it also is the most expensive because of the extensive dredging required. However the other alternatives offer attractive management options, given different restoration goals and socio-economic constraints. They provide many conditions and functions associated with the reference condidtion at a lower cost.

This project successfully accomplished its primary goal of creating a range of enhancement alternatives that would guide future restoration and enhancement projects at the Ocean Meadows Golf Course site. The spectrum of alternatives covers the reasonable range of likely outcomes, so that this document will be a valuable restoration tool regardless of which stakeholder manages the site.

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Appendix A: History of Land use of the Site

This section describes the land-use history of the Devereux Slough and its immediate vicinity.

Prehistoric Period

Humans have lived in the Devereux watershed for approximately 10,000 years (Ferren et al., 1987). Prior to the founding of the Santa Barbara Presidio in 1782 the Chumash people occupied the region in large, relatively dense settlements fronting the coast; with Goleta Slough hosting one of the densest populations of California Native Americans, as noted by western explorers (Ferren and Thomas, 1995). Not being agriculturists, the Chumash depended primarily on hunting marine animals and gathering acorns.

18th Century

Chumash populations declined substantially after the founding of the Santa Barbara Mission in 1786. In the late 18th century, the Goleta Valley became part of the Los Dos Pueblos royal rancho, which was managed by the Mission. Spanish settlers modified the area by introducing non-native plants, diverting and impounding creeks, altering fire regimes and clearing vegetation (Ferren et al., 1987).

19th Century

In the early 1800s the newly formed Republic of Mexico encouraged colonization of the region by granting large tracts of land to ranchers. In the 1842 the republic granted U.S. citizen Nicholas Den a tract of land he named the Rancho Dos Los Pueblos, which included much of present-day Goleta west of Fairview Avenue, including Devereux Slough. Although the land was not well suited to agriculture, in years of adequate rainfall Den grew crops of hay and lima beans (Thomkins, 1966). Farming and cattle grazing activities at the rancho most likely increased erosion and stream sedimentation, and altered the plant species composition of the coastal grasslands (Ferren et al., 1987)

A map of the Rancho Dos Los Pueblos in 1861 is the first known representation of Devereux Slough (Figure A-1). On the map the Slough is labeled 'salt lake' and has a narrow mouth, which suggests the Slough mouth was not consistently open to the ocean and may often have been hypersaline and/or ringed with a saline evaporate (Ferren and Thomas, 1995).

During the winter of 1861/62 a catastrophic storm altered the distribution of wetland habitats in the region (Speth et al., 1970). Residents reported the storm filled in the formerly navigable Goleta Slough, and converted it from a deepwater bay to a salt flat estuary by depositing sediments 10 to 14 feet deep (Thompkins, 1966). There is no direct information about the storm's effect on Devereux Slough. Since it drains a much smaller watershed, it may not have received as much sediment as the Goleta Slough system (LSA, 1985). Drawings from the years 1861 and 1873, which show little difference in the size of the slough between years, support this hypothesis. However, given seasonal and annual variability of precipitation common to the watershed, these maps may not show even moderate sedimentation of Devereux Slough as a result of the storm. Sedimentation of the upper Slough, which first appears in air photos of the 1920's, may have begun with this catastrophic storm.

In 1850 California became the 31st state of the United States. Eastern Americans, some of them disillusioned gold rush immigrants, began colonizing the Goleta region in larger numbers. To facilitate settlement by U.S. citizens, the Coastal Survey mapped the Goleta shoreline in 1871/73, providing the first habitat map of the Devereux Slough (Figure A-2). This map depicts the lower slough as a large lagoon, running north from the coast with no outlet to the ocean, as evidenced by the coastal dunes that separate the slough from the sea. In addition, the map shows the flooded upper slough running east-west along the More Ranch fault, and the Devereux watershed being dominated by coastal grasslands.

In 1879 Goleta beach became the site of a whale oil refinery camp. The 100-gallon whale rendering kettles on the beach required large quantities of wood for fuel, for which woodchoppers cleared extensive coast live oak (*Quercus agrafolia)* woodlands from the coastal mesas. Coal Oil Point, formerly named Oak Point, was covered at one time with dense live oak forests and may have been cleared of trees during this period. By the time the whale oil refineries at Goleta Beach closed in the 1890's, Coal Oil Point was bare of trees (Thompkins, 1966)

In 1895 the town of Goleta included the Elwood train depot, a post office, an express office and two hundred residents (U.S. Census Map, 1895). Connection to Los Angeles and San Francisco by the Southern Pacific Railroad allowed for the export of larger quantities of perishable produce from the Goleta Valley. Landowners found lemon and avocado trees produced particularly well in Goleta, in addition to walnuts, lima beans, oranges and ornamental plants.

20th Century
A 1903 U.S. Geologic Survey (Figure A-3) depicts the Devereux Slough as roughly the same size and conformation as drawn in the Coastal Survey map of 1871, with the upper and lower Sloughs fully connected. The 1900 map does, however, depict the mouth of the slough as open to the ocean, suggesting that the mouth may have had cycles of breaching and closing.

The land parcels surrounding the slough changed ownership several times in the first two decades of the new century. Alphonse Den, inheritor of the western portion of the Rancho Dos Los Pueblos, sold his property to speculator Joseph Archambault. In about 1919 a British retired Colonel, Colin Campbell, purchased and developed the 500-acre parcel directly east of the Slough, to be known as the Campbell Estate. On the property Campbell built a manor house, a guesthouse, laborer shacks, barns, an auto garage and an airfield. In addition, he planted the estate with exotic crop plants and ornamentals, and built a road that required a dam separating the upper and lower sloughs.

The first aerial photograph of the site, taken in the summer of 1928, shows this road separating the lower slough from the partially drained upper slough (Figure A-4). In the photo the eastern arm of the upper slough is flooded and ringed by vegetation, while the western arm is filled with sediment, perhaps due to land use changes in the watershed. The land directly above the upper slough shows evidence of human activity including developments, roads and habitat fragmentation.

A 1933 Coastal Survey drawing of the site only depicts the lower Slough and the eastern arm of the upper Slough (Figure A-5), and the two are drawn as separate bodies of water. Apparently the western arm was no longer flooded for any substantial amount of time throughout the year, having been completely filled with sedimentation from Devereux creek. The lower Slough is illustrated with a gate at the southern end of the basin and is inscribed "salt pond partially improved Nearly dry at low water if gate opened". The gate was evidently intended to impound water in the lower Slough, making it deeper, more permanent and less saline. The gate did not appear on aerial photographs or on any other drawings of the slough, and may not have existed long. Estuarine vegetation is illustrated around the edges of the Slough.

From 1934 to 1961 naturalist Egmond Z. Rett collected information about bird populations at the Goleta and Devereux Sloughs, although only the earliest notes (1934-1941) survive. The records note species sighted at "Bishop Pond" during that time period, referring to the eastern arm of the upper Slough (Table A-1). Information about the species inhabiting the watershed in the early part of the century may also be teased out of a 1972 interview with naturalist Waldo Abbott. These long-time residents of Goleta noted species found in the area from about 1900 to 1972, focusing on the Goleta Valley in the 1930's and 40's (Table A-2). Many of the species listed in these tables are no longer found in the watershed, or are rare visitors (Holmgren, personal communication).

Table A-1: Birds From Egmont Rett field notes noted at Upper Devereux Slough (Bishop Pond) 1934-1940
Anthony's Green Horn
Avocet
Blact Tern
Black-necked Stitt
Bonaparte's Gull
Caspian Tern
Cinnamon Teal
Coastal Scrub Jay
Coot
Forster's Tern
Great Egret
Hudsonian Cerlew
Lesser Yellowleg
Long-Billed Dowitcher
Marbled Godwit
Northern Phalarope
Peregrine Falcon
Pie-billed Grebe
Pintail
Snowy Egret
Sora Rail
Spotted Sandpiper
Wilson Phalarope
Wilson's Snipe
Wood Ibis

Table A-2 Abbott interview Flora and Fauna noted in the Devereux and Goleta watersheds c1900-1940 ***Page 1 of 2***	
Plants:	
	Coastal Sage
	Pickleweed
	Wild Radish (exotic)
Birds:	
	Bald Eagle
	Black-crowned Night Heron
	Burrowing Owl
	Canada Goose
	Clark's Nutcracker
	Coot
	Goldfinch
	Horned Lark
	House Finch
	Least Tern
	Martin
	Meadowlark
	Peregrine Falcon
	Quail
	Redwing Blackbird
	Roadrunner
	Snow Goose
	Snowy Plover
	Tri-colored Blackbird
	Western Bluebird
	White-faces Ibis

	White-tailed Kite

Table A-2 Abbott interview Flora and Fauna noted in the Devereux and Goleta watersheds c1900-1940 *Page 2 of 2*	
Reptiles:	
	California Racer
	Garter Snake
	Gopher Snake
	King Snake
	Legless Lizard
	Side-blotched Lizard
	Western Fence Lizard
Mammals:	
	Brush Rabbit
	Coyote
	Fox
	Ground Squirrel
	Harbor Seal
	Jack Rabbit
	Meadow Mouse .

In 1941 the Army Corps of Engineers began expanding the Santa Barbara Municipal Airport on the Goleta Slough, directly east of the upper Devereux Slough. Taking advantage of the newly expanded airport, the U.S. Marines began building the Goleta Marine Corps Air Station on the lower Goleta Slough in 1942. In 1945 educator Helena T. Devereux constructed a small campus directly east of the lower Slough, the Devereux School, which still exists. In addition, in 1945 the Marine Base closed, and was subsequently acquired by the University of California, Santa Barbara. Most of these developments extensively modified the adjacent Goleta Slough system and increased accessibility to and demand for housing in the both Devereux and Goleta watersheds.

By 1947, as shown in a photo taken in August (Figure A-6), much of the western arm of the upper slough was silted over. Salt flats are visible in parts of the upper Slough, but with the exception of the northeastern section, the outline of the original Slough above the dam is difficult to distinguish. In the photo the eastern arm remains a disjunct pond surrounded by well-developed vegetation that was most likely dominated by willows (Ferren and Thomas, 1995). Salt marsh vegetation ringing the lower slough had expanded since the 1928 photo, and to the west of the Slough two oil storage tanks are visible; they were constructed in the late 1930's and accessed from the north. The photo also depicts orchards directly above the upper Slough, and extensive modification of lands surrounding the entire Slough.

In 1967 construction began on the University Village Golf Course, later the Ocean Meadows Golf Course, at the site of what had been the Upper Devereux Slough. In order to fill the low seasonally flooded lands, soil was scraped from a parcel directly northwest of the lower slough and deposited on the golf course site. The newly constructed golf course may be seen in a 1969 photo of the site (Figure A-7). In addition to the golf course, the photo depicts terracing on the scraped parcel and extensive urbanization of the lands surrounding the Slough. Sediment from the scraped parcel found its way into the lower Slough, and is visible as a deposit in the Slough directly below the bisecting road. By 1969, the oil-storage tanks were no longer accessible from the north; they were now only accessible from the east.

Between 1968 and 1973 UCSB acquired 117 acres of land of the lower Slough for preservation as the Coal Oil Point Natural Reserve, a part of the University of California's Natural Reserve System. The reserve is managed as a site for education, research and for the protection of native flora and fauna. A 1997 photo of the site (Figure A-8) shows further urbanization of the parcels immediately surrounding the Slough, with few sites remaining undeveloped. These parcels include Monarch Point (A) to the west, the "North Parcel" (B) and the "South Parcel" (C), and the "East Parcel" (D). These latter three properties are owned by UCSB, and all four parcels are currently under consideration for development. In addition, the 1998 photo depicts the sediment deposit in the lower Slough remaining as a result of scraping of the South Parcel, although the deposit did not substantially increase in size between 1969 and 1998 (Davis et al., 1990).

Summary

Since the founding of the Santa Barbara Mission in the late 18th century, the region surrounding Devereux Slough has undergone extensive modification. Ranching, farming, and urbanization have dictated filling in wetlands, introducing non-native species and fragmenting habitats. The historic Devereux Slough, specifically, was modified in the following key ways:

1) increased amounts of sediment from disturbed lands upstream filled in much of the historic upper slough and created a large sediment deposit in the lower slough,
2) an east-west road separated the upper and lower portions of the slough, and
3) infilling of the slough north of the road in order to construct a golf course on the site entirely buried the historic upper slough.

In addition, many species observed in the slough and watershed in the 1930's and 40's have been extripated from the region.

