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Wetland buffers in the Monterey Bay Region : a field study of function and effectiveness

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**WETLAND BUFFERS IN THE MONTEREY BAY REGION:
A FIELD STUDY OF FUNCTION AND EFFECTIVENESS**

A Thesis

Presented to

The Faculty of the Department of Geography and Environmental Studies

San Jose State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

by

Rosemary Dyste

December 1995

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ABSTRACT

WETLAND BUFFERS IN THE MONTEREY BAY REGION: A FIELD STUDY OF FUNCTION AND EFFECTIVENESS

by Rosemary Dyste

This thesis addresses the topic of wetland buffers in the Monterey Bay region. The purpose is to analyze how buffer zones protect wetlands from adjacent development and to examine the effectiveness of regulated buffers in the study region. Selected characteristics of 15 buffer zones are recorded, as well as the history and regulatory background of the sites.

This research shows that while the buffer width required by regulating agencies in the study region is 100 feet, the actual average width of the sites varied from 25-186.5 feet. Eight sites were maintained in a natural condition, 5 have been revegetated with native species, and 2 have plans for revegetation. Functions that the buffers provide include preventing erosion into the wetland, wildlife habitat features, and some limited control of public access. The study concludes with recommendations for improving buffer function and the permitting process and maintaining buffer sites.

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CHAPTER 1

INTRODUCTION

Wetland restoration and protection is a significant issue in California due partly to the cumulative loss of 91% of wetland area between the 1780s and 1980s and to a recognition of wetland values by the public and government (U.S. EPA 1992a; Josselyn 1982). The need to sustain existing systems and restore or construct others is especially critical on the California coast because of severe habitat fragmentation and loss. Coastal California, prior to 1900, included 300,000 acres of wetlands; now, fewer than 79,000 acres remain (U.S. EPA 1992b).

In response to this loss and to manage the long-term problems associated with unmanaged growth along the coast, California voters passed a "Save the Coast" initiative in 1972 that eventually led to the California Coastal Act of 1976 (Cal. Pub. Res. Code 30000 - 30900) and the formation of the California Coastal Commission (CCC). Under the Act it is state policy to maintain, and where feasible, restore, the biological productivity and quality of wetlands and estuaries (Horsley & Witten, Inc. n.d.). The Act requires that every coastal city and county prepare a Local Coastal Plan (LCP) that describes its specific policies for protecting coastal resources and managing future development. The CCC must approve LCPs before they go into effect (U.S. EPA 1992b).

The Commission has extensive regulatory authority over coastal land-use issues in the state. Before a permit is issued for development near a coastal wetland, the Commission

may require demonstration that there is not a feasible less damaging alternative, that measures will be taken to minimize impacts, and that the functional capability of the wetland is maintained or enhanced (Kusler et al. n.d.). To protect wetland resources, the CCC may require mitigation efforts to offset adverse impacts of development adjacent to wetlands; furthermore, they may require a buffer zone (i.e., a bordering strip of natural land) to separate environmentally sensitive areas from development.

The California Coastal Act of 1976 does not contain specific requirements for buffer widths; if a buffer is imposed, the width is determined on a case-by-case basis using standards contained in the CCC's 1981 Statewide Interpretive Guidelines. The suggested standard is a minimum of 100 feet (30.5 meter) for the buffer (CCC 1981) despite the lack of scientific support for the effectiveness of a 100-foot buffer. A few other state agencies and commissions have developed width regulations governed by the type of wetland and the presence of endangered species, but limited data are available as to the type and size of buffer zones and their value (Shisler 1990).

The use of buffer zones between wetlands and upland development can be a controversial topic because buffers are sometimes in areas not regulated by federal and state agencies. Landowners often consider such uplands as developable property; however, resource agencies sometimes require buffers as a part of approved land-use plans. Thus, the nature, size, and use of the buffer zone can become a subject of intense debate, fueled by the lack of scientific information on the effectiveness of various buffer configurations (Josselyn et al. 1990).

Function of Wetland Buffers

Introducing development adjacent to a naturally occurring wetland system has the potential to interfere with natural conditions and introduce new elements that could adversely impact the system. While a variety of methods may be used to protect the wetland from adjacent development, imposing buffer zones is one technique to potentially lessen the negative impacts of development adjacent to wetlands.

Buffer zones provide a variety of functions to prevent the potentially negative impacts of development, maintain the naturally occurring wetland system, and even enhance the human appreciation of wetlands. Vegetated wetland buffers prevent potential development impacts by diminishing runoff and erosion and filtering harmful substances (Shisler et al. 1987; Dunne 1978). Buffers reduce the adverse impacts of human disturbance to the wetland by blocking noise and light, discouraging trampling and garbage dumping, and acting as a visual screen to limit easy uncontrolled access to the wetland (Young 1989). Vegetated buffer strips maintain the wetland system by moderating water level fluctuations, slowing the rate of storm water flow, and encouraging infiltration (FEMA 1981). Buffers also maintain the wetland as wildlife habitat by providing habitat for species using the wetland-upland ecotone and by shielding wetland species from disturbance (Castelle et al. 1992). Wildlife use wetland edges for feeding, denning, nesting, and as travel routes during migration (Porter 1980). Buffers can enhance the human appreciation of wetlands by providing a space for controlled access to the wetland. Controlled access to the wetland and upland area can be provided

in the buffer with fences, paths, and observation platforms. Such access features can increase the educational, recreational, and aesthetic value of wetlands for humans.

Features of buffer zones may include fencing to keep out humans and pets, vegetation and berms to reduce noise and visual intrusion, and open water to separate pedestrians from wetlands. Buffers vegetated with native trees and shrubs may be the most beneficial, as they also provide for wildlife habitat (Josselyn et al. 1990).

Researchers have used a variety of approaches to assess the adverse impacts on wetlands from adjacent land uses and to determine an appropriate buffer width. Research has focused on the use of buffers to reduce impacts of specific land uses such as silviculture, agriculture, and recreation. Buffer effectiveness is often measured by using biological, chemical, and physical components to assess wetland impacts (Broderson 1973; Wong and McCuen 1982; Phillips 1989). Methodologies include monitoring water quality and quantity, examining plant and animal species distribution, monitoring habitat quality and composition, and measuring levels of human use (Shisler et al. 1987; State of Washington Department of Wildlife 1992).

To determine the success of regulated buffer zones, it would be necessary to prove that they are performing their intended functions. Ideally, to measure buffer function, the researcher would need detailed baseline information on a “pristine” wetland system with surrounding undeveloped upland area to make pre-and postdevelopment comparisons. It would also be necessary to have historical data on the hydrological regime, species counts, and vegetation studies. In addition, this information would have to be collected for all

wetland types in the study area and it would be helpful to have a control wetland nearby where buffers were not imposed. A study of this magnitude is extremely expensive and time consuming. An alternative approach is to gather data on buffer function indicators; parameters which assess whether a buffer is fulfilling a larger function. Such indicators include the presence of erosion, human intrusion, wildlife use, aesthetic enhancement, and water ponding in the buffer.

Purpose

The purpose of this study is to analyze the extent that buffer zones protect wetlands from the human impacts of adjacent development and to begin an investigation of the effectiveness of recommended buffer widths in the study region. This work was accomplished by collecting data on buffer function indicators on fifteen wetland buffers in the Monterey Bay region (Table 1). The study area roughly coincides with the area selected for the Coastal Commission's Regional Cumulative Assessment Project (ReCAP) Pilot Project (1994). The ReCAP study assesses the cumulative impacts of development on wetlands, coastal hazards, and public access. ReCAP's preliminary report (1994) found that wetland resources in the study region have suffered significant adverse impacts over time and the lack of readily available and useable data has hampered the management of wetland resources in the study area. The effectiveness of wetland buffers is identified as a problem in the study region because natural vegetation adjacent to wetlands has diminished over time leading to a chronic loss of transitional habitat and a hardening of wetland edges. The information collected on wetland buffers in this field study will supply

Table 1. Wetland Buffer Field Study Sites

Site No.	Name of Wetland	Site Location	Project Description
1	Neary Lagoon	End of Chestnut Street, Santa Cruz	Multifamily Residential
2	Neary Lagoon	Near Bay Street, Santa Cruz	Wastewater Treatment Plant
3	Corcoran Lagoon	West Side of Coastview Drive, Santa Cruz County	Single Family Residential
4	Moran Lake	Near Palisades Ave and East Cliff Drive, Santa Cruz County	Single Family Residential
5	Struve Slough	Off Westridge Drive, Watsonville	Business Park
6	Struve Slough	Near Main Street and Green Valley Rd, Watsonville	Commercial
7	Struve Slough	Pennsylvania Drive, Watsonville,	Multifamily Residential
8	Blohm-Porter Marsh	Off 466 Elkhorn Road, North Monterey County	Minor Subdivision
9	Moro Cojo Slough	Highway 1 and Moss Landing Road, North Monterey County	Commercial
10	Moro Cojo Slough	Moss Landing Road, North Monterey County	Mixed-use Retail/Residential
11	Moro Cojo Slough	Off 400 Castroville Blvd., North Monterey County	High School
12	Marina Vernal Pond 1 (Robin Drive Pond)	South of Robin Drive, Marina	Single Family Residential
13	Marina Vernal Pond 3 (Marina Landing Pond)	Reservation Road and Beach Road, Marina	Commercial
14	Marina Vernal Pond 7 (Lake Drive Pond)	West of Lake Drive, Marina	Single Family Residential
15	Laguna Grande	Near 1350 Del Monte Blvd., Seaside	Commercial

data on the level of erosion, wildlife use, human activities, moderation of water level fluctuation, vegetation characteristics, buffer width, buffer goal statements, and buffer maintenance. These data will provide a portion of the information necessary for better management of wetland resources in the study region.

Research Questions

The research in this thesis was guided by two types of questions: those relating to buffer function effectiveness and those relating to effective permitting of buffer size. The specific buffer function questions were:

1. *How well do current buffers prevent human impacts from adjacent development, as measured by human presence, wildlife, vegetation and erosion indicators?*
2. *What features of the buffers seem to limit human impacts?*

Permitting questions include:

1. *Do buffer widths meet the regulatory requirements?*
2. *Are wetland buffer goals established for each buffer?*
3. *Has the buffer changed over time and do the permits require monitoring or a post-development analysis of success?*

CHAPTER 2

STUDY AREA

Study Area Regional Setting

The Monterey Bay region (Figure 1), including both Santa Cruz and Monterey Counties, is an ideal geographic area in which to study the effectiveness of and impacts to wetland buffers. The diversity and natural beauty of the landscape of both counties makes them a desirable place to live, leading to extensive development and regional growth. While management plans and restoration projects have been prepared or are being prepared for many of the area's diverse range of wetlands (CCC 1994), they are under the continuous pressure of development and human population growth. This combination of a desirable natural setting, development pressure, and the fairly high level of commitment that local governments show towards preserving their wetland resources makes the Monterey Bay area an ideal region to study the use and effectiveness of wetland buffer zones.

The Monterey Bay area encompasses mountains, forests, sand dunes, and beaches. The coastline is home to rare forests of redwoods, pines, and cypress, developed and undeveloped dune systems, extensive slough and wetland complexes, and large tracts of rare and endangered species habitat (CCC 1994). The diverse array of wetlands in the area includes coastal lagoons, large slough complexes, salt and freshwater marshes, lakes, and rivers. Wildlife found in the wetland and slough complexes of Monterey Bay include

Fig. 1. Map of Study Region

Source: U.S. Geological Survey State of California Base Map 1970

small mammals, amphibians, and birds that thrive on the abundant plant life. These small mammals and amphibians make up a prey base for raptors, while insects provide food for other birds. Monterey Bay was recently named as one of the top ten birding spots in North America (Dunne 1995). In addition, Monterey Bay itself became a National Marine Sanctuary in 1992; an area of sufficient national significance to warrant protection and management by the federal government.

Recreation and tourism are important components to the economies of both counties. Land use in the area is characterized by several urban centers, surrounded by open space and agricultural land. Low density residential areas are also dispersed throughout the region. Predominant land use in the area includes agriculture, grazing, and recreation.

The population figures for the Monterey Bay region show substantial historical growth in the region with projections indicating that this growth will continue. Future trends show development in Santa Cruz County funneled to areas within the urban services line. On the other hand, potential growth in Monterey County appears to be in and around areas of coastal resources such as wetlands (CCC 1994).

Regulatory Framework in the Study Area

The California Coastal Commission (CCC) is the lead state agency charged with the regulation of development in California's coastal zone. The CCC relies on the Coastal Act for overall guidance and direction in fulfilling its responsibility. In addition to the specific provisions in the Coastal Act, in 1981 the Commission adopted the Statewide Interpretive Guidelines for Wetlands and Other Wet Environmentally Sensitive Habitat Areas (CCC

1994). The guidelines include a comprehensive set of directions to establish permitted uses in wetland areas, provide standards for determining compensatory wetland mitigation, and provide specific functional criteria establishing wetland buffers (Castelle et al. 1992). In addition, the State Department of Fish and Game (DFG) may consult with the CCC on matters related to fish and wildlife resources and guide them in determining project impacts, adequacy of technical data, and identification of appropriate mitigation or restoration measures for affected habitat (CCC 1981).

The Coastal Act. Section 31021 of the Coastal Act defines wetlands simply as lands within the coastal zone "which may be covered periodically or permanently with shallow water" (CCC 1981). Section 30001 of the Coastal Act declares (in part) that the legislature finds that the California coastal zone is a distinct and valuable resource, that permanent protection of the natural resources is of paramount concern to residents of the state, and that it is necessary to protect the ecological balance of the coastal zone and prevent its deterioration and destruction.

Parts of the Act (sections 30233 and 30240) provide general policies for development in and adjacent to wetlands, and specific policies for protection of these areas. Section 30233 states (in part) that "the diking, filling, or dredging of open coastal waters, wetlands, estuaries, and lakes shall be permitted . . . where there is no less environmentally damaging alternative, and where feasible mitigation measures have been provided to minimize adverse environmental effects" (CCC 1981). Section 30240 protects environmentally sensitive habitat areas against "any significant disruption of habitat

values” and allows “only uses dependent on such resources” within sensitive areas. Furthermore, development near sensitive habitat areas is to be “sited and designed to prevent impacts which would significantly degrade such areas, and shall be compatible with the continuance of such habitat areas” (CCC 1981).

CCC’s Statewide Interpretive Guidelines for Wetlands. The CCC hired Dr. Christopher Onuf, a salt marsh ecologist, to provide a scientific basis for the guidelines and to prepare scientifically supportable standards for protecting wetlands from land use impacts. The CCC convened a panel of federal and state agency wetland regulatory experts to review Onuf’s recommendations. Along with Onuf’s report, literature reviews, technical workshops, and informal interviews with scientists constituted the basis of the recommendations contained in the guidelines for determining buffer widths (Castelle et al. 1992). Use of the guidelines is not mandatory; rather they are intended to be viewed as a tool in reviewing coastal permit applications and LCPs for wetlands and adjacent areas.

The CCC’s guidelines define wetlands as environmentally sensitive areas or “any area in which plant or animal life or their habitats are either rare or especially valuable because of their special nature or role in an ecosystem and which could be easily disturbed or degraded by human activities and developments ” (CCC 1981). If the CCC determines that an adjacent area is necessary to maintain the functional capacity of the wetland, they may require that the area be protected against any significant disruption of habitat values. These areas may be protected by inclusion in a buffer area subject to land use restrictions or by providing a buffer around the adjacent area itself (CCC 1981).

The Commission established criteria for buffer areas to ensure that the type and scale of development proposed in an environmentally sensitive area will not significantly degrade the habitat area. Development allowed in a buffer area is limited to access paths, fences necessary to protect the habitat area, and other uses that are either beneficial or have no adverse impacts. The buffer itself is not considered a part of the environmentally sensitive habitat area. The guidelines state that the width of the buffer will vary depending upon the analysis but there should be a minimum width of 100 feet for small projects on existing lots unless the applicant can demonstrate that 100 feet is unnecessary to protect the resources of the habitat area.

Standards for determining the appropriate width of the buffer area include:

- Biological significance of adjacent lands
- Sensitivity of species to disturbance
- Susceptibility of parcel to erosion
- Use of natural topographic features to locate development
- Use of existing cultural features to locate buffer zones
- Lot configuration and location of existing development
- Type and scale of development proposed

If the project involves increased human impacts, a much wider buffer area should be required (CCC 1981).

Local coastal programs. The Coastal Act of 1976 authorized the CCC to issue Coastal Development Permits until cities and counties within the coastal zone obtain certification of their own local coastal development programs. Monterey Bay area local governments have completed a high percentage of LCPs and have been issuing coastal permit and processing program amendments for some time. Each LCP consists of a land use and implementation plan. Most local governments prepare these in two phases. A LCP does not become final until both phases are certified, are formally adopted by the local government, and are then certified by the CCC as being consistent with the Coastal Act.

Some of the certified LCPs of the Monterey Bay region include a provision for a buffer around the wetlands in their area. Specific buffer zone policies for Santa Cruz County, North Monterey County, and the cities of Santa Cruz, Marina, and Watsonville are summarized below.

The LCP of the city of Santa Cruz identifies wetlands, marshes, and seasonally flooded grasslands in a Coastal Land Use Plan. The precise boundaries of wetlands are to be determined on a case-by-case basis by a biologist with relevant training and experience in wetland boundary related issues. Construction of main or accessory structures, grading, or removal of vegetation is not permitted within 100 feet of a wetland. Construction, grading, or removal of vegetation is permitted in wetlands and within required setbacks when a restoration or management plan has been submitted and approved, and the construction or use is consistent with the approved plan. A policy for additional setback

width is provided if the additional setback is necessary to address the purposes of conservation regulations.

Santa Cruz County defines wetlands, estuaries, lagoons, and intermittent wetlands as environmentally sensitive habitat areas. The minimum setback for wetlands, estuaries, and lagoons is 100 feet for agriculture and for all compatible development measured from the high watermark. Other wetland LCP policies include restricting general public access and requiring measures to prevent water quality degradation from adjacent land uses.

The city of Marina's LCP policy prohibits development in wetlands. The only exception is access for nature observation and only if a qualified biologist determines that the impacts of construction and human observation can be sufficiently mitigated to ensure protection of rare and endangered species and their habitats. The LCP has a special section dealing with vernal pools, the only type of wetland found within the city. Vernal ponds are wetlands that form in shallow depressions that fill with rainwater during winter and evaporate by the end of spring (San Francisco Estuary Project 1991). The vernal ponds in Marina expand in the wet season and support marshy vegetation for much of the year. Several vernal ponds are in Marina's coastal zone and all but one supports a marsh. A 100-foot riparian setback is required from the edge of all wetlands in Marina.

North Monterey County identifies environmentally sensitive habitats in their Land Use Plan (LUP). Estuarine sloughs are identified as perhaps the most unique and sensitive habitat in the Monterey Bay area. The key policy for environmentally sensitive habitats is that these habitats are unique, limited, and fragile; accordingly, they should be protected,

maintained, and, where possible, enhanced and restored. The specific setback policy for wetland and aquatic habitat requires a setback of 100 feet from the landward edge of coastal wetlands, which is to be maintained in open space use. North Monterey County also recommends completing a comprehensive wetland management plan for four estuarine areas with criteria set in the management plan for setbacks to protect the wetland areas.

The field study sites selected in the city of Watsonville are outside the coastal zone and are not subject to LCP policies. The city's buffer policy contained in the 2005 General Plan (adopted 1994) states that proposed projects adjacent to, surrounding, or containing wetlands will be subject to a site specific analysis to determine the appropriate size and configuration of wetland buffer areas. In addition, the city's grading ordinance calls for the creation of a buffer 30 horizontal feet from the high water mark of a marsh or natural body of standing water.

Summary

The local governments in the Monterey Bay area recognize that wetlands are environmentally sensitive habitats and accordingly are granted protection in the form of development prohibitions and setbacks. Unfortunately, the policies do not define wetlands and how the buffer is to be measured in a consistent manner. Local governments should state who will determine the wetland boundary in cases where boundary determinations and definitions are important. The terms that are used to demarcate the buffer zone such as highwater mark and landward edge of wetland vegetation could be subject to numerous

interpretations, depending on who is making the decision. Furthermore, the LCPs should include provisions for a greater than 100-foot setback when necessary to protect the wetland resource.

CHAPTER 3

METHODS

To gain an understanding of how wetland buffers are functioning to protect the coastal wetlands of Monterey Bay, this field study was designed to collect and evaluate data on the level and quantity of human use, wildlife use, erosion, and vegetation characteristics. In addition, when possible a linear measurement was made at each site to determine if the measurements in the field match the regulated setback stated in the permit file.

The field studies were conducted in January, February, and July 1995. The sites were walked and thoroughly examined. Special features were noted on a map and the sites were photographed. All data were recorded on a standardized form. A Rolatape™ was used to measure distances and 7 x 35 binoculars were used to identify birds. Specific data collection methods are given below.

Methods of Data Collection

Human use. Human caused disturbances including dumping of garbage and yard waste, campfires, trails, vegetation removal, and evidence of adjacent development (e.g., backyards) extending into the buffer area were counted and recorded. Human activities within the buffer that would enhance the human experience including interpretive signs and controlled public access features were also recorded.

Wildlife use. Evidence of wildlife use was recorded by observing the availability of structural features such as snags, cavities, brush, and cover. Nests, trails, droppings, and

burrows were also noted. The wildlife observations were made mainly during the winter months in either the morning or the afternoon. Two sites were revisited with observations made during the summer. Wildlife species (mainly birds) seen at the time of the field visit were identified if possible and counted. Species heard but not seen were noted. The presence of domestic pets or feral animals was also reported on the field form.

Erosion. Erosion was recorded by examining the site for rills, shallow gullies, or deep gullies. Rills are defined as cuts in the soil less than 3 inches in depth, shallow gullies as incisions in the soil 3-6 inches in depth, and deep gullies as incisions in the soil greater than 6 inches in depth (Baker and Haemmerle 1990). If a rill or gully was found, the depth, length, and width was measured and the number counted.

Vegetation characteristics. Vegetation cover, height, and type in each buffer was determined by using a Rolatape™ measuring device, a random number table, and a 1m x 1m quadrat. The location of the quadrat was determined by selecting a random number from the table and wheeling that number in feet with the Rolatape™. This procedure was repeated until either the buffer area was fully traversed in a zigzag pattern or at least 20 times, whichever came first.

Vegetation characteristics were visually estimated and recorded at each quadrat location on a vegetation survey form. The data gathered at each quadrat site included percent cover, average height, and percent vegetation type. Percent cover and percent vegetation type were measured by visual estimation to the nearest 5 percent. Average height was measured for all vegetation types at the quadrat location with a yardstick at

least 3 times and averaged to the nearest half inch. Heights above 6 feet were estimated to the nearest foot. Vegetation types were defined by the following guidelines: herbaceous—land dominated (more than 2/3) by herbaceous species with an average height of less than 12 inches; scrub-shrubland—land dominated either by herbaceous species with an average height of greater than 12 inches, shrub species with an average height of less than 20 feet, or a combination of both; and forest—land dominated by trees with an average height of greater than 20 feet (Rogers, Golden & Halpern, Inc. 1988). Other descriptive guidelines included tree litter, paved, and bare earth. Any other unusual features or identified vegetation species were noted on the form. The data collected on the vegetation survey form became the basis for determining the buffer type.

Size. In the buffers that had an obvious beginning and ending point, the width was measured to the nearest foot with the Rolatape™ at least 3 times and averaged to determine if the size regulated in the permit was the same as the size found in the field. The width was measured in the harder to demarcate buffers using best estimate markers such as the edge of the wetland inland to the edge of development indicated by roads, landscaping, or buildings. Some linear width measurements were made using an engineer's scale and United States Geological Survey (USGS) topographic maps.

Additional information. Additional information was compiled for each site to collect consistent information and to make comparisons between sites. This additional information was assessed both from review of permit files and other information about the wetlands on-site. The information collected included the following: wetland area history,

permit conditions and history, existing wetland evaluation results, current land use adjacent to wetland, buffer goals, and additional comments.

