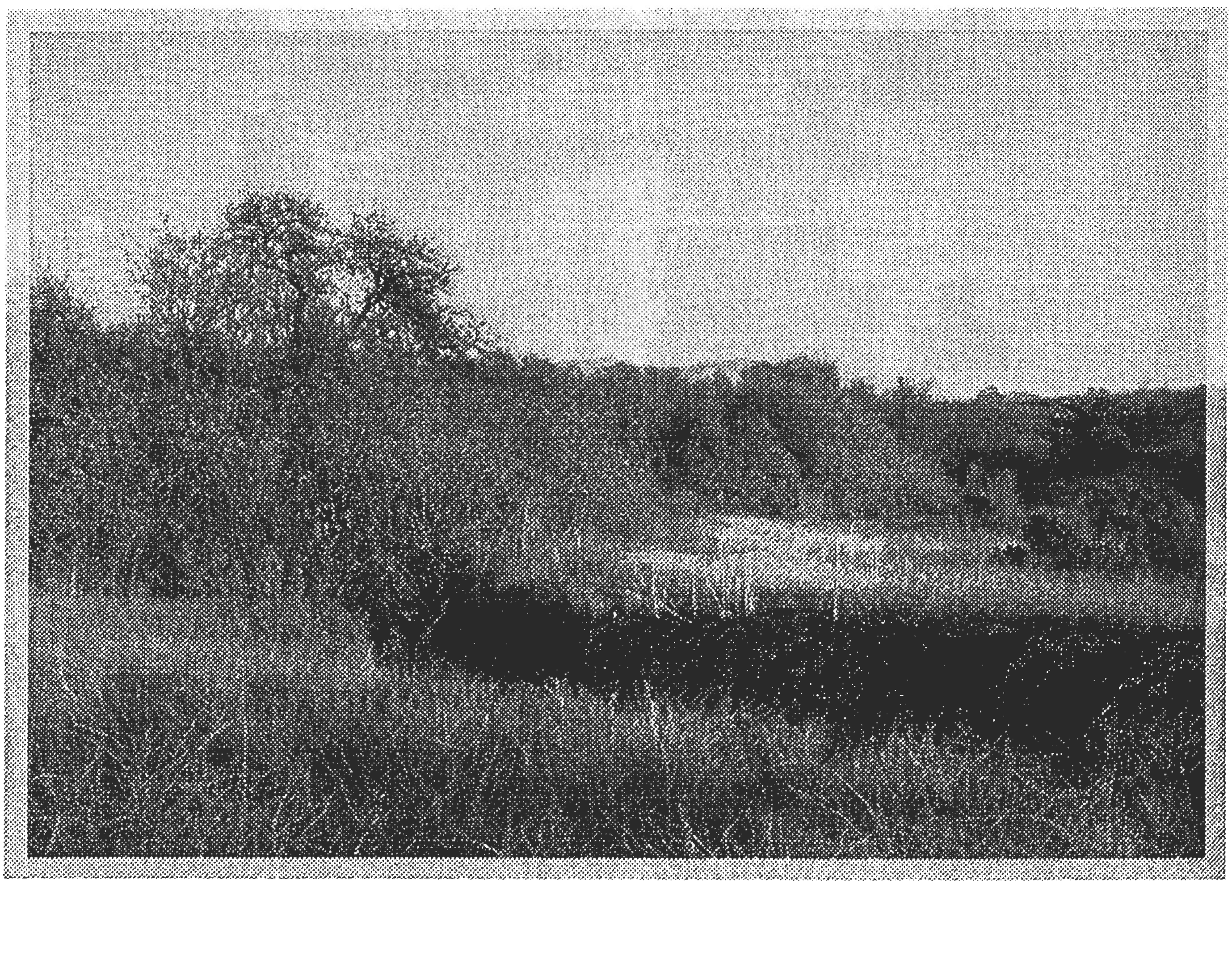
Natividad Creek Wetland and Upland Habitat Restoration Plan