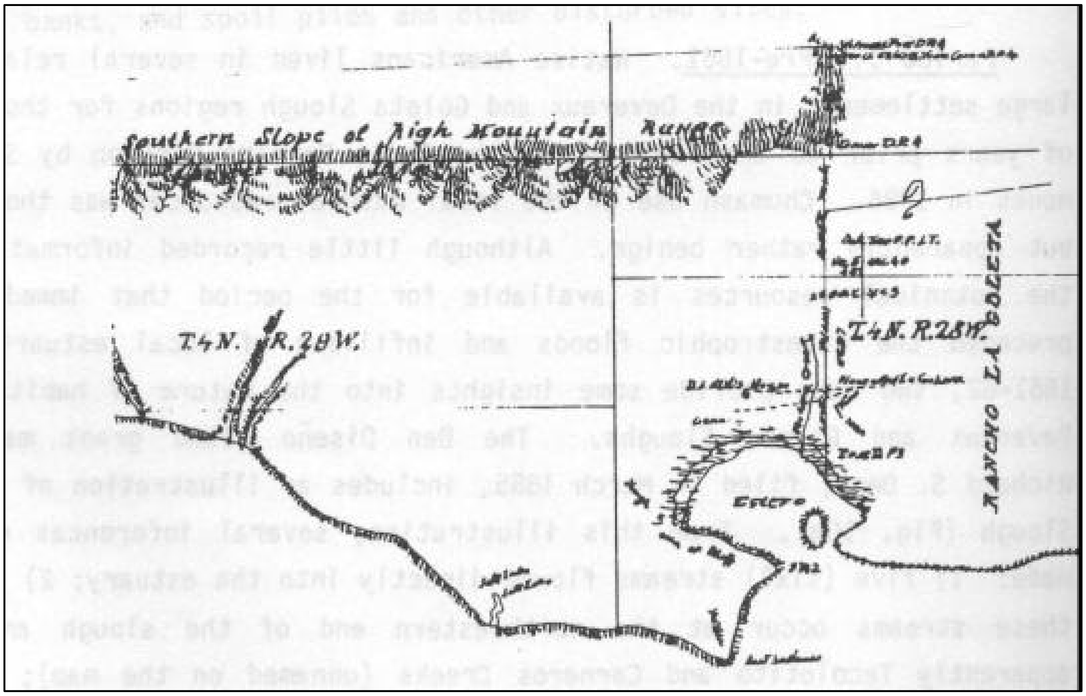


Figure A-1 Map of the Rancho Dos los Pueblos, 1861. Adapted from Davis et al. 1990.
On the first known map of the site Devereux Slough is illustrated as a small inlet labeled Salt Lake '.

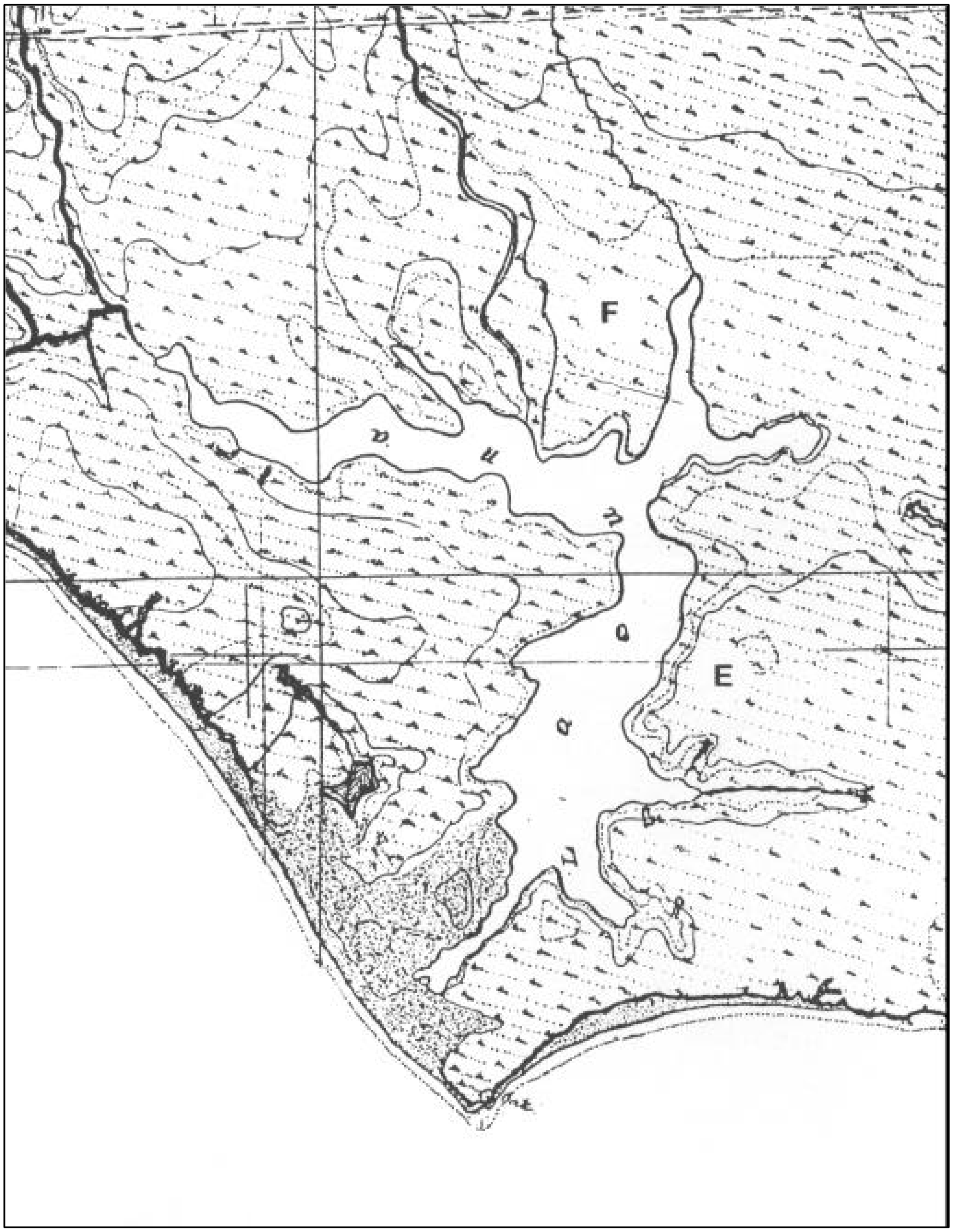


Figure A-2 U.S. Coastal Survey Map, 1871/73. Adapted from Ferren and Thomas 1995.

The entire Slough is depicted as a flooded lagoon with wide channels running north of the east/west trending upper Slough. The mouth of the Slough was separated from the ocean by a sand berm. Coastal grasslands surrounded the Slough.

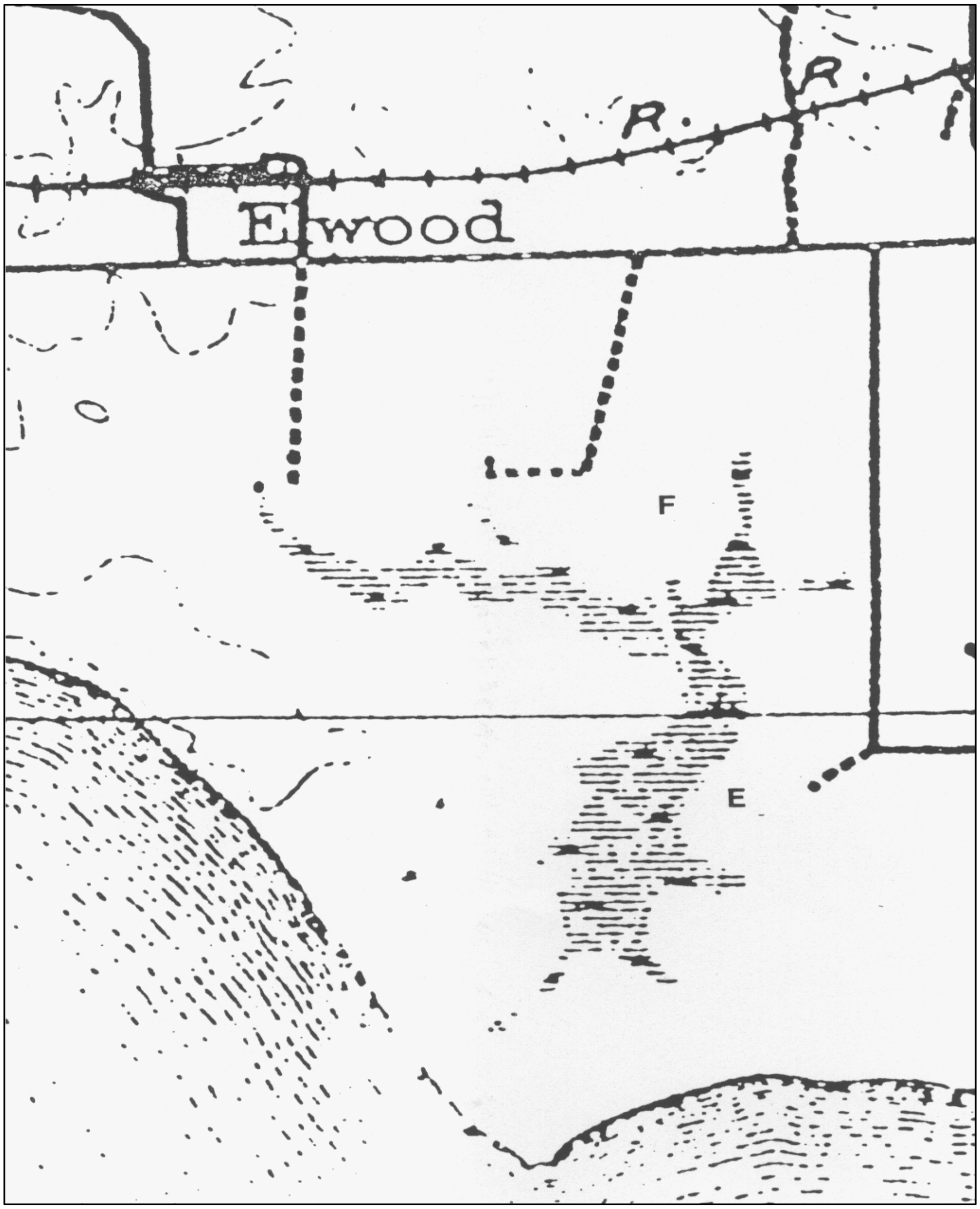


Figure A-3 U.S. Geological Survey Map, 1903. Adapted from Ferren and Thomas 1995.
Both the upper and lower sections of the Devereux Slough were flooded, with the north-reaching fingers still intact. The mouth of the Slough is closed. The Elwood Depot and several roads indicate the beginning of residential and agricultural development of the watershhed.

Figure A-4 First Known Aerial Photograph of the Site, 1928. Fairchild Aerial Surveys, photo CA307A-72, Santa Barbara, CA.
This photo illustrates some of the first dramatic changes to the Slough system; an east-west running access road separated the upper and lower sections of the Slough. In addition, the upper Slough was filled with sediment, except for an eastern arm, which remained flooded and ringed with

palustrine vegetation. The mouth of the slough was closed. The Campbell Estate is visible in the photograph to the east of the lower slough.

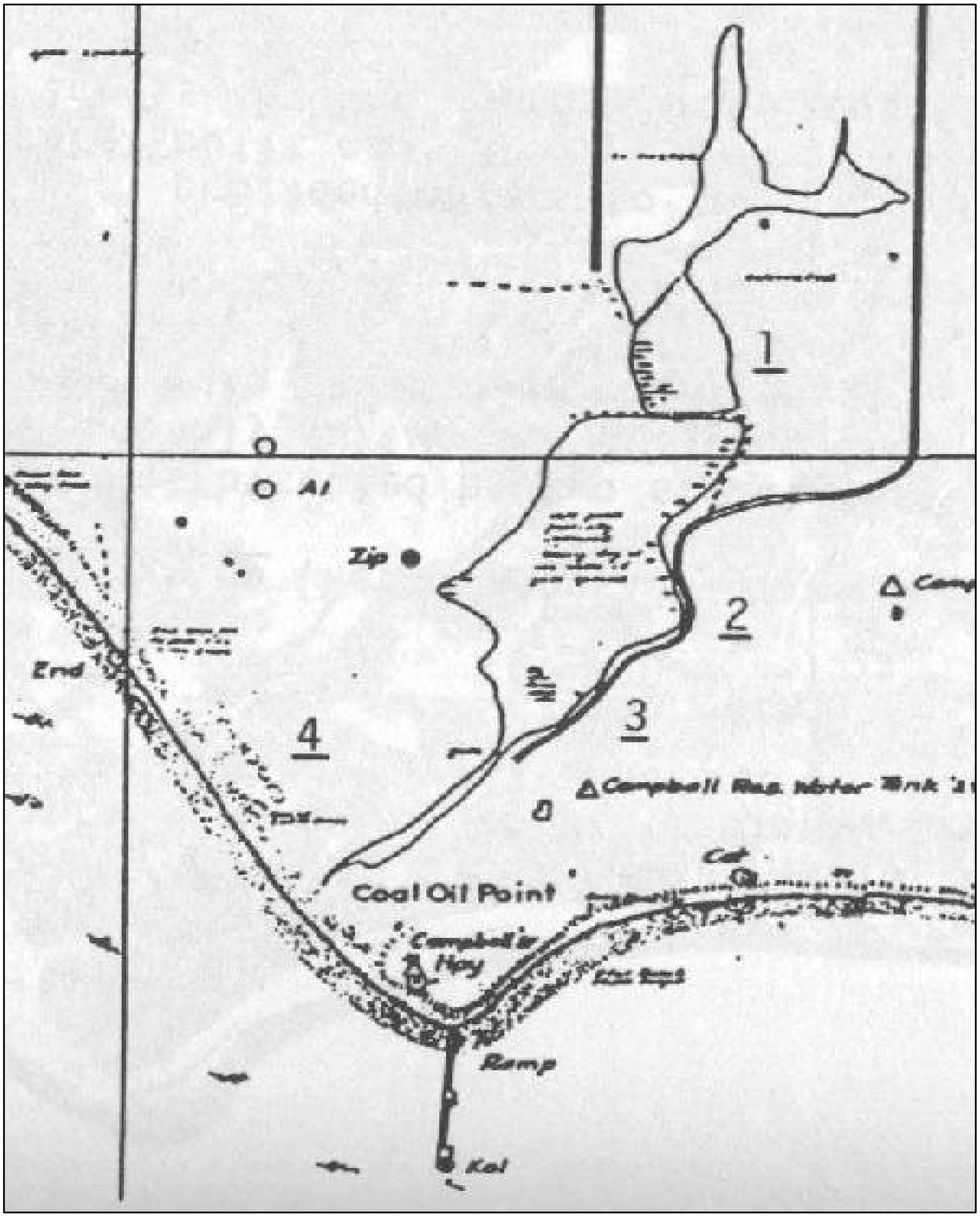


Figure A-5 Coastal Survey Map, 1933. Adapted from Davis et al. 1990. The Slough was fully separated into two portions: an upper flooded region encompassing only the eastern arm of the former upper Slough, and a lower slough labeled 'salt pond partially improved'. The mouth of the Slough was closed.