Aerial photography. A review of aerial photographs provided a basis for further analysis at each site. The most recent available aerial photographs from the University of California Santa Cruz collection were used to make measurements of buffer sites in acres, linear measurements of wetland buffers, measurements of the wetland in acres, and to obtain historical information on individual sites. The measurements made from the aerial photographs can be compared with the measurements made on the ground to gain a better understanding of the buffer width.

The area measurements were made using the dot grid method. The dot grid method makes area measurements with transparent overlays of dots uniformly spaced in a grid pattern. Each dot represents an area and is counted systematically (Avery and Berlin 1992). The dot grid used for the area measurements was Stock No. 45026 from Forestry Suppliers, Inc. With this dot grid, acreage can be calculated regardless of the photo scale by following these instructions:

1. On the photo determine acres per square inch by the following formula:
(where RF = representative fraction of the photograph)

$$\frac{(RF)^2}{6,272,640 \text{ (sq. inches per acre)}}$$

2. Divide acres per square inch by 16 to determine the acreage conversion factor that each dot equals.
3. Multiply dots counted by the acreage conversion factor to get total acres in type, area, etc. (Forestry Suppliers, Inc. n.d.)

Linear measurements were made by using an engineer's scale. The measurement obtained with the scale is multiplied by the RF of the photograph to determine the corresponding distance on the ground. Large-scale aerial photographs were used when available. Buffer width measurements were made from the high water mark of the wetland inland to a building, fence, or obvious change in vegetation type.

Analysis methods. The Pearson product moment coefficient of correlation, r , was used to determine if the width of the buffer and the level of human intrusion were correlated. The level of human intrusion was determined by dividing the human use count by the area of the buffer in acres. Student's t -statistic was used to find if the average level of human intrusion was significantly different in fenced buffer sites versus unfenced buffer sites. Fenced is defined as a barrier that would restrict easy human access to the buffer.

CHAPTER 4

FIELD STUDY SITES DATA

The field study component of this thesis was planned to search for indicators of buffer function in the selected sites in the Monterey Bay area. The field study sites are located in the city and county of Santa Cruz, in the city of Watsonville, in North Monterey County, in the city of Marina, and in the city of Seaside. Permit files were searched for historical information, permit conditions, and other background information relevant to each site. The information gleaned from the files is presented below for each site. The buffer site description information was developed from the permit files and from direct observation.

Santa Cruz County Sites

Site History 1. Neary Lagoon Santa Cruz Community Housing Corporation Project

Site number 1 is located adjacent to Neary Lagoon within the Santa Cruz city limits (Figure 2). Neary Lagoon and its environs comprises about 44 acres of wetland, riparian, and woodland habitats (Jones & Stokes Associates, Inc. 1992). The lagoon's drainage basin consists of mostly forested hills leading to an urbanized coastal terrace.

The coastal lagoon once drained into Monterey Bay; however, the lagoon was modified by construction, filling, and draining and by the 1930s became primarily a shallow freshwater marsh. In the early 1970s areas adjacent to the lagoon were

Fig. 2. Map of Neary Lagoon site number 1 and 2

Source: U.S. Geological Survey 7.5 Minute Series Santa Cruz Quadrangle

developed with apartments and condominiums (Jones & Stokes Associates, Inc. 1992).

Near the subject site, the lagoon consists of open water habitat that is slowly converting to freshwater marsh through invasion by tules, cattails, and yellow iris. The edge of the lagoon contains a noncontiguous band of emergent freshwater marsh vegetation, riparian forest habitats, non-native grassland, and parkland and managed landscape. Beyond the vegetation strip are homes, a wastewater treatment plant, roads, and railway tracks—generally within 10-100 feet of the open water habitat.

The city's LCP policies include a requirement to prepare a wetland management plan for Neary Lagoon to preserve and enhance the habitat value. The management plan includes a baseline inventory of the lagoon habitat, plans for habitat preservation and restoration, and plans for public use and safety (Jones & Stokes Associates 1992).

Field Survey Site and Development Description

The buffer selected for this field survey was an approximately 3 acre vacant parcel consisting of non-native grassland with a narrow strip of riparian willow forest adjacent to the open water of the lagoon (Figure 3). The non-native grassland community supports annual and perennial grass species, mainly European exotics. Tall fescue (*Festuca arundinacea*), Himalayan blackberry (*Rubus procerus*), and domestic yellow iris (*Iris pseudacorus*) were the dominant non-native species growing on the buffer site in 1993 (Central Coast Wilds 1994). The buffer was imposed for two separate yet adjoining housing projects of about 6.5 acres developed by Santa Cruz Community Housing Corporation (CHC).

Fig. 3. Neary Lagoon buffer site number 1 and 2. Drawing by author based on map (Jones & Stokes Associates, Inc. 1992).

Permit Framework

The proposed housing developments were approved by the city of Santa Cruz in 1988. A portion of the proposed developments was within the CCC's appeal jurisdiction (within 100 feet of wetlands or riparian corridors). Both projects became the subject of an appeal; thus, there are two coastal permits covering each project—the city permit (remaining in effect for the part of the project that is not appealable) and the 1989 CCC permit for the portion that is within the appeal jurisdiction (CCC 1989a). An Environmental Impact Report (EIR) was prepared for the proposed developments in 1988.

Setback requirement. A 100-foot setback is required under the LCP (unless a variance is obtained). The permit setback requirement is 100 feet from the edge of the wetland boundary (CCC 1989a).

EIR mitigation measures. The EIR contains mitigation measures for the CHC projects to protect habitat and buffer areas. The mitigation measures include the following buffer related terms:

- Maintain the buffer area including native plantings for erosion prevention and aesthetics
- Restrict thinning vegetation in the 100-foot buffer
- Submit an annual monitoring report of the buffer area to the Department of Parks and Recreation
- Fence the edge of the 100-foot buffer to restrict access (Community Planning Consultants 1988)

Permit conditions. The wetland buffer related conditions imposed in the permits include the following:

- Roadway, parking, and building is not allowed in the wetland and seasonally flooded grassland buffer
- Control drainage within the buffer and habitat areas by nonstructural means and in a manner that does not alter the functional value of the wetland and wetland buffer
- Map the wetland boundary at the eastern shoreline consistent with the U.S. Army Corps of Engineers Map of December 1988 and revised with the written concurrence of the DFG
- Delete public improvements not appropriate for a habitat refuge in the setback from the wetland boundary and designate the setback as a refuge area (CCC 1989a)

Buffer Site Description

The permitted development was constructed in 1992. The 3-acre buffer site shields the lagoon from the development and a small park (Figure 4). The buffer site is fenced and posted as wildlife habitat but access can be made through a locked gate. The distance from the chain-link fence adjacent to the housing development to the edge of the riparian forest strip is 88.5 feet. At the time of the field visit, the buffer was flooded throughout with a water depth from 2-10 inches.

The Neary Lagoon Management Plan called for the restoration of the buffer area as a coastal prairie. The restoration plan proposes the removal of the non-native tall fescue,

yellow iris, Himalayan berry, and pampas grass, replacing them with native species.

Tractor excavation of the non-natives and transplanting native grass and wildflower seedlings was recommended as the first step in the restoration effort. The buffer site was planted in late 1993 and early 1994 with California oatgrass (*Danthonia californica*) and tufted hairgrass (*Deschampsia caespitosa*). Purple needle grass seed (*Nasella pulchra*) and wildflower seed were hand broadcast. The site is managed by hand weeding, hoeing, and mowing of non-native weeds (Central Coast Wilds 1994).

One monitoring report (Central Coast Wilds 1994) has been produced since the onset of the restoration plan. The restoration of the buffer site was evaluated for the percent survival of transplanted and seeded coastal prairie species and the percent cover of native species. The monitoring survey reports that the vast majority of plug planted native grasses survived (92%). Many of the species from broadcasted seeds were evident including purple needle grass, California poppy (*Eschscholzia californica*), and farewell-to-spring (*Clarkia amoena*).

The monitoring report concluded with the following recommendations:

- Continue to maintain and monitor the site for two more years
- Make additional efforts to eradicate the Himalayan berry, including application of agricultural lime and tarping areas
- Continue periodic yearly mowing and hand weeding
- Plant more wildflower seedlings in areas not likely to see seedling recruitment
- Continue to monitor native species survival and percent coverage

Future plans for the buffer area include a pedestrian entry with a locked gate as the principal entry for the lagoon's natural area and a planned loop trail. The portion of the trail through the buffer area will consist mainly of a raised boardwalk designed to meander through the area. Access to this area may be restricted during certain periods to protect the wildlife (Jones and Stokes Associates, Inc. 1992).

Fig. 4. Photograph of Neary Lagoon buffer site number 1

Site History 2. Neary Lagoon: Wastewater Treatment Plant

Site number 2 is also located adjacent to Neary Lagoon. The subject site is located next to a 5.2-acre wastewater treatment plant at the southern edge of the lagoon (Figure 2). Near the subject site, the open water habitat of the lagoon consists of a narrow channel in the freshwater marsh vegetation. Beyond the freshwater marsh vegetation is a paved public access path within several feet of the lagoon. Nearby is developed parkland and the wastewater treatment plant.

Field Survey Site and Development Description

The buffer site consists of approximately 0.75 acre of revegetated levee separating the wastewater treatment plant from Neary Lagoon (Figure 3). The site characteristics prior to revegetation are unknown; however, the CCC permit reports that in the vicinity of the proposed development there was a drainage ditch, weedy area, gravel road, a few bushes, and a levee (CCC 1986).

The proposed project involved upgrading the wastewater treatment plant to advanced primary treatment. The proposed construction would result in the removal of approximately 0.02 acre of open water and wetland vegetation and approximately 0.18 acre of riparian vegetation. To compensate for the removal of riparian vegetation, the levee was revegetated and a mitigation area of 0.20 acre was established near the Chestnut Street drain outfall in another area of the lagoon. The levee revegetation was proposed to create a habitat buffer and to visually screen the plant from the lagoon area (Harvey & Stanley Associates, Inc. 1986).

Permit Framework

The CCC granted a permit in 1986 for proposed improvements to the treatment plant subject to special conditions. The permit request covers an area that was not certified by the city LCP because it showed wastewater treatment plant expansion toward and into Neary Lagoon.

An EIR was prepared and certified for this proposed project by the State Water Resources Control Board and the Environmental Protection Agency. The project alternative, at the time of the EIR preparation, did not show significant expansion toward the lagoon and no mitigation measures were suggested to address this issue. Compliance with the California Environmental Quality Act (CEQA) was made with revised plans that mitigate the impacts on the lagoon system (CCC 1986).

Setback requirement. A 100-foot buffer between the lagoon and the wastewater treatment plant is required; however, part of the proposed expansion of the plant encroaches within 100 feet of the lagoon. The permit states that if the encroachment is limited, if improvements are made to the buffer area, and if compensatory mitigation is made to another portion of the lagoon, then the project is consistent with the Coastal Act. The extent of the encroachment allowed and a numerical setback requirement is not stated.

Project mitigations. To maintain consistency with the Coastal Act wetland protection policies, the city hired a consultant to complete a mitigation and enhancement plan for proposed project impacts to the lagoon. Buffer related mitigations in the consultant's plan

limits encroachment within the 100-foot buffer area, makes levee, soundwall, and vegetation improvements within this area to result in a functional buffer, and contains all surface runoff and possible spillage on-site (Harvey & Stanley Associates, Inc. 1986).

Permit conditions. The conditions include incorporating the recommendations of the consultant's report and requiring the city to complete the wetland management plan for Neary Lagoon (CCC 1986).

Buffer Site Description

The proposed development was completed in late 1991. As part of the permit conditions, the levee was raised and revegetated to screen the wastewater treatment plant's soundwall (Figure 5). The levee buffer area is accessed via a public path within the lagoon that leads towards the wastewater treatment plant. The buffer lies between a soundwall adjacent to the treatment plant and the lagoon. There is a paved 6 foot wide trail in between the open water of the lagoon and the levee. The buffer measured approximately 60 feet from the soundwall to the edge of the lagoon.

The preliminary list of appropriate plant species for the revegetation of the levee included natives that typically grow near watercourses. Some of the plants species that were recommended for revegetating the buffer area include coast live oak (*Quercus agrifolia*), madrone (*Arbutus menziesii*), toyon (*Heteromeles arbutifolia*), matilda poppy (*Romneya coulteri*), and ceanothus (*Ceanothus* spp).

Fig. 5. Photograph of Neary Lagoon buffer site number 2

Site History 3. Corcoran Lagoon Single Family Dwelling

Site number 3 is located adjacent to Corcoran Lagoon in the Live Oak area of Santa Cruz County (Figure 6). Corcoran Lagoon is part of the drainage of Rodeo Creek Gulch that originates in the foothills above Soquel Drive and empties into Monterey Bay via Corcoran Lagoon. East Cliff Drive separates the lagoon from Monterey Bay.

A literature search found little historic information about the lagoon; however, a Santa Cruz County Community Resources Agency Report (1977) stated that noticeable changes have occurred in Corcoran Lagoon in the past 40 years. Tidal flushing has apparently occurred more frequently, the marsh area to the north has become more salty, and landfill activities decreased the marsh area and riparian habitat. A noticeable decline of Western pond turtles (*Clemmys marmorata*), red-legged frogs (*Rana aurora*), garter snakes (*Thamnophis* sp.), and brush rabbits (*Sylvilagus bachmani*) is attributed in part to this change. Three-spine stickleback (*Gasterosteus aculeatus*) fish populations have declined as well, possibly due to inadequate tidal influx and pollution.

The report also identified problems that have been caused by human alterations including roads located too close to the shoreline, eucalyptus trees inhibiting the growth of natural vegetation, people intruding on the fragile marsh area, and a high fecal coliform/streptocoliform level indicating human waste contamination.

Despite the significant alterations that occurred within the lagoon, Corcoran still remains one of the best examples of a naturally functioning lagoon located within the

Fig. 6. Map of Corcoran Lagoon site number 3 and Moran Lake site number 4
 Source: U.S. Geological Survey 7.5 Minute Series Soquel Quadrangle

urban services line area. The lagoon margin has a good bulrush and sedge plant community and feeding activity by coots, mallards, egrets, grebes, and terns suggests a good source of food here (Santa Cruz County 1991a).

The shallow shoreline gradient of the lagoon permits a diverse range of shoreline habitat types. The presence of glasswort (*Salicornia subterminalis*), saltgrass (*Distichlis spicata*), fleshy jaumea (*Jaumea carnosa*) and saline dodder (*Cuscuta salina*) indicates that Corcoran Lagoon is technically a coastal salt marsh. Daily tidal fluctuations occur within the lagoon even during summer months when the mouth is often closed by a beach berm (Santa Cruz County 1991a).

Near the buffer site, the lagoon has a fluctuating sandbar edge. Adjacent to the sandbar is a thick bulrush and sedge plant community. Beyond the bulrush and sedge plant community the edge gradient becomes steep. The steeper edge contains non-native grassland and eucalyptus. Beyond the upland vegetation are roads, homes, and businesses surrounding the lagoon. Some of the buildings and roads are as close as 3 feet to the lagoon while others are set back about 100 feet.

Field Survey Site and Development Description

The buffer site was a vacant 2,584 square foot parcel vegetated with coastal grasses in an area of single family homes (Figure 7). The proposed project was a two-story single family dwelling located 50 feet from Corcoran Lagoon.

Fig. 7. Corcoran Lagoon buffer site number 3. Drawing by author based on aerial photograph (10-18-89) from the University of California Santa Cruz collection.

Permit Framework

The development proposal required a Coastal Zone Permit and granting of a Riparian Exception. The permit was granted by Santa Cruz County in 1991 for plans to construct a two-story single family dwelling with basement garage.

Setback requirement. Santa Cruz County requires a 100-foot setback measured from the high watermark. The entire parcel is considered to be within the 100 foot riparian setback and the permit does not state the required width of the exception setback. The riparian exception findings state that the lagoon has benefited by an increased buffer because the proposed development is separated from the lagoon by an existing paved road that eliminated a dirt parking lot and the former parking lot area is now well vegetated with grasses and some colonizing coastal lagoon native flora (Santa Cruz County 1991b). The findings also justify the riparian exception setback because other recently approved family dwellings exist next to the one proposed, at similar setbacks. Neither the width of similar setbacks nor the width of the “increased” buffer is confirmed in the permit.

The lack of a specified riparian exception distance was noted in the permit file by an Inter-Office Correspondence from County Supervisor Jan Beautz. She notes that the project raises a number of environmental concerns including the reduction of the required 100-foot setback to an unknown distance. She felt that the exact setback variance should be determined along with the clear edge of the coastal wetland and the distance necessary to reduce impacts to the wetland (Santa Cruz County 1991b). Her concerns were not

specifically addressed in the permit file although it was noted that the riparian exception was approved.

Permit conditions. The conditions of approval for the permit do not mention the wetland buffer.

Buffer Site Description

The permitted development was constructed soon after the grading permit was issued in 1992. The buffer is accessible on the northwest shore of the lagoon where Coastview Road meets East Cliff Drive. Coastview Road is paved for a short way then it becomes a dirt parking lot that is gated to prevent through traffic to Portola Drive.

The buffer for the single family home is composed of a ornamental chain-link and post fence, a strip of non-native grassland, a row of eucalyptus trees, and the vegetation that borders the lagoon (Figure 8). The coastal permit states that the distance to Corcoran Lagoon from the vacant parcel prior to development is 50 feet; however, the distance from the high watermark of the lagoon to the developed side of the paved road measured in this field survey was about 102 feet. The vegetation has been maintained in a natural state since development took place.

The habitat in the buffer was characterized in a field survey (Santa Cruz County 1977) that found that the majority of Corcoran's immediate shoreline consists of typical salt marsh vegetation. In the shrub areas, dwarf coyote bush (*Baccharis pilularis* var. *pilularis*), poison oak (*Toxicodendron radicans* var. *diversiloba*), and California blackberry (*Rubus ursinus*) are the common plant species. A subsequent field survey

(Davilla 1984) found that the predominant habitats are characterized as disturbed ruderal, horticultural, and coastal brackish marsh. Vegetation is characterized by introduced and ruderal plant species including blue gum eucalyptus (*Eucalyptus globulus*), Monterey pine (*Pinus radiata*), and green wattle (*Acacia decurrens*). The vegetation component of the brackish marsh is characterized by the broad-leaved cattail (*Typha latifolia*), bog rush (*Juncus effusus* var. *brunneus*), pickleweed (*Salicornia virginica*), and common tule (*Scirpus acutus*). No rare or endangered plant species or their habitats were observed during the survey.

Fig. 8. Photograph of Corcoran Lagoon buffer site number 3

Site History 4. Moran Lake Riparian Buffer Setback

Site number 4 is located adjacent to Moran Lake in the Pleasure Point/Live Oak area of Santa Cruz County (Figure 6). Moran Lake's watershed is highly altered and urbanized with both commercial and residential uses. Most of the tributary channels in the upper watershed are buried in culverts. In the lower watershed the tributaries are also buried in culverts and channelized, with development and fill encroaching on the top of the banks (Santa Cruz County 1991a).

Moran Lake was once a healthy tidal lagoon of approximately 8 acres but has suffered from a number of past human alterations that severely degraded water quality and wildlife habitat and reduced its size to 5 acres. The lagoon experienced fill and a restriction of tidal flushing leading to stagnation of lagoon waters and increased salinities due to high evaporation rates (Josselyn et al. 1993). Despite the lake's degradation, the DFG considers the lake essential for the continuing existence in Santa Cruz County of 150-200 species of water-associated birds that use the Pacific Flyway. It also is a significant scenic and recreational resource for Santa Cruz residents (State Coastal Conservancy 1980).

Near the buffer site, the lake forms a narrow channel lined with houses on both sides. One side is accessible by a public path, the other side contains the backyards of single family homes generally within 20-50 feet of the lake. Where the lake widens, there is a small public park with a parking lot and restroom facilities. The banks of the lakeshore are steep and the diversity, quality, and extent of vegetation is limited. Large eucalyptus trees form a nearly contiguous band around the lake.

The lake and some of the surrounding land were acquired by Santa Cruz County in 1975 for development as a park. An enhancement plan was developed for the lake and a restoration effort was initiated in 1980. The restoration and enhancement efforts achieved limited success because soon after the completion of the project, a major storm event eroded the recontoured shoreline, leaving a steep bank unsuitable for salt marsh vegetation and destroying the vegetation planted along the banks. Upland plantings are not successful due to poor and potentially toxic soil conditions, shading, and allopathic suppression by eucalyptus trees. A subsequent improvement plan proposed in 1992 has not been initiated or even gone beyond the draft stage due to lack of funds (Bradford pers. com. 1995).

Field Survey Site and Proposed Development Description

The subject site is an approximately 1500 square foot rectangular shaped buffer separating Moran Lake from a single family home (Figure 9). The site characteristics prior to the project proposal are unknown. The proposed project was a reconstruction of an existing single family home to a 3-story single family home on a 7,650 square foot parcel.

Permit Framework

The proposed project required a Coastal Zone Permit and a Riparian Exception. Santa Cruz County staff conducted a field check in 1985 to delineate the riparian corridor and to determine the appropriate riparian buffer setback.

Approximate Scale 1"=100'

Fig. 9. Moran Lake buffer site number 4. Drawing by author based on map from the permit file (Santa Cruz County 1986).

Permit setback. The riparian exception findings state that because the existing house is located within the riparian buffer area, the only area available for an addition is within the buffer area. A 35-foot setback was deemed adequate to protect the riparian area consistent with applicable ordinances and General Plan Policies. However, the setback was reduced as a result of the field check conducted to determine the appropriate setback. The field check findings state that given the site conditions, a reduction from the required 100-foot buffer setback to a minimum 20-foot buffer setback (approximately the 15-foot contour) would adequately protect the riparian corridor and meet the intent of the Riparian Corridor and Wetlands Protection Ordinance (Santa Cruz County 1986).

Permit conditions. The conditions include a requirement to submit an irrevocable offer of dedication of the buffer to Santa Cruz County for a 20 foot wide open space and conservation easement. The landscape plans for the parcel include revegetation and restoration of the buffer (Santa Cruz County 1986).

Buffer Site Description

The buffer site is not accessible because it is behind a row of single family homes on the east side of the lake; however, because the lake is a narrow channel here, the buffer site is easily viewed from the west side (Figure 10). Although the permit was granted for the proposed development, the reconstruction of the existing home never took place. Thus, the buffer has been retained in its natural state without the required revegetation and restoration.

The buffer for the existing home is about 30 feet wide. It consists of lake shoreline, herbaceous vegetation, eucalyptus trees, and tree litter. A backyard fence marks the end of the visible buffer setback and the beginning of the homeowner's backyard. Adjacent to this buffer site on both sides are more single family homes. While some are fenced with similar setbacks to the subject site, others are unfenced with evidence of backyards extending within several feet of the lakeshore.

The vegetation resources of Moran Lake were surveyed for Santa Cruz County by BioSystems Analysis (1992) as part of an urban watershed study. It was found that the existing vegetation bordering the lake consists mostly of non-native, weedy or invasive grasses and herbs. Only small amounts of two native salt marsh species, pickleweed and saltgrass, exist along the shoreline. The lake area itself is bordered by blue gum eucalyptus and a few Monterey cypress (*Cupressus macrocarpa*) trees remain on created terraces from enhancement plantings done in the early 1980s.

Fig. 10. Photograph of Moran Lake buffer site number 4

Site History 5. Struve Slough Westridge Business Park Buffer

Site number 5 is located in southern Santa Cruz County adjacent to Struve Slough in the city of Watsonville (Figure 11). Struve Slough is a branch of a larger wetland complex known as the Watsonville Slough wetlands. This is the largest and most significant wetland complex in the Santa Cruz County coastal area. The approximately 800-acre slough system drains a 13,000-acre watershed to the Pajaro River which empties into Monterey Bay through a tidal marsh. The watershed topography is generally characterized by low-lying, rounded hills while the sloughs themselves occupy broad valleys with low to moderate slopes. Struve Slough is one of six branches of the Watsonville Slough system and generally drains the Watsonville urban areas. The subject site is adjacent to a portion of the Struve Slough branch.

Prior to human settlement, the slough system had more tidal influence and was characterized by broad expanses of tules and other marsh plants. Beginning in the 1870s, the slough system was altered by agricultural activities, ditching, and the installation of a pump station near the coast that precludes significant tidal action above it (Questa Engineering Corporation 1995).