Creative Environmental Consultants
&
Moss Landing Marine Laboratories



Prepared for
City of Salinas

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EXECUTIVE SUMMARY

The Natividad Creek Park was designed with a nature area where wetland habitat along the creek and surrounding upland plant communities will be restored. The restoration site or nature area includes public access and is part of a unique education project called the Return of the Natives, where city schools help to grow native plants and accomplish the restoration. The restoration includes three upland habitat components and two wetland or creek components with different restoration problems and solutions. The plan includes a description of the major watershed challenges in the Salinas Valley including salt water intrusion of ground water, poor surface water quality, and endangered ecosystems and species. The main goals of the Natividad Creek restoration are to restore the historical model for the creek as much as possible, to integrate the restored nature area into the city park, to maximize the biological diversity of the site, and to create an outdoor classroom for schools and other volunteers to learn about watershed restoration. Perhaps the most significant goal is to increase the volume of water flowing into the recharge area between the City of Salinas and the Gabilan Mountains. This section of Natividad and especially Gabilan Creeks may be one of the best aquifer recharge areas in the lower Salinas Valley. The Natividad Creek restoration may be the most important catalyst for restoring the natural watershed of the Monterey Bay, by bringing water back to the natural system of rivers, creeks and marshes. If so, the City of Salinas will emerge as a leader in positive environmental action and the future of the watershed might be healthy.

1. INTRODUCTION

Natividad Creek was once part of a magnificent watershed draining the Gabilan Mountains behind the City of Salinas and flowing through Castroville to the ocean at Moss Landing (Figures 1-2). The old Natividad Creek ended in Carr Lake (Figures 2-3), an expansive seasonal marshland. The entire creek system flowed through large marshes and lakes that were flanked by riparian forests all the way to the sea (Figure 2). The creeks were full of steelhead and salmon and the marshes supported a great number of birds. Today the Natividad Creek and the interacting wetland systems of Gabilan Creek, Alisal Creek and Slough, and Tembladero Slough are channeled into drainage ditches (Figure 1).

The City of Salinas has initiated an exemplary creek restoration effort focusing primarily on Natividad Creek. The restoration project area is part of a large park complex including a wide variety of playgrounds and fields, picnic areas, a recreation center and the restored nature area. Since the restoration of rivers, creeks, and marshes is the most important positive environmental action needed in the Salinas Valley- today and in the future- the City is emerging as the regional leader in watershed restoration and therefore sound watershed management. President Clinton and Governor Wilson have placed watershed planning and restoration at the center of their environmental agendas. The Salinas City Council has taken the next step- to restore their creek.

This restoration plan provides an ecological perspective for the restoration of the watersheds of the Salinas Valley and outlines a plan and the key tasks necessary to implement the restoration of the nature area within the Natividad Creek Park. The park restoration will be aided by volunteer students from Salinas schools participating in the Return of the Natives Project, an environmental education and science program that brings students into nature and nature into schools. Local youth learn about the solutions to watershed problems while growing and planting wetland trees.

2. MONTEREY BAY AND SALINAS VALLEY WATERSHED

2.1. Historical Perspective

2.1.1. Indian Period

The first native Indians migrated into the Monterey Bay area between 12,000 to 8,000 years before present. The earliest documented dates for a local Indian midden come from the Moss Landing area at 7000 years (Breschini and Haversat 1993). Gordon (1979) compiles an impressive number of historical accounts of extensive burning by