Figure A-6 U. S. Geological Survey Aerial Survey, 1947.
The upper Slough remained restricted to the eastern arm, which was ringed with dense vegetation. The western arm of the upper Slough was visibly impacted by agriculture and soil removal activities. The salt marsh vegetation surrounding the lower Slough became more developed since the 1928 photograph. By 1947 two oil storage facilities had been built to the west of

the lower Slough, and the watershed showed additional signs of development.

Figure A-7 Aerial Photograph, 1969. (Mark Hurd Aerial Surveys, photo AN-AM-32, Santa Barbara, CA)

By 1969 the upper Slough had been raised with fill from surrounding parcels to form the golf course. The lower Slough experienced an increase in sediment due to soil moving activities, and showed evidence of a raised delta of sediment directly below the east-west running access road. By 1969 this road was the only approach to the oil storage facilities west of the site. The

1969 photo depicts extensive new housing developments north, west and east of the site.

Figu Santa Barbara, CA.

In this photo further housing developments immediately adjacent to the site are visible, in addition to several undeveloped parcels. These include A) Monarch Point, B) the North Parcel C) the South Parcel and D) the East

Parcel. These parcels are all under consideration for development.

Appendix B: Wetland Classification System

Definitions and Characteristics of Wetland Habitat

For the purposes our study, we define "habitat" to describe an area or environmental feature having a certain combination of physical and/ or biological attributes that result in it supporting a distinctive association of plants at a particular point in time (Ferren et. al., 1987). Habitats are classified into two major categories, wetland and upland.

1) the land at least periodically supports predominantly hydrophytes,
2) the substrate is predominantly undrained hydric soil,
3) the substrate is nonsoil and is saturated or covered with shallow water at some time during the growing season of each year.

While the habitat types proposed for the study site will vary along a gradient of hydrologic regime from wetter to dryer areas, we expect that all habitats created on the golf course or subsequent to golf course removal will exhibit at least one of the accepted characteristics of wetlands. The upland limit of wetlands is defined by the following limits (Cowardin et al., 1979):

1) the boundary between land with predominantly hydrophytic cover and land with predominantly mesophytic or xerophytic land cover
2) the boundary between soil that is predominantly hydric and soil that is predominantly nonhydric
3) for wetlands without vegetation or soil, the boundary between land that is flooded or saturated at some time during the growing season each year and land that is not.

Cowardin et al. (1979) Wetlands Classification System

For the purposes of our study, we have chosen to adopt the widely used classification of wetlands developed for the US Fish and Wildlife Service by Cowardin et al. (1979). This hierarchical classification system is regarded as the single best method for classifying wetlands on the national scale (Ferren et al., 1996a). While there is a more detailed method of classification specific to the central and southern California Coast region (Ferren et al., 1996b), the wetlands proposed for creation in this study are adequately described according to the classification provided by Cowardin et al. (1979).

The Cowardin et al. (1979) classification system describes wetlands according to: systems and subsystems, designated by hydrologic, geomorphologic, chemical, or biological factors; classes, based on dominant life form of the vegetation or the physiography and composition of substrate material; subclasses, for finer differences in life form, and; modifying terms, describing water regime, water chemistry, and dominance types (Cowardin et al., 1979). Please refer to Table B-1 at the end of this section for definitions of the wetland descriptors and terms applied in this document.

Description of Habitat Types

The proposed Five Alternatives include the addition of wetlands to the site that belong to two major systems: estuarine and palustrine, or the transition zone between them. A description of each potential habitat type proposed in the alternatives is provided in the following sections. One or more of the water regime modifiers defined in Table B-2 characterize each habitat type. Floral species characteristic to the given wetland habitat types will be included, with a focus on species of special concern. The hierarchical structure of the classification system, along with the terms, definitions, modifiers, and classifiers will be used throughout this section, and will be referenced to Table B-1, Table B-2, Table B-3 and Figure B-1. Therefore, an initial perusal of these references may be of assistance. Reference sites of local wetlands (primarily the Devereux Slough, Goleta Slough, and Storke Campus wetlands), with similar habitat conditions and characteristics, and associated vegetation, were cataloged in Appendix I.

TABLE B-1: Water Regime Modifiers Described in Cowardin et al. (1979) Wetland Classification	
Wetland Modifier	**Description**
Irregularly exposed (estuarine)	land surface is exposed by tides less often than daily
Irregularly flooded (estuarine)	tidal water alternatively floods and exposes the land surface less often than daily
Seasonally flooded (estuarine)	estuarine mouth is seasonally-closed and surface water is present for extended periods but is absent by the end of the season in most seasons
Permanently flooded	surface water is present throughout the year except in years of extreme drought
Semipermanently flooded	surface water persists throughout the growing season in most years
Intermittently flooded	substrate is usually exposed, but surface water is present for variable periods without detectable seasonal periodicity
Seasonally flooded	surface water is present for extended periods, especially early in the growing season, but is absent by the end of the season in most years
Saturated (seasonal)	substrate is saturated to the surface for extended periods during the growing season, but surface water is seldom present
Temporarily flooded	surface water is present for brief periods especially early in the growing season, but the water table usually likes well below the soil surface for most of the year

TABLE B-2: Definitions of Wetland Terms Applied in Description of Habitat Types (Cowardin et al., 1979[1]; Ferren et al., 1987[2]; Ferren et al., 1996[3]). *Page 1 of 2*	
Wetland Term	**Definition**
Estuarine	Deepwater tidal habitats and adjacent tidal wetlands that are usually semienclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land[1]
Palustrine	
Subtidal	Substrate is continuously submerged[1]
Intertidal	Substrate is exposed and flooded by tides[1]
Aquatic bed	
Emergent hydrophytes ("Emergents")	Erect, rooted, herbaceous angiosperms (flowering plants) that may be temporarily to permanently flooded at the base but do not tolerate prolonged inundation of the entire plant[1]
Emergent wetlands	Characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens, and which is present for most of the growing season[1]
Persistent	Plant species that remain standing through the winter until the beginning of the next growing season1[1]; perennial emergents, shrubs, and trees[2]
Nonpersistent	Plants that fall to the surface of the substrate or are present only below the surface at the end of the growing season, so that there

	is no obvious sign of emergent vegetation[1]; above- ground annuals[2]
Submerged	
Rooted vascular	A large array of vascular plants rooted in a substrate and that are found in aquatic bed habitat[1]
Halophytes	A plant living in saline conditions; a plant thriving in an alkaline soil rich in sodium and calcium salts[3]

TABLE B-2: Definitions of Wetland Terms Applied in Description of Habitat Types (Cowardin et al., 1979[1]; Ferren et al., 1987[2]; Ferren et al., 1996[3]). ***Page 2 of 2***

Wetland Term	Definition
Hydrophytes	Any plant growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content; plants found typically in wet habitats[1]
Phreatophyte	A perennial plant that is very deeply rooted, deriving its water from a more or less permanent, subsurface water supply[3]
Saline	General term for waters containing various dissolved salts[1]
Haline	Term used to indicate dominance of ocean salt[1]
Hypersaline/ Hyperhaline	Characterizes water with salinity greater than 40 ppt[1]
Mixosaline/ Mixohaline	Characterizes water with salinity of 0.5 ppt to 30 ppt[1]
Oligosaline/ Oligohaline	Characterizes water with salinity of 0.5 to 5.0 ppt
euhaline/ ensaline	Salinity approximating seawater (33 ppt)[3]
Euryhaline zone	Sodium chloride salt based, marine influenced zone that

	experiences low salinity in the winter months and high salinity in the summer
brackish	Marine and estuarine waters with mixohaline salinity [1]
Vernal pond/ vernal wetland	A body of water usually smaller than a true lake and larger than a pool that fills with seasonal rain and usually desiccates sometime before the next rain season[3]

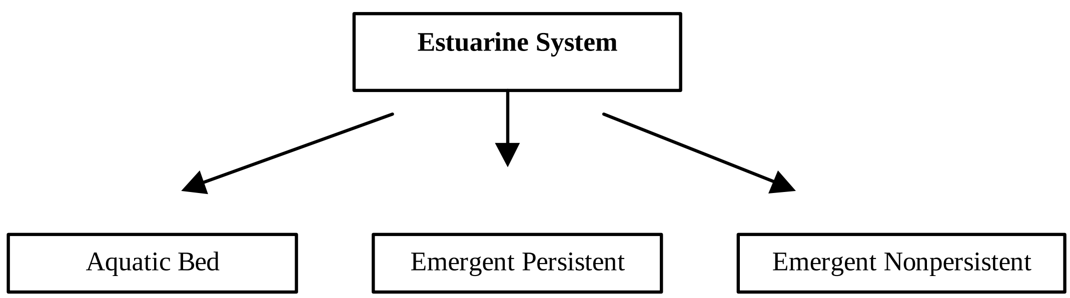
As stated above, this section will describe the two major habitat types: Estuarine and Palustrine. Subcategories of these two habitat types will be detailed below in their correct hierarchical order, along with a Transitional Wetland habitat type.

Estuarine System

The estuarine system consists of deepwater tidal habitats and adjacent tidal wetlands that are usually semi-enclosed by land but have open, partly obstructed, or sporadic access to the open ocean, and in which ocean water is at least occasionally diluted by freshwater runoff from the land (Cowardin et al. 1979). Estuarine salinities range from hypersaline (greater than 40 ppt) to oligosaline (0.5 to 5.0 ppt). Estuarine water regimes and water chemistry are usually affected by oceanic tides, precipitation, freshwater runoff from land areas, evaporation, and wind (Cowardin et al., 1979). Estuarine salt marshes consisting of subtidal and intertidal wetlands usually confined to coastal embayments or other physiographic features that are at some point during the year open to the ocean, receive freshwater runoff and are flooded by water with an annual low flow salinity greater than 0.5 ppt from ocean derived salts (Ferren et al. 1987). Intertidal wetlands include a variety of habitat/ vegetation types that are associated with variations in frequency of flooding, type of substrate, salinity, and topography (Ferren and Rindlaub, 1983).

All areas of the west campus wetland system that are flooded at least seasonally by brackish or saline water from Devereux Slough are estuarine in nature. Estuarine wetlands created at the study site will be connected to lower Devereux Slough and may include aquatic bed and emergent wetland (persistent and nonpersistent) habitat. All emergent wetlands are flooded frequently, enough so that the roots or the vegetation prosper in an anaerobic environment (Gosselink and Turner, 1978). Cowardin et al. (1979) state that emergent wetlands are characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Estuarine emergent wetlands are known by common names such as salt marsh, brackish marsh, and slough.

Persistent emergent wetlands are dominated by plant species that remain standing through the winter until the beginning of the next growing season (Broome, 1990; Cowardin et al., 1979). In contrast, plants that fall to the surface of the substrate or are present only below the surface at the end of the growing season, so that there is no obvious sign of emergent vegetation, characterize Nonpersistent emergent wetlands (Broome, 1990; Cowardin et al., 1979). Therefore, the Estuarine alternatives include the following habitat types: subtidal (aquatic bed), and intertidal (emergent persistent and emergent nonpersistent) wetlands.



Estuarine aquatic bed (rooted vascular)

Description of habitat type

Aquatic beds represent a diverse group of plant communities that require surface water for optimum growth and reproduction (Cowardin et al. 1979). Aquatic bed vegetation is either floating or submerged, and when submerged it is either suspended in water or composed of rooted vascular species (Ferren et al., 1987). Estuarine aquatic bed habitat occurs in a range of water regimes, including (but not limited to) *subtidal*, *intertidal*, *irregularly exposed*, *permanently flooded*, and *seasonally flooded* (Cowardin et al., 1979; Ferren et al., 1996). Aquatic bed habitat at lower Devereux Slough is classified as an estuarine intertidal seasonally flooded euryhaline shallow-bottom wetland with rooted vascular vegetation (Ferren et al., 1996); creation of this habitat at the study is expected to be of this same classification. It occurs in the Devereux Slough at elevations lower than the emergent wetland zones that occur at about 4 –7 feet MSL. In the full and partial estuarine alternatives, this wetland type was mapped at future condition elevations of about 3.5-4 feet MSL.

Associated native plant species
The estuarine alternatives will include expansion of habitat for *Ruppia maritima* (ditchgrass), the characteristic rooted vascular species that dominates aquatic bed habitat type at lower Devereux Slough.

Persistent Estuarine emergent wetland

Description of habitat type
Persistent Estuarine emergent wetlands included in the proposed alternatives are expected to occur in areas that are *irregularly exposed*, *irregularly flooded*, or *seasonally flooded.* This habitat type is commonly observed in areas with moderate to high soil salinity or alkalinity, sometimes with infrequent tidal inundation (Amendment EIR, North and West Campus Housing Wallace Roberts and Todd, 1997). These wetlands occur in the lower Devereux Slough at elevations of about 4 –7 feet MSL (Ferren et al. 1997). In the estuarine alternatives, this wetland type was mapped accordingly at future condition elevations of about 4- 7 feet MSL.

Associated Plant Species
Bulrushes (*Scirpus spp*.) are characteristic species in permanently flooded, irregularly exposed or seasonally flooded habitats that generally have flooded substrates for most or all seasons (Ferren et al., 1987). *Scirpus maritimus* is characteristic of a wide range of salinities and flooding regimes, while *Scirpus californicus* and *S. robustus* are generally restricted to brackish water habitats (Ferren et al., 1987). Many types of persistent emergent wetlands that belong to the estuarine system have been identified at lower Devereux Slough as discussed below (Ferren et al., 1987). Habitat conditions such as topography, flooding and salinity regime vary between each type and are reflected in dominant species or associations.