The portion of Struve Slough adjacent to buffer site number 5 is about 14 acres within the Watsonville city limits and is bounded by Highway 1 and Harkins Slough Road. Near the wetland buffer site, the slough is a freshwater channel with a moderate slope and an edge defined by a change in vegetation from freshwater marsh vegetation to non-native

Fig. 11. Map of Struve Slough site number 5, 6, and 7

Source: U.S. Geological Survey 7.5 Minute Series Watsonville West Quadrangle

grassland. Beyond the grassland buffer strip is a large business park on one side and agricultural land on the other.

Field Survey Site and Development Description

The buffer site was a vacant rolling grassland parcel in the late 1970s to early 1980s. Specific site characteristics prior to development are unknown. By the mid 1980s the parcel adjacent to the slough began to be developed as Westridge Business Park (Figure 12).

Permit Framework

This project is outside the coastal zone and thus not subject to a coastal permit. Neither a Watsonville City permit nor an EIR was found for this site. The project was built when Watsonville's 1990 General Plan was in effect and there was no policy regarding wetland setbacks; however, since 1981, the city's Grading Ordinance (Section 7-6.152 (c)) calls for the creation of a buffer or setback 30 horizontal feet from the high watermark of a marsh or natural body of standing water in projects located adjacent to the sloughs.

In addition, the DFG has permitting authority for dredge and fill activities and other streambed alterations via the Streambed Alteration Act for streams that are shown as a dashed and dotted blue line (including this portion of Struve Slough) on USGS topographic maps (Van Houten pers. com. 1995).

Fig. 12. Struve Slough buffer site number 5. Drawing by author based on an aerial photograph (5-9-92) from the University of Santa Cruz collection.

Setback requirements. The DFG determined setback at this site is the 20-foot contour interval. The center of the slough (dashed and dotted blue line) to the 20-foot contour, measured using the USGS Watsonville West Quadrangle (revised 1994) map at a scale of 1:24000, ranged from 120 feet to 520 feet. The regulated setback in feet from the edge of the slough to the 20-foot contour is unknown.

Permit conditions. A 1980 DFG permit was found for the parcels that were eventually developed as the Westridge Business Park.. According to the permit, the operator must agree to accept recommendations contained in an attached Memorandum of Understanding (MOU).

The MOU states that no construction or earth moving should occur below the 20-foot contour. Further, a berm of suitable material is to be constructed at or above the 20-foot contour elevation in areas where water discharge from the development of the parcel drains toward the wetlands. In areas where the berm is not practical, an extra 20-foot buffer strip above the 20-foot contour line is required. This original permit was reapplied for in 1982 with the same conditions attached.

Buffer Site Description

The buffer is accessible from a parking lot at the back of the business park. The long, narrow buffer follows the contours of the slough (Figure 13). It is approximately 3 acres in area and 84 feet wide from the high watermark to the parking lot edge. Except for a row of trees planted adjacent to the parking lot, the buffer vegetation has been maintained in a natural state since development.

Fig. 13. Photograph of Struve Slough buffer site number 5

Site History 6. Struve Slough Crossroads II Auto Center buffer.

Site number 6 is located adjacent to Struve Slough just north of site number 5 between Main Street, Green Valley Road, and Harkins Slough Road (Figure 11). In the past the slough area was used for cattle grazing and was significantly altered by cultivation and ploughing. Near the subject site, the freshwater slough channel is flanked by a non-native grassland and herbaceous buffer with a low slope. Beyond the upland vegetation, the slough is bound by two roads and surrounded by commercial development and housing on one side and agricultural land on the other.

Field Survey Site and Development Description

The subject site was a 3.8 acre partially vacant parcel of non-native grassland adjacent to Struve Slough (Figure 14). The proposed project is a commercial auto center (Crossroads II) of seven commercial structures for a total building area of 26,675 square feet.

Permit Framework

The applicant applied to the city of Watsonville in 1994 for a permit to develop a commercial auto center on the project site. This site was subject to an initial study (Denice Duffy & Associates 1991) that identified impacts and mitigation measures.

Setback requirements. The city requires that new construction on slopes leading toward sloughs and wetlands maintain an undisturbed protective buffer between all cut and fill slopes and the riparian zone. The policy to determine the width of the buffer is to

Fig. 14. Struve Slough buffer site number 6. Drawing by author based on an aerial photograph (5-9-92) from the University of Santa Cruz collection.

conduct a site specific analysis. The proposed buffer setback requirement determined in the initial study extends approximately 80 feet between the southeast border and 85 feet between the project and the upper boundary of the slough wetlands along the southwest boundary. Along the southwest boundary between the 25-foot contour and the wetland vegetation of an existing detention pond there is a proposed 45-foot buffer zone. The buffer is intended to reduce, but not eliminate, project impacts associated with increased light and glare, increased human activity along the slough, increased noise levels, and a reduction in uplands grassland habitat (Denice Duffy & Associates 1991).

Initial study mitigation measures. While the study predicted that the planned development would not directly effect wetland plant communities, indirect impacts were identified including unauthorized dumping of construction wastes, soil erosion, and contaminated runoff from project operation. Mitigation measures relating to the buffer include the following:

- Establish a permanent buffer zone prior to construction to maintain the integrity of the slough wetland habitat
- Delimit the upper edge of the buffer zone with a six foot high fence or dense hedge to discourage human activity within it
- Monitor the effectiveness and maintenance of the buffer zone by a qualified botanist or wildlife biologist on a yearly basis for at least five years and submit the results to the City of Watsonville Planning Department and the DFG (Denice Duffy & Associates 1991)

Goals were outlined for the buffer landscape plan to minimize soil erosion, establish wildlife habitat, and enhance natural areas by revegetating with native species (Denice Duffy & Associates 1991).

Buffer Site Description

The buffer site was accessed behind some existing commercial development buildings and around the proposed development. The buffer area of about 1.4 acres follows contours around the proposed development and the slough (Figure 15). The average width of the buffer was about 82.5 feet. The development, at the time of the site visit in January 1995, consisted of a gas station and car wash. The rest of the site was graded in anticipation of leasing the remaining sites.

The buffer has been recently planted with native vegetation and the planted areas were separated from the graded areas by a line of hay bales. Some bales of hay were also in the buffer area to protect the recent plantings from erosion.

The site was investigated prior to development to determine if it was used by burrowing owls (*Athene cunicularia*) and the Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*). It was found that because the site has been graded the property does not contain suitable salamander habitat and only very marginal burrowing owl winter feeding habitat (Denice Duffy & Associates 1991).

Fig. 15. Photograph of Struve Slough buffer site number 6

Site History 7. Struve Slough Pennsylvania Drive Apartment Project Buffer

Site number 7 is also located adjacent to Struve Slough just north of site 6 near the junction of Clifford Avenue and Pennsylvania Drive (Figure 11). The property was primarily used as grazing land and pasture since at least 1937. Due to the present extreme disrepair of fences and high grass cover, the site has not been actively grazed for a number of years (Davilla 1992).

Near the subject site, the slough is a freshwater channel with a moderate slope. There is a distinct visual change from the freshwater marsh vegetation of the slough to the non-native grassland vegetation of the upland area. The slough is lined on both sides with single and multi-family homes and some undeveloped land.

Field Survey Site and Proposed Development Description

The subject site was a vacant 3.3-acre parcel in an area of single and multiple family homes (Figure 16). Site conditions prior to development show that the parcel supported a dense, nearly homogenous cover of canary grass grading downslope to dense stands of farmer's foxtail (*Hordeum leporinum*) and prickly lettuce (*Lactuca serriola*). The standing water in the slough supported remnant, preceding year stands of cocklebur (*Xanthium strumarium*). The remainder of the parcel included introduced annual herbs and grasses. A single individual of blue elderberry (*Sambucus mexicana*) was found in the center of the parcel (Davilla 1992). The proposed project is a sixteen unit apartment complex on two parcels comprising 3.3 acres.

Fig. 16. Struve Slough buffer site number 7. Drawing by author based on site plan map (City of Watsonville 1992).

Permit Framework

This parcel is subject to city of Watsonville and DFG approval. The developable portion of the parcel was determined by the DFG. This area was the focus of several site specific biotic assessments and a negative declaration in 1992.

Setback requirements. The site specific project boundary delineation was made in 1989 at the 20-foot contour line. However, the DFG noted in their 1992 permit that when the original 1989 site inspection was made, the site reflected conditions related to the ongoing drought. This resulted in a riparian corridor line that the DFG believes does not adequately protect the slough. However, due to the extended past history of the project and the advanced stage of planning, the DFG reluctantly abided by the project boundary delineation at the 20-foot contour line (Hunter 1992). The 20-foot contour is approximately 166 feet from the center of the slough, measured with a USGS Watsonville West quadrangle map (revised 1994) at a scale of 1:24000. It is unknown what the required width is from the edge of the slough.

Permit conditions. The city of Watsonville did not impose permit conditions regarding the wetland buffer for this development.

Buffer Site Description

The permitted development was in the process of construction at the time of the field visit (Figure 17). The approximately 1.4 acre buffer is accessed by walking through a vacant area of land north of the development site. The buffer is fenced at the 20-foot contour line to separate it from development but not at the wetland. The width of the

buffer from the high watermark to the edge of the fence averaged about 52.5 feet. The opposite side of the slough is lined with single family homes at varying setbacks. In some cases the backyards of the homes extend right into the slough.

The buffer vegetation is currently maintained in a natural condition. The development site was assessed in 1992 for the potential to support the endangered Santa Cruz tarplant (*Holocarpha macradenia*). The site is near a now extinct Santa Cruz tarplant population site that is now primarily covered with homes. The potential for the tarplant to occur at the Pennsylvania Drive site is considered to be low; however, the sites proximity to other historical sites makes it difficult to entirely rule out the potential occurrence of the species in the project area (Davilla 1992).

A biotic assessment (Luke 1992) was conducted on the parcel prior to development to ascertain the presence of the state and federally listed endangered Santa Cruz long toed salamander and the state species of special concern California tiger salamander (*Ambystoma californiense*). The assessment report found that while the property is potential salamander habitat it is not optimal and neither the long toed salamander nor the tiger salamander have been found in Struve Slough.

Fig. 17. Photograph of Struve Slough buffer site number 7

Monterey County Sites

Site History 8. Blohm-Porter Marsh: Elkhorn Heights Buffer

Site number 8 is located adjacent to the Blohm-Porter Marsh near Elkhorn Slough in North Monterey County (Figure 18). The 145 acre Blohm-Porter Marsh is separated from the main channel of Elkhorn Slough by Elkhorn Road. Elkhorn Slough, a Federal Estuarine Sanctuary, is a large tidally flushed estuary with little freshwater input.

The upland habitat around the 225 square mile Elkhorn Slough drainage basin and the Blohm-Porter Marsh is in low density rural housing with some cattle pastures and greenhouses. Large areas of strawberry fields surround the marsh (ABA Consultants 1989).

The hydrology and wildlife of the marsh was once similar to Elkhorn Slough when it was a large shallow embayment and quiet water estuary with little tidal influence. The marsh was altered with the construction of a railway trestle, roads, and the opening of Moss Landing Harbor. After 1951, the marsh became a highly seasonal wetland and was grazed with cattle into the 1960s. Culverts placed in the 1980s leaked heavily allowing as much as 3 feet of salt water to cover the marsh. As a result, salt marsh plants became more prevalent and cattle grazing decreased markedly (ABA Consultants 1989).

Near the subject site, the wetland vegetation community of Blohm-Porter Marsh is now dominated by pickleweed and salt grass. The upland portion of the parcel contains mostly non-native weedy species. Most of the land nearby is either undeveloped or farmland.

Fig. 18. Map of Blohm-Porter Marsh site number 8

Source: U.S. Geological Survey 7.5 Minute Series Moss Landing Quadrangle

A habitat restoration plan (ABA Consultants 1991) was developed for the project site in conjunction with the Elkhorn Slough Foundation and Moss Landing Marine Laboratories. The plan includes a two-year program to restore the major habitats, a longer term plan for habitat maintenance and continuing restoration, a monitoring plan, and an easement and landscaping plan.

Field Survey Site and Proposed Development Description

The subject site is a 37 acre vacant parcel consisting primarily of non-native grasses (Figure 19). Approximately 31 acres of the parcel is wetland habitat dominated by pickleweed (Monterey County 1992). The proposed development plan at this site is to design three ecologically sustainable single family homes on less than 6 acres surrounded by a large conservation easement including the remaining 31 acres.

Permit Framework

The Monterey County Minor Subdivision Committee adopted a negative declaration and approved a combined development permit in 1992. The permit allows for a minor subdivision of a 36.3-acre parcel into three parcels.

Setback requirements. The permit states that the proposed project is consistent with policies of the LCP dealing with development adjacent to an environmentally sensitive habitat. The permit does not explicitly state the setback requirement but if it is consistent with LCP policies of North Monterey County, it must be at least 100 feet from the

Fig. 19. Blohm-Porter Marsh buffer site number 8. Drawing by author based on map (ABA Consultants 1991).

landward edge of vegetation. In addition, the consultant's plan shows a 100-foot setback fence on a vegetation and topography map of the parcel.

Permit conditions. Development plans include three single family dwellings on the flat terrace shoulder of the hill and habitat restoration around the homes and the remaining parcel area. The permit was approved provided that a scenic easement is conveyed to the Elkhorn Slough Foundation or other appropriate agencies to manage the easement including a sufficient buffer as determined by the project's consulting biologist (Monterey County 1992).

Buffer Site Description

The permitted development has not yet been constructed. The location of the 100 foot wide buffer site was determined in this field study by following ABA Consultants' vegetation map. The 100 foot wide buffer area contains approximately 2.9 acres. A gate stops road access to the site from Elkhorn Road but the parcel is easily approached by walking around the gate (Figure 20). The proposed development parcel is bordered by a road, a small farm, and undeveloped land. Some revegetation of native species has taken place on the upland areas of the parcel, beyond the 100-foot buffer zone.

The consultant's vegetation survey found that the open areas of the marsh are colonized by non-native, introduced plants but they are gradually being replaced by pickleweed and saltgrass. The upland community plant surveys found over 100 species of mostly non-natives. Almost all the introduced plants are weedy. No endangered species are now known or expected to be found on the parcel.

Fig. 20. Photograph of Blohm-Porter Marsh buffer site number 8

Site History 9. Moro Cojo Slough Commercial Development Buffer

Site number 9 is located adjacent to Moro Cojo Slough near Moss Landing in North Monterey County (Figure 21). The Moro Cojo Slough watershed encompasses approximately 17 square miles bound by Moss Landing Harbor to the west, Highway 156 to the south, Elkhorn Slough to the north and San Miguel Canyon Road to the east (The Habitat Restoration Group 1994a). The subject site is located adjacent to the lower slough watershed near the coast between Moss Landing Road and Highway 1 beside the town of Moss Landing. The lower slough wetlands are characterized as coastal salt marsh communities that were disturbed by grazing, agricultural activities, and a modified hydrologic regime.

Near the buffer site, the wetland is channelized. The channel is flanked by a relatively flat and broad pickleweed marsh that slopes steeply up to an upland vegetation band of non-native grasses and patches of salt marsh plants. Beyond the vegetation band are businesses that lie generally within 100 feet of the open water of the slough. On the other side of the narrow slough channel, the slope is low and some the homes and businesses are within 10 feet of the open water.

The present wetland is considered to be degraded; however, future wetland enhancement plans for Moro Cojo Slough can restore much of the wetland habitat. Moro Cojo Slough is considered one of the most promising sites in the state for wetland restoration (Gordon 1987). In 1990, a management and enhancement plan was initiated by Monterey County to respond to land use conflicts and development pressures in the

Fig. 21. Map of Moro Cojo Slough site number 9 and 10

Source: U.S. Geological Survey 7.5 Minute Series Moss Landing Quadrangle

slough watershed. The study was conducted during 1993 and 1994 and portions of the draft report by the Habitat Restoration Group (1994a) are referenced in this study.

Field Survey Site and Development Description

The buffer site is part of an approximately 3-acre lot adjacent to Moro Cojo Slough (Figure 22). Prior to development, the lot was a broad flat area of non-native grasses, herbs, and patches of salt marsh plants (ABA Consultants 1987). The proposed project was to expand an existing restaurant and make parking lot improvements.

Permit Framework

The parking lot improvements and restaurant remodeling was begun in 1985 without the benefit of a Monterey County Use Permit or a Coastal Development Permit. Because of the site's proximity to Moro Cojo Slough there were concerns involving potential adverse impacts on the sensitive habitat area. The appropriate permits were applied for and granted in 1986 and 1987. The coastal permit granted in 1987 includes conditions to protect environmentally sensitive habitat features. Monterey County planners determined that the project was categorically exempt from CEQA.

Setback requirement. The development site is subject to the North Monterey County LUP including provisions for appropriate setbacks and buffer areas. An open space setback of 100 feet from the landward edge of vegetation is required.

Fig. 22. Moro Cojo Slough buffer site number 9 and 10. Drawing by author based on permit file map (CCC 1987).

Permit conditions. The conditions state that the permittee must offer to dedicate an open space conservation easement to a public agency or a private association for protection of the environmentally sensitive habitat area located within the Moro Cojo Slough floodplain. The location of the easement is from the westerly boundary of the entire parcel to 100 feet inland from the approximate landward edge of the wetland vegetation along the slough. The applicant must also submit a biotic assessment which includes a mapped survey showing the location and type of vegetation of the entire parcel, and recommendations regarding location of the open space conservation easement and appropriate buffer areas (CCC 1987).

Buffer Site Description

The buffer area is located behind the restaurant parking lot area adjacent to Moro Cojo Slough near Moss Landing Road and Highway 1 (Figure 23). A rope and wood post fence separates the buffer from a landscaped area and parking lot behind the restaurant. The buffer is fairly level for approximately 80 feet then became very steep at the edge of the slough. The buffer is approximately 93 feet wide from the high watermark to the edge of the parking lot. The buffer vegetation has remained in its natural condition.

ABA Consultants' Ecological Assessment (1987) found that six species of salt marsh plants occur in the parcel's wetland. The existing vegetation on the upper, flat buffer area of the parcel was a complex mixture of annual grasses, herbs, and patches of salt marsh plants.

Fig. 23. Photograph of Moro Cojo Slough buffer site number 9

Site History 10. Moro Cojo Slough Retail/Residential Development Buffer

Site number 10 is located across from site number 9 adjacent to Moro Cojo Slough (Figure 21). Near the subject site, the condition of the slough is nearly identical to site number 9. The only observable difference is that the slope on this side of the slough is less steep and the adjacent homes and business tend to be much closer to the open water of the slough (within 3-50 feet).

Field Survey Site and Development Description

The subject site is a portion of a parcel that lies near Moro Cojo Slough (Figure 22). Site conditions prior to development are unknown. The proposed development is the phased construction of a 2-story, 7,360 square foot mixed-use retail/residential complex. The parcel size is approximately 1.5 acres and while only a portion of the parcel actually fronts the slough due to the presence of an intervening lot, the rear area of the parcel does lie within 100 feet of the wetland vegetation of Moro Cojo Slough. No development was planned for this back portion of the lot.

Permit Framework

The CCC permit was granted in 1985 subject to wetland setback buffer conditions. The permit states that the proposed project will not create significant adverse environmental impacts under CEQA.

Setback requirements. A 100 foot open space easement is required.

Permit conditions. The project's developer was required to offer to dedicate to a public agency or private association an open space conservation easement over the entire width of the property extending 100 feet in from the landward edge of wetland vegetation along Moro Cojo Slough. Development is restricted in the easement except for resource dependent uses or for flood control (CCC 1985).

Buffer Site Description

The permitted development was begun in the mid-late 1980s. The buffer area is accessed by crossing over an adjacent property to the edge of the slough and walking along the edge to the subject site (Figure 24). The property line is demarcated by a diagonal chain-link fence, which splits the buffer. The approximately 0.7-acre buffer measured about 5-50 feet from the edge of the fence to the edge of wetland vegetation. Because the easement extends 100 feet inland from the edge of wetland vegetation for the entire width of the property, the buffer extends inland beyond the fence. The buffer vegetation has remained in a natural condition since development.

Fig. 24. Photograph of Moro Cojo Slough buffer site number 10

Site History 11. Moro Cojo Slough North Monterey County High School Buffer

Site number 11 is located adjacent to Moro Cojo Slough in the upper watershed near Castroville Boulevard (Figure 25). The upper Moro Cojo Slough watershed contains gentle to moderately sloping terraces that bound the low-lying slough drainages. The watershed is characterized by low-elevation wetlands, upland grassland and chaparral vegetation, and agricultural, grazing, and rural residential land use (The Habitat Restoration Group 1994a).

The wetland community in the upper watershed consists of freshwater marsh and freshwater herbaceous wetlands. Some of these wetland communities have been disturbed by cattle grazing activities and agriculture. The hillsides bordering the slough and abandoned agricultural areas nearby are associated with non-native grassland vegetation. Much of the terrain surrounding the slough was reclaimed for agricultural and grazing purposes in the last two centuries (The Habitat Restoration Group 1994a).

In the vicinity of the subject site, the freshwater slough forms a natural channel. Adjacent to the slough edge is a steep non-native grassland buffer. Where the slope levels off, the subject site is developed with a high school. The top of the slope on the other side of the slough channel is developed with single family and mobile homes.

The development of a high school on the subject site changed the land use from agricultural grazing to institutional with the attendant concerns of traffic, noise, biological, water, and air quality issues. On site is a significant portion of the drainage basin that feeds the lower slough complex (CCC 1977).

Fig. 25. Map of Moro Cojo Slough site number 11

Source: U.S. Geological Survey 7.5 Minute Series Prunedale Quadrangle

Field Survey Site and Development Description

The buffer site was part of a vacant 84-acre parcel (Figure 26). The project site included grass covered hills with species such as bermuda grass (*Cynodum dactylon*), Pacific bentgrass (*Agrostisa venacea*), and purple stipa (*Stipa pulcha*), and a seasonal flooded basin. The proposed project was a high school development on 3.5 acres.

Permit Framework

Permits were granted by Monterey County and the Central Coast Regional Commission in 1977 subject to conditions. An EIR was filed in 1976.

Setback requirements. The permits do not contain a numerical setback regulation from the slough; however, the Monterey County permit requires that a conservation and scenic easement be deeded to the county for all of the property below the 10-foot contour elevation. In addition, the Commission's permit states that the Board of Trustees, prior to the school's opening, shall adopt a resolution dedicating in perpetuity those lands below the 10-foot contour as a permanent natural preserve and field laboratory (CCC 1977).

The 10-foot contour is aligned with school's perimeter road in some places. At this point, the easement is 56 feet wide from the delineated boundary of the slough to the road. At its widest point, the easement boundary is 210 feet from the edge of development to the slough boundary. Thus, the buffer ranges from 56-210 feet.

Fig. 26. Moro Cojo Slough buffer site number 11. Drawing by author based on permit file map (CCC 1977).

EIR mitigation measures. There were no specific mitigation measures relating to the buffer; however the EIR states that future development and planned activities should take into consideration the sensitivity and biological value of the seasonal flooded basin (Earth Metrics Inc. 1976).

Permit conditions. The Monterey County permit requires that runoff from buildings, walkways, paved surfaces, and other impervious additions to the property be ponded and stored for irrigation or tested before release to Moro Cojo Slough (CCC 1977). It is not clear if the ponding is to take place in the buffer area.

Buffer Site Description

Construction was begun on the proposed development after 1977. The high school buffer was easily accessed from a road on the perimeter of the school (Figure 27). The buffer was quite steep from the road down towards the slough. It flattened out toward the high watermark of the slough and a mowed track here may occasionally accommodate a vehicle. There is no fence to prevent access to the buffer or the wetland. The approximately 3.6-acre buffer measured an average of 186.5 feet from the edge of the road to the high watermark of the slough.

The buffer vegetation has been left in a natural condition since development. Dominant trees in the vicinity of the site in 1976 included Monterey cypress, and California pepper (*Schinus molle*). Large plants and scrubs include coyote bush (*Baccharis pilularis*) and California wild rose (*Rosa californica*) while the marsh-grass habitat has slough sedge (*Carex obmptia*) and curly dock (Earth Metrics Inc. 1976).