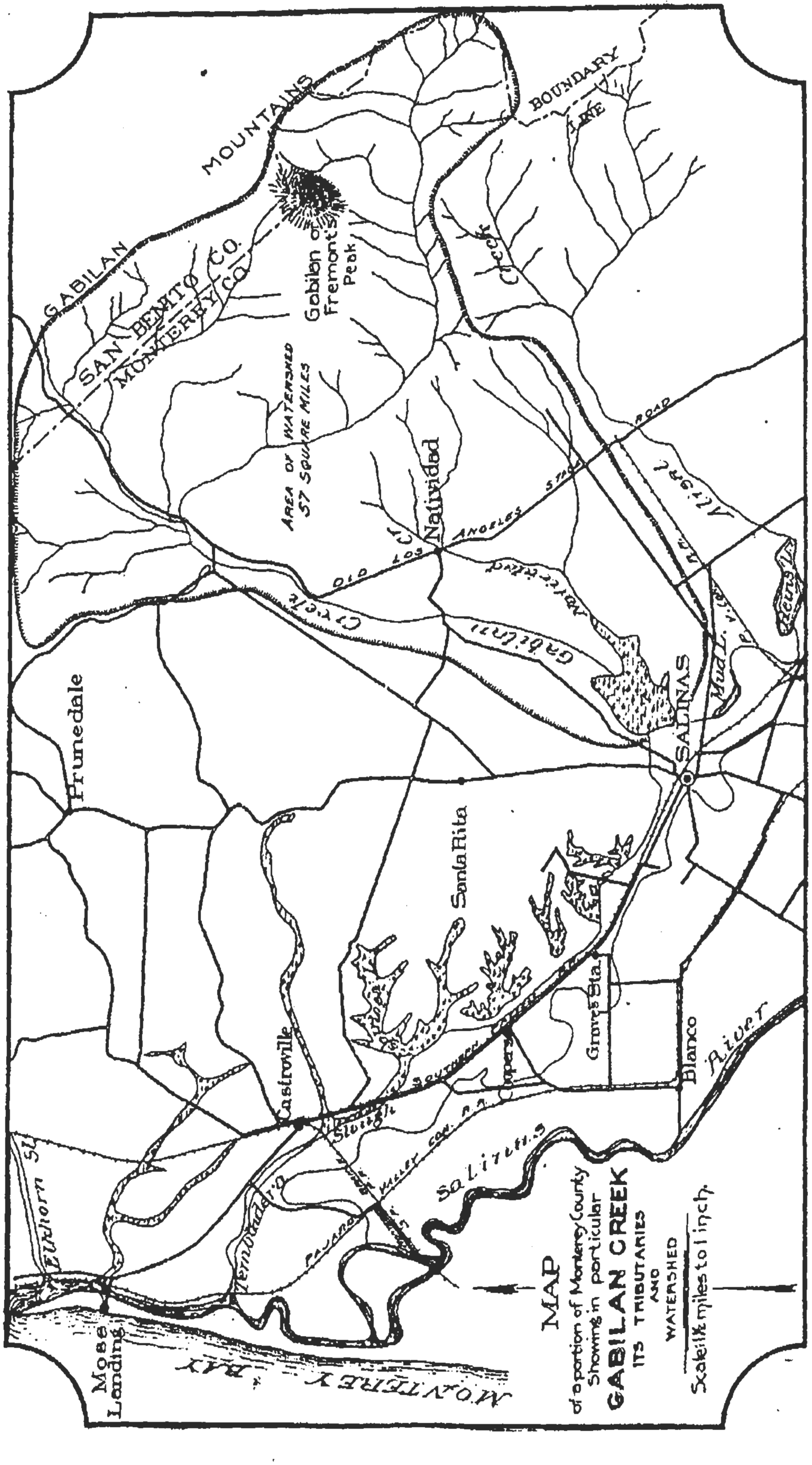

Figure 2. Natividad Creek watershed in the 1906 survey of Lou Hare.