The persistent estuarine emergent wetlands included in the proposed alternatives are described generally as including all of the above mentioned species, although it is important to note that within this habitat type there will be a gradient of topography, flooding and salinity regimes. Therefore, there will be zones of habitats differing in dominant species or associations within the persistent estuarine emergent wetland habitat type.

TABLE B-3: Native Species Characteristic of (or associated with) Persistent Estuarine Emergent Wetlands Included in Enhancement Alterntives (* species of special concern; see methods)	
Salicornia virginica*	Pickleweed
Distichlis spicata*	Coastal salt grass
Frankenia salina	Alkali heath
Jaumea carnosa	Marsh jaumea
Scirpus robustus	Salt marsh bulrush
Atriplex lentiformis	
Atriplex coulteria	Coulter's saltbrush
Scirpus maritimus	Prairie bulrush
Scirpus californicus	California bulrush

Nonpersistent Estuarine emergent wetland

Description of habitat type

Nonpersistent estuarine emergent wetlands included in the proposed alternatives are expected occur in irregularly *flooded* or *seasonally flooded* areas and are dominated by annual species (Ferren et al., 1996b). Nonpersistent estuarine emergent wetland occurs in the lower Devereux Slough at elevations of about 4.5 –7 feet MSL (Ferren et al., 1987). In the estuarine alternatives, this wetland type was mapped accordingly at future condition elevations of about 4.5 to 7 feet MSL. These wetlands are generally supported in a zone of evaporation and desiccation that is immediately adjacent to the more consistently flooded, wet substrates at lower elevations, and to the less frequently flooded substrates of higher elevations (Ferren et al., 1987).

TABLE B-4: Native Species Characteristic of (or associated with) Nonpersistent Estuarine Emergent Wetlands Included in Enhancement Alternatives (* species of special concern; see methods)	
Chenopodium macrospermum farinosum	Coast goosefoot
Stephanomeria elata*	
Lasthenia glabrata ssp. coulteri*	Coulter's goldfields
Atriplex patula ssp hastata	Spear- leaved saltbush
Cressa truxillensis	Alkali weed
Juncus bufonius var. bufonius	Common toad rush
Spergularia marina	Salt marsh sand spurry

Transitional communities- Estuarine/ Palustrine hybrid wetlands

Estuarine/ palustrine hybrid wetlands

Description of habitat type

The transitional zone between lower elevation estuarine and higher elevation palustrine habitats is technically (and commonly) referred to as estuarine upper marsh, although there is clearly a gradient from more saline estuarine to less saline palustrine zones. A distinctive ecological assemblage of plants unique to the upper intertidal fringes of southern California salt marshes includes a mixture of persistent and nonpersistent emergents that are tolerant of brackish and freshwater conditions. According to the draft Goleta Slough Ecosystem Management Plan, upper marsh is a botanical resource of special concern, i.e. a plant community/ habitat that is locally or regionally rare or endangered and that deserves special recognition (City of Santa Barbara, 1997).

The estuarine/ palustrine hybrid wetland habitat type included in the proposed alternatives is a specialized community expected to occur in *irregularly flooded* or *seasonally flooded* areas near the upper limits of tidal flooding, predicted to be roughly at 7.6 feet MSL at lower Devereux Slough (Ferren et al., 1996; Ferren et al., 1987). This transitional habitat type was mapped accordingly for the estuarine alternatives, at future condition elevations between 7 and 8 feet MSL.

Associated Plant Species
The transition from salt to fresh marshes is a continuum with plant species diversity increasing as salinity decreases (Broome 1990). Brackish water tidal marshes can be classified as persistent estuarine emergent wetlands characterized by mixohaline (0.5- 30 ppt) water (Cowardin et al., 1979), although many nonpersistent species and hydrophytes with freshwater affinities are likely to occur.

TABLE B-5: Native Species Characteristic of (or associated with) Transition Habitat Included in Enhancement Alternatives (* species of special concern; see methods)	
*Suaeda calceoliformis**	Horned seablite
Suaeda esteroa	Estuary seablite
*Hordeum depressum**	Alkali barley
Triglochin concinna	Arrow grass
Atriplex watsonii	Matscale
Scirpus robustus	Salt marsh bulrush
*Arthrocnemum subterminalis**	Parish's glasswort
Monanthocloe littoralis	Salt cedar
Batis maritima	Saltwort
Scirpus robustus	Salt marsh bulrush
scirpus californicus	California bulrush
Cressa truxillensis	Alkali weed
Spergularia marina	Salt marsh sand spurry
*Lasthenia glabrata ssp. Coulteri**	Coulter's goldfields
*Stephanomeria elata**	
Chenopodium macrospermum farinosum	Coast goosefoot
Juncus bufonius var bufonius	Common toad rush
Limonium californicum	Western marsh rosemary
*Salicornia virginica**	Pickleweed
*Distichilis spicata**	Coastal salt grass

The transitional wetlands included in the proposed alternatives are described generally as including all of the above mentioned species, although it is important to note that within this habitat type there will be a gradient of topography, flooding and salinity regimes. Therefore, there will be zones of differing dominant species or associations within this habitat type. However, we have not mapped these more specific zones. Furthermore, constituents of this transitional community may be found more commonly at higher elevations as part of palustrine or transitional wetland- to- upland communities, or at lower elevations as part of estuarine habitats.

Palustrine System

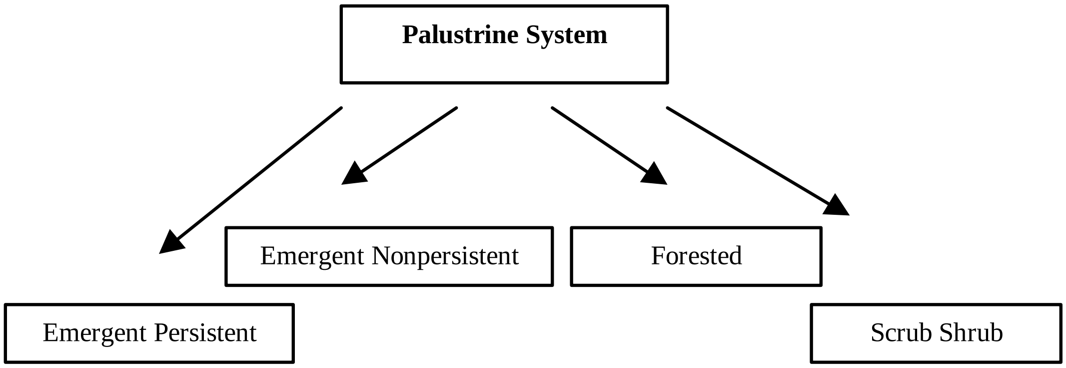
According to Ferren et al. (1987), palustrine wetlands at include wetlands that are characterized by persistent or nonpersistent plant types when vegetated and that are flooded by water with an average salinity less than 0.5 ppt from ocean- derived salts. In the Devereux Slough wetland system, salt marshes no longer contiguous to estuaries (because of isolation by berms, roads, or other structures) are classified as palustrine even though the seasonally flooded habitats may be saline and support salt marsh vegetation because of the unleached saline soils.

Likewise, Storke Campus wetlands are classified as palustrine, even though salt marsh vegetation still characterizes those areas that remain saline (Ferren et al., 1987) because estuarine water no longer floods the basins. Habitats include permanently flooded ditches and troughs, and seasonally flooded or saturated ditches, flats, banks, and disturbed sites.

According to the Goleta Slough Ecosystem Management Plan, palustrine wetlands include various wet areas persistently or non- persistently vegetated, largely nontidal stream, ditch, or channel beds, banks, slopes and terraces; nontidal salt, sand and mud flats; and depressions occurring on old alluvial fans, disturbed coastal habitats, grasslands, and impounded or diked areas once connected to the estuary. Other palustrine wetlands include vernal pools, seeps and springs, with ephemeral drainage.

Currently, at the North Finger of Devereux Slough, palustrine wetlands that are flooded or saturated with freshwater runoff occur at elevations greater than about 7.6 ft MSL. Open water areas are predicted to occur in January, and peak flooding may reach about 8.8 feet MSL in March, but are eliminated by July (Ferren et al., 1987). Like these wetlands that occur in higher elevations of the north finger, the created palustrine wetlands will be maintained primarily by seasonal freshwater input. While the water table will fluctuate seasonally, the primary hydrologic source for freshwater wetlands will not be groundwater. Water flowing through Devereux Creek during runoff conditions has been determined to be fresh (0.0 parts per thousand) (Ferren et. al., 1987).

Palustrine wetlands included in the alternatives for the study site may include emergent wetland (persistent and nonpersistent), forested wetland, and scrub shrub wetland habitat.



Persistent Palustrine emergent wetland

Description of habitat type
All emergent wetlands are frequently flooded so that the roots prosper in an anaerobic environment (Gosselink and Turner, 1978). Emergent wetlands are characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens, which are present for most of the growing season in most years. *Persistent* emergent wetlands are dominated by plant species that remain standing through the winter until the beginning of the next growing season (Broome, 1990; Cowardin et al., 1979). Persistent emergents are perennial emergents, shrubs, and trees. Persistent palustrine emergent wetlands are commonly referred to as freshwater marshes or riparian habitats. Persistent emergent vegetation will occur in areas of our study site that are *seasonally flooded* or *semipermanently flooded* (Cowardin et al., 1979). The draft Goleta Slough Ecosystem Management Plan considers freshwater marshes to be a botanical resource of special concern, i.e. a plant community/ habitat that is locally or regionally rare or endangered and that deserves special recognition (City of Santa Barbara, 1997).

In the alternatives involving palustrine wetlands, areas of persistent emergent wetland habitat type were mapped at future condition elevations of roughly 7 to 9 feet MSL. In some of the alternatives, persistent vegetation will be associated with the creeks that run through the study site.

Halophytic plants, which are commonly associated with salt marsh habitat, may also be included here due to the saline nature of the soil at the study site. Salts leach out from the estuarine soils and substrates that occur in the area of Ocean Meadows golf course, which historically was upper Devereux

Slough. As a result, brackish conditions (5-8 ppt) have been observed at Devereux Creek during low flow or standing conditions (Ferren et al., 1987).

Associated Plant Species
Bulrushes (*Scirpus spp*.) and cattails (*Typha*) are characteristic species in permanently flooded or seasonally flooded habitats that generally have flooded substrates for most or all seasons (Ferren et al., 1987).

Persistent emergent wetland vegetation zones typically occur as a series of concentric rings that reflect the relative depth and duration of flooding (Kramer, 1988). However, vegetation zones may be present in a patchy configuration rather than the classic concentric ring pattern if the bottom of the wetland is very uneven (Millar, 1976). Some emergent vegetation such as spikerush (*Eleocharus spp*.) and cattail (*Typha spp*.) will colonize areas that are permanently or semipermanently flooded (15 to 50 cm), while other emergents including the sedges (*Cyperus spp*.; *Carex spp*.) will colonize more shallow areas that are seasonally to permanently flooded up to 15 cm in depth (Hammner, 1992). The different zones of persistent emergent vegetation in created wetlands were not mapped to this detail, but it is expected that emergents will recolonize areas of the created palustrine wetlands according to depth and duration of flooding.

TABLE B-6: Native Species Characteristic of (or associated with) Palustrine Wetlands Included in Enhancement Alternatives (* species of special concern; see methods)	
Arthrocnemum subterminale*	Parish's glasswort
Euthamia occidentalis*	Western goldenrod
Distichlis spicata*	Coastal salt grass
Leymus triticoides	Alkali ryegrass
Cyperus eragrostis	Umbrella sedge
Eleocharis palustris	Spike rush
Juncus mexicanus	Mexican rush
Scirpus californicus	California bulrush
Ambrosia psilostachya var. californica	Western ragweed
Oenothera hookeri	Evening primrose
Scirpus acutus	Common tule
Scirpus microcarpus	Small- fruited bulrush
Sparganium eurycarpum	Bur- reed
Typha domingensis	Narrow- leaved cattail
Salicornia virginica*	Pickleweed
Frankenia salina	Alkali heath
Juncus phaeocephalus	Dark- headed rush
Rubus ursinus	California blackberry
Baccharis salicifolia	Mulefat
Carex sp.	Sedges
Malvella leprosa	Alkali mallow
Agrostis stolonifera var. palustris	Creeping bentgrass
Calystegia sepium ssp. binghamiae	Santa Barbara morning glory

Nonpersistent Palustrine emergent wetland

Description of habitat type

Plants that fall to the surface of the substrate or are present only below the surface at the end of the growing season, so that there is no obvious sign of emergent vegetation, characterize *Nonpersistent* emergent wetlands (Broome, 1990; Cowardin et al., 1979). Nonpersistent plants are above ground annuals. The Draft Goleta Slough Ecosystem Management Plan refers to nonpersistent palustrine emergent wetlands as haline vernal wetlands, considered to be a botanical resource of special concern, i.e. a plant community/ habitat that is locally or regionally rare or endangered and that deserves special recognition (City of Santa Barbara, 1997).

Nonpersistent emergent vegetation tends to occur in palustrine wetlands that are *seasonally flooded* or *saturated* (Ferren et al., 1996). In the alternatives involving palustrine wetlands, areas of persistent emergent wetland habitat type were mapped at future condition elevations of roughly 9 to 12 feet MSL.