No rare or endangered species, as listed by the DFG, were known to exist within the project area in 1976. The EIR biological survey found numerous marsh hawks (*Circus cyaneus*) perched in the wooded area and hovering over the hills and marshland. Although they were not seen, teal ducks (*Anas* sp.) were known to be one of the primary visiting ducks of this area. Mice and muskrats were known to inhabit the seasonal flooded basin (Earth Metrics Inc. 1976).

Fig. 27. Photograph of Moro Cojo Slough buffer site number 11

Site History 12. Marina Vernal Pond 1 (Robin Drive Pond) Single Family Homes Buffer

Site number 12 is located adjacent to Marina Vernal Pond 1 in the city of Marina (Figure 28). The vernal ponds in Marina are designated as sensitive habitat in Marina's LCP. Although vernal pools are defined as ephemeral, seasonally wet habitats, the ponds in this study include both seasonal and perennial. They are the remnants of what once was an extensive salt marsh system. Each pond receives stormwater runoff from its own surrounding watershed. Pond 1 receives water from an area of residential development and from a 1 mile length of Highway 1 (The Habitat Restoration Group 1994b).

The Marina ponds were once part of the extensive Salinas River marsh system. Historically, the ponds may have supported tules, cattails, and rushes. The ponds have been altered by grazing, removal of riparian vegetation, planting of non-native trees for windbreaks, and urbanization (The Habitat Restoration Group 1994b).

Pond 1 and the adjacent Pond 7 (Lake Drive Pond) were in unobstructed contact with the dune scrub habitat of Monterey Bay shoreline in the 1940s. These conditions remained relatively unchanged until around 1956, when agricultural development was established just north of Pond 1 and a coastal access road was installed just south of Pond 7. The ponds were further altered by the expansion of Highway 1 and the construction of additional housing around the perimeter of the ponds. Recent fencing of the ponds has eased the impact of pets and trespassers (The Habitat Restoration Group 1994b).

Fig. 28. Map of Marina Vernal Pond site number 12, 13, and 14
 Source: U.S. Geological Survey 7.5 Minute Series Marina Quadrangle

In the vicinity of the subject site, the wetland is a brackish to hypersaline seasonal pond of 1.7 acres that is surrounded by a band of coastal saltwater marsh plant community. The shoreline slope is gradual, creating extensive areas of seasonally inundated mudflat. Beyond the vegetation band are homes, roads, and some non-native vegetation and mixed grassland plant communities.

In 1994, an enhancement and management plan (The Habitat Restoration Group 1994b) was developed for seven of Marina's vernal ponds to maintain high water quality and enhance wildlife habitats. The management plan was required as part of Marina's proposed LCP amendment No. 1-88 that intended the conversion of an agricultural area to a regional shopping center and encroachment on a vernal pond. The management plan includes the following recommendations specific to wetland buffers for enhancing the habitats of the vernal ponds:

- Maintain or add fencing
- Remove invasive non-native species and revegetate with appropriate native species
- Educate area residents about the resource quality of the ponds with stewardship programs, interpretive signs, and controlled access
- Create stormwater retention basins

Field Survey Site and Development Description

The subject site was part of a vacant approximately 15-acre parcel in an area with an existing small development of single family homes (Figure 29). The site characteristics prior to development are unknown. The proposed development includes a subdivision of

32 single family lots, the creation of a 7.7-acre vernal pond and coast wallflower preserve, and installation of a 6 foot high fence.

Permit Framework

The proposed subdivision for Pond 1 was originally approved by the CCC in 1979. A preserve area for the vernal pond and dunes on the site was required and disturbance of the wetland minimized. The project was subsequently amended in 1980 to modify setback and pond protection requirements and the amendment was approved without conditions. The permit findings state that the project does not have significant adverse impacts as identified by CEQA.

Setback requirements. The amended project was approved in 1980 changing the setback requirement from 59 feet from the highwater limits of the pond to a minimum of 44 feet.

Permit conditions. The original permit conditions in 1979 stated that the entire sensitive area would be fenced off and established and maintained as a preserve. All structures and access roads were to be setback from the pond a minimum of 38 feet. A homeowners association was to be established with the responsibility of maintaining the percolation area, vernal pond, and preserve areas. Because significant concerns remained it was recommended that the minimum width of the undisturbed buffer area be changed to 59 feet from the pond and the maintenance should be transferred to an appropriate public agency or private foundation.

Fig. 29. Marina Vernal Pond buffer site number 12 and 14. Drawing by author based on plant communities map (The Habitat Restoration Group 1994b).

In 1980, the setback was amended. The amendment was approved without conditions and with findings indicating that the modifications would provide adequate protection for the pond resources. It was stated that although the amendment permits a minimal setback from the vernal pond and habitat area, drainage and access to the pond will be strictly controlled. Also, additional landscaping between the pond and the road would enhance the buffer area and use of the habitat area. The DFG was contacted about the proposed amendment and they were satisfied with the CCC's decision (CCC 1980).

Buffer Site Description

The permitted development was constructed in the early 1980s. Most of the pond is surrounded by a chain-link fence (Figure 30). Access to the pond was made by obtaining permission and a key from Marina's Public Works Department. The pond and adjacent area was conveyed to the DFG, placed in an ecological reserve, and subsequently managed by the City of Marina (The Habitat Restoration Group 1994b).

The buffer measured about 57 feet from the edge of the fence to the high water mark. The vegetation surrounding the pond has remained in a natural condition since development took place. About two-thirds of the pond is surrounded by homes and Highway 1 while the remaining one-third is open space. Although development adjacent to the subject site is set back from the pond, a few homes across the pond have backyards immediately adjacent to the highwater mark.

Botanical and biological surveys completed at the ponds find that of the seven Marina ponds studied, Pond 1 has the greatest quantity of coastal salt marsh vegetation. Coastal

salt marsh community occurs along the borders of the pond where the slope is conducive to the establishment of a salt marsh. Beyond the salt marsh border, a small scrub community in the pond area has been significantly degraded by non-native species, such as ice plant, Monterey cypress, eucalyptus, and ruderal herbaceous species. Key wildlife use and resources available at Pond 1 include foraging for shorebirds and migratory wildfowl (The Habitat Restoration Group 1994b).

Fig. 30. Photograph of Marina Vernal Pond buffer site number 12

Site History 13. Marina Vernal Pond 3 (Marina Landing Pond) Commercial Development Buffer

Site number 13 surrounds Marina Vernal Pond 3 (Figure 28). Pond 3 is a reconstructed freshwater to brackish perennial pond located about a mile north of Pond 1. The pond receives stormwater runoff from an area of residential development, major surface streets, and a small portion of Highway 1 (The Habitat Restoration Group 1994b).

Originally the area around Pond 3 was probably a coastal scrub plant community where scattered shrubs and herbs stabilized the rolling sandy dune topography. The pond was gradually reduced in size between 1937 and 1966 due to the encroachment of agriculture (Earth Metrics Inc. 1988). The pond was further altered by road improvements undertaken in the mid-1970s. To allow for Beach Road street improvements, a portion of Pond 3 was filled, and as mitigation, another small pond was created. No long-term maintenance and monitoring efforts were established to assure wetland protection for the now two ponds. Unfortunately, the habitat quality of the ponds deteriorated over the years (CCC 1988).

At the subject site, the small oval pond has a distinct edge because it has recently been revegetated. The moderately sloped upland area has clumps of native plants spaced several inches apart with irrigation hoses threaded among them. The sandy soil is exposed in between the plants. Beyond the revegetated area is a low wire fence separating most of the pond from the adjacent roads. Two observation platforms are placed at either end of

the pond. One side of the pond is adjacent to a housing development. A steep slope and a row of trees screen the pond from the development.

Field Survey Site and Development Description

The subject site was originally two existing vernal ponds with brackish water marsh vegetation and non-native grassland upland areas. The subject site now surrounds the reconstructed Pond 3 (Figure 31). The proposed development was a 19.6 acre regional shopping center.

Permit Framework

The two ponds comprising the reconfigured Pond 3 were the subject of an EIR for the Marina Landing Shopping Center Project in 1988. The pond was also part of the Coastal Commission approval of the City of Marina LCP Amendment No. 1-88. A Coastal Development Permit and Environmental Determination was granted by the city in 1992.

Setback requirements. The proposed Pond 3 improvements would provide 2.93 acres of habitat where 2.15 existed but with a limited buffer area. The Marina General Plan (1985) and the LCP (1982) require a 100-foot building setback. Therefore, final plans for the project must prohibit buildings or other structures within 100 feet of the new confines of the pond and its associated wetland vegetation (CCC 1988). The improvements to the new, larger off-site pond were designed to improve it to a coastal pond habitat and the final plans include a 100-foot building setback.

Fig. 31. Marina Vernal Pond buffer site number 13. Drawing by author based on schematic habitat map (The Habitat Restoration Group 1989).

The city issued permit contains a condition that no building on the shopping center site shall lie within 100 feet of the relocated and enhanced off-site pond (CCC 1992).

EIR mitigation measures. The proposed development plan in the EIR calls for combining the existing on and off-site ponds into one larger off-site pond. The new single, larger pond is expected to permit the establishment of a buffer zone between the pond and the north shoulder of the road. Development of a vegetated buffer screen in this zone between the roadway and the pond edge is planned to obscure vehicle and pedestrian traffic from wildlife activities on the pond (Earth Metrics Inc. 1988).

LCP amendment conditions. The 1988 LCP amendment retains provisions that prevent encroachment on vernal ponds and maintaining open space with an exception for development that implements the plan and guidelines for Pond 3 enhancement and correlates it with the development of a comprehensive management plan for the area's wetland resources.

Permit conditions. The city requires that the relocation and enhancement of the off-site pond shall be conducted in compliance with the city, the DFG, and the approved 1989 plan and guidelines for pond enhancement. Also, the pond enhancement plan must include measures to filter and treat stormwater runoff before it enters the pond (CCC 1992). It is unclear if the stormwater runoff will be filtered and treated in the buffer area.

Buffer Site Description

The proposed development of the shopping center and the realignment of Beach Road was completed several years ago. Access is controlled to the pond by a low wire fence. The buffer surrounds the entire pond and measures about 46 feet from the highwater mark to the edge of the fence (Figure 32). The pond is designated as open space and is to be managed by the City of Marina upon successful completion of the revegetation activities (The Habitat Restoration Group 1994b).

Pond 3 is in the process of being revegetated as a coastal freshwater marsh with a mixed grassland and scrub upland community. It is expected to be of value to migratory waterfowl and shorebirds and breeding amphibians (The Habitat Restoration Group 1994b). The pond edge along Beach Road was recontoured to allow for the establishment of a brackish water marsh habitat and a riparian and upland shrub buffer zone. The vegetation for the brackish marsh habitat will be dominated by cattails (*Typha* sp.) and bulrush (*Scirpus* sp.). A dense growth of willow (*Salix lasiolepis*) will provide habitat and screen the pond from the road. Herbaceous wetland vegetation is provided for nesting and feeding habitat for waterfowl and other wildlife. Finally, the upland scrub community, such as bush lupine (*Lupinus arboreus*), coyote bush, and California sagebrush (*Artemisia californica*) will provide wildlife habitat and will screen the pond from adjacent activities (The Habitat Restoration Group 1989).

Fig. 32. Photograph of Marina Vernal Pond buffer site number 13

Site History 14. Marina Vernal Pond 7 (Lake Drive Pond) Single Family Homes Buffer

Site number 14 surrounds Marina Vernal Pond 7 (Figure 28). Pond 7 is a 0.9 acre perennial freshwater pond and marsh directly south of and connected to Pond 1 by an area of open space. Pond 7 receives stormwater runoff from the surrounding neighborhood (The Habitat Restoration Group 1994b).

At the subject site, the pond is encircled with a coastal freshwater marsh plant community. Beyond the marsh community is coyote bush scrub, mixed grassland, and non-native vegetation. A portion of the pond is in open space contact with Pond 1 while the rest of the pond is surrounded by a fence and single family homes.

Field Survey Site and Development Description

The subject site was a vacant parcel surrounding Pond 7 (Figure 29). Site characteristics prior to development are unknown; however, a subsequent proposal for development characterized the site in 1975 as a graded, moderately sloping basin centered around the pond that was encircled by pickleweed. The surrounding soils on the parcel supported no trees, but many weedy species (CCC 1975). The development was 127 single family homes (Marina Hills Subdivision) that partly surrounded the pond and outlying areas.

Permit Framework

The grading permit was issued and final map accepted for the development in 1972. A Central Coast Regional Coastal Zone Conservation Commission permit was granted in

1973 subject to conditions stated in the resolution. It is unknown whether the subdivision was subject environmental review per CEQA.

A subsequent application for a permit was submitted in 1975 to the Commission for a neighborhood park on the site. Pond 7 would have occupied the center of the area proposed for the park. A Negative Declaration was declared by Monterey County in 1975 but the park was never built.

Setback requirements. The permit did not contain a numerical setback requirement from the pond; however, a 5.33-acre parcel including Pond 7 and some of the surrounding upland was designated as a Drainage and Open Space area (CCC 1973). This designation effectively gave the pond a buffer ranging from 47 to 90 feet from the existing open water of the pond in 1975 to the property lines of the single family homes.

Permit conditions. The permit did not contain any specific conditions relative to the pond or pond buffer aside from designating the pond and upland area as open space. A field inspection conducted at the time revealed that there was no plant or animal life on the site (CCC 1973).

Buffer Site Description

The west, south, and east shores adjacent to Pond 7 were developed with single family homes beginning in 1976. The homes face the street rather than the pond. The Pond 7 buffer was accessed through a locked gate with a key provided by Marina's Public Works Department. Pond 7 is designated as open space and managed by the city of Marina (The Habitat Restoration Group 1994b).

Three-quarters of Pond 7 is surrounded by the backyards of the homes while the remaining area is connected to Pond 1 by a strip of open space land (Figure 33). The buffer is fenced at the back yards of the homes but not at the wetland or at the strip of open space. The buffer surrounding Pond 7 is about 1.4 acres in area and measures an average of 71 feet from the back of the fences to the highwater mark. The buffer vegetation has remained in a natural condition since development.

Pond 7 has a coastal freshwater marsh community around its perimeter. The vegetative composition of this freshwater marsh changes in response to seasonal changes in the water level. The aquatic area is dominated by alkali bulrush (*Scirpus robustus*). When the water level recedes, annual herbaceous species such as golden dock (*Rumex maritimus*) and fat hen (*Atriplex patula* var. *hastata*) germinate in the substrate of the receding pond. A disturbed area of dune scrub lies in the open space between Pond 7 and Pond 1. Three individuals of the sensitive species Monterey ceanothus (*Ceanothus cuneatus* var. *rigidus*) were observed adjacent to Pond 7. Key wildlife use and resources at Pond 7 include seasonal use by wintering waterfowl, waterfowl nesting habitat, amphibian breeding habitat, and potential legless lizard (*Anniella* sp.) habitat (The Habitat Restoration Group 1994b).

Fig. 33 Photograph of Marina Vernal Pond buffer site number 14

Site History 15. Laguna Grande Commercial Development Buffer

Site number 15 is located adjacent to Laguna Grande Lake near the city limits line that divides the cities of Monterey and Seaside (Figure 34). Laguna Grande Lake consists of approximately 34 acres of water and 12 acres of land.

Laguna Grande was once a seasonal estuarine body of water; it is now a freshwater marsh and lake. It forms a portion of the Canyon Del Rey creek that drains the 13.5 square mile Canyon Del Rey creek watershed to the southeast. The creek flows from Laguna Grande to Roberts Lake and finally into Monterey Bay.

Originally Laguna Grande was one lake; however, two lakes were formed, Laguna Grande and Roberts Lake, when a railroad bed was constructed on fill through the lake in the 1880s. Shoreline landfill operations over the years reduced the size of the lake.

Near the subject site, the freshwater lake has a defined edge fringed with a bulrush and cattail marsh. Adjacent to the edge is a noncontiguous band of riparian woodland and non-native vegetation. Beyond the vegetation is a paved public path surrounding the lake, public park facilities, and a parcel currently being developed as an office building. Land on the Monterey side of the lake is now subdivided for primarily residential use while land on the Seaside side of the lake is primarily developed for commercial use.

The Laguna Grande complex was purchased by the Monterey Peninsula Regional Park District in 1976. The approved LUP includes recommendations for upgrading Laguna

Fig. 34. Map of Laguna Grande Lake site number 15
 Source: U.S. Geological Survey 7.5 Minute Series Seaside Quadrangle

Grande. In response to these recommendations, a wetland restoration and enhancement plan was approved by the Coastal Commission in 1986 (CCC 1989b).

Field Survey Site and Proposed Development Description

The subject site was a portion of a vacant 2.23-acre parcel of relatively flat terrain (Figure 35). The existing vegetation was mostly weedy plant species with some riparian habitat and bulrush/cattail marsh on the portion of the site that borders Laguna Grande Lake (CCC 1989b). The proposed project includes the installation of a 25-car parking area, bike/pedestrian path, landscaping, and a stormwater drainage/filtration system. These improvements are part of a 5-story office building development.

Permit Framework

The 1989 Coastal Commission permit is for installation of a 25-car parking area, bike/pedestrian path, landscaping, and a stormwater drainage/filtration system. These improvements are a portion of the total development that is located in the coastal zone. The coastal zone extends along 25 feet from the edge of the lake. The city of Seaside certified an EIR for the proposed project in 1988.

Setback requirements. The Laguna Grande LCP calls for a 50-foot setback from the inland extent of the wetland and its associated vegetation. The project, as proposed in the EIR, encroaches slightly upon the riparian habitat; however, according to the EIR, the 50-foot setback is not necessary because the vegetation at this site does not support the ecological attributes necessary for the protection of wetland habitat (Strelow 1988).

Approximate Scale 1"=50'

Fig. 35. Laguna Grande Lake buffer site number 15. Drawing by author based on permit file site plan map (CCC 1989b).

According to the project plans, there will be a 20 foot wide strip of native vegetation which will act as a buffer between the parking lot and the footpath (CCC 1989b).

EIR mitigation measures. The EIR states that proposed project will result in the direct loss of habitat and indirect degradation of habitat. Mitigations for the loss relating to the buffer zone include redesigning the pedestrian pathway and parking area to locate them outside the riparian and wetland vegetation, removing competitive weeds within the riparian community and replanting with arroyo willow, and using native upland plant species for landscaping. The EIR states that the pathway will provide a buffer between the parking lot and habitat area (Strelow 1988).

Permit conditions. There are no specific permit conditions imposed relating to the buffer.

Buffer Site Description

The proposed development was in the process of being built when the site visit was made. The buffer site is bordered by the as yet unfinished parking lot and is bisected by a paved footpath (Figure 36). A chain-link fence separates the construction site from the buffer area, public path, and lake. Nearby is a hotel development, park facilities, and local roads. The buffer measured an average of about 25 feet from the edge of the lake to the fence. Some of the vegetation bordering the lake has been removed but the proposed revegetation has not yet taken place.

Fig. 36. Photograph of Laguna Grande Lake buffer site number 15

CHAPTER 5

RESULTS AND EVALUATION

The primary objective of the field component was to assess the characteristics of selected wetland buffers in the Monterey Bay area to determine the effectiveness of wetland buffer zones in protecting the wetland from disturbance. The evaluation was based on data that was collected on field data and vegetation survey forms (Appendix 1). This study measured buffer function indicators to assess the overall effectiveness of the buffer. The indicators included erosion prevention, wildlife use, human activities, moderation of water level fluctuation, and vegetation characteristics.

Wetland buffer function indicators were measured by researcher observation, taking measurements, and researching previously conducted studies on the fifteen wetland buffers in the study area. The findings are summarized below for the buffer function indicators collected in the field.

Buffer Function Indicators

Erosion prevention. Vegetated wetland buffers prevent excessive stormwater runoff into the wetland. The presence or lack of erosion in the buffer may be one indication of the water quality of the wetland. Water quality functions that a buffer can provide include biofiltration of sediments, nutrient uptake within the vegetated system, and provision of a settling basin for the deposition of suspended solids (Cooke n.d.).

Visible signs of erosion were easy to detect because the field visits were made in a particularly heavy rainy season. When erosion was noted, the number of rills or gullies were counted and measured. The number was divided per buffer acre (Table 2). An attempt was made during field investigation to differentiate between on-site erosion and erosion caused by off-site factors.

Table 2—Erosion in Buffer Sites

Site Number	Site Name	No. of Rills (per acre)	No. of Shallow Gullies (per acre)	No. of Deep Gullies (per acre)
3	Corcoran Lagoon	0.7		
5	Struve Slough		0.3	
11	Moro Cojo Slough		0.3	
13	Marina Vernal Pond 3	28.6	14.3	5.7
15	Laguna Grande Lake	4.3	11.4	

Thirty-three percent of the buffer sites showed some sign of erosion. Marina Vernal Pond 3 and Laguna Grande Lake buffer sites were eroded because of runoff, while the other buffer sites were eroded because of stormwater outlets in the buffer. The buffer sites that reported the highest level of erosion, Marina Vernal Pond 3 and Laguna Grande Lake, had relatively low slopes with partly exposed soil. Both sites are undergoing revegetation efforts. Erosion at these sites will likely decrease as the revegetation becomes established and spreads.

Wildlife use. The evaluation of wildlife use and habitat availability was limited to one approximately 4 hour observation made mainly in the winter at each site. The information

gathered at this time can provide a preliminary assessment of wildlife habitat components of wetland buffers. Habitat components that can be provided by a wetland buffer include vegetation species diversity, structural complexity, community complexity, shelter, and food.

Wildlife use at the buffer sites was determined by describing the available habitat, counting and identifying species in the wetland and in the buffer when possible, and looking for evidence of trails, nests, and burrows in the buffer (Table 3).

Most sites had good cover and many had snags and cavities available. No nests were seen due to the season and it was sometimes difficult to determine if a trail was animal or human-caused. Domestic animals were seen in areas near residential housing where the wetland was not fenced. Coots and mallard ducks, both year-round residents in this area (Peterson 1990), were the most commonly identified species. Future studies should determine if buffers that were restored with native species enhance wildlife habitat and increase the diversity of species.

Table 3—Wildlife Habitat and Use of Buffer Sites

Site Name	Snags or Cavities	Brush or Cover	Wildlife	Nests*	Burrows	Trails	Feral or Domestic Species
Nearby Lagoon CHC Housing	Yes	Yes	Hummingbird	No	No	No	No
Nearby Lagoon WW Site	Yes	Yes	No	No	No	No	No
Corcoran Lagoon	Yes	Yes	Coots, Mallards, Seagulls, Egret	No	No	No	No
Moran Lake	Yes	Yes	No	No	No	No	Dogs
Struve Slough Westridge	No	Yes	No	No	Yes	Yes	No
Struve Slough Crossroads	Yes	Yes	Mallards, Egret	No	Yes	No	No
Struve Slough Penn. Ave	No	Yes	Coots	No	Yes	No	Cat
Blohm-Porter Marsh	Yes	Yes	Red-winged Blackbirds, Hawk	No	No	No	No
Moro Cojo Restaurant	No	Yes	Mallards, Blackbirds, Seagulls, Hawk	No	No	No	No
Moro Cojo Retail/Residential	No	Yes	Coots, Mallards	No	No	Yes	No
Moro Cojo High School	Yes	Yes	Mallards, Kite, Seagulls, Egret, Coots, Hawk	No	No	No	Dogs
Marina Vernal Pond 1	Yes	Yes	Terns, Mallards, Red-winged Blackbirds	No	No	No	No
Marina Vernal Pond 3	No	No	Mallards, Coots	No	No	Yes	No
Marina Vernal Pond 7	Yes	Yes	Red-winged Blackbirds, Coots	No	No	Yes	No
Laguna Grande	Yes	Yes	Coots, Seagulls, Red-winged Blackbirds, Snake	No	No	No	No

*Due to the season, observations were limited to nest remnants from the previous spring.

All of these sites are isolated in the landscape by development or roads which may limit their value as wildlife habitat. The destruction of natural corridors connecting wetlands to other habitats could lead to isolation of wildlife populations, disease, and a reduction in the gene pool (Porter 1980). Due to the nature and position of these urban wetlands, it is probably unreasonable to expect them to provide suitable habitat for a great variety of species. On the other hand, these wetlands are a significant resource for some species in this area that merit protection. It will remain important to consider the habitat value of the buffer when developing restoration plans or planning for future development.