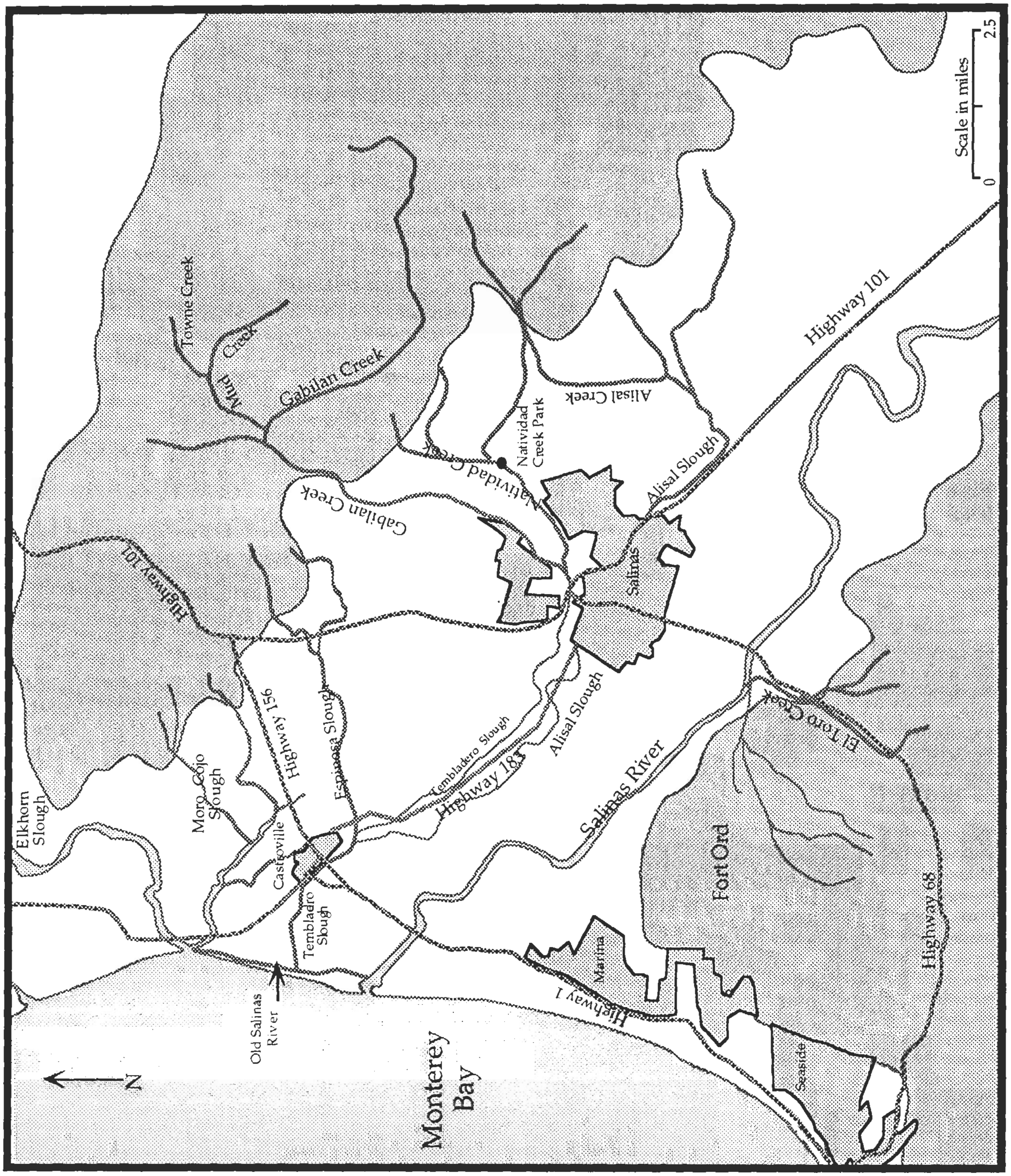

Figure 1. Major water drainages of the Lower Salinas Valley

Indians in order to obtain food. The burning also cleared land of heavy brush and trees and thereby favored the development and procurement of certain food items and probably facilitated travel. Since natural fires are not common along the coast, the most important effect of Indian burning was probably the maintenance of much larger areas of grassland habitats. Therefore, the coastal landscape was burned and extensively modified by human activities for thousands of years (Gordon 1979). Indian impacts on wetland and water resources were probably small, except again through burning (ABA Consultants 1989).

The Salinas Valley was a smaller version of the Great Valley of central California. In the Great Valley were vast tracts of wetland, exemplified by Tule Lake, the largest lake west of the Mississippi River, in the United States. The wetlands supported enormous numbers of waterfowl. Their numbers were so great that flocks in flight blackened the sky. This habitat supported most of the estimated one half million elk that lived in pristine California. Forests of valley oak were dominant on the deep, rich soil of the valley floor. Riparian forests covered an estimated 775,000 acres in the Sacramento Valley. Now, almost 99% of these forests are gone (Smith 1980).

Salinas Valley was a wide riparian floodplain forest of willow, cottonwood, and sycamores. Lakes were common (Figure 2). Salmon and steelhead were abundant in the rivers and creeks and early drawings and paintings suggest a remarkable density of wildlife in the valley wetlands (e.g., Margolin 1978). The rolling hills in the northern end of the valley were covered with tracts of live oak and native grasslands.