Associated Plant Species

TABLE B-7: Native Species Characteristic of (or associated with) Nonpersistent Palustrine Emergent Wetlands Included in Enhancement Alternatives (* species of special concern; see methods)	
Camissonia micrantha	
Gnaphalium palustre	Lowland cudweed/ everlasting
Cressa truxillensii	Alkali weed
Lasthenia glabrata ssp. coulteri*	Coulter's goldfields
Suaeda calceoliformis*	Horned seablite
Hordeum depressum*	Alkali barley
Hemizonia parryi ssp australis*	Southern tarplant
Hutchinsia procumbens	
Spergularia marina	Salt marsh sand spurry
Juncus bufonius var bufonius	Common toad rush
Epilobium ciliatum	Northern willow herb
Aster exilis	Aster

Palustrine forested wetland

Description of habitat type
Forested wetland is characterized by woody vegetation that is 6 m tall or taller (Cowardin et al., 1979). Forested wetland includes areas with 50% aerial coverage of trees over a shrub layer with 60% aerial coverage. The draft Goleta Slough Ecosystem Management Plan considers palustrine forested wetlands to be a botanical resource of special concern, i.e. a plant community/ habitat that is locally or regionally rare or endangered and that deserves special recognition (City of Santa Barbara, 1997).

In the created wetlands of the proposed alternatives, palustrine forested wetlands will be seasonally flooded or saturated areas above elevations of approximately 9 feet MSL. This habitat type was generally mapped contiguous to palustrine and estuarine emergent wetland habitat along the northern edge of the study site to serve as a buffer between adjacent land use and the freshwater or salt marsh habitat.

Associated Plant Species
For the purposes of this study, the forested wetland habitat type refers to the areas that will be dominated by *Salix lasiolepis* and other native willows, although areas characterized by the younger shrub form of this species may be technically classified as scrub- shrub wetlands.

TABLE B-8: Native Species Characteristic of (or associated with) Palustrine Forested Wetlands Included in Enhancement Alternatives (* species of special concern; see methods)	
Salix lasiolepis	Arroyo willow
Salix laevigata	Red willow
Salix exigua	Sandbar willow
Sambus mexicanus	Mexican elderberry
Quercus agrifolia	Coast live oak
Baccharis salicifolia	Mule fat
Alnus rhombifolia	White alder
Platanus racemosa	Western sycamore
Populus trichocarpa	Black cottonwood

The Forested wetlands included in the proposed alternatives are described generally as including the above- mentioned species, although it is important to note that within this habitat type there will be a gradient of topography and flooding regime. Therefore, there will be vegetation zones differing in dominant species or associations within the forested wetland habitat type. However, we have not mapped these more specific vegetation associations.

Palustrine scrub shrub wetland

Description of habitat type
This habitat type is often characterized as mesic upland scrub, although it is considered as a palustrine wetland type under the chosen wetland classification system (Ferren et al., 1996a; Cowardin et al., 1979). The draft Goleta Slough Ecosystem Management Plan considers palustrine scrub- shrub wetlands to be a botanical resource of special concern, i.e. a plant community/ habitat that is locally or regionally rare or endangered and that deserves special recognition (City of Santa Barbara, 1997). Palustrine scrub shrub wetland habitat is characterized by mixed deciduous and evergreen vegetation and is expected to occur in *intermittently flooded* or *temporarily flooded* or *saturated* areas (Cowardin et al., 1979), and it generally occurs in areas above 12 feet MSL.

According to the Cowardin et al. wetland classification (1979), scrub shrub habitat type is generally characterized by areas dominated by woody vegetation less than 6 m (20 feet) tall. These species include true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. Scrub shrub wetlands include areas with 20% aerial coverage of trees over a shrub layer with a 60% aerial coverage, as well as areas in which trees or shrubs alone cover less than 30% but in combination cover 30% or more. In addition, forested wetlands composed of young trees less than 6 m tall are generally classified as scrub shrub wetlands.

This habitat type may be beneficial to the created estuarine and palustrine emergent wetlands as a buffer from land use activities on adjacent lands and/or as a transition to upland habitats outside of the study site. Buffers are important in reducing excess nutrient and sediment loading to wetland (Josselyn et al., 1990). White (1986) and Josselyn et al. (1990)

recommended that 30-meter buffers would reduce impacts of human intrusion on Belding's savannah sparrows, an endangered species.

Associated Plant Species

The scrub- shrub wetlands generally include the below mentioned species, although it is important to note that within this habitat type there will be a gradient of topography and flooding regime. Therefore, there will be vegetation zones differing in dominant species or associations within the scrub-shrub wetland habitat type.

TABLE B-9: Native Species Characteristic of (or associated with) Palustrine Scrub Shrub Wetlands Included in Enhancement Alternatives (* species of special concern; see methods)
Baccharis pilularis
Salix lasiolepis (scrub habit)
Salix exigua (scrub habit)
Salix laevigata (scrub habit)
Sambucus mexicanus
Toxicodendron diversilobum
Rubus ursinus
*Isocoma menziesii var vemonioides**
Leymus condensatus
Phacelia ramossisima ssp austrolittoralis
Solanum douglasii
Artemesia californica
Heteromeles arbutifolia
Artemesia douglasiana
Rosa californica
Rhamnus californica
Ribes amarum var. hoffmannii
Eriogonum parviflorum
Gnaphalium californicum
Clematis ligusticifolia

Appendix C: Species of Special Concern

This appendix gives a more complete description of species of special concern, as idenitfied in this report.

Selected Plant Species

Formerly Widespread Upper Marsh Species

1) *Arthrocnemum subterminale* (Parish Glasswort) - Historically was probably widespread on the habitat removed with the construction of the Ocean Meadows Golf Course. Occupied transition zone areas characteristic of high estuarine deltas. These were frequently flooded areas where a zone of evaporation and concentration of salts occurred. This habitat is formally defined as *Euryhaline*, a sodium chloride salt based, marine influenced zone that experiences low salinity in the winter months and high salinity in the summer. These *Euryhaline* zones are characteristic of upper estuarine transition zones. This plant also provides habitat for the rare Pygmy Blue Butterfly.

    Determined To Be, 1) Regionally Rare (City of Santa Barbara, 1997), 2) Devereux Slough species of special concern (Ferren et al., 1990).

    Associated with Habitat Types: Transitional community (estuarine/ palustrine hybrid); Palustrine emergent wetland-persistent.

2) *Hordeum depessum* (alkali barely) - similar characteristics to *Arthrocnemum subterminalis.* Alkali barley was likely widespread on the study site prior to construction of the golf course and was observed recently at the top of lower Devereux slough (just below the road) and to the west of the golf course (Ferren, 1987).

    Determined to be, 1) regionally rare (City of Santa Barbara, 1997), 2) Devereux Slough species of special concern (Ferren et al., 1990).

    Associated with Habitat Types: Transitional community (estuarine/ palustrine hybrid); Palustrine emergent wetland-nonpersistent.

3) *Suaeda calceoliformis* (horned seablite) - similar characteristics to *Arthrocnemum subterminalis.* Horned seablite was likely widespread on the study site prior to the construction of the golf course.

Determined to be, 1) regionally rare (City of Santa Barbara, 1997), 2) Devereux Slough species of special concern (Ferren et al., 1990).
Associated with Habitat Types: Transitional community (estuarine/ palustrine hybrid); Palustrine emergent wetland-nonpersistent.

Flora that Provide Resources for Regionally Rare and Important Fauna

1) *Distichilis spicata* (Coastal salt grass) - provides habitat for the Salt Marsh Wandering Skipper (*Panoquina errans)*, the region's rarest butterfly (Sandoval, personal communication). The larvae of the Wandering Skipper (*Panoquina errans)* can only live on coastal salt grass, which is found at Devereux primarily in transitional zones. Salt grass occurs on the wet and upper margins of estuaries. At Coal Oil Point Reserve, it grows above the zones dominated by pickleweed.
   Associated Habitat Types: Estuarine emergent wetland- persistent; Estuarine emergent wetland- nonpersistent

2) *Salicornia virginica* (Pickleweed) - estuarine, halophytic species. Potentially the most salt tolerant plant species in the world, and primarily grows in areas with some tidal influence. It can grow in saline areas without tidal influence if seasonal rainfall accumulates long enough to allow seed germination and seedling establishment (Zedler, 1982). However, other plants may be able to invade such stands if they can establish their seedlings (Zedler, 1982). Belding's Savannah Sparrow, a federally listed species, is a pickleweed obligate. Therefore, increasing the pickleweed stand size at Devereux Slough will improve Belding's Savannah Sparrow habitat (Sandoval, personnal communication).
   Associated Habitat Types: Estuarine emergent wetland- persistent

3) *Isocoma menziesii var vernonioides* (Coast Goldenbrush) -- Provides feeding and breeding habitat for the Salt Marsh Wandering Skipper and the Pygmy Blue butterfly. At the Coal Oil Point Reserve, Coast Goldenbrush grows above the pickleweed zone, generally above two feet elevation on the highland bluffs. This species does not require saline soils to grow, and proliferates very well from seeds in good soils with irrigation.
   Associated Habitat Types: Palustrine scrub shrub wetland

4) *Eurhamia occidentalis* (Western Goldenrod) – Transitional palustrine emergent persistent, late-summer flowering species that largely occurs above, or at limits of estuaries. The late-summer flowers provide important nectar and are a critical food source for adult pollinators. These plants help complete the cycle for butterflies, with the adults feeding on flowering upland shrubs, and the juveniles residing on estuarine or parent species.
   Associated Habitat Types: Palustrine emergent wetland- persistent.

5) *Ruppia maritimaes* -- Estuarine Aquatic Bed rooted vascular species. Extensive mats of it flourish after slough break-outs cover flats on the seaward two-thirds of the slough basin. Largest population in So. California. Is an important resource for aquatic animals becuase: 1) provides food, shade, shelter, and spawning for fish, and 2) feeding resources for birds. The resource is temporary but significant. Flooding and nutrient influx may cause *Ruppia* explosion so any change in the hydrological regime must take into account how it will effect it.
   Associated Habitat Types: Estuarine aquatic bed

Introduction of Species with High Probability of Existing on the Site Historically

1) *Lasthenia glabrata ssp. coulteri* (Coulter's Goldfields) -- Is not currently present in watershed, but very likely was before construction of the Ocean Meadows Golf Course. Rare in local wetlands, introduction of this species would raise biodiversity of watershed and increase stability of the regional population.

   Coulter's Goldfields prefer the high delta transition, evaporation zones that were eradicated by the Ocean Meadows Golf Course. It has similar habitat requirements of the other upper marsh species listed above.

   Determined to be, 1) regionally rare (City of Santa Barbara, 1997), 2) Devereux Slough species of special concern (Ferren et al., 1990).

   Associated with Habitat Types: Estuarine emergent wetland- nonpersistent; Palustrine emergent wetland- nonpersistent

Species at Their Northern or Southern Limit

1) *Hemizonia parryi ssp. australis* (southern tarplant) – Alkaline flora of concern because it is rare in the region, and the Coal Oil Point area marks its northern limit. Currently a few specimens are located on the golf course.

   Determined to be, 1) Federal Species of Concern, 2) CNPS rare, endangered, or threatened (Wallace Roberts and Todd, 1997).
   Associated with Habitat Types: Palustrine emergent wetland-nonpersistent.

2) *Stephanomeria elata* – currently only found near upper edges of COPR, which marks the southern-most limit of the species' range.

   Determined to be, 1) Devereux Slough species of special concern (Ferren et al., 1990).
   Associated with Habitat Types: Estuarine Emergent Wetland-nonpersistent.

Table C-1: Plant Species of Special Concern Associated with Habitat Types	
Habitat Type	**Associated Plant Species of Special Concern**
Estuarine aquatic bed	1) *Ruppia maritimae*
Estuarine emergent wetland-persistent	1) *Salicornia virginica* 2) *Distichilis spicata*
Estuarine emergent wetland-nonpersistent	1) *Stephanomeria elata* 2) *Distichilis spicata* 3) *Lasthenia glabrata ssp. coulter*
Transitional community (estuarine / palustrine hybrid)	1) *Suaeda clceoliformis* 2) *Hordeum depessum* 3) *Arthrocnemum subterminale*
Palustrine emergent wetland-persistent	1) *Arthrocnemum subterminale* 2) *Eurhamia occidentalis*
Palustrine emergent wetland-nonpersistent	1) *Suaeda calceoliformis* 2) *Hordeum depessum* 3) *Hemizonia parryi ssp. australis*
Palustrine forested wetland	
Palustrine scrub shrub wetland	1) *Isocoma menziesii var vernonioides*

Animal Species of Special Concern

Insects

1) Salt Marsh Wandering Skipper (*Panoquina errans*)

The salt marsh wandering skipper is the region's rarest butterfly (Sandoval, personnal communication). The larvae of the wandering skipper can live only on salt grass (*Distichlis spicata*), which is found at Devereux primarily in transitional zones. Salt grass is a broadly distributed persistent hydrophyte that occurs in Estuarine and Palustrine emergent wetlands

(City of Santa Barbara, 1997). While suitable habitat currently occurs in Devereux Slough, this species has not been observed in the area of North and West Campus (Wallace Roberts and Todd, 1997).

2) Pygmy Blue Butterfly (*Brephidium exillis*

This regionally rare butterfly is often seen in association with *Atriplex* and *Chenopodium,* estuarine plants that occur in lower Devereux Slough (Zedler, 1982). The Pygmy Blue Butterfly is considered to be a habitat indicator species in that it may indicate the connection of estuarine wetlands to palustrine habitats. The butterfly utilizes both salt marsh and habitat in higher elevations for food resources during its life history. In particular, it relies on the presence of western goldenrod (*Euthamia occidentalis*) as an adult (Court, persersonnal communication).