Human activities. A wetland buffer can function two ways with regard to human activities. First, it discourages human activities from negatively impacting the wetland by preventing access to the wetland; second, it enhances the human experience of wetlands by providing controlled access, recreation, and educational opportunities. The buffer sites were tested to see if they functioned to prevent human intrusion by looking for indications of uncontrolled access in the buffer and wetland area. Indicators of controlled access facilities were noted to determine if the buffer was functioning to enhance the human experience of the wetland.

Human intrusion. All the buffer sites had some level of human intrusion displayed by the amount of garbage deposited in the buffer or the wetland and other aspects such as trails and vegetation trampling. The indicators of human intrusion were counted and are shown on a per acre basis (Table 4). These wetlands are all located within or adjacent to urbanized areas and therefore the level of human intrusion was not unexpected. Wetlands

are often one of the few natural remnant landscapes found within the urban structure. Thus, they have the potential to provide sensory experience, recreation, and even living spaces in the adjacent uplands. The urban pressure also threatens the wetlands' continued existence making them highly stressed ecosystems (Smardon 1988).

The most common type of garbage found was cardboard followed by bottles, cans, and bits of plastic. Three of the fifteen sites had tires (bicycle and automobile) in the wetland or the buffer. Other common discarded materials included bits of wood and chunks of building materials. Ten sites had trails including dirt tracks, old roads, and paved access trails. Vegetation was trampled at one site. Dumped yard waste was found at four sites.

It is unknown whether the amount of human intrusion occurring in these wetland buffers is having a detrimental effect on the wetland. However, the condition of the wetland buffer could influence the wetland itself because the wetland, its edge, and the upland cannot be separated by a distinct line using either physical or biological indicators. There is an important flow back and forth between them that is most easily recognized in the activities of resident wildlife. Water quality and plant and animal life in the wetland are affected by conditions along the wetland edge (Porter 1980).

Table 4—Evidence of Human Intrusion in Buffer Sites

Site Name	No. of pieces of garbage (per acre)	No. of piles* of yard waste (per acre)	No. of trails** (per acre)	No. of campfires (per acre)
Neary Lagoon CHC Housing	2.9	0	0	0
Neary Lagoon WW Site	0	0	3.0	0
Corcoran Lagoon	13.3	0.7	0.7	0
Moran Lake	0	33.3	0	0
Struve Slough Westridge	2.4	0	0.3	0
Struve Slough Crossroads	5.7	0	0.7	0
Struve Slough Penn. Ave	10.7	0	0.7	0
Blohm-Porter Marsh	3.4	0	1.0	0
Moro Cojo Restaurant	9.2	0	0.8	0
Moro Cojo Retail/Residential	5.7	1.4	0	0
Moro Cojo High School	6.1	0	1.4	0
Marina Vernal Pond 1	1.9	0	0	0
Marina Vernal Pond 3	0	0	0	0
Marina Vernal Pond 7	3.6	2.1	2.1	0
Laguna Grande	12.1	0	0	0

* a pile is a discernible amount of cut vegetation lying one on another

** a trail is an informal path of dirt or flattened vegetation

Human presence in the wetland buffer can affect animals in the wetland as a person approaching a heron or a flock of waterfowl can agitate and flush them even at distances of greater than 200 feet (State of Washington Department of Wildlife 1992). Josselyn et al. (1989) measured bird disturbance responses in San Francisco Bay region wetland habitats and found that the distance from the human activity causing a disturbance ranged between 50 and 175 feet. The range of distances at which disturbance responses are observed provides a general support for a buffer of at least 100 feet. Unregulated trails and other types of human intrusion may prove detrimental to the wildlife that use the wetland and buffer area. Litter and yard waste left by humans can affect water quality and plant and animal life. Plastic or other harmful items can be eaten by wildlife and toxic substances can pollute the wetland.

The litter and yard waste found in the buffer also affects the visual amenity value of wetlands. A wetland study in Juneau, Alaska (Palmer and Smardon 1988) found that one important visual wetland attribute is being free of litter.

Vegetation removal and trampling in the buffer without restoration may affect water quality and plant and animal life. Compaction of soil damages roots, decreases soil water retention, lessens seed germination and seedling survival, and promotes the survival of more aggressive weedy species (Castelle et al. 1992). If the vegetative cover is removed or trampled, the bare earth surface will be subject to increased erosion and the resultant runoff is likely to end up in the wetland. Removing vegetative cover may also decrease habitat value for wildlife.

A Pearson's Product-moment correlation was run to determine if the width of the buffer and the level of human intrusion were related. However, the coefficient of correlation was calculated as $r = -0.25$. This near 0 value implies that there is little or no linear relationship between the two factors (McClave and Dietrich 1992). A Student's t -test was used to determine if the data provided sufficient evidence to indicate a difference between the average level of human intrusion in fenced and unfenced buffer sites. The test results showed that the sample evidence was insufficient to indicate a statistically significant difference in intrusion levels at the $\alpha = .05$ level of significance. Although the data in this sample did not provide sufficient evidence that the width and/or fencing of the buffer influenced the level of human intrusion, further studies may show that the size of the buffer and especially the addition of a fence may have some impact on the level of human intrusion in wetland buffers.

Human enhancement. The aesthetic function of a buffer includes values associated with open space and views, opportunities for passive recreation, and opportunities for education (Cooke n.d.). A real potential for wetlands in urban areas is a combined aesthetic-recreational-educational usage through interpretation and limited access to wetlands (Smardon 1988). Very few of the wetlands in the study area had planned aesthetic development in the buffer that allows limited accessibility to the wetland. One site, Neary Lagoon site 1, has plans for interpretive signs and a loop trail. The planned pedestrian entry will include a lockable gated entry to the buffer zone with access to important wildlife habitat areas restricted during certain periods (Jones & Stokes

Associates, Inc 1992). Other aesthetic development noted in the study sites included observation decks and benches facing the wetland. A fence was noted only if it limited or directed access to the buffer or wetland (Table 5).

Aesthetic development is fairly low for these wetlands despite the heavy public use that, in some areas, has contributed to soil compaction and excessive litter in the buffer and the wetland. It is noteworthy that the Marina Vernal Pond 3 which had reported no garbage has been recently replanted and has two observation decks overlooking the wetland. No litter was reported here because someone had cleaned the area and left a bag of litter at one of the observation decks. This action shows an awareness of the resource quality of the pond. The recently submitted Coastal/Vernal Pond Comprehensive Management Plan (1994) stresses stewardship of the pond resources by city residents through a pond stewardship and education program. The plan also recommends interpretive signs and observation platforms for some of the ponds to provide safe, controlled access and educate residents.

Table 5—Human Enhancement in Buffer Sites

Site Name	Paths	Signs	Fences	Observation Deck or Benches
Neary Lagoon CHC Housing	No, to be installed	Yes, "No Public Access - Wildlife Habitat"	Yes	Yes
Neary Lagoon WW Site	Yes	No	No	No
Corcoran Lagoon	No	No	No	No
Moran Lake	No	No	No	No
Struve Slough Westridge	No	No	No	Yes
Struve Slough Crossroads	No	No	No, to be installed	No
Struve Slough Penn. Ave	No	No	No	No
Blohm-Porter Marsh	No	No	No, but vehicle access is restricted by a gate	No
Moro Cojo Restaurant	No	No	No	No
Moro Cojo Retail/Residential	No	No	Yes, buffer is partly fenced	No
Moro Cojo High School	No	No	No	No
Marina Vernal Pond 1	No	No	Yes	Yes
Marina Vernal Pond 3	No	No	Yes	Yes
Marina Vernal Pond 7	No	No	Yes	No
Laguna Grande	Yes	Yes, restricting certain uses of the wetland	No	Yes

Other proposals have been developed for restoration and improved public access to the wetlands in the study area. The ecological assessment prepared by ABA Consultants (1987) for the Moss Landing portion of Moro Cojo Slough recommends a wetland park to restore degraded habitat and educate a broad segment of society. The preliminary plan includes access trails and observation platforms. Proposed enhancement activities in this area and other portions of Moro Cojo Slough are to be integrated into a comprehensive wetland management and enhancement plan for the slough.

Any proposals for improved public access and enhancement features must be carefully designed to avoid adverse impacts to wildlife. As Josselyn et al. (1989) showed, as human activity increased around a site, the number of birds using the site decreased. The results of Josselyn et al. (1989) suggest assessing species-specific and population level responses to disturbance in addition to food availability, habitat configuration, and seasonal and daily behavior patterns when designing access facilities in wetlands. Public access should be planned on a case-by-case basis that includes a regional perspective. In the same study, a survey of wetland managers found that the most effective buffer was either high vegetation or a channel.

Moderation of water level fluctuation. The ability of a wetland buffer to moderate water level fluctuations can be shown by evidence of ponding in the buffer. Another indication may be the evidence of highwater marks. One wetland buffer, Neary Lagoon site 1, showed evidence of ponding. Neary Lagoon buffer site number 1 was flooded with a water depth of 2-10 inches at the time of the field visit. Evidence of historical highwater

marks was more difficult to ascertain due to the unusually heavy amount of rain experienced in the winter and spring of 1995. However, it can be noted that no developments adjacent to study site buffers were flooded as the result of high water level in the wetland.

Vegetation characteristics. The ability of a wetland buffer to provide wildlife habitat, limit access to the wetland, and reduce erosion is tied into the characteristics of its vegetation. The characteristics of the vegetation were determined by classifying the vegetation into categories, estimating the percent cover for each category, and estimating average height for all vegetation types (Table 6).

Herbaceous vegetation is present in an average of 66% of the study sites. The remaining composition includes an average of 13% scrub-shrub, 1% forest, 9% plant litter, 9% bare earth, and 2% paved surface. The average vegetation height of all sites is 22 inches and the average cover is 89%. It should be noted that nine sites have been maintained in a natural condition (native or non-native vegetation unchanged since development took place), and six have been restored or will be revegetated with native species.

Table 6—Average Vegetation Characteristics of Buffer Sites

Site Name	Herb- aceous (%)	Scrub- Shrub (%)	Forest (%)	Plant Litter (%)	Paved Surface (%)	Bare Earth (%)	Average Height (in.)	Average Cover (%)
Neary Lagoon CHC Housing	79	4				17	6	83
Neary Lagoon WW Site	49	38	2	1	8	2	29	90
Corcoran Lagoon	48	11		28	12	1	8	87
Moran Lake*	10		10	60		20	183	80
Struve Slough Westridge	85	8		8			15	100
Struve Slough Crossroads	91					9	5	91
Struve Slough Penn. Ave	38	62					17	100
Blohm-Porter Marsh	60	35			3	2	11	95
Moro Cojo Restaurant	98					2	4	98
Moro Cojo Retail/Residen tial	100						9	100
Moro Cojo High School	65	2		30		3	9	97
Marina Vernal Pond 1	100						5	100
Marina Vernal Pond 3	48	1		5		45	3	55
Marina Vernal Pond 7	81	19					12	100
Laguna Grande	42	19		1	8	30	12	62

*Moran Lake site was not physically accessible.

The characteristics of the vegetation influence the rate of erosion, the wildlife habitat, and to some extent the amount of human intrusion into the buffer. The two sites with the most erosion also had the most bare earth. Because of the brief nature of the wildlife survey, it is difficult to establish a relationship between vegetation characteristics and wildlife use of the buffer. The position of the wetland in the landscape and the surrounding land use may be as important or more so for wildlife use than the characteristics of the vegetation. Fencing may also encourage better wildlife use of the buffer than the characteristics of the vegetation.

Additional Findings Relating to Buffer Effectiveness

While the field study portion of this thesis was designed to assess buffer function, the research was also guided by several questions to determine if the buffers met the regulations outlined for them in the permits. The questions are repeated below with the results summarized.

Question 1: Wetland Buffer Size

Does the buffer width meet the regulatory requirements?

Wetland Buffer Size: Findings

There were some discrepancies between the regulated setback requirements and the observed results (Table 7). The required width of the buffers in the study region varied depending on the provisions in the certified LCPs and the LUPs for local jurisdictions and city regulations. In many cases, the LCPs and LUPs were not in effect at the time the

development took place. In those cases, the size of the buffer was determined on a case-by-case basis rather than applying a standard width. Even when standards are in place, case-by-case evaluations and exceptions granted may reduce the width requirement.

Table 7—Buffer Widths

Site Name	Measured Buffer Width (feet)	LUP/LCP or City Required Buffer Width	Imposed Buffer Width
Neary Lagoon CHC Housing	88.5	100 feet	100 feet
Neary Lagoon WW Treatment	63.0	100 feet	not stated**
Corcoran Lagoon	102.0	100 feet	not stated**
Moran Lake	25-30*	100 feet	20 feet**
Struve Slough Business Park	84.0	Site-specific	20 ft contour
Struve Slough Auto Center	82.5	Site-specific	45-85 feet
Struve Slough Housing	52.5	Site-specific	20 ft contour
Blohm-Porter Marsh	100.0	100 feet	100 feet
Moro Cojo Slough Restaurant	93.0	100 feet	100 feet
Moro Cojo Slough Retail/Residential	50.0	100 feet	100 feet
Moro Cojo Slough High School	186.5	100 feet***	10 ft. contour
Marina Vernal Pond 1	57.0	100 feet***	44 feet**
Marina Vernal Pond 3	46.0	100 feet	100 feet
Marina Vernal Pond 7	71.0	100 feet***	not stated
Laguna Grande	25.0	20 or 50 feet	20 feet
Standard Deviation	39.3		
Mean	75.2		

* measured using visual estimation

** exception granted

***policy not adopted at the time of project approval

The width of buffers in the study region ranged from a low of 25 feet to a high of 186.5 feet. In some cases, exceptions were granted from the standard buffer width because the parcel in question is within the buffer zone. If 100 feet is considered to be the standard regulatory requirement, then the buffer widths did not meet the standard. The average width was 78.5 feet. Twelve out of fifteen sites were less than 100 feet, one site was 100 feet, and two sites were over 100 feet.

It should be noted that accurate measurement of the buffer area was difficult for several reasons including vague guidance on where the buffer edge begins and ends, lack of clear definition of terms, lack of maps, and physical barriers to making measurements.

The definition of the buffer edge in the local LCP/LUPs includes the highwater mark, the wetland, the edge of wetland, and the edge of wetland vegetation. These terms are not well defined. For example, the term “edge of wetland” is open to interpretation unless a wetland delineation has been made. Moreover, the criteria used to ascertain the highwater mark is not indicated—it could be the 10, 50, or 100-year storm event. Making accurate wetland delineations was beyond the scope of this study; therefore, the width measurements were made from the high water of the wetland at the time of the field visit to the inland point that marked the beginning of development.

The lack of good standard maps in the permit files can make it difficult to determine exactly where the buffer is meant to be. The process could be improved by including recent accurate maps in the permit files with the buffer area clearly marked. The maps should be based on a standard map that is easily available to the public such as the USGS

topographic series maps. Lastly, access to measure the full buffer was sometimes blocked by thick vegetation or fences. In these cases, fairly accurate measurements can be made by using aerial photographs.

Question 2: Wetland Buffer Goal Statements

Are wetland buffer goal statements established for the buffer area?

Wetland Buffer Goal Statements: Findings

Wetland buffer goals were found by searching the permit file or management and restoration reports for language stating why the buffer was imposed (Table 8). The goal statements had to be extracted from paragraphs in the permits and reports that described the need for a buffer. Clear, measurable goals were mostly lacking. Goals were best stated for buffers that were being restored with native species. The buffer restoration plan often listed specific restoration goals with some mention of monitoring and quantitative measurements of success.

Two sites had erosion prevention as a specific goal, enhancement or protection of natural areas was a goal for seven sites, and controlling access was a goal for five sites. No goals were found for four sites.

Table 8—Buffer Goal Statements

Site No.	Source of Goal Statements	Stated Goals	Goals Met
1	Management Plan	<ul style="list-style-type: none"> • Erosion prevention • Aesthetics • Restrict access • Restore native grassland 	Yes Unknown Yes Yes, currently monitored with qualitative and quantitative results
2	Management Plan	<ul style="list-style-type: none"> • Restore with native species to provide noise barrier, screen facilities, and compensate for loss of habitat • Provide visitor access 	Yes Yes
4	Permit File	<ul style="list-style-type: none"> • Protect riparian areas 	Project never built
5	DFG Permit	<ul style="list-style-type: none"> • Construct berm to drain water to catch & filter basin 	Yes
6	Initial Study	<ul style="list-style-type: none"> • Restore with native species to minimize soil erosion, establish wildlife habitat, enhance natural areas, and maintain gene pool 	Yes Unknown Yes Unknown
7	Permit File	<ul style="list-style-type: none"> • Fencing to reduce intrusion of pets • Protect water quality • Revegetation to improve habitat 	Not installed yet Unknown Not done yet
8	Restoration Plan	<ul style="list-style-type: none"> • Restoration of native species 	Restoration in progress
9	Permit File	<ul style="list-style-type: none"> • Prohibit development • Protect natural area • Prevent disturbance of trees, ground cover and wildlife 	Yes Yes Yes
10	Permit File	<ul style="list-style-type: none"> • Restrict development 	Yes
12	Permit File	<ul style="list-style-type: none"> • Protect sensitive areas • Control drainage • Control access 	Yes Yes Yes
13	Enhancement Plan	<ul style="list-style-type: none"> • Restore with native species to provide habitat for wildlife • Screen pond from road • Observation platform for limited public access • Monitor restoration periodically for 5 years 	Yes Too soon to tell Yes Restoration just completed at time of field visit

Question 3: Wetland Buffer Maintenance

Has the buffer area changed over time and do the permits require monitoring or a post-development analysis of success?

Wetland Buffer Maintenance: Findings

Determining if the buffer has changed over time is made difficult by the lack of baseline information about the buffer in the permits. A field evaluation of wetland buffers in Washington State (Cooke n.d.) found that buffer zones were altered with time in over three-quarters of the study sites. The most frequent change was the conversion of the natural vegetation community to lawn over time in projects that incorporated the buffer in the lots. Cooke found that “the ownership of the buffer appears to mean to the homeowner that it is acceptable to remove the natural vegetation and replace the buffer with a less valuable, mown-lawn type of buffer.” This does not appear to be the case with the buffers measured in this study because no lawn type conversions were seen.

One monitoring report, produced by Central Coast Wilds 1994 for Neary Lagoon site number 1, contains measurable criteria for success of the restoration effort. Monitoring is required at Neary Lagoon site number 1 and Marian Vernal Pond site number 13. Monitoring programs are recommended but have not yet occurred for two recently revegetated buffers—Struve Slough site number 6 and the Blohm-Porter Marsh site number 8. Several sites are maintained by public works departments that are mainly responsible for clearing storm drains or detention ponds.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

The findings of this study provide an assessment of the effectiveness of buffers in the study area. The data from the permit files provide information related to effective permitting such as whether buffer size, goals, and maintenance were set and followed. The conclusions from field data, which were not conclusive (Table 9), suggest that the wetland buffers imposed in the study region are generally effective in preserving wetland water quality, moderating water level fluctuations, and providing wildlife habitat. On the other hand, the wetland buffers are not preventing human intrusion and the opportunities for education, recreation, and aesthetic enjoyment of the wetlands are limited or not used to their best advantage. Finally, the regulatory process needs to be improved and more data is needed to make better judgments on buffer function and effectiveness.

Table 9—Data Findings Summary

Function	Ideal Methods (using pre-and postdevelopment buffers and a control area)	Methods Used in This Study (using indicators for 15 study sites)	Data Findings	Conclusions
Erosion prevention	Sediment studies in wetland Vegetation type, density, and diversity surveys	Count and measurement of rills and gullies Average vegetation cover estimation	Table 2 Table 6	-poor revegetation effort -stormwater outlets in buffer +good vegetative cover
Wildlife Habitat	Wildlife species counts over a period of time Vegetation characteristics studies	Wildlife habitat features noted, single direct observation of species Average vegetation cover, type, and height estimation	Table 3 Table 6	+good habitat indicators +good cover -too much non-native vegetation
Human use (uncontrolled)	Survey levels of human use over a period of time	Indicators of human use counted	Table 4	-lack of maintenance and controls -lack of improvements
Human use (controlled)	Count human access control features, survey levels of use over a period of time	Human access control features counted	Table 5	+good when present -could be improved
Moderation of water level fluctuation	Survey historical records of water level fluctuation Obtain baseline and historical hydrology information	Indicators of ponding or flooding observed	Ponding on 1 site, no direct observation of flooding	+occurs but not enough data

The 5 main conclusions based on the results of the study are as follows:

- ◆ The buffers are functioning to preserve wetland water quality. Direct observation showed that there was little evidence of erosion in the buffers that would lead to excess sedimentation in the wetlands. Where erosion was noted, it was due either to poor or unfinished revegetation efforts or stormwater outlets in the buffer area. Both problems could be improved to further reduce the erosion rate. The vegetative cover at most of the sites was good and effective in preventing erosion. Good vegetative cover will diminish runoff and erosion, filter harmful substances, and moderate water level fluctuations.
- ◆ Wildlife habitat potential is good in the wetland buffers. Direct observation showed that the buffers and the wetland are used by birds, small mammals, and reptiles. The availability of snags, cavities, brush, and cover shows that wildlife species will be provided with shelter. Evidence of burrows and trails shows that some of the buffers are used by small mammals and reptiles. Taking into consideration the degree of urbanization surrounding most the area's wetlands, these buffers may be providing important and increasingly rare wildlife habitat.
- ◆ There is an excess of unregulated human use in the wetland buffers. Indicators show that there was a large amount of litter and yard waste in these wetland buffers. This shows a lack of maintenance and control in the buffer area. There was also a lack of improvements that would enhance human use of the buffers such as observation platforms and interpretive signs. Buffers that had some way of either preventing human use (with

fences) or channeling it (with observation platforms) had lower incidences of litter and yard waste.

◆ There is not enough data on baseline conditions available in the permit files. The lack of baseline data on the wetland and adjacent upland area prior to development made it difficult to ascertain if introducing development in the system had a negative impact. The lack of standard, legible maps made it difficult to determine the buffer width and boundaries. At one site, even basic permit information was not available for a development built adjacent to a slough where it was assumed that the development was subject to city permits or even CEQA.

◆ Regulatory requirements for wetland buffers are not explicit enough. There is no standard way of stating where the buffer is to be measured from in the study region. The terms presently used for demarcating the buffer are not defined. Goals for the wetland buffer are either not stated or, when stated, are too general and cannot be measured. Postdevelopment monitoring of the buffer is only required in several cases where the buffer was restored with native vegetation.

Recommendations

The following recommendations are suggestions to improve the effectiveness of wetland buffers in the Monterey Bay area. Responsibility for the suggested procedures can be divided among developers, regulators, the public, and the academic community. Implementation of the suggested recommendations is not exclusively the responsibility of one particular group; responsibility is best shared between the different stakeholders. The

property developers can become responsible for improving water quality protection and wildlife habitat, and controlling human use. Regulators can improve the regulatory program, guide the developer's projects, and help educate the public. The public can become involved in education and maintenance through volunteer efforts and interest in their natural surroundings. Lastly, the academic community can educate the public and conduct further research to expand our knowledge of wetlands and their surrounding uplands.

Recommendations Associated with Data Findings

Channel human access in buffer areas. Unrestricted human access in the buffer can lead to vegetation trampling, disturbance to wildlife, and the introduction of pets, noise, and litter to the area. Specific design features that can be introduced in the buffer zone to channel human access includes fences, carefully planned pathways or boardwalks, and observation platforms. It may be necessary to provide mechanisms for restricting access to wildlife habitat areas in the buffer during certain critical breeding periods. Buffer areas that include human access elements should be periodically inspected to ensure that the area is not damaged by public contact.

Remove or improve stormwater drain outlets in the buffer. Wetlands naturally receive stormwater; however, when flows are structurally diverted to the wetland, it is important to consider that wetlands have a limited capacity for handling increased flows or additional pollutant loading (U.S. EPA 1993). Several of the buffers in this study had stormwater outlets that directed flow to the wetland with no structural controls to mitigate adverse

impacts. Three buffer sites showed erosion indicators directly below stormwater drain outlets. Both structural and nonstructural methods are available to control urban runoff and stormwater flow.