2.1.2. European Settlement

The land use activities of Spanish and Mexican settlers primarily involved cattle grazing during the previous century. Widespread agriculture was first practiced by American settlers (Gordon 1979). Wheat, sugar beets and potatoes were important crops and were developed earlier in the Pajaro Valley than in the Salinas Valley. This is reflected in the first U.S. Coast and Geodetic Survey map in 1854, when cultivated fields were shown to occur only in the Pajaro Valley. The Chinese were among the first to dike, ditch and drain local wetlands for agriculture, especially sugar beets in the 1880's and 1890's (Lydon 1985). By the time of the next U.S. Coast and Geodetic Survey map in 1910, reclamation of coastal wetlands was widespread in central Monterey Bay. Wetland corridors persisted along major drainages such as the Salinas and Pajaro Rivers, Elkhorn and Moro Cojo Sloughs, and the Old Salinas River. However, even the major drainages were closely flanked by cultivated land. While the largest area of wetland habitat was reclaimed before 1900, additional large wetlands were reclaimed around Castroville and Moro Cojo and Elkhorn Sloughs into the 1930's and 1940's (Gordon 1979, Dickert and Tuttle 1980).

2.1.3. Wetland Degradation

The impacts of human agricultural activities on the historic Tule Lake are similar to what happened to the wetlands and lakes in the Salinas Valley. These activities changed water by ditching, diking and draining; soil by plowing, leveling and draining; flora by removing forests and other plants by introducing exotic species of crops and inadvertently weeds; fauna by removing habitat, replacing with agricultural species, and controlling natural predators. The Great Valley oak and riparian forests were destroyed for agriculture, as they were in the Salinas Valley.

Little of the original native habitat remains in the Salinas Valley. Most of the oaks have been cut. Grasslands have been plowed into agricultural fields. Riparian forests on the floodplain were cut and plowed and reduced to a narrow fringe along the river. Water flow down the valley has been greatly constrained by channelization for wetland reclamation. The vast complex of wetlands, including lakes, which occupied the lowlands around present-day Salinas (Figure 2) were ditched and drained and the plant and animal communities greatly reduced or extirpated.

Introduced plants, especially annual weed grasses and cultivated crops, have largely displaced native plants. Pest animal species have colonized the extensive landscapes modified by human development. For example, the brown-headed cowbirds, nest parasites of other birds, moved into the Salinas Valley in the 1920's and have caused catastrophic population declines in riparian bird species. Wetland reclamation caused the most serious human impacts on birdlife throughout California (Grinnell 1922, Gordon 1979). Even into the 1930's and 1940's, there were 50,000-100,000 mud hens or coots in a single flock on local wetlands (ABA Consultants 1989). The regional decrease in wetland area must have eliminated millions of waterfowl and shorebirds from the Monterey Bay area.

2.2. Present Environmental Conditions

2.2.1. The Watershed Problem

Degraded water quality is a serious world-wide problem (EPA 1992). Saltwater intrusion of aquifers and non-point source pollution are two major water quality problems afflicting California in general and the central coast specifically. Movement of water from the land to the sea is radically modified in the Salinas Valley, the primary watershed of Monterey Bay. Water is drained into ditches adjoining agricultural fields, into central collecting ditches that were once magnificent creeks, into the Salinas River which is now a flood control channel, and finally into Monterey Bay. Dozens of creeks were long ago converted to de-vegetated ditches. Thousands of acres of wetlands are ditched and dried, reducing flood and natural water quality control and the ground water recharge necessary to forestall saltwater intrusion. Most of the wetland landscape is now gone (Gordon 1979).

2.2.2. Saltwater Intrusion and Ground Water Recharge

The most severe and pressing environmental problem in the Monterey Bay area is saltwater intrusion into surface and deep aquifers. Fresh water is the most limiting natural resource to human populations as well as other animals and plants. Restoring the historical rivers, creeks, and marshes will fill the watershed and feed the natural recharge areas, especially the river beds, ancient inland sand dunes, and surrounding mountains. Much ground water has been removed from the subsurface water table and replaced by seawater from Monterey Bay which has crept along permeable sand and gravel layers. Marshes adjacent to the bay are critical in holding water at all elevations so that hillside and mountain recharge areas have more water for longer periods of time.