3) Sandy Beach Tiger Beetle (*Cincindela hirticollis gravida*)

The sandy beach tiger beetle is a Federal species of concern (CERES, 1999). This species is useful as an indicator of ecosystem integrity; it is able to survive only in localities that have not been impacted by excessive recreation, urban expansion or other human disturbance (Zedler, 1982). The sandy beach tiger beetle inhabits coastal areas from San Francisco Bay to Northern Mexico and prefers clean, dry, light colored sand in the upper zone. The sandy beach tiger beetle is known to occur at Coal Oil Point Reserve (Wallace Roberts and Todd, 1997).

Birds

Species of Federal, State, and Local Concern

1) Tricolored Blackbird *(Agelaius tricolor)*

The tricolored blackbird breeds in dense stands of bulrushes and cattails characteristic of palustrine marsh habitat (City of Santa Barbara, 1997; Holmgren, 1999). This species of special concern winters locally and in small numbers in Goleta Slough, north of the Goleta Sanitary District near Fowler Road (City of Santa Barbara, 1997). Creation of freshwater marsh (i.e. Persistent Palustrine emergent wetland) habitat at the study site would provide additional foraging and breeding habitat for the tricolored blackbird.

2) White-faced Ibis *(Plegadis chihi)*

The white- faced ibis inhabitats freshwater habitat (Holmgren, personnal communication). Although this species formerly bred in the

Goleta Slough Ecosystem, now it only occurs as a rare transient and occasional spring migrant through southern Santa Barbara County (City of Santa Barbara, 1997). Potential habitat for the white- faced ibis would be provided through the creation of additional Palustrine emergent wetland (persistent) habitat at the study site.

3) Short Eared Owl (Asio Flammeus)

Short Eared Owls occur at the north and west campus wetland areas as winter coastal residents (Zeiner et al., 1990). Short- eared owls require dense vegetation for resting and roosting cover, which they may find in the palustrine forest and scrub scrub wetland areas of the site. Devereux Slough and adjacent grasslands currently provide high-quality roosting and foraging habitat for this species of special concern (Wallace Roberts and Todd, 1997). Short Eared Owls frequents Goleta Slough, where up to two owls have been observed almost annually at More Mesa from late fall to early winter (City of Santa Barbara, 1997).

4) American Bittern (*Botaurus lengtginosus)*

The American bittern is known to inhabit palustrine marshes (Holmgren, 1997) and also frequents salt marshes during migration and winter (Udvardy and Farrand, 1994). Although formerly a nesting species locally in fresh and brackish marshes, now the American bittern is rarely seen along the south coast of Santa Barbara county (City of Santa Barbara, 1997). This species of special concern may still occur with the Goleta Slough as a rare visitor (City of Santa Barbara, 1997). Expansion of palustrine emergent wetland (persistent) and estuarine emergent wetland (persistent) and transitional wetlands at the study site would provide additional habitat for the American bittern.

5) Northern Harrier (*Circus cyaneus)*

The northen harrier occurs in Santa Barbara County as a winter visitor, although this species has not been observed recently in the West Campus area (Wallace Roberts and Todd, 1997). Between one to three individuals may be seen in Goleta Slough, but in other years are rare or absent (City of Santa Barbara, 1997). The northern harrier nests in dense grasslands and wetlands and forages in wetlands, grasslands, and agricultural fields (Terres, 1980; Wallace, Roberts and Todd,1997). High quality nesting and foraging habitat is present in the

West Campus area for the northern harrier (Wallace, Roberts and Todd,1997). We expect the Palustrine emergent (persistent) and Palustrine scrub shrub wetlands to provide additional habitat for the northern harrier.

<u>*6)* Western Burrowing Owl (*Athene cunicularia hypugea*)</u>
Burrowing owls prefer open, dry and nearly level grassland habitats where they feed on insects, small mammals, and reptiles (Zeiner et al., 1990). They live and nest in burrows, two of which have been observed in the More Mesa area of Goleta Slough (Storrer and Ferren, 1992). Burrowing owls have been identified in the West Campus area; grasslands in the vicinity provide medium to high quality foraging and nesting habitat (Wallace Roberts and Todd, 1997). However, this species 'numbers continue to decline even as a rare winter visitor (City of Santa Barbara, 1997). While the habitat created at the site will not directly support this species, it will provide for increased prey resources for burrowing owls in the area.

<u>*7)* White- tailed kite (*Elanus caeruleus)*</u>
White- tailed kites nest in riparian and oak woodlands and forage in nearby grasslands, pastures, agricultural fields, and wetlands (Wallace Roberts and Todd, 1997). Two pairs of white- tailed kites have been observed foraging over the southwestern and west- central areas of North and West campus (Wallace Roberts and Todd, 1997). White-tailed kites are regular breeders and year- round residents in portions of Goleta Slough; roost sites have been identified on More Mesa, Los Carneros wetland and Atascadero Creek northeast of More Mesa. This species has been observed foraging in Goleta Slough, as many birds use the grasslands, salt marsh and sparse brushy areas (City of Santa Barbara, 1997). The estuarine emergent wetland (persistent), palustrine emergent wetland (persistent) and palustrine forested wetland areas are expected to provide additional habitat for this species of special concern.

Species of Federal and State Concern

<u>8) Least Bittern (*Ixobrychus exilis)*</u>
The least bittern inhabits freshwater and brackish ponds along the coast (Holmgren, 1999). This species of special concern prefers freshwater marshes where cattails and reeds predominate (Udvardy and Farrand, 1994). The least bittern may benefit primarily from the

creation of palustrine emergent wetlands (persistent), as well as estuarine emergent wetlands (persistent), at the study site.

9) Cooper's Hawk (*Accipiter cooperi*)

Population declines of Cooper's Hawk have primarily been attributed attributed to the loss of lowland riparian forests in coastal valleys of Central California (Remsen 1978, cited in Wallace Roberts and Todd, 1997). Cooper's Hawk is known to nest in deciduous riparian forest or oak woodland, usually near streams or other open water habitat (Reynolds 1983, cited in Wallace Roberts and Todd, 1997). Additionally, Cooper's Hawk frequents slough margins and well-vegetated residential areas (City of Santa Barbara, 1997). Coopers' Hawk has been recorded within Goleta Slough and was observed nesting on the west margin of More Mesa in 1995 (City of Santa Barbara, 1997). Although no nesting Cooper's Hawk were observed recently at the west campus area, moderate- to high- quality nesting and foraging habitat occurs at the western edge of north and west campus (Wallace Roberts and Todd, 1997). We expect potential habitat of this species of special concern to be expanded in the creation of Palustrine forested wetlands and Palustrine scrub shrub wetlands.

10) Little (Brewster's) willow flycatcher (*Empidonax traillii brewsteri)*

The little willow flycatcher breeds in the Sierra Nevada but migrates through the south coast of Santa Barbara County. Although this bird is fairly common in the Goleta Slough Ecosystem, it is considered locally rare (City of Santa Barbara, 1997). This species of special concern lives primarily in its characteristic willow habitat. Expansion of willow flycatcher habitat would occur with creation of Palustrine forested wetland and Palustrine scrub- shrub wetland at the study site.

11) Peregrine Falcon *(Falco peregrinus anatum)*

The peregrine falcon occurs throughout coastal southern California in small numbers during migration and winter. Individuals could be expected to hunt within the Goleta Slough Ecosystem as visitors (City of Santa Barbara, 1997). The peregrine falcon is known to inhabit areas near water; habitat would be provided in the palustrine emergent wetland (persistent) and palustrine forested wetland areas near the creeks on the study site.

12)Osprey (*Pandion haliaetus*)

The osprey is an uncommon fall transient and rare winter visitor to rivers, channels, and open bodies of water in the Goleta Slough area (City of Santa Barbara, 1997). This species of special concern would likely benefit from expansion of the creeks and creation of estuarine emergent wetlands and palustrine emergent wetlands at the study site.

13)Sharp- shinned hawk *(Accipiter striatus)*

The sharp- shinned hawk frequents woodlands and the periphery of open areas, and is commonly recorded within Goleta Slough (City of Santa Barbara, 1997). It is likely to benefit from areas of created palustrine forested wetlands and palustrine emergent wetlands (persistent) at the study site.

*14)*Long- billed curlew *(Numenius americanus)*

The long- billed curlew frequents mudflats, salt marshes, and sandy beaches during migration (Udvardy and Farrand, 1994). This species is seen annually in Goleta Slough from late June to April (City of Santa Barbara, 1997). Creation of estuarine emergent wetland (persistent and nonpersistent) would provide habitat for this species of special concern.

15)Loggerhead Shrike (*Lanius ludovicianus)*

The loggerhead shrike is a resident species throughout the lowlands and foothills of California (Grinnell and Miller 1994, cited in Wallace Roberts and Todd, 1997). The shrike inhabits grasslands, agricultural lands, open shrublands and open woodlands and nest in low trees and dense shrubs (Wallace Roberts and Todd, 1997). A loggerhead shrike was observed foraging at the northern portion of the west campus area (Wallace Roberts and Todd, 1997). The loggerhead shrike has been observed regularly at Goleta Slough, where ideal breeding habitat is present (City of Santa Barbara, 1997). Grasslands and adjacent willow scrub habitat present at north and west campus provide high-quality foraging and nesting opportunities for this species of special concern (Wallace Roberts and Todd, 1997). We expect potential habitat expansion to occur for the loggerhead shrike with the creation of Palustrine scrub shrub wetlands and Palustrine forested wetlands.

Species of State and Local Concern

16) Yellow-breasted Chat *(Icteria virens)*

The yellow- breasted chat breds in dense willows riparian habitat (Holmgren, personnal communication; City of Santa Barbara, 1997). Therefore, this species of special concern would benefit primarily from revegetation of willows in the Palustrine forested wetlands and Palustrine scrub- shrub wetlands proposed for the study site.

17) Yellow warbler *(Dendroica petechia)*

The yellow warbler inhabits moist thickets, especially along streams and in swampy areas (Udvardy and Farrand, 1994). In the Goleta Slough ecosystem, the yellow warbler is a common spring and fall transient, although it is possibly extirpated as a breeder in the Goleta Slough ecosystem (City of Santa Barbara, 1997). This species of special concern is found in shrubby and wooded habitats on migration. Palustrine forested wetlands and Palustrine scrub shrub wetlands at the study site would contribute to migratory habitat for the yellow warbler.

Species of Federal Concern

18) Sandhill crane *(Grus canadensis)*

The sandhill crane is a casual winter visitor along the coast that frequents grasslands, marshes, and agricultural fields (City of Santa Barbara, 1997). Habitat for this species of special concern consists of large freshwater marshes, prairie ponds and marshy tundra. The sandhill crane is sensitive to human disturbance, and the draining of marshes has reduced nesting populations in the United States (Udvardy and Farrand, 1994). Wintering habitat may be expanded with the creation of palustrine marsh habitat at the study site.

Species of State Concern

19) Belding's Savannah Sparrow (*Passerculus sandwichensis beldingi*)

Belding's Savannah Sparrow is a year- round resident in coastal salt marsh habitat in Central- Southern California. Belding's Savannah Sparrow prefers wetlands with dense patches of pickleweed (*Salicornia virginica*). Expansion of pickleweed, a broadly distributed salt marsh species, would occur with the creation of palustrine and estuarine emergent wetland (persistent) habitat, as well as in the transitional zones between them. Belding's Savannah Sparrow has been observed at the north end of Devereux Slough along coastal marsh habitat containing pickleweed (Wallace Roberts and Todd, 1997).

20) California Black Rail (*Laterallus jamaicensis coturniculus*)
This species of special concern frequents salt marshes along the coast that are heavily vegetated with pickleweed (*Salicornia virginica*) (City of Santa Barbara, 1997). California black rail may also benefit from the expansion of pickleweed, which will occur with the creation of palustrine and estuarine emergent wetland (persistent) habitat, as well as in the transitional zones between them.

21) Purple martin *(Progne subis)*
The purple martin, the largest swallow in the western region, is becoming scarcer in much of the West, probably due to competition with European Starlings for nest sites (Udvardy and Farrand, 1994). This species of concern to California may utilize the palustrine forested wetland areas as habitat. The purple martin has been recorded in Goleta Slough as a rare migrant and was formerly present along the South Coast of Santa Barbara County (City of Santa Barbara, 1997).

Species of Local Concern

22) Coast (California) horned lark *(Eremophila alpestris actia)*
The Coast horned lark is a locally common but decreasing winter visitor in sparse grasslands and disturbed fields (City of Santa Barbara). This species of special concern is known to summer in Goleta Slough.

23) Virginia Rail (*Rallus limacola*)
The Virginia Rail, a species of Local Concern, inhabits freshwater and brackish marshes (Udvardy and Farrand, 1994; Holmgren, personnal communication). In addition, this species is known to visit salt marshes in the winter (Udvardy and Farrand, 1994). Therefore, the Virginia rail may benefit from the expansion of freshwater marsh (i.e. Palustrine persistent emergent wetland) and salt marsh (i.e. Estuarine persistent emergent wetland) at the study site.

Appendix D: Geographic Information System (GIS)

The primary tool used to map the habitat mosaics for each enhancement alternative was *ArcView* GIS. The GIS was used to map the area for each habitat type, and to estimate the volumes of soil needed to be removed for each plan.

This process began by acquiring appropriate data layers from Mark de la Garza, a local environmental consultant. These data included an aerial photo of the watershed, a three-meter digital elevation model (DEM) layer, and a polygon of the golf course shape. A theme for Devereux and Phelps creeks was added by creating a new line theme and drawing the creeks by hand using the aerial photo as a guide. The three-meter DEM was converted to feet using the map calculator and interpolated to 2 foot intervals using the legend editor.