The administration of control methods for urban runoff can be the responsibility of both the developer and the regulator. Structural controls that the developer could design into a project to mitigate adverse impacts from stormwater runoff include exfiltration trenches, infiltration structures, retention and detention systems, wet ponds, sediment traps, porous pavement, and oil and grease separators. Measures to control impacts from increased water quantity include baffles, dissipaters, and control gates.

Nonstructural alternatives that regulators administer to prevent nonpoint source pollution include practices such as the following:

- Developing regional comprehensive stormwater management programs
- Planning future development or redevelopment to minimize stormwater runoff
- Limiting impervious surfaces
- Requiring setbacks from surface water and wetlands
- Discouraging development in environmentally sensitive areas that are critical to maintaining water quality
- Requiring the use of best management practices
- Inspecting stormwater management systems and erosion control structures to ensure that they are functioning properly

- Providing education programs to reduce individual contributions to stormwater problems (U.S. EPA 1993).

Improve the permitting procedures for wetland buffers. In this study, the regulatory requirements for wetland buffers were not explicit enough, permit format was not consistent, and baseline data was often lacking in the permit files. Simple refinements would go a long way towards improving the process and making after-the-fact research easier. All permits for projects proposed next to wetlands should include some baseline habitat data of the buffer, a standard map showing the wetland delineation and the buffer area, a numerical buffer width and area, a statement of measurable goals for the buffer, and a monitoring schedule. Goal statements and monitoring is especially important if restoration of the buffer is proposed. In addition, if the required buffer width is less or more than the regulated setback (usually 100 feet), justifications for the exception need to be clearly stated.

Additional Recommendations

Revegetate with native species. When a project is proposed adjacent to a wetland and the imposed buffer is vegetated with invasive, non-native weedy species, the developer should be required to revegetate the buffer with native species. The Coastal/Vernal Ponds Comprehensive Management Plan (1994) recommends establishing native perennial grasslands in wetland buffers. Native coastal prairie grassland provides for a high level of biological diversity, and provides increased educational and aesthetic features. The floral

diversity in coastal prairie wildflower species supports an even greater diversity of insect and animal life (Central Coast Wilds 1994).

The use of native species serves two purposes: (1) maintenance is reduced because native species are drought tolerant and (2) rare and usually highly disturbed transitional habitat is enhanced. Zedler (1984) recommends selecting native species for coastal wetlands by referring to data on natural abundance of transition and coastal scrub communities. Appendix 2 lists native species, selected from recently completed buffer revegetation efforts, that are recommended for planting in the Monterey Bay area. Especially hardy colonizers of disturbed areas next to wetlands include salt grass (*Distichlis spicata*), wild rye grass (*Elymus glaucus*), and coast buckwheat (*Eriogonum latifolium*).

Native grassland buffers are developed through preparing the site by eradicating annual species and re-seeding with native perennial grasses and native perennial and annual herbaceous plants. The site is then managed by hand weeding, hoeing, and mowing non-native weeds. Supplemental irrigation may be needed during drought conditions. Drip irrigation is recommended. Maintenance and monitoring may need to be continued for 4-7 years. Recent studies on grassland restoration show that the establishment of native species takes 4-7 years with staggered plantings throughout the timeline (Central Coast Wilds 1994).

In addition to native grassland restoration, protected buffer areas may be ideal places to establish sensitive or endangered species. The rare salt marsh bird's beak

(Cordylanthus maritimus ssp. maritimus), an upper salt marsh species, is a candidate for experimental research for establishing habitat in higher elevations. Successful “experimental gardens” of rare and endangered species could then provide seeds or plants for reintroduction to habitats where the species has been eliminated (Zedler 1984).

Any buffer site that is being restored with native vegetation should be monitored for success and maintained until the vegetation is well established. The costs for monitoring should be included in the overall project and the person or agency responsible for evaluating the results of the monitoring should be clearly identified (Zedler et al. 1982).

Existing buffers that are not restored or included in a wetland restoration plan also merit a maintenance and monitoring program. In the absence of restoration plans and the research and funding that is usually included with them, it may still be possible to perform some maintenance and monitoring tasks in the buffers and in the associated watersheds that will increase their functioning and make them more aesthetically pleasing.

Volunteers, in conjunction with a stewardship program, can be used for such tasks.

Education. When the public is made aware of the resource quality of wetland habitats where they live, the habitat is appreciated for the educational, recreational, and aesthetic value that it can provide. The Coastal/Vernal Pond Comprehensive Management Plan (1994) includes recommendations for pond stewardship and education that could be adapted for the wetlands of the Monterey Bay area. A pond or wetland stewardship plan should include the related uplands buffer area. The importance of the upland area to the wetland for wildlife habitat as well as maintenance of wetland water quality should be

stressed. A key feature in a successful stewardship/education program is the effective dissemination of information to city residents. Recommended implementation devices include:

- An educational brochure that describes the wetland resources and lists actions that residents can take to improve the resource quality. The brochure can also include a self-guided walking, bicycling, or driving tour.
- An educational video on wetland resources that would be available to schools and the public for viewing.
- An educational coloring poster for dissemination to schools and as a city handout for children.
- A monthly newspaper article on the wetlands of Monterey Bay.

The management plan identifies funding sources for these various implementation strategies including area businesses (through advertisements), Coastal Conservancy grants, and the Coastal Zone Management Program—NOAA. Increasing citizen awareness of wetland resources will foster an understanding that will increase respect and protection of the wetlands and buffer area.

Adopt a wetland program. The public could be involved in maintaining wetland buffers with volunteer clean up programs. The Coastal Commission runs an Adopt-A-Beach program to clean up beaches that could include coastal wetlands and their buffer areas. According to an Adopt-A-Beach fact sheet, “the Adopt-A-Beach program is an ongoing, statewide campaign that combines conservation, education, recycling,

community involvement and hands-on action to solve problems of litter and ocean pollution.” Elements in the program include an annual cleanup day, year ‘round cleanup programs by groups, schools, and individuals, public education, a series of Coastal and Marine Educational Resources Directories, and a K-12 conservation oriented education curriculum. The one-day beach cleanup from the Oregon border to Baja California removed more than 500,000 pounds of trash in 1994.

A plan for an annual cleanup of the wetlands, creeks, and rivers of the Monterey Bay area has been initiated. The field sites evaluated in this study formed the basis for developing a list of wetland areas to be included in the annual coastal cleanup day in September 1995. The list was given to the Santa Cruz County cleanup coordinator based in Ecology Action of Santa Cruz. The cleanup was carefully planned to take into account the sensitive nature of wetlands and their buffers. Including the wetlands in this highly publicized event will begin the process of educating local residents in the importance of the wetland habitat.

Variable buffer zones. Although a wetland buffer protects habitat and lessens development impacts, its use should be coupled with watershed management techniques that consider inputs into the wetland beyond the 100-foot buffer zone. One way to begin to move beyond the standard fixed buffer is to implement a variable buffer. With a variable buffer, the width changes depending on specific criteria (U.S. EPA 1992b). Community regulatory agencies can establish a minimum fixed buffer plus a wider floating buffer width. The width of the floating area may depend on steeply sloped terrain, mature

woodlands, type of development, and poorly drained soil. Buffer zones can be designed for maximum protection by communities with access to information about aquifer flow, migration pathways, and other aspects of the watershed surrounding the environmentally sensitive area they want to protect.

Palfrey and Bradley (n.d.) of the Maryland Department of Natural Resources recommend a minimum buffer width of 100 feet maintained from the mean highwater line of the edge of tidal and nontidal wetlands. In addition, they recommend that buffer areas be sufficiently wide to include such factors as the 100 year riverine floodplain, steep slopes (greater than 15%), erodable soils adjacent to waterbodies, and upland areas of high biological significance. They recommend wider buffers when septic systems are located near waterbodies and when adjacent land areas are subject to high nutrient loading.

Improve practices in the watershed. Improving practices in the watershed may go a long way towards improving the water quality and habitat value of the wetland. Small urban wetlands may develop problems in terms of habitat, water quality, or sedimentation very soon after they are urbanized. Something as simple as a regularly cleaned sediment trap upstream from the wetland will lengthen the lifespan of the associated wetland (Willard 1988).

Federal, state, and local agencies have begun to take a broad, comprehensive view of environmental protection that includes a focus on the watershed as a fundamental management unit. Regulators can improve the management of wetlands and the function of wetland buffers by designing policies around a watershed approach. With the

watershed approach, agencies can target areas where pollution poses the greatest risk to human health and ecological resources. All parties with a stake in the local situation can participate in the analysis of problems and in the creation of solutions (Horsely & Witten, Inc. n.d.).

Further Research

Opportunities are plentiful for further research in this subject area. Additional studies could be conducted by the academic community, by regulators, or the public in the following areas:

- ◆ **Study wetland buffers adjacent to agricultural land uses.** In the Monterey Bay area and throughout the United States, many wetlands are surrounded by land in agricultural use. Research could be conducted to determine the effectiveness of wetland buffers adjacent to agriculture. It would also be informative to determine the best width and configuration for buffers adjacent to agriculture and compare the function of buffers adjacent to agricultural vs urban land uses.
- ◆ **Compare buffers restored with native vegetation to buffers composed of mainly non-native weedy annuals.** More data is needed to determine if a restored buffer functions better than a nonrestored one. Restoration is a costly and time consuming proposition and regulations to restore buffers may meet with some objections by developers. Before restoration is proposed, data is needed to show that it is ultimately beneficial to the wetland habitat.

♦ Explore the use of variable buffers versus a fixed buffer zone. This thesis recommends pursuing the flexible option of using variable buffer zones based on a fixed width that can be expanded depending on site conditions. It would be interesting to conduct further studies comparing fixed and variable buffer zones and how different widths may effect buffer function and the health of the wetland.

♦ Develop methods for delineating wetland buffers. Rather than relying on an arbitrary method of determining buffer width, it would be helpful for both developers and regulatory agencies to have a sound method for delineating buffer zones. This method could take into consideration ways to best protect different wetland types, variable buffer zones depending on degree and type of development, special impacts to the wetland from the watershed, and a minimum buffer width that should never be decreased.

The research conducted for this study provided a portion of the information that is needed about wetland buffers. Effective, functional buffers are needed to protect environmentally sensitive areas. This study showed that while size is an important criteria when designing wetland buffers, it is also important to consider impacts to the wetlands from beyond the buffer boundary. Goals for the buffer must be clearly stated with measurable criteria for success. Lastly, buffers themselves need to be valued for the functions they provide and as habitat for wetland-dependent species.

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APPENDIX 1. FIELD STUDY AND VEGETATION SURVEY FORMS

Date: February 7, 1995

Site/Project Name: Neary Lagoon/Cooperative Housing

Location/Address: Chestnut Street, City of Santa Cruz, Santa Cruz County

1. EXISTING WETLAND TYPE (From NWI Map): NWI map not available
2. SIZE OF WETLAND (Acres): 14
3. CURRENT OBSERVED LAND USE ADJACENT TO WETLAND: Land use adjacent to this portion of Neary Lagoon is multi-family housing and a small park area
4. ZONING ADJACENT TO WETLAND: Zoning around Neary Lagoon includes RM - Multiple residence medium rise, RL - Multiple residence low rise, R1 - Single family residence, and CT - Thoroughfare commercial. The lagoon itself is zoned PK/FP - Parks, flood plain.

5. BUFFER CHARACTERISTICS

HUMAN INTRUSION	COMMENTS
Garbage: <i>A couple of cans, a cardboard box, bits of carpet (5)</i>	
Yard Waste: <i>None</i>	
Trails: <i>None</i>	
Campfires: <i>None</i>	
Vegetation Removal/Trampling: <i>Yes, Himalayan berry suppression (1)</i>	
Other (Explain)	
AESTHETICS	COMMENTS
Interpretive Walks: <i>Not yet, to be installed</i>	
Fences: <i>Yes, green chain-link fence between housing and buffer</i>	
Decks: <i>None</i>	
Signs: <i>Yes, No Public Access Wildlife Habitat</i>	
Ornamental or Native Landscaping: <i>Yes, site has been planted with native species</i>	

WILDLIFE USE	COMMENTS
Snags/Cavities: <i>Yes, available in dense existing riparian vegetation</i>	
Brush/Cover: <i>Yes</i>	
Nests: <i>None</i>	
Trails: <i>None</i>	
Wildlife Species Observed: <i>Birds heard in riparian vegetation, 1 hummingbird seen</i>	
Feral/Domestic Species Observed: <i>None</i>	
EROSION	COMMENTS
Rills (channels <3''):	<i>No erosion noted</i>
Shallow Gullies (channels 3-6'')	
Deep Gullies (channels >6'')	

6. BUFFER DIMENSIONS: Permit calls for a 100 foot buffer from the edge of the wetland boundary. Two measurements were made from the edge of the thick riparian vegetation to the edge of the fence with the result of an average of 88.5 feet. The wetland boundary is most likely within the willows bringing the dimensions of the buffer to 100 feet.
7. DATE OF CONSTRUCTION OR PERMIT, IF APPLICABLE: 1989, housing built in 1992-1993.
8. BUFFER GOALS, IF STATED: Buffer area will be maintained for erosion prevention and aesthetics. Riparian areas will be protected by restricting and limiting access to them by the public and domestic animals. The Neary Lagoon Management Plan (1992) calls for restoration of native grassland here.

Neary Lagoon/Chestnut Street Housing Vegetation Survey 2/7/95

Cover	Height (average)	Vegetation Type			Other		
		Herbaceous	Scrub-Shrub	Forest	Tree Litter	Paved	Bare Earth
100%	0.5 in	100%					
100%	3.0 in	100%					
100%	10.0 in	100%					
100%	10.0 in	100%					
100%	9.0 in	100%					
100%	12.0 in	100%					
100%	8.0 in	100%					
40%	2.0 in	40%					60%
95%	6.0 in	95%					5%
40%	2.0 in	40%					60%
0%	0.0 in						100%
85%	3.0 in	85%					15%
30%	2.0 in	30%					70%
100%	4.0 in	100%					
100%	4.0 in	100%					
80%	6.0 in	80%					20%
80%	3.0 in	80%					20%
70%	4.0 in	70%					30%
50%	4.0 in	50%					50%
95%	3.0 in	95%					5%
95%	4.0 in	95%					5%
100%	16.0 in		100%				
100%	10.0 in	100%					
100%	9.0 in	100%					
100%	10.0 in	100%					
100%	8.0 in	100%					

Average Percent Cover	83%
Average Height	6 in
Average Vegetation Type:	
Herbaceous	79%
Scrub-Shrub	4%
Average Other:	
Bare Earth	17%

Notes: This site was saturated with 3-10 inches of water at time of field visit. Two quadrats contained 15-20 iris plants. Berry suppression effort was in place at the site (suffocation by plastic tarps).

Date: July 31, 1995

Site/Project Name: Neary Lagoon Wastewater Treatment Plant Site

Location/Address: Neary Lagoon, City of Santa Cruz, Santa Cruz County

1. EXISTING WETLAND TYPE (From NWI Map): Not available
2. SIZE OF WETLAND (Acres): 14
3. CURRENT OBSERVED LAND USE ADJACENT TO WETLAND: Public park, public path, wastewater treatment plant
4. ZONING ADJACENT TO WETLAND: RM - multiple residence medium rise, RL - Multiple residence low rise, R1 - single family residence, and CT - thoroughfare commercial.

5. BUFFER CHARACTERISTICS

HUMAN INTRUSION	COMMENTS
Garbage: <i>None</i>	
Yard Waste: <i>None</i>	
Trails: <i>Yes, several through buffer (3)</i>	
Campfires: <i>None</i>	
Vegetation Removal/Trampling: <i>None</i>	
Other (Explain)	
AESTHETICS	COMMENTS
Interpretive Walks: <i>None</i>	
Fences: <i>Sound wall separates treatment plant from buffer area</i>	
Decks: <i>None</i>	
Signs: <i>None</i>	
Ornamental or Native Landscaping: <i>Site has been revegetated with native plants</i>	

WILDLIFE USE	COMMENTS
Snags/Cavities: <i>Yes</i>	
Brush/Cover: <i>Yes, site is very brushy</i>	
Nests: <i>None</i>	
Trails: <i>A few (3)</i>	
Wildlife Species Observed: <i>None</i>	
Feral/Domestic Species Observed: <i>None</i>	
EROSION	COMMENTS
Rills (channels <3")	<i>No erosion at this site</i>
Shallow Gullies (channels 3-6")	
Deep Gullies (channels >6")	

6. BUFFER DIMENSIONS: The 100 foot required buffer has experienced some encroachment with the expansion of the wastewater treatment plant. The permit does not state how much the encroachment changes the dimensions of the buffer. The buffer is now about 60 feet from the soundwall to the edge of the lagoon.
7. DATE OF CONSTRUCTION OR PERMIT, IF APPLICABLE: Permit granted in 1986. Expansion completed in 1991.
8. BUFFER GOALS, IF STATED: Minimize facilities within the buffer zone, create noise barrier between plant facilities and lagoon, screen facilities from lagoon visitors, provide visitor access along the lagoon shoreline, compensate for the loss of habitat.

Neary Lagoon Wastewater Treatment Plant Site Vegetation Survey 7/31/95

Vegetation Type								Other	
Cover	Height	Herbaceous	Scrub-Shrub	Forest	Tree Litter	Paved	Bare Earth		
(average)									
100%	2.0 in	100%							
100%	6.0 in	25%	75%						
100%	8.0 in	50%	50%						
100%	168.0 in		25%	25%	25%				
100%	60.0 in		100%						
100%	24.0 in		100%						
100%	15.0 in	75%	25%						
100%	80.0 in		100%						
100%	0.0 in					100%			
85%	12.0 in	85%					15%		
100%	16.0 in	100%							
100%	60.0 in	25%	60%	15%					
90%	15.0 in	90%					10%		
100%	39.0 in	40%	55%	5%					
100%	10.0 in	100%							
100%	90.0 in	50%	50%						
100%	15.0 in	60%	40%						
90%	8.0 in	90%					10%		
100%	20.0 in	70%	30%						
100%	14.0 in	35%	65%						
100%	24.0 in	10%	90%						
100%	1.0 in	5%				95%			
90%	4.0 in	90%					10%		
100%	33.0 in		100%						
100%	10.0 in	75%	25%						
100%	12.0 in	100%							

Average Percent Cover	98%
Average Height	29 in
Average Vegetation Type:	
Herbaceous	49%
Scrub-Shrub	38%
Forest	2%
Average Other:	
Tree Litter	1%
Paved	8%
Bare Earth	2%

Notes: Revegetated plants seem to be doing well. Lots of weeds growing amongst the native species.

Date: January 12 and July 27 1995

Site/Project Name: Corcoran Lagoon

Location/Address: Between Coastview Drive and 24th Avenue in the Live Oak area of Santa Cruz, Santa Cruz County

1. EXISTING WETLAND TYPE (From NWI Map): Main body of the Lagoon is PUBHh - Palustrine Unconsolidated Bottom Permanently Flooded Diked/Impounded. Also small areas of PUSCh - Palustrine Unconsolidated Shore Seasonally Flooded Diked/Impounded, PSSCh - Palustrine Scrub-Shrub Seasonally Flooded Diked/Impounded, PEMCh - Palustrine Emergent Seasonally Flooded Diked/Impounded and PFOC Palustrine Forested Seasonally Flooded.
2. SIZE OF WETLAND (Acres): 10.3
3. CURRENT OBSERVED LAND USE ADJACENT TO WETLAND: Cocoran Lagoon is surrounded by single family homes and a radio station and is in between two roads, East Cliff Drive and Portola Drive. North of Portola Drive the lagoon continues and is categorized on the NWI maps as PFOC (see above).
4. ZONING ADJACENT TO WETLAND: Single family residential
5. BUFFER CHARACTERISTICS

HUMAN INTRUSION	COMMENTS
Garbage:	<i>Some garbage in buffer including cardboard, a brick, and some rubble. Lots of plastic and miscellaneous trash at the edge of wetland. (20)</i>
Yard Waste:	<i>Some noted in buffer at the edge closest to the road (1)</i>
Trails:	<i>One trail leading to the edge of the wetland (1)</i>
Campfires:	<i>None</i>
Vegetation Removal/Trampling:	<i>None</i>
Other (Explain):	<i>A neighbor stated that people park in this area at night and leave much garbage behind (2 trashbags full a week)</i>
AESTHETICS	COMMENTS
Interpretive Walks:	<i>None</i>
Fences:	<i>Wood post and chain link fence extends from the intersection of East Cliff and Coastview and separates Coastview from the buffer. Extends about halfway down Coastview.</i>
Decks:	<i>None</i>
Signs:	<i>None</i>

Ornamental or Native Landscaping: *Some landscaping on the East side of the Lagoon extends from backyards down a steep slope close to the wetland. Dense wetland edge vegetation prevents backyard use from getting too close to the wetland*

WILDLIFE USE	COMMENTS
Snags/Cavities:	<i>Some available within Eucalyptus grove and in large logs and stumps on the ground</i>
Brush/Cover:	<i>Yes - tule grass is thick and tall at the edge of wetland</i>
Nests:	<i>None seen</i>
Trails:	<i>None seen</i>
Wildlife Species Observed:	<i>Many coots, a few mallard ducks, 1 snowy egret and many seagulls noted at time of visit</i>
Feral/Domestic Species Observed:	<i>None seen but dogs are walked through this area</i>
EROSION	COMMENTS
Rills (channels <3"):	
Shallow Gullies (channels 3-6"):	<i>One gully 8 feet long, 3 inches deep, 5 inches wide formed at the mouth of a storm water outlet pipe</i>
Deep Gullies (channels >6")	

6. BUFFER DIMENSIONS: Regulations would call for a 100 foot buffer here; however, this site was granted a riparian exception because the entire parcel was within the riparian setback. Measurements taken from the high water mark of the lagoon to the fence averaged 102 feet.

7. DATE OF CONSTRUCTION OR PERMIT, IF APPLICABLE: July 1991

8. BUFFER GOALS, IF STATED: None stated

Corcoran Lagoon Vegetation Survey 1/12/95

Cover	Height (average)	Vegetation Type			Other		
		Herbaceous	Scrub-Shrub	Forest	Tree Litter	Paved	Bare Earth
100%	0.5 in	90%			10%		
95%	1.0 in	50%			40%		5%
100%	2.0 in				100%		
100%	15.0 in		95%		5%		
95%	4.0 in	50%			50%		5%
100%	5.0 in	95%			5%		
100%	0.0 in					100%	
100%	1.0 in	60%			40%		
100%	8.0 in	70%			30%		
100%	0.0 in					100%	
100%	5.0 in	20%			80%		
100%	24.0 in		100%				
100%	1.0 in	100%					
100%	0.0 in					100%	
100%	2.0 in	70%			30%		
100%	2.0 in	95%			5%		
100%	30.0 in		100%				
95%	10.0 in	65%			30%		5%
100%	5.0 in	5%			95%		
100%	48.0 in				100%		
100%	8.0 in	40%			60%		
100%	12.0 in	70%			30%		
100%	10.0 in	90%			10%		
100%	3.0 in	95%			5%		
100%	1.0 in	100%					
100%	0.5 in	90%			10%		

Average Percent Cover	99%
Average Height	8 in
Average Vegetation Type:	
Herbaceous	48%
Scrub-Shrub	11%
Average Other:	
Tree Litter	28%
Paved	12%
Bare Earth	1%

Notes: Seaweed and burnt wood deposited on edge of buffer due to recent storm.
Large eucalyptus tree stumps in buffer along with a row of large eucalyptus trees.

Date: July 27, 1995

Site/Project Name: Moran Lake

Location/Address: North side of East Cliff Drive in the Live Oak area of Santa Cruz
between Palisades and 26th Avenue

1. EXISTING WETLAND TYPE (From NWI Map): PUBHh - Palustrine
Unconsolidated Bottom, Permanently Flooded, Diked/Impounded
2. SIZE OF WETLAND (Acres): 5 acres
3. CURRENT OBSERVED LAND USE ADJACENT TO WETLAND: Single family
homes, recreational facilities, trail, road
4. ZONING ADJACENT TO WETLAND: Moran Lake is zoned PR - Parks,
Recreation, Open Space. Surrounding land is zoned R-1-5 - Single Family Residential
and RM-4 - Multi-family Residential
5. BUFFER CHARACTERISTICS

HUMAN INTRUSION	COMMENTS
Garbage: <i>None seen</i>	
Yard Waste: <i>Piles of wood (eucalyptus) (1)</i>	
Trails: <i>None</i>	
Campfires: <i>None</i>	
Vegetation Removal/Trampling: <i>None</i>	
Other (Explain):	
AESTHETICS	COMMENTS
Interpretive Walks: <i>None</i>	
Fences: <i>One to mark the end of the buffer and the beginning of the backyard</i>	
Decks: <i>None</i>	
Signs: <i>None</i>	
Ornamental or Native Landscaping: <i>Eucalyptus and nasturtium.</i>	

WILDLIFE USE	COMMENTS
Snags/Cavities: <i>Only available in eucalyptus</i>	
Brush/Cover: <i>Very little</i>	
Nests: <i>None observed</i>	
Trails: <i>None observed</i>	
Wildlife Species Observed: <i>None</i>	
Feral/Domestic Species Observed: <i>None</i>	
EROSION	COMMENTS
Rills (channels <3")	<i>No erosion seen</i>
Shallow Gullies (channels 3-6")	
Deep Gullies (channels >6")	

6. BUFFER DIMENSIONS: A reduction of the required 100 foot buffer setback (to a minimum 20 foot buffer setback) was granted due to the disturbed and extensively landscaped nature of the site. The site is estimated to be about 23 feet wide.
7. DATE OF CONSTRUCTION OR PERMIT, IF APPLICABLE: Permit, May 1985. Construction never took place.
8. BUFFER GOALS, IF STATED: The buffer is called for in order to protect the riparian area and the associated vegetation.

Moran Lake Vegetation Survey* 7/27/95

Cover	Height (average)	Vegetation Type			Other		
		Herbaceous	Scrub-Shrub	Forest	Tree Litter	Paved	Bare Earth
	5.0 in	10%					
	540.0 in			10%			
	5.0 in				60%		
	0.0 in						20%

*This site was not accessible;
consequently, it was not surveyed the
same way the others were. The
survey for this site was done by visual
estimation.

Average Percent Cover	80%
Average Height	183 in
Average Vegetation Type:	
Herbaceous	10%
Forest	10%
Average Other:	
Tree Litter	60%
Bare Earth	20%

Notes: Buffer mainly composed of eucalyptus trees and debris, some ivy, and nasturtium.

Date: February 14, 1995

Site/Project Name: Struve Slough/Westridge Business Park

Location/Address: Off Westridge Drive, Watsonville, Santa Cruz County

1. EXISTING WETLAND TYPE (From NWI Map): PEMCx - Palustrine Emergent Seasonally Flooded Excavated
2. SIZE OF WETLAND (Acres): not known
3. CURRENT OBSERVED LAND USE ADJACENT TO WETLAND: Slough is located between Harkins Slough Road and Highway 1. There is a business park on one side and undeveloped plowed land on the other
4. ZONING ADJACENT TO WETLAND: IP - Industrial Park and the slough is zoned OS - Open Space.
5. BUFFER CHARACTERISTICS

HUMAN INTRUSION	COMMENTS
Garbage: <i>Some cups, bottles, and 2 tires (7)</i>	
Yard Waste: <i>None</i>	
Trails: <i>One through the grass at the edge of the wetland (1)</i>	
Campfires: <i>None</i>	
Vegetation Removal/Trampling: <i>None</i>	
Other (Explain): <i>Noisy fan in business park was on for 15 minutes during field visit</i>	
AESTHETICS	COMMENTS
Interpretive Walks: <i>None</i>	
Fences: <i>Barbed wire and wood post fence around detention basin</i>	
Decks: <i>None</i>	
Signs: <i>None</i>	
Ornamental or Native Landscaping: <i>Trees planted at edge of buffer adjacent to business park include redwoods, pepper trees and other</i>	

WILDLIFE USE	COMMENTS
Snags/Cavities: <i>In trees and in a small stand of willows nearby</i>	
Brush/Cover: <i>One large coyote bush and brushy buffer vegetation</i>	
Nests: <i>None</i>	
Trails: <i>Several trails</i>	
Wildlife Species Observed: <i>Frogs heard, small mammal burrows noted, lone egret in wetland</i>	
Feral/Domestic Species Observed: <i>None</i>	
EROSION	COMMENTS
Rills (channels <3"):	
Shallow Gullies (channels 3-6"):	<i>1 shallow gully leading from stormwater outlet 6' long, 5" deep, 7" wide</i>
Deep Gullies (channels >6"):	

6. BUFFER DIMENSIONS: Measured observations found an 84 foot buffer from the edge of the parking lot to the high water mark of the wetland.
7. DATE OF CONSTRUCTION OR PERMIT, IF APPLICABLE: 1980
8. BUFFER GOALS, IF STATED: Construction of a berm to retain and drain water runoff to be processed through a catch and filter basin.

Struve Slough/Westridge Business Park Vegetation Survey Form 2/14/96

		<i>Vegetation Type</i>			<i>Other</i>		
Cover	Height	Herbaceous	Scrub-Shrub	Forest	Tree Litter	Paved	Bare Earth
(average)							
100%	0.5 in	100%					
100%	10.0 in				100%		
100%	4.0 in	100%					
100%	6.0 in	100%					
100%	6.0 in	100%					
100%	7.0 in	100%					
100%	8.0 in	100%					
100%	6.0 in	100%					
100%	10.0 in	100%					
100%	8.0 in	100%					
100%	7.0 in	100%					
100%	10.0 in	100%					
100%	11.0 in	100%					
100%	72.0 in		50%		50%		
100%	8.0 in	100%					
100%	7.0 in	100%					
100%	9.0 in	100%					
100%	8.0 in	100%					
100%	7.0 in	100%					
100%	7.0 in	100%					
100%	6.0 in	100%					
100%	72.0 in		70%		30%		
100%	8.0 in	100%					
100%	72.0 in		80%		20%		
100%	6.0 in	100%					
100%	9.0 in	100%					

Average Percent Cover	100%
Average Height	15 in
Average Vegetation Type:	
Herbaceous	85%
Scrub-Shrub	8%
Average Other:	
Tree Litter	8%

Notes: A fairly homogenous site. From the parking lot towards the wetland, an edge of planted trees screen the buffer and wetland, next is approximately 45 feet of fennel with 6 foot high dead stalks and 2 inch high new growth and following the fennel is about 24 feet of lush grass from 6 - 12 inches long.

Date: January 23, 1995

Site/Project Name: Crossroads II Auto Center/Struve Slough

Location/Address: 1851 Main Street, City of Watsonville, Santa Cruz County

1. EXISTING WETLAND TYPE (From NWI Map): Not marked on NWI map.
Closest identification is PEMCx - Palustrine Emergent Seasonally Flooded Excavated
2. SIZE OF WETLAND (Acres): Not known.
3. CURRENT OBSERVED LAND USE ADJACENT TO WETLAND: Parking lot, roads, gas station, shopping center, and graded site for future development
4. ZONING ADJACENT TO WETLAND: Development site is zoned CT - Thoroughfare Commercial. Struve Slough is designated E - Environmental Management
5. BUFFER CHARACTERISTICS

HUMAN INTRUSION	COMMENTS
Garbage: <i>Some in and around detention pond area (8)</i>	
Yard Waste: <i>None</i>	
Trails: <i>Paved road becomes dirt track (1)</i>	
Campfires: <i>None</i>	
Vegetation Removal/Trampling: <i>None</i>	
Other (Explain): <i>Bales of hay prevent erosion and protect recent plantings</i>	
AESTHETICS	COMMENTS
Interpretive Walks: <i>None</i>	
Fences: <i>None</i>	
Decks: <i>None</i>	
Signs: <i>None</i>	
Ornamental or Native Landscaping: <i>Buffer recently restored with native vegetation, irrigated with drip irrigation hoses.</i>	

WILDLIFE USE	COMMENTS
Snags/Cavities: <i>Some available in willows in detention pond.</i>	
Brush/Cover: <i>Brush and cover available that will improve when planted species become established.</i>	
Nests: <i>None seen</i>	
Trails: <i>None seen but some small animal burrows are in the buffer</i>	
Wildlife Species Observed: <i>Unidentified bird use in willows, frogs heard, mallards, an egret, and a small mammal seen.</i>	
Feral/Domestic Species Observed: <i>None seen</i>	
EROSION	COMMENTS
Rills (channels <3"):	<i>No erosion present at this site</i>
Shallow Gullies (channels 3-6")	
Deep Gullies (channels >6")	

6. **BUFFER DIMENSIONS:** The EIR calls for an approximately 80 foot buffer between the project and the upper boundary of the potential wetlands along the east and southeast border and 85 feet between the project and the upper boundary of the potential slough wetlands along the southwest boundary. The EIR also calls for a fence or dense hedge to delimit the upper edge of the buffer zone. The fence or dense hedge was not in place at the time of the field visit making it difficult to determine the buffer zone boundary. An average of several measurements found a width of 82.5 feet.
7. **DATE OF CONSTRUCTION OR PERMIT, IF APPLICABLE:** March 1993
8. **BUFFER GOALS, IF STATED:** Minimize soil erosion, establish habitat that will maximize diversity for wildlife particularly upland mammals and birds, enhance natural areas by replacing non-native weed species with slough representative species, minimize use of irrigation, fertilizer, pesticides and herbicides and maintain local gene pool of native vegetation by planting primarily local native species.

Crossroads Auto Center Vegetation Survey 1/23/95
Vegetation Type Other

Cover	Height	Herbaceous	Scrub-Shrub	Forest	Tree Litter	Paved	Bare Earth
(average)							
95%	0.5 in	95%					5%
25%	5.0 in	25%					75%
55%	3.0 in	55%					45%
100%	2.0 in	100%					
100%	10.0 in	100%					
100%	4.0 in	100%					
40%	1.0 in	40%					60%
100%	8.0 in	100%					
100%	3.0 in	100%					
100%	10.0 in	100%					
100%	5.0 in	100%					
100%	9.0 in	100%					
100%	2.0 in	100%					
100%	4.0 in	100%					
90%	1.0 in	90%					10%
100%	8.0 in	100%					
95%	4.0 in	95%					5%
100%	5.0 in	100%					
95%	8.0 in	95%					5%
100%	12.0 in	100%					
100%	7.0 in	100%					
100%	4.0 in	100%					
100%	1.0 in	100%					
100%	10.0 in	100%					
100%	3.0 in	100%					
80%	3.0 in	80%					20%

Average Percent Cover	91%
Average Height	5 in
Average Vegetation Type:	
Herbaceous	91%
Average Other:	
Bare Earth	9%

Notes: This site recently revegetated in patches with native vegetation. Found a few small animal burrows during vegetation survey.

Date: January 23, 1995

Site/Project Name: Struve Slough/Pennsylvania Drive Apartment Project

Location/Address: Pennsylvania Drive & Clifford Street, City of Watsonville

1. EXISTING WETLAND TYPE (From NWI Map): Not identified on NWI map.
Closest identification is PEMC - Palustrine Emergent Seasonally Flooded
2. SIZE OF WETLAND (Acres): 17
3. CURRENT OBSERVED LAND USE ADJACENT TO WETLAND: This portion of Struve Slough is surrounded by roads, single family homes, and multi-family homes
4. ZONING ADJACENT TO WETLAND: RM-2 Multiple residential medium density and a small pocket of RM-3 Multiple residential high density and the slough is zoned OS - Open Space
5. BUFFER CHARACTERISTICS

HUMAN INTRUSION	COMMENTS
Garbage: <i>Car tires (at least three), bicycle wheels and tires, some trash scattered throughout, most of it close to existing apartment buildings. (13)</i>	
Yard Waste: <i>None</i>	
Trails: <i>Some trails lead to and through wetland. others criss-cross the site possibly due to nearby construction (3)</i>	
Campfires: <i>None</i>	
Vegetation Removal/Trampling: <i>None</i>	
Other (Explain)	
AESTHETICS	COMMENTS
Interpretive Walks: <i>None</i>	
Fences: <i>A chain link fence separates future development from buffer area</i>	
Decks: <i>None except on other side of wetland</i>	
Signs: <i>None</i>	
Ornamental or Native Landscaping: <i>None except on other side of wetland</i>	

WILDLIFE USE	COMMENTS
Snags/Cavities: <i>None</i>	
Brush/Cover: <i>Only what is available in long grass</i>	
Nests: <i>None</i>	
Trails: <i>Many small trails leading from small mammal burrows</i>	
Wildlife Species Observed: <i>Coots, frogs heard</i>	
Feral/Domestic Species Observed: <i>A cat on the other side of the wetland</i>	
EROSION	COMMENTS
Rills (channels <3"):	<i>No erosion noted</i>
Shallow Gullies (channels 3-6")	
Deep Gullies (channels >6")	

6. BUFFER DIMENSIONS: The buffer width is based on a project boundary delineation made in 1989 that mainly follows the USGS 20 foot contour line. Measurements in the field from the high water mark to the fence placed it at 52.5 feet.
7. DATE OF CONSTRUCTION OR PERMIT, IF APPLICABLE: The site is graded but construction has not yet commenced. The Department of Fish and Game stated that they would concur with an adoption of a Negative Declaration with mitigation measures in 1992.
8. BUFFER GOALS, IF STATED: Fish and Game requested that mitigation measures for the protection of sensitive amphibian species be incorporated as conditions of project approval. Mitigations include protective fencing to reduce intrusion of pets into the slough, protection of water quality, and revegetation to improve habitat quality.

Struve Slough Pennsylvania Ave Apt Site Vegetation Survey 1/23/95

Cover	Height (average)	Vegetation Type			Other		
		Herbaceous	Scrub-Shrub	Forest	Tree Litter	Paved	Bare Earth
100%	0.5 in		100%				
100%	25.0 in		100%				
100%	20.0 in		100%				
100%	31.0 in		100%				
100%	10.0 in	100%					
100%	8.0 in	100%					
100%	8.0 in	100%					
100%	5.0 in	100%					
100%	6.0 in	100%					
100%	30.0 in		100%				
100%	17.0 in		100%				
100%	42.0 in		100%				
100%	15.0 in		100%				
100%	26.0 in		100%				
100%	15.0 in		100%				
100%	6.0 in	100%					
100%	18.0 in		100%				
100%	20.0 in		100%				
100%	28.0 in		100%				
100%	30.0 in		100%				
100%	17.0 in		100%				
100%	16.0 in		100%				
100%	10.0 in	100%					
100%	9.0 in	100%					
100%	10.0 in	100%					
100%	8.0 in	100%					

Average Percent Cover	100%
Average Height	17 in
Average Vegetation Type:	
Herbaceous	38%
Scrub-Shrub	62%

Notes: Very homogeneous site composed of approximately 60 inch tall dead stalks and short 6 inch clumps of green vegetation.

Date: February 9, 1995

Site/Project Name: Blohm-Porter Marsh/The Conservation Fund

Location/Address: 466 Elkhorn Road, North Monterey County

1. EXISTING WETLAND TYPE (From NWI Map): PEMS - Palustrine Emergent Temporary Tidal (tidally influenced freshwater systems)
2. SIZE OF WETLAND (Acres): The parcel is 37 acres, over 1/2 of which is part of the marsh.
3. CURRENT OBSERVED LAND USE ADJACENT TO WETLAND: Elkhorn Road, small farms, Southern Pacific railway tracks nearby
4. ZONING ADJACENT TO WETLAND: LDR/2.5 - Low Density Residential and RC - Resource Conservation
5. BUFFER CHARACTERISTICS

HUMAN INTRUSION	COMMENTS
Garbage:	<i>Garbage close to the road including 3 tires in buffer, 2 tires in wetland, old spray cans, and some wood (12)</i>
Yard Waste:	<i>None</i>
Trails:	<i>An old road and several old tracks (1)</i>
Campfires:	<i>None</i>
Vegetation Removal/Trampling:	<i>None</i>
Other (Explain)	
AESTHETICS	COMMENTS
Interpretive Walks:	<i>None</i>
Fences:	<i>A gate prevents driving onto the site</i>
Decks:	<i>None</i>
Signs:	<i>A sign stating Estuary View Lots for Sale</i>
Ornamental Landscaping or Native Landscaping:	<i>Upland areas of the parcel have been revegetated with native species.</i>

WILDLIFE USE	COMMENTS
Snags/Cavities: <i>Available in small stand of willows near the road</i>	
Brush/Cover: <i>Site is fairly brushy, coyote bush etc</i>	
Nests: <i>None seen</i>	
Trails: <i>None seen</i>	
Wildlife Species Observed: <i>Frogs heard, hawk and red-winged blackbirds seen</i>	
Feral/Domestic Species Observed: <i>None</i>	
EROSION	COMMENTS
Rills (channels <3"):	<i>No erosion at this site</i>
Shallow Gullies (channels 3-6")	
Deep Gullies (channels >6")	

6. BUFFER DIMENSIONS: Permit approval requires a sufficient buffer as determined by the project's consulting biologist. Construction has not commenced. Development plans show a 100 foot setback fence.
7. DATE OF CONSTRUCTION OR PERMIT, IF APPLICABLE: February 1992 (permit).
8. BUFFER GOALS, IF STATED: Building and septic system envelopes to be designed which allow for minimal impacts to the wetlands, as determined appropriate by the consulting biologist. Restoration goals include making a wetland buffer at the edge of the hillside and attracting certain wildlife to the area by combined planting of selected cover and food species.

Blohm-Porter Marsh, 466 Elkhorn Road, North Monterey County 2/9/95

Cover	Height (average)	Vegetation Type			Other		
		Herbaceous	Scrub-Shrub	Forest	Tree Litter	Paved	Bare Earth
100%	0.5 in	100%					
100%	30.0 in		100%				
70%	12.0 in	70%				30%	
100%	6.0 in	100%					
100%	13.0 in		100%				
100%	34.0 in		100%				
100%	12.0 in	100%					
100%	12.0 in	100%					
100%	7.0 in	100%					
100%	15.0 in		100%				
100%	10.0 in	100%					
100%	16.0 in		100%				
100%	10.0 in	100%					
100%	18.0 in		100%				
100%	10.0 in	100%					
100%	18.0 in		100%				
100%	9.0 in	100%					
100%	19.0 in		100%				
100%	10.0 in	100%					
5%	0.5 in	5%				45%	50%
100%	4.0 in	100%					
90%	4.0 in	90%			10%		
100%	2.0 in	100%					
100%	15.0 in		100%				
95%	2.0 in	95%					5%
90%	3.0 in	90%				10%	

Average Percent Cover	94%
Average Height	11 in
Average Vegetation Type:	
Herbaceous	60%
Scrub-Shrub	35%
Average Other:	
Tree Litter	0%
Paved	3%
Bare Earth	2%

Notes: Some revegetation has taken place in the uplands with native container plants.

Date: January 17, 1995

Site/Project Name: Moro Cojo Slough/Whole Enchilada Restaurant

Location/Address: Highway 1 and Moss Landing Road, North Monterey Co.

1. EXISTING WETLAND TYPE (From NWI Map): E1ABL - Estuarine Subtidal Aquatic Bed Subtidal and a small portion of E2EMN - Estuarine Intertidal Emergent Regularly Flooded
2. SIZE OF WETLAND (Acres): 4.3 acres
3. CURRENT OBSERVED LAND USE ADJACENT TO WETLAND: Highway 1 and Moss Landing Road, restaurant, and parking lot
4. ZONING ADJACENT TO WETLAND: Commercial Recreation and Visitor Serving
5. BUFFER CHARACTERISTICS

HUMAN INTRUSION	COMMENTS
Garbage:	<i>Garbage found scattered in buffer, dumpster overflows, cardboard boxes etc. (12)</i>
Yard Waste:	<i>None</i>
Trails:	<i>One trail (1)</i>
Campfires:	<i>None</i>
Vegetation Removal/Trampling:	<i>None</i>
Other (Explain)	
AESTHETICS	COMMENTS
Interpretive Walks:	<i>None</i>
Fences:	<i>Post and rope fence between the buffer and the restaurant parking lot</i>
Decks:	<i>None</i>
Signs:	<i>None</i>
Ornamental or Native Landscaping:	<i>Ornamental landscaping on restaurant side of the fence</i>

WILDLIFE USE	COMMENTS
Snags/Cavities: <i>None</i>	
Brush/Cover: <i>Minimal</i>	
Nests: <i>None</i>	
Trails: <i>None</i>	
Wildlife Species Observed: <i>Mallards, blackbirds, seagulls, and a bird of prey</i>	
Feral/Domestic Species Observed: <i>None</i>	
EROSION	COMMENTS
Rills (channels <3''):	<i>No erosion noted</i>
Shallow Gullies (channels 3-6'')	
Deep Gullies (channels >6'')	

6. BUFFER DIMENSION: Permit requires a 100 foot buffer from landward edge of vegetation. The buffer measured in the field was an average of 93 feet.
7. DATE OF CONSTRUCTION OR PERMIT, IF APPLICABLE: May 1987
8. BUFFER GOALS, IF STATED: The buffer is to be dedicated as an open space/conservation easement to prohibit development, provide for the protection and preservation of the natural habitat area, and to prevent disturbance of native trees, groundcover and wildlife.

Moro Cojo Slough/Whole Enchilada Vegetation Survey 1/17/95

Cover	Height (average)	Vegetation Type			Other		
		Herbaceous	Scrub-Shrub	Forest	Tree Litter	Paved	Bare Earth
100%	0.5 in	100%					
100%	4.0 in	100%					
100%	6.0 in	100%					
100%	5.0 in	100%					
100%	2.0 in	100%					
100%	2.0 in	100%					
100%	1.0 in	100%					
100%	7.0 in	100%					
100%	5.0 in	100%					
100%	10.0 in	100%					
100%	10.0 in	100%					
100%	3.0 in	100%					
95%	1.0 in	95%					5%
90%	2.0 in	90%					10%
95%	3.0 in	95%					5%
100%	5.0 in	95%			5%		
100%	4.0 in	100%					
100%	7.0 in	100%					
100%	4.0 in	100%					
100%	6.0 in	100%					
100%	3.0 in	100%					
95%	5.0 in	95%					5%
95%	3.0 in	95%					5%
100%	6.0 in	100%					
90%	2.0 in	90%					10%
100%	2.0 in	100%					

Average Percent Cover	98%
Average Height	4 in
Average Vegetation Type:	
Herbaceous	98%
Average Other:	
Tree Litter	0%
Bare Earth	2%

Notes: Buffer heavy with iceplant to the break in slope, then non-native grasses, coyote bush and pickleweed take over

Date: January 28, 1995

Site/Project Name: Moro Cojo Slough, Retail/Residential Complex

Location/Address: Moss Landing Road, opposite Post Office, Moss Landing, Monterey
County

1. EXISTING WETLAND TYPE (From NWI Map): E1ABL - Estuarine Subtidal
Aquatic Bed Subtidal
2. SIZE OF WETLAND (Acres): 4.3
3. CURRENT OBSERVED LAND USE ADJACENT TO WETLAND: Business/retail,
and Highway 1
4. ZONING ADJACENT TO WETLAND: Commercial Recreation and Visitor Serving
and General
5. BUFFER CHARACTERISTICS

HUMAN INTRUSION	COMMENTS
Garbage: <i>Wood, concrete foundation pieces, pipes (4)</i>	
Yard Waste: <i>One dead tree (1)</i>	
Trails: <i>None</i>	
Campfires: <i>None</i>	
Vegetation Removal/Trampling: <i>None</i>	
Other (Explain): <i>Manmade drainage ditch bisects the buffer</i>	
AESTHETICS	COMMENTS
Interpretive Walks: <i>None</i>	
Fences: <i>Chain-link fence separates buildings and parking lot from buffer</i>	
Decks: <i>None</i>	
Signs: <i>None</i>	
Ornamental Landscaping or Native Landscaping: <i>None</i>	

WILDLIFE USE	COMMENTS
Snags/Cavities: <i>None</i>	
Brush/Cover: <i>None</i>	
Nests: <i>None</i>	
Trails: <i>One track noted</i>	
Wildlife Species Observed: <i>Mallards, coots</i>	
Feral/Domestic Species Observed: <i>None</i>	
EROSION	COMMENTS
Rills (channels <3''):	<i>No erosion noted at this site</i>
Shallow Gullies (channels 3-6''):	
Deep Gullies (channels >6''):	

6. BUFFER DIMENSIONS: The permit states that the project provides for a 100 ft open space easement from the edge of the wetland vegetation along Moro Cojo Slough. From a fence to the edge of the wetland, the measurements averaged 50 feet. Only a portion of the parcel actually fronts the slough due to an intervening lot. The buffer measurements taken in the field may have included this intervening lot.
7. DATE OF CONSTRUCTION OR PERMIT, IF APPLICABLE: September 1985
8. BUFFER GOALS, IF STATED: Prohibit development within the easement area (the entire width of the property extending 100 ft. in from the landward edge of wetland vegetation along Moro Cojo Slough) except for resource dependent uses or for flood control.