The next major step was to add the habitat polygons in each alternative. New polygon themes were created and used to draw the habitats using the aerial photo and current elevation as a guide. This delineation was also guided by location, elevation, and size of similar habitat types in the lower Devereux slough, especially for estuarine plans, historical photos of the slough, and consultation with wetland specialists familiar with the area. The habitat types were given the same fill and color patterns across the plans for ease of identification and comparison. Using Spatial Analyst, an ArcView extension package, the area for each of these habitat polygons was tabulated using the tabulate area function. These data were entered into an excel spreadsheet where the appropriate conversions were done and the areas summed for the golf course.

In order to calculate the volume of soil removed for each plan it was necessary to create a theme of predicted elevation values that would accommodate each plan. This was done by creating a new point theme and entering in elevation values for each point entered. The estuarine habitat types used had necessary elevation parameters that were associated with them that were found using values for the same habitat types in the lower slough. Other habitat types were based on necessary hydrological requirements given the current topography, current stream elevation, and upper extent of potential tidal influence. Once this theme was created it was interpolated to a surface using the spatial analyst extension. A spline tension interpolation was used, as it best approximated the idealized topography. The legend editor was then used to set the interval to 2 feet with the same number of breaks and same color scheme to match the current topography theme. The map calculator was used to subtract the created topography from the current topography to get a theme of the differences. This difference theme was given a blue color ramp and broken down into one-foot intervals from 0 to 12. Using the map query function two-foot elevation difference slices were taken from the difference theme. For example all the cell values between 0 and 2 feet on the difference theme are on the golf course. To specify the golf course area the golf course polygon was converted to a grid theme, which could then be queried against the difference values. The results of these operations were number of cell values, accessed from the attribute table, for each difference interval theme. Thus number for the cells between 0 and 2 feet, a number for the cells between 2 and 4 feet, etc. These values were entered into an excel spreadsheet and converted using the known cell size to an area. The area was multiplied by the average depth for that difference, i.e. 1 foot for the 0-2 foot theme, giving a volume. These volumes were then summed up for all the difference themes that were tabulated, giving a total number for soil removal.

The calculations for soil removal on the green golf course were done by hand as not many topography changes were made. It was simply enlargement of the riparian area and creation of some ponds. The current general width of the creek was assumed to be 6 feet, and this would be widened to 20 feet. It was assumed that the creek bed was 3 feet deeper than the surrounding fairways. Pond volumes were calculated by obtaining the area from the GIS and assuming the depth would be 3 feet deeper than the current creek bed. In the volume calculations for the ponds and riparian areas the current volume of creek, 6-feet by 3-feet assumption, was subtracted for a more accurate number.

It must be remembered that all calculations are extremely rough, the initial map used was a three-meter DEM. This was interpolated to a higher resolution, which is not entirely accurate to the actual current site elevation. In creating the future elevations, elevation points were entered and interpolated, giving an elevation surface that is a rough approximation. Given this extreme variability the numbers are primarily for comparison between plans and not for general factual value.

The water holding capacity was calculated for each plan. The volume for the current golf course was calculated (Lawrence, 1983) by assuming a water depth of +1.5 feet depth above creek bottom. This corresponded to +9 feet MSL at the upstream end of the golf course and +8.5 feet MSL at the lower end. To have comparable numbers, the water holding capacity for palustrine and green golf course alternatives was calculated using a water depth of +9 feet MSL across the site. For the full and partial estuarine alternatives a water height of +8 feet MSL was used, this assumed to be maximum height as it is the winter berm height.

The calculations were done using the created topography theme for each plan. Using the map query function, all the cells within a selected elevation range were selected, such as 2 to 4 feet, 4 to 6 feet, etc. The new theme for the query was then queried against the golf course grid to obtain cells within the specified elevation range within the golf course. The number of cells was obtained from the attribute table. In Microsoft Excel, values for area were calculated, given the known cell size. The volume was calculated from the hypothesized water depth and the elevation range of one queried theme. The average depth of water over these pixels was then obtained and multiplied by the area. This was done for each elevation section, then they were all summarized together.

Water volume for the green golf course alternative was done by hand, given that most of the topography does not change. The length of creek was tabulated and using an assumed width of 6 feet the volume of water calculated. The area of the ponds to be created was found with the tabulate area function in spatial analyst and multiplied by an assumed depth of 3 feet less than the creek bottom. Again these numbers are rough calculations and for comparison only, especially as three different techniques were used to obtain values for different scenarios.

Appendix E: Costs

To determine the potential cost of each enhancement alternative we outlined the primary expenses associated with configuring the site to the required conditions. As is common is cost assessment, many expense values were derived from estimates given by local construction cost experts. Since enhancement of the site has not yet begun, we could not request firm cost bids from local contractors. Therefore, consultants would only provide rough first-glance cost estimates, and requested anonymity.

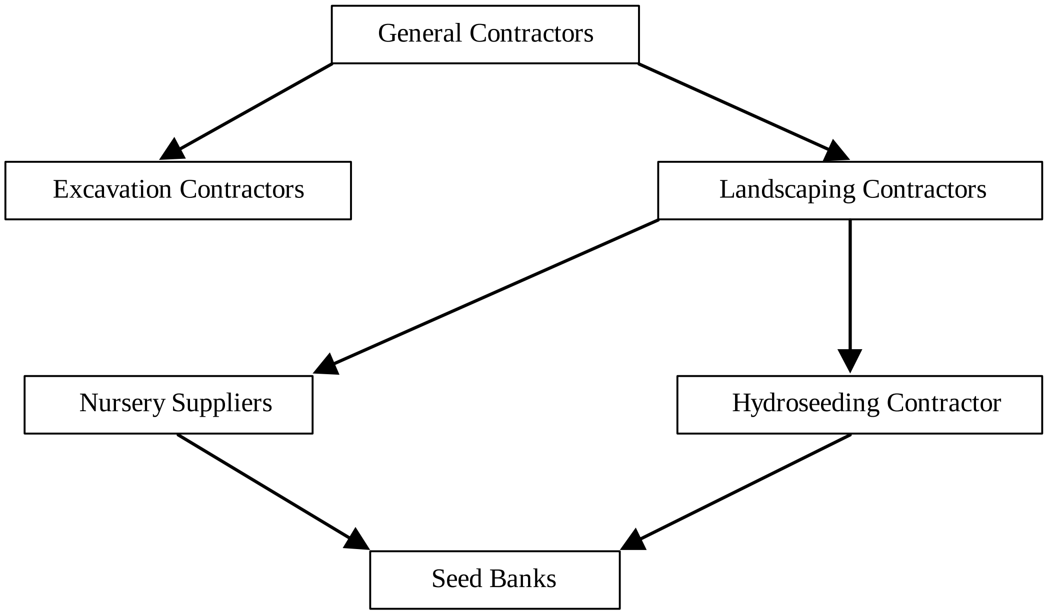
Land Acquisition

The current owner of the property wishes to maintain the site as a functional golf course. Therefore, any plan to significantly restore the site will require acquisition of the site. No recent appraisal of the site exists. However, from values considered for the site in 1993 negotiations between UCSB and the owner under profoundly different circumstance we estimate that the site is valued at less than $10 million.

Construction Activities

The estimation of construction activities requires the involvement of various levels of contractors and sub-contractors (Figure E-1). Conventionally general contractors are responsible for overall project management. This involves accumulation of cost estimates from sub-contractors, as well as coordination of efforts on the job site. We consulted five separate general contractors, thirteen excavation sub-contractors, twelve landscapers, eight nursery suppliers and four seeding banks from Santa Barbara and Los Angeles. Three civil engineers were consulted prior to deciding upon the construction of the bridge over the culvert. They also aided in the determination of cost estimates for bridge construction.

Figure E-1



These sources provided information regarding the process involved in bidding as well as some of the specifics involved in each of the major construction activities. The process of determining cost values began with discussions on the specifics of the different activities. General cost estimates were then discussed for scenarios where there were no mitigating circumstances. Site-specific characteristics were then discussed with an eye towards how these characteristics might influence the cost values. Site–specific cost estimates were then elicited from the different sub-contractors from a description of the job site. These estimates were then used to create the range of dollar values presented in the report.

Excavation and Removal of Fill

Though the process of bidding was not possible, the costs associated with excavation and removal were determined through consultation with 13 different excavation sub-contractors in the Santa Barbara and Los Angeles area. Other projects, such as the Ash Avenue Project, which involved the movement of earth were also consulted. It is of interest to note that the high end value comes from estimates made for the Carpinteria Salt March Restoration Project, while the low end estimate come from the two different construction cost estimators.

The cost of soil removal can be broken down into two major components, excavation and disposal. Each of these can vary depending upon different assumptions regarding the site. Particularly relevant to our study site are the water content of the soil and the location of disposal. High water content can dramatically increase the expense of excavating and removing fill material. We expect the fill of the seasonally flooded Ocean Meadows site to have high water content, particularly at elevations near the water table. Furthermore, large amounts of vibrations that can occur as a result of construction activity bring water to the surface through percolation. The per unit soil removal cost is also strongly dependent upon the cost of transporting fill materials. This portion of the cost, which can be larger than the cost of excavation, depends upon the distance of the relocation site from the excavation site. It is complicated by the potential of selling the fill material to local contractors, who will usually arrange for the material to be transported off-site.

Bridge Construction

Two of the enhancement alternatives require replacement of the low water crossing at the south end of the site with a small two-lane bridge. The construction of a bridge was selected over a culvert because due to ecological considerations; structures with hard bottoms may restrict movement of organisms. To determine this cost, we consulted contractors as well as with a county civil engineer.

Revegetation

Because hydroseeding is less expensive than hand planting from containers, this method was used in calculating costs for species available from S & S Seeds, a native seed supplier in Carpinteria, CA. The remaining species proposed for inclusion in revegetation of the site were included in cost calculations of hand planting from containers. Appendix B provides a complete list of native plants potentially associated with wetland creation at the study site, arranged according to planting method.

Hand Planting (from containers)

Planting from container is estimated to cost a total of $7- 10/ plant (Hubbard, personal communication). This estimate includes all costs associated with hand planting, including purchasing or growing and labor. For the purposes of comparing between alternatives, an estimate of $7/ plant was used in calculating costs.

For each alternative, the total number of container plants included for revegetation was calculated using an estimated spacing distance between plants that is dependent on the species included in each wetland habitat type. The average spacing distances included in the table below were decided upon for each habitat type after consultation with a local restoration ecologist (Chirman, personal communication)

Table E-1: Recommended Spacing Distance Between Plants Established From Containers According to Habitat Type	
Habitat Type	**Recommended spacing (average distance between plants, in feet)**
Estuarine emergent wetland (Persistent)	3'
Estuarine emergent wetland (Nonpersistent)	3'
Transitional Community	3'
Palustrine emergent wetland (Persistent)	3.5'
Palustrine emergent wetland (Nonpersistent)	3'
Palustrine forested wetland	20'
Palustrine scrub- shrub wetland	6'

The area of created wetland habitat type (feet^2) was divided by the average distance between plants (plant/ feet). The total number of plants was calculated by summing the number of plants per habitat type among all habitat types included in the alternative.

Hydroseeding

S & S Seeds, a native seed supplier in Carpinteria, CA, estimated the cost of supplying native seeds of species selected to be established at the study site by hydroseeding. Estimates were made using information of species included in each habitat type and estimated area of coverage (i.e. area of habitat type, as delineated in each alternative), with the assumption that seed would be collected on- site (in the vicinity of the study site). Cost estimates also include the price of cleaning and storage of seed for one season. The following mixtures of species were included in estimates of securing seeds for hydroseeding purposes. We have included the reported cost per pound per seed mixture. The number of pounds needed per acre varys between 15 and 33 pounds.

Estuarine emergent wetland (persistent) ($565 per pound): *Atriplex lentiformes; Frankenia salina; Scirpus robustus; Scirpus maritimus; Salicornia virginica; Scirpus californicus*

Estuarine emergent wetland (nonpersistent) ($492 per pound): *Cressa truxillensis; Juncus bufonius var bufonis; Atriplex patula ssp. hastata*

Transitional Community (estuarine/ palustrine hybrid wetland) ($414 per pound): *Scirpus robustus; Salicornia virginic; Cressa truxillensis; Limonium californicum*

Palustrine emergent wetland (persistent) ($1,550 per pound): *Malvella leprosa; Scirpus californicus; Scirpus acutus; Typha domingensis; Cyperus eragrostis; Leymus tritocoides; Sparganium eurycarpum; Juncus mexicanus*

Palustrine emergent wetland (nonpersistent) ($930 per pound): *Cressa truxillensis; Epilobium ciliatum; Camissonia micrantha; Juncus bufonius var bufonis*

Palustrine scrub shrub wetland ($1,254 per pound): *Leymus condensatus; Eriogonum parviflorum; Toxicodendron diversilobum; Artemesia douglasiana; Artemesia californica; Rhamnus californica; Baccharis pilularis; Solanum douglasii; Rosa californica; Phacelia ramossisima ssp austrolittoralis*

Species included in Habitat Types A (estuarine aquatic bed) and G (palustrine forested wetland) were not identified to be appropriate for establishment by hydroseeding.

For each habitat type, the amount of seed in pounds per acre for each species was recommended by S & S Seeds with information on species mixes to be seeded within each created wetland habitat. From this estimate we calculated, for each alternative, the number of pounds of seed of each species per habitat type based on the mix of species and amount of seed of each species recommended. S & S Seeds provided a maximum cost per pound for each species, based on the minimum amount (pounds) of seed required. S & S Seeds generally charges less as the amount of seed purchased increases, so this cost per pound is considered to be the maximum estimate. The cost per pound was multiplied by the number of pounds for each species in all habitat types to estimate the total cost of securing seed for revegetation.