Moro Cojo Slough Moss Landing Road, North Monterey County 1/28/95

Cover	Height (average)	Vegetation Type			Other		
		Herbaceous	Scrub-Shrub	Forest	Tree Litter	Paved	Bare Earth
100%	0.5 in	100%					
100%	8.0 in	100%					
100%	12.0 in	100%					
100%	6.0 in	100%					
100%	8.0 in	100%					
100%	10.0 in	100%					
100%	12.0 in	100%					
100%	12.0 in	100%					
100%	7.0 in	100%					
100%	8.0 in	100%					
100%	10.0 in	100%					
100%	7.0 in	100%					
100%	10.0 in	100%					
100%	8.0 in	100%					
100%	10.0 in	100%					
100%	7.0 in	100%					
100%	9.0 in	100%					
100%	12.0 in	100%					
100%	10.0 in	100%					
100%	11.0 in	100%					
100%	7.0 in	100%					
100%	8.0 in	100%					
100%	8.0 in	100%					
100%	12.0 in	100%					
100%	11.0 in	100%					
100%	10.0 in	100%					

Average Percent Cover	100%
Average Height	9 in
Average Vegetation Type:	
Herbaceous	100%

Notes: Another homogeneous grassy buffer site with approximately 8 inch deep grass with a pickleweed edge.

Date: January 28, 1995

Site/Project Name: Moro Cojo Slough, North Monterey County High School

Location/Address: Off Castroville Blvd., North Monterey County

1. EXISTING WETLAND TYPE (From NWI Map): Not available
2. SIZE OF WETLAND (Acres): 40
3. CURRENT OBSERVED LAND USE ADJACENT TO WETLAND: High School, road, trailer park, and single family homes
4. ZONING ADJACENT TO WETLAND: not known
5. BUFFER CHARACTERISTICS

HUMAN INTRUSION	COMMENTS
Garbage: <i>Lots of cardboard, cans, roofing material, PVC pipe, plastic food wrapping (20)</i>	
Yard Waste: <i>None</i>	
Trails: <i>Many trails leading from the high school through the buffer plus an old road at the edge of the wetland (6)</i>	
Campfires: <i>None</i>	
Vegetation Removal/Trampling: <i>Yes, mowed track at the edge of the wetland (1)</i>	
Other (Explain): <i>Lights from the high school may shine into the buffer area at night. It looks like students are using cardboard to slide down steep slopes in buffer</i>	
AESTHETICS	COMMENTS
Interpretive Walks: <i>None</i>	
Fences: <i>None</i>	
Decks: <i>None</i>	
Signs: <i>None</i>	
Ornamental or Native Landscaping: <i>None</i>	

WILDLIFE USE	COMMENTS
Snags/Cavities: <i>Yes, willows</i>	
Brush/Cover: <i>Yes, coyote bush etc</i>	
Nests: <i>None</i>	
Trails: <i>None</i>	
Wildlife Species Observed: <i>Mallards, coots, great egret, seagulls, kite, and frogs heard</i>	
Feral/Domestic Species Observed: <i>Cat in brush and 2 dogs in wetland</i>	
EROSION	COMMENTS
Rills (channels <3"):	
Shallow Gullies (channels 3-6"):	<i>1 long (122'), 6" deep, 10" wide gully originating at stormwater outlet</i>
Deep Gullies (channels >6"):	

6. BUFFER DIMENSIONS: Land below the 10-foot contour is protected with conservation easement designation. Several measurements found an average of 186.5 feet from the high water mark to the fence or road.
7. DATE OF CONSTRUCTION OR PERMIT, IF APPLICABLE: 1977
8. BUFFER GOALS, IF STATED: None stated.

Moro Cojo Slough/North Monterey County High School Vegetation Survey 1/28/95

Cover	Height (average)	Vegetation Type			Other		
		Herbaceous	Scrub-Shrub	Forest	Tree Litter	Paved	Bare Earth
100%	0.5 in	15%			85%		
30%	0.5 in	5%			25%		70%
80%	30.0 in		40%		40%		20%
100%	6.0 in	100%					
100%	8.0 in	90%			10%		
100%	6.0 in	90%			10%		
100%	15.0 in	70%			30%		
100%	4.0 in	70%			30%		
100%	8.0 in	70%			30%		
100%	8.0 in	30%			70%		
100%	12.0 in	20%			80%		
100%	28.0 in				100%		
100%	8.0 in	100%					
100%	3.0 in	100%					
100%	5.0 in	100%					
100%	8.0 in	10%			90%		
100%	10.0 in	100%					
100%	5.0 in	90%			10%		
100%	12.0 in	100%					
100%	5.0 in	100%					
100%	3.0 in	100%					
100%	12.0 in	20%			80%		
100%	7.0 in	80%			20%		
100%	10.0 in	100%					
100%	10.0 in	100%					
100%	8.0 in	25%			75%		

Average Percent Cover	97%
Average Height	9 in
Average Vegetation Type:	
Herbaceous	65%
Shrub-Scrub	2%
Average Other:	
Tree Litter	30%
Bare Earth	3%

Notes: This site contained a large amount of fennel with tall dead stalks and lush green undergrowth.

Date: January 24, 1995

Site/Project Name: Marina Vernal Pond #1

Location/Address: Adjacent to Robin Drive, City of Marina, Monterey Co.

1. EXISTING WETLAND TYPE (From NWI Map): POWZ - Palustrine Open Water Intermittently Exposed/Permanent
2. SIZE OF WETLAND (Acres): 5.7
3. CURRENT OBSERVED LAND USE ADJACENT TO WETLAND: Highway 1, single family homes, residential roads
4. ZONING ADJACENT TO WETLAND: Single family residential and public facilities in the area adjacent to Highway 1. The pond and adjacent area are zoned open space/coastal development permit combing district.
5. BUFFER CHARACTERISTICS

HUMAN INTRUSION	COMMENTS
Garbage: <i>Small amounts of garbage inside fence (4)</i>	
Yard Waste: <i>None</i>	
Trails: <i>None</i>	
Campfires: <i>None</i>	
Vegetation Removal/Trampling: <i>None</i>	
Other (Explain):	
AESTHETICS	COMMENTS
Interpretive Walks: <i>None</i>	
Fences: <i>Chain-link fence separates the pond from Robin Drive and Highway 1</i>	
Decks: <i>None, but 2 benches on Robin Drive face the pond</i>	
Signs: <i>A sign states, Keep Out Authorized Personnel Only</i>	
Ornamental or Native Landscaping: <i>Icepiani. Backyards on one side intrude into the wetland.</i>	

WILDLIFE USE	COMMENTS
Snags/Cavities: <i>Some available in row of non-native cypress</i>	
Brush/Cover: <i>Yes, in patches of coyote bush</i>	
Nests: <i>None</i>	
Trails: <i>None</i>	
Wildlife Species Observed: <i>Excellent bird use. Approximately 25 terns, mallards, and many red-winged blackbirds</i>	
Feral/Domestic Species Observed: <i>None</i>	
EROSION	COMMENTS
Rills (channels <3''):	<i>No erosion noted</i>
Shallow Gullies (channels 3-6'')	
Deep Gullies (channels >6'')	

6. BUFFER DIMENSIONS: The setback is listed in the permit as 44 feet minimum. An average of several measurements found a setback of 57 feet. This measurement includes the approximately 13 feet of iceplant from the sidewalk to the fence.
7. DATE OF CONSTRUCTION OR PERMIT, IF APPLICABLE: Original permit in 1978, amended with smaller buffer in 1980
8. BUFFER GOALS, IF STATED: Protect sensitive habitat areas, control drainage and access to the pond. Additional landscaping between the pond and the road would enhance the buffer area and use of the habitat area.

Marina Vernal Pond #1 Vegetation Survey 1/24/95
Vegetation Type **Other**

Cover	Height	Herbaceous	Scrub-Shrub	Forest	Tree Litter	Paved	Bare Earth
(average)							
100%	0.5 in	100%					
100%	7.0 in	100%					
100%	8.0 in	100%					
100%	4.0 in	100%					
100%	5.0 in	100%					
100%	7.0 in	100%					
100%	7.0 in	100%					
100%	4.0 in	100%					

Average Percent Cover	100%
Average Height	5 in
Average Vegetation Type:	
Herbaceous	100%

Notes: Very homogeneous site - consisted of about 15-17 feet of iceplant giving way to about 40 feet of saturated wetland vegetation.

Date: January 24, 1995

Site/Project Name: Marina Vernal Pond 3 (Marina Landing Pond)

Location/Address: Reservation Road and Beach Road, City of Marina, Monterey County

1. EXISTING WETLAND TYPE (From NWI Map): POWZ - Palustrine Open Water Intermittently Exposed/Permanent. This pond has been modified as part of development of a shopping center and is now a freshwater to brackish perennial pond
2. SIZE OF WETLAND (Acres): 2.74 acres (The Habitat Restoration Group 1989)
3. CURRENT OBSERVED LAND USE ADJACENT TO WETLAND: Surrounded by roads on one side and multi family housing on the other (separated by a steep bank and trees)
4. ZONING ADJACENT TO WETLAND: The pond is in an area zoned for commercial use, the pond itself is designated as open space. Surrounding zoning is retail business and single family residential.
5. BUFFER CHARACTERISTICS

HUMAN INTRUSION	COMMENTS
Garbage:	<i>There may have been some but somebody collected it and left a small bag at the observation deck</i>
Yard Waste:	<i>None</i>
Trails:	<i>None</i>
Campfires:	<i>None</i>
Vegetation Removal/Trampling:	<i>None</i>
Other (Explain)	
AESTHETICS	COMMENTS
Interpretive Walks:	<i>None</i>
Fences:	<i>Fenced off from the road by a low wire fence</i>
Decks:	<i>Two observation deck on either side of the pond</i>
Signs:	<i>None</i>
Ornamental or Native Landscaping:	<i>Recently planted species are all natives and irrigation hoses are in place. A screen of trees is planted on the steep slope adjacent to housing.</i>

WILDLIFE USE	COMMENTS
Snags/Cavities: <i>None</i>	
Brush/Cover: <i>Very little, plantings are too recent</i>	
Nests: <i>None</i>	
Trails: <i>None</i>	
Wildlife Species Observed: <i>Mallards, coots, and small mammal burrows</i>	
Feral/Domestic Species Observed: <i>None</i>	
EROSION	COMMENTS
Rills (channels <3"): <i>Yes, numerous rills (20) approximately 8' long, 3" wide</i>	
Shallow Gullies (channels 3-6"): <i>Yes, several channels (up to 10)</i>	
Deep Gullies (channels >6"): <i>Several gullies up to 10" deep (up to 5)</i>	

6. BUFFER DIMENSIONS: The EIR states that plans for this pond should include a 100 foot building setback. The average of several measurements found 46 feet from the high water mark to the fence.
7. DATE OF CONSTRUCTION OR PERMIT, IF APPLICABLE: EIR completed in December 1988, restoration plan in July 1989, pond constructed in 1993.
8. BUFFER GOALS, IF STATED: Construct observation platforms for limited public access, screen pond from adjacent activities, provide nesting and feeding habitat for waterfowl and other wildlife.

Marina Vernal Pond #3 Vegetation Survey 1/24/95

Cover	Height (average)	Vegetation Type			Other		
		Herbaceous	Scrub-Shrub	Forest	Tree Litter	Paved	Bare Earth
0%	0.5 in						100%
100%	7.0 in	100%					
30%	2.0 in	30%					70%
60%	4.0 in	60%					40%
70%	8.0 in	70%					30%
10%	1.0 in	10%					90%
90%	1.0 in	90%					10%
0%	0.0 in						100%
0%	0.0 in						100%
0%	0.0 in						100%
0%	0.0 in						100%
60%	4.0 in	60%					40%
70%	1.0 in	70%					30%
60%	2.0 in	60%					40%
100%	1.0 in	30%			70%		
90%	4.0 in	90%					10%
30%	2.0 in	30%					70%
80%	5.0 in	80%					20%
90%	3.0 in	90%					10%
80%	6.0 in	80%					20%
100%	20.0 in		30%		70%		
40%	4.0 in	40%					60%
70%	1.0 in	70%					30%
70%	2.0 in	70%					30%
60%	3.0 in	60%					40%
60%	1.0 in	60%					40%

Average Percent Cover	55%
Average Height	3 in
Average Vegetation Type:	
Herbaceous	48%
Scrub-Shrub	1%
Average Other:	
Tree Litter	5%
Bare Earth	45%

Notes: This site was recently revegetated with container plants. In between the plants the the site is fairly bare.

Date: January 24, 1995

Site/Project Name: Marina Vernal Pond #7 (Lake Drive Pond)

Location/Address: Off Lake and Messinger Drive, City of Marina, Monterey Co.

1. EXISTING WETLAND TYPE (From NWI Map): POWZ - Palustrine Open Water Intermittently Exposed/Permanent
2. SIZE OF WETLAND (Acres): 1.4
3. CURRENT OBSERVED LAND USE ADJACENT TO WETLAND: Surrounded on 3 sides by single family homes (backyards surround the pond), and on one side by a fence that separates it from Marina Vernal Pond 1
4. ZONING ADJACENT TO WETLAND: Single family residential, except for the area that abuts Pond 1. The pond area is designated open space/coastal development permit combing district.
5. BUFFER CHARACTERISTICS

HUMAN INTRUSION	COMMENTS
Garbage: <i>Some found in a pile and a good bit emanating from a storm water outlet (7)</i>	
Yard Waste: <i>Yes, some thrown over backyard fence, and tree trimmings left in the buffer from where they were cut. (2)</i>	
Trails: <i>An old vehicle trail still evident (used for mosquito abatement) and other trails through the bush (2)</i>	
Campfires: <i>None</i>	
Vegetation Removal/Trampling: <i>None</i>	
Other (Explain)	
AESTHETICS	COMMENTS
Interpretive Walks: <i>None</i>	
Fences: <i>Pond surrounded by a chain and board fence</i>	
Decks: <i>None</i>	
Signs: <i>None</i>	
Ornamental or Native Landscaping: <i>Iceplant and cypress trees</i>	

WILDLIFE USE	COMMENTS
Snags/Cavities: <i>Yes, in trees</i>	
Brush/Cover: <i>Yes, good coyote bush scrub</i>	
Nests: <i>None</i>	
Trails: <i>Yes, but difficult to determine what caused them</i>	
Wildlife Species Observed: <i>Coots, red-winged blackbirds, frogs heard, 1 Allen's hummingbird</i>	
Feral/Domestic Species Observed: <i>None, but plenty of barking dogs in backyards</i>	
EROSION	COMMENTS
Rills (channels <3''):	<i>No erosion noted</i>
Shallow Gullies (channels 3-6'')	
Deep Gullies (channels >6'')	

6. BUFFER DIMENSIONS: The buffer at this site measured an average of 71 feet from the high water mark to the fence.
7. DATE OF CONSTRUCTION OR PERMIT, IF APPLICABLE: The pond was surrounded by a housing development in 1976
8. BUFFER GOALS, IF STATED: No buffer goals were found for this site.

Marina Vernal Pond #7 Vegetation Survey 1/24/95
Vegetation Type **Other**

Cover	Height	Herbaceous	Scrub-Shrub	Forest	Tree Litter	Paved	Bare Earth
	(average)						
100%	0.5 in	100%					
100%	7.0 in	100%					
100%	48.0 in		100%				
100%	7.0 in	100%					
100%	4.0 in	100%					
100%	8.0 in	100%					
100%	60.0 in		100%				
100%	40.0 in		100%				
100%	6.0 in	100%					
100%	10.0 in	100%					
100%	4.0 in	100%					
100%	6.0 in	100%					
100%	8.0 in	100%					
100%	7.0 in	100%					
100%	6.0 in	100%					
100%	10.0 in	100%					
100%	6.0 in	100%					
100%	6.0 in	100%					
100%	4.0 in	100%					
100%	16.0 in		100%				
100%	4.0 in	100%					
100%	30.0 in		100%				
100%	3.0 in	100%					
100%	7.0 in	100%					
100%	3.0 in	100%					
100%	7.0 in	100%					

Average Percent Cover	100%
Average Height	12 in
Average Vegetation Type:	
Herbaceous	81%
Scrub-Shrub	19%

Notes: Very brushy site.

Date: January 28, 1995

Site/Project Name: Laguna Grande

Location/Address: 1350 Del Monte Blvd, City of Seaside, Monterey County

1. EXISTING WETLAND TYPE (From NWI Map): POWKZ - Palustrine Open Water Artificial Intermittently Exposed/Permanent
2. SIZE OF WETLAND (Acres): 34 acres of water and 12 acres of land in the Laguna Grande complex
3. CURRENT OBSERVED LAND USE ADJACENT TO WETLAND: Office Building under construction, regional park, single family homes and roads
4. ZONING ADJACENT TO WETLAND: Visitor Serving Commercial
5. BUFFER CHARACTERISTICS

HUMAN INTRUSION	COMMENTS
Garbage: <i>Yes, bedsprings, bottles, cans (17)</i>	
Yard Waste: <i>None</i>	
Trails: <i>Paved trail between construction site and lake (1)</i>	
Campfires: <i>None</i>	
Vegetation Removal/Trampling: <i>Yes, between paved trail and wetland vegetation (1)</i>	
Other (Explain)	
AESTHETICS	COMMENTS
Interpretive Walks: <i>None</i>	
Fences: <i>Chain-link between footpath and construction site</i>	
Decks: <i>5 observation decks and footbridge</i>	
Signs: <i>A sign stating No Diving, No Swimming, No Fishing, No Boating, or Wading</i>	
Ornamental or Native Landscaping: <i>Iceplant</i>	

WILDLIFE USE	COMMENTS
Snags/Cavities: <i>A few trees left at this site</i>	
Brush/Cover: <i>Some available at lake edge</i>	
Nests: <i>None</i>	
Trails: <i>None</i>	
Wildlife Species Observed: <i>Coots, seagulls, red-winged blackbirds, Western aquatic garter snake</i>	
Feral/Domestic Species Observed: <i>None</i>	
EROSION	COMMENTS
Rills (channels <3"): <i>Several rills approximately 3' long, 3-6" wide, .5-1" deep</i>	
Shallow Gullies (channels 3-6"): <i>At least 8 gullies approximately 8' wide, 5' long, and 5-10" deep</i>	
Deep Gullies (channels >6")	

6. BUFFER DIMENSIONS: A 20 foot wide strip of native vegetation is to act as a buffer between the parking lot and the footpath. This was not in place at the time of the field visit. An average of measurements from the edge of the lake inland to the fence that separates construction from the lake found a buffer of 25 feet.
7. DATE OF CONSTRUCTION OR PERMIT, IF APPLICABLE: March 1989
8. BUFFER GOALS, IF STATED: None stated.

Laguna Grande, Monterey County 1/28/95

Cover	Height (average)	Vegetation Type			Other		
		Herbaceous	Scrub-Shrub	Forest	Tree Litter	Paved	Bare Earth
0%	0.5 in						100%
100%	3.0 in	100%					
70%	2.5 in	70%					30%
40%	1.0 in	40%					60%
0%	0.0 in					100%	
100%	48.0 in		100%				
0%	0.0 in						100%
50%	3.0 in	50%					50%
60%	2.0 in	40%			20%		40%
100%	54.0 in		100%				
70%	4.0 in	70%					30%
80%	5.0 in	80%				20%	
100%	2.5 in	100%					
65%	3.5 in	65%					35%
80%	47.0 in	20%	80%				

Average Percent Cover	61%
Average Height	12 in
Average Vegetation Type	
Herbaceous	42%
Scrub-Shrub	19%
Average Other:	
Paved	8%
Tree Litter	1%
Bare Earth	30%

Notes: Very disturbed site. Buffer consists of between 10-40 feet of sand with small clumps of grass to edge of tule approximately 1-2 feet wide and a 3 foot wide paved path.

APPENDIX 2. PLANT SPECIES LIST

Plant Species That May Be Suitable for Revegetation of Wetland Buffers in the Monterey Bay Area

Plant Type	Species Name	Common Name
Tree	<i>Alnus oregona</i>	Red Alder
	<i>Cercis occidentalis</i>	Western Redbud
	<i>Lyonothamnus asplenifolius</i>	Catalina Ironwood
	<i>Pinus contorta</i>	Shore Pine
	<i>Platanus racemosa</i>	California Sycamore
	<i>Populus fremontii</i>	Western Cottonwood
	<i>Quercus agrifolia</i>	Coast Live Oak
	<i>Salix laevigata</i>	Red Willow
	<i>Salix lasiolepis</i>	Arroyo Willow
	<i>Salix lucida</i> var. <i>lasiandra</i>	Yellow Willow
	<i>Sambucus mexicana</i>	Blue Elderberry
Shrub	<i>Ambrosia chamissonis</i> ssp. <i>chamissonis</i>	Beach-bur
	<i>Artemisia californica</i>	California Sagebrush
	<i>Atriplex californica</i>	California Atriplex
	<i>Atriplex patula</i> var. <i>hastata</i>	Fat Hen
	<i>Baccharis pilularis</i>	Coyote Brush
	<i>Ceanothus griseus horizontalis</i>	Carmel Creeper
	<i>Dendromecon rigida</i>	Bush Poppy
	<i>Eriogonum latifolium</i>	Coast Buckwheat
	<i>Eriogonum parvifolium</i>	Seacliff Buckwheat
	<i>Eriophyllus staechadifolium</i>	Lizard Tail
	<i>Fremontodendron californicum</i>	Flannel Bush
	<i>Heteromeles arbutifolia</i>	Toyon
	<i>Rhamnus Californica</i>	California Coffeeberry
	<i>Salvia mellifera</i>	Black Sage
	<i>Solanum americanum</i>	Small-flowered Nightshade
	<i>Solanum umbelliferum</i>	Blue Witch
Herbaceous	<i>Abronia umbellata</i>	Pink Sand Verbena
	<i>Achillea millefolium</i>	White Yarrow
	<i>Chorizanthe cuspidata</i> var. <i>cuspidata</i>	San Francisco Spineflower
	<i>Chorizanthe pungens</i> var. <i>pungens</i>	Monterey Spineflower
	<i>Clarkia amoena</i>	Farewell-to-spring
	<i>Corethrogyne leucophylla</i>	Branching Beach Aster
	<i>Dudleya ceaspitosa</i>	Sea Lettuce
	<i>Erysimum ammophilum</i>	Coast Wallflower
	<i>Eschscholzia californica</i>	California Poppy

Plant Type	Species Name	Common Name
Herbaceous	Gnaphalium sp.	Everlasting
	Horkelia cuneata ssp. cuneata	Wedge-leaved Horkelia
	Lotus scoparius	Deer Tongue Lotus
	Lupinus arboreus	Bush Lupine
	Orthocarpus purpurascens	Purple Owl's Clover
	Ranunculus californicus	California Buttercup
Grass	Bromus carinatus	California Brome
	Danthonia californiaca	California Oatgrass
	Deschampsia caespitosa	Tufted Hairgrass
	Elymus glaucus	Wild Rye Grass
	Hordeum branchyantherum	Meadow Barley
	Juncus patens	Wire Grass
	Leymus triticoides	Creeping Wild Rye Grass
	Stipa pulchra	Purple Needlegrass

Sources: Central Coast Wilds. 1994. Neary Lagoon coastal prairie restoration plan. Santa Cruz: Central Coast Wilds, The Habitat Restoration Group. 1994. Coastal/Vernal pond comprehensive management plan. Felton, CA: The Habitat Restoration Group, and Tsugawa, Harry H. 1991. Planting plan and plant materials list. Record Drawing. Santa Cruz, CA.