The costs associated with application of seed were not included in the cost estimates for hydroseeding. Application costs are likely to be more similar across the alternatives than the cost of supplying native seed mixtures for revegetation efforts.

Appendix F: Watershed Context

Human activities within the watershed impact the Ocean Meadows Golf Course site. These include urban development, agricultural growth, and recreation; all of which may impact water quality, sedimentation, runoff, and enhancement efforts. To give a more thorough understanding of how the study site is impacted by the surrounding watershed, key processes within the watershed will be analyzed. First, we detail the current impacts from watershed activities to the site will be detailed. Second, we exam the impacts from new housing developments in the watershed will be examined, and analyze of future predicted trends.

Current impacts

Water quality is highly dependent on the processes, natural and anthropogenic, that occur in the watershed. The type of climate, geology, and vegetation play a large role in the amount of water and sediment that move down the watershed. In this case the watershed is a small steep coastal range that is fairly young and highly erosive. This is compounded by the lack of vegetation, given the dry climate and highly erosive winter rains, which results in large pulses of sediments moving downwards during large winter events. This situation tends to be exacerbated by human changes to the landscape. Primarily this includes removal of vegetation and expanding urbanization. These cause a higher proportion of the rainfall to become runoff in a shorter amount of time.

Given that urbanization may also contribute pollutants in the form of metals, chlorinated pesticides, volatile organic compounds, and bacteria from waste, these pollutant levels will also be increased as runoff increases. The Devereux watershed is predominantly developed, with 63 % of the area in roads, residential, commercial, and industrial, and another 21% in agriculture and golf courses (de la Garza and Ryan, 1998). No systematic survey of water quality has been done for this watershed. However Santa Barbara County has recently initiated water quality testing in streams around the county including Devereux Creek. The first large rain of the 1999/2000 rain season showed large pulses of bacterial contamination, well above levels of beach closure. No pesticides or volatile organic compounds were found, levels of metals were under EPA standards (but copper and lead were above the chronic exposure limit) and no oil or grease was found.

The amount of runoff has increased approximately a 30% rom the 1920's (Davis et al., 1990). There is little information on the sedimentation that occurs in the watershed. Santa Barbara County flood control removes approximately 7-acre feet of accumulated sediments every 3-5 years above Ocean Meadows Golf Course. Sedimentation in the lower slough has occurred from runoff of the south parcel, adjacent to and south west of the golf course. This sedimentation was a result of grading and removal of topsoil for the golf course construction. A fan delta was created that displaced 6.5% of the basin volume at 6.5 feet MSL. This sedimentation problem was arrested when erosion controls, berms and ditches, were placed on the south parcel. There is no measure of what the "normal" level of sedimentation may be, again keeping in mind that high levels would be expected from a steep coastal, erosive, watershed.

The South Parcel, owned by UCSB and currently under consideration for development, was scraped in 1965 to provide fill for the golf course. Subsequently the University constructed five diversion ditches draining to a sediment catch basin, which is currently full. The site is still vacant, and now heavily networked with dirt bike trails and footpaths. These trails increase erosion from the site substantially, particularly the trails that cross the steep banks of the diversion ditches. In addition, the disturbances appear to make the soils of the parcel hypersaline: samples collected of recently exposed soils on the site were much more saline than samples of vegetated undisturbed soils on the site. This salinity may inhibit revegitation of the disturbed areas (Wallace Roberts and Todd, 1997). Contrarily, disturbance from recreationists may also encourage growth of aggressive disturbance-following plants, such as fennel (*Foeniculum vulgare*) and black mustard (*Brassica nigris*).

Some possible contamination may occur from the oil tanks located on the parcel to the south west of the Ocean Meadows golf course. Some levels of total recoverable petroleum hydrocarbons were found in the dune pond that is connected to the lower slough at a water level of 5.6- feet. MSL (Harding Lawson Associates, 1993). This may result in some contamination into the lower slough, which, with mixing and tidal flushing may circulate up into any restored estuarine areas in the golf course site. This does not appear to be causing large problems in the lower slough at this time and most is probably cleaned out and diluted to very low levels with the onset of tidal flushing.

Future Trends

There is the potential for future growth in this watershed, with the possibility of increased impacts on the Ocean Meadows Golf Course site. A large residential community may be built on Monarch Point, the area to the west of the golf course. Other commercial and residential building has occurred or is currently occurring, such as the El Paseo shopping complex, commercial building on Hollister and the apartment units behind these. As of 1998, 11% of the watershed, approximately 256 acres, was zoned for residential that was currently not developed. As mentioned previously the University may build housing on the parcels immediately surrounding the golf course.

A report assessing the hydrologic and hydrochemical impacts of full University build-out and a partial build-out scenario was done (de la Garza and Ryan, 1998). Using a land cover type runoff model it was predicted that for average antecedent moisture conditions and full development the runoff would increase 2.7%, while an analysis of pollutants showed an increase of 1-5%. This is for 83 acres of student and faculty housing. Several of the commercial and housing projects mentioned earlier would be or are large projects. The Camino Real complex, including Costco, is 72 acres. In general any increase in stream discharge will allow for higher levels of sediments to be carried down the watershed, potentially causing filling and sedimentation to the lower watershed.

As parcels immediately surrounding the golf course are developed, impacts from exotic plants and animals will become an increasing problem at the site. Housing developments are commonly planted with non-native landscaping trees and shrubs, and seeds and cuttings from these plants wash into drainages. Also, developments often give rise to additional human-caused disturbance of accessible non-developed areas, such as creek banks and open parcels, can create opportunities for aggressive disturbance-following plants. These plants have the potential to invade restored areas on the golf course site.

Pets associated with housing developments may also disrupt natural systems restored to the site. Dogs and cats dig up planted native vegetation and catch small birds, reptiles and mammals. Although dogs may be successfully eliminated from the site though exclusion regulations, cats can only be controlled through aggressive trapping and community outreach.

It must be kept in mind that predictive changes in the watershed due to growth are difficult to make. We can say that generally increased growth can and has increased the levels of runoff and pollutants. However future projects may have better mitigation to help control these problems, with catch basins and water quality testing mandated in the project.

Appendix G: Rejection of a Fully Tidal Alternative

Various stakeholders have been proposed by various stakeholders that the mouth of Devereux Slough be opened (Davis et al., 1990), and forced to stay open, to allow permanent tidal influence. The possibility of a *fully tidal alternative* was dismissed as infeasible for a number of reasons, all of which will be outlined below. To summarize the proposed plan, extensive dredging of the golf course site would also be required to allow tidally influenced waters to reach the upper slough. The primary motivation for this proposal is the hypothesis that the slough was historically fully tidal (Lafferty 1999), as evidenced by the presence of open estuary shells found in limited soil cores, and increased diversity found in coastal inlets with regular saltwater influx.

This proposed alternative was rejected as infeasible for reasons listed below.

1. *Lack of Historical Evidence* – Although there has been speculation that the Dereveux Slough was historically open to the ocean, there is no direct evidence of this (Davis et al., 1990). Nineteenth century maps, and early 20th century aerial photographs (Figures A-1 through A-6) depict the Slough separated from the ocean by a berm. Shells occur in deposits at various locations in the slough, at an elevation above sea level, but it is unknown whether the shells reflect an ingenuous mudflat fauna, or a reworking and secondary disposition of shells deposited from older marine terraces (Stone Geologic Services, 1965).

2. *High Maintenance* – Due to the speed at which the Devereux Slough is blocked from the tidal influence following a breakout, an extensive and continual dredging project would be needed to artificially keep it open. A rock groin, or jetty, have been proposed as alternatives for keeping the breach open, but each of these would have large, unknown implications on local and down-current marine and terrestrial systems. The predominantly north-south longshore current along California continually moves sediment across the location of breach openings, causing them to quickly fill in unless the estuarine outflow is strong enough to prevent this. The outflow of water from the Devereux Slough is generally not large enough to keep the breach open for long periods of time (Davis et al., 1990), causing the barrier to quickly reestablish itself.

Davis (1990) recommended in the 1990 University of California, Santa Barbara Campus Wetland Management Plan to preserve the current tidal regime because of the rapidity at which the beach barrier can establish itself, even after large breakouts due to heavy storms. The author saw "no good reason to alter this regime, especially given the difficulty of predicting the physical or biological effects of such alterations."

3. *Exorbitant Costs* – It is likely that any connection to the ocean necessitate frequent mechanical maintenance. This frequent manipulation will require the regular deployment of heavy machinery to continually dredge the slough opening, and could cost in excess of $1,000,000 per deployment.

4. *Uniqueness of Devereux Slough Wetlands* – Local biologists have stated that the Devereux Slough should not be converted to a tidally influenced estuary because of the uniqueness of wetland habitat currently found there (Ferren, 1999). The slough supports many rare plant species, and offers a unique estuary habitat characterized by hyper-saline summers and diluted winters; habitat that is not found elsewhere in the surrounding regions.

Appendix H: Legislative Jurisdiction and Permitting

The implementation of the scenarios presented in this report will require cooperation of the agencies under whose jurisdiction it falls. Enhancement activities will require permits at the Federal, State and Local Levels. Table H-1 adapted from Ferren et al., 1997.gives a brief overview of some of the laws and agencies that may impact wetland restoration.

Table H-1. Major Legislation Relating to Wetland Restoration		
Name of Document or Law	**Administered by**	**Authority**
Federal Legislation		
• Rivers and Harbors Act (Section 10) – 1899	• Army Corp of Engineers	• Corps issues permits for projects affecting navigable waters
• US Fish and Wildlife Coordination Act - 1958	• US Fish and Wildlife Service	• Lead federal agency must consult with USFWS before decision
• Clean Water Act - 1964	• Regional Water Quality Control Board (Section 401 and 402) • Army Corp of Engineers (Section 404) • EPA (Section 404)	• Water quality certification for Section 404 (Section 401); • Discharge into waters of US (Section 402) • Filing of wetlands (Section 404)
• National Environmental Policy Act – 1973	• Federal lead Agency, depending upon project	• Analyze impacts of projects that involve federal actions
• Endangered Species Act - 1976	• US Fish and Wildlife Service •Nat l Marine Fisheries Service	•Action relating to endangered species
State Legislation		
•California Environmental Quality Act – 1970	• State or local agencies, depending on project	• Analyze impacts and mitigation due to projects; state and university role as "Trustee Agency"
• California Fish and Game Code	• California Department of Fish and Game	• Action that result in alteration of stream (Section 1601)
• California Endangered Species Act	• California Department of Fish and Game	• Establish lists of threatened and endangered species and evaluates proposed "take" of such species
• Coastal Act - 1976	• California Coastal Commission (and local planning agencies through Local Coastal Programs)	• "Development" in the Coastal Zone which encompasses all areas within 1 mile of the coast
Local Legislation		

• Flood Control Regulations	• SB County Flood Control District • National Resources Conservation Service	• Provide flood protection (Various federal and state laws)
• Local Coastal Program – City of Santa Barbara and Santa Barbara County	• SB City Planning Division and Santa Barbara County Planning and Development Department	• Administer the Coastal Act on a local level through Local Coastal Programs
• Santa Barbara County Comprehensive Plan/Elements	· *Santa Barbara County planning and Development Department*	• State Planning and General Plan laws

Influencing Agencies

Six agencies will primarily influence enhancement activities at the Ocean Meadows Golf Course: the Army Corps of Engineers, US Fish and Wildlife, California Fish and Game, the California Coastal Commission, the County of Santa Barbara Department of Planning and Development and the University of California Natural Reserve System.

Army Corps of Engineers

The US Army Corps of Engineers regulates activities in the "waters of the United States" pursuant to section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act. The Army Corps will issue permits for the excavation of the golf course due to the presence of creeks on the site. Moreover, permits would also have to be issued for alterations made to the creek.

US Fish and Wildlife

The US Fish and Wildlife Service manages fish and wildlife resources on federal lands, regulates migratory species, and manages federally listed or candidate endangered and threatened species. This agency's authority comes from the Endangered species Act of 1976. There is a strong likelihood that current species that exist on the site could be effected by alteration activities that occur on our study site. Furthermore, permits may be required to disturb the migratory birds that currently forage on the golf course.

California Department of Fish and Game

The California Department of Fish and Game manages rare species and their habitats under the California Endangered Species Act. Alteration of the habitat of California threatened and endangered species, or any expected 'taking' of a listed species, if any, on the site will require permits from CDFG.

California Coastal Commission

According to Proposition 20 (Coastal Initiative, 1972), the California Coastal Plan (1975) and the Coastal Act of 1976, the California Coastal Commission has jurisdiction over the Coastal Zone, a three mile-wide strip of land extending inland from the mean tide level. Consequently, the Coastal Commission will be responsible for permitting any alterations required by the scenarios. This includes excavation, alteration of creek beds, revegetation, culvert removal and bridge construction.

Specifically, under sections 300231, 30233, 300411(b) and 30607.1 of the California Coastal Act, the Commission is responsible for promoting the restoration of wetlands. We cautiously expect Commission approval of any restoration and enhancement activities at the Ocean Meadows Golf Course Site.

County of Santa Barbara, Department ofPlanning and Development

This department has broad responsibilities for the preservation, management, and the development of natural resources in the Santa Barbara area. Implementation of enhancement plans on the site will require consultation with the county, particularly with regard to bridge construction, excavation and the creek bed alterations. The County has already shown interest in the development of this project.

University of California Natural Reserve System

The mission of the Natural Reserve system is to "contribute to the understanding and wise management of the earth and its natural systems by supporting university-level teaching, research and public service at protected natural areas throughout California" (UC NRS, 1991). The NRS maintains the Coal Oil Point Reserve, directly south of the course. Enhancement activities on the site may benefit species found in the reserve, as this project may provide a vehicle for expanding the area protected as natural habitat.