A healthy watershed retains water, slows water movement, and increases downward flow into aquifers. For example, around Castroville, an area of extreme saltwater intrusion, riparian corridors can be restored into the sandy hills over 200 feet high, recharging the top 100 feet of aquifers at sea level. Almost all of the natural riparian habitats were destroyed by ditching. Any plan to provide more directed aquifer recharge will work best if it is part of this natural recharge system. The more the natural wetland system is restored, the more saltwater intrusion will be retarded and reversed, protecting the entire watershed from future problems.

2.2.3. Non-Point Source Pollution and Wetland Filters

Agricultural lands receive higher levels of known poisons than any other landscape in the state (Oakden and Oliver 1990, EPA 1992, Watkins et. al, 1984, Ladd et. al, 1984). Year after year, farm chemicals drain into a ditch system which empties directly into the Monterey Bay National Marine Sanctuary. Urban runoff is less important here than farm sources.

The wetland complex is an extensive biological filter. It dilutes, filters, retains, and biologically degrades toxic chemicals (Finlayson et. al, 1986; Gearhart, 1992; Puckett et. al, 1993). Farmers on the dry sides of dikes pump water from a tile ditch into the restored or managed wetland. The drainage flows across the wetland gradient. Most toxic compounds are concentrated on fine sediment and organic particles; these are the first to be trapped and filtered by the dense plant growth. Farm runoff is physically filtered by the wetland, reducing downstream toxicity (Kelman-weider et. al, 1988; Mitsch, 1989; Gearhart, 1992; Hupp et. al, 1993; Phillips et. al, 1993; Puckett et. al, 1993). Toxic substances are diluted by the large volume of wetland water, reducing toxicity to animals and plants.

The surface of the wetland is itself a biological factory, degrading and recycling chemicals. Toxic compounds are usually broken down the fastest on the sediment surface, reducing toxicity again (Gearhart, 1992). If rates of sediment and organic deposition are high, toxic compounds will be trapped within sediment and below ground. Here, breakdown rates are usually slower, but are often still significant. The overall effect of the wetland filter is a dramatic reduction in chemical concentrations and potential toxicity to wildlife. Thus, at the lowest energy and fiscal costs, environmental returns are enormous.

2.2.4. Biological Diversity: Endangered Ecosystems and Species

Watershed restoration is the best action to protect and restore biological diversity in Monterey Bay. The greatest diversity of plant and animal species are dependent on wet areas in the landscape. Because 90% of the wetland habitats have been destroyed in Monterey Bay and the few surviving systems are highly modified or degraded, wetland ecosystems and habitats are themselves endangered (Roberson and Tenney, 1993). Restoration of river, creeks, and marshes will have a highly positive impact on the survival and growth of populations of many endangered and threatened species. Extinction of local and regional populations and now at alarming rates the permanent loss of species is the most important global environmental problem. The natural habitats and communities of Monterey bay are not an exception, they are a classic example of endangered ecosystems, habitats, and species (Jones and Stokes, 1987). Wetlands have the highest endangered status (Anon., 1991). The human species will survive in the bay area, but the quality of life presented to future generations is already lower than ever and may be irreversibly degraded within the next few decades. Assuming repetitive climatic patterns, we are at the end of a drought and will move into a period of maximum rainfall within the next two decades, followed by a period of gradual drying to the next drought (the 30 year drought cycle observed in tree rings: Anon., 1978). If watershed restoration is not implemented during the period of maximum rainfall, the next drought may be devastating to every major human community in the bay area- certainly the farmers. The impact to natural ecosystems is much worse. The freshwater wetlands are already endangered.

2.3. Restoration Considerations

2.3.1. Ecological Engineering

The watershed should be rebuilt with ecologically engineered or natural berms starting at the ocean. The first berm is the coastal sand dune and beach, spreading river water along the dunes from Moss Landing to Marina. Upstream, the river can be dammed at natural high sites to spill into adjacent low lands, the historical wetlands. Surrounding farm land can be protected by dikes greatly improving flood control.

The berms and dikes are simple and inexpensive because they are ecologically engineered. Berms are formed by trees and bushes on high areas in the flood control ditches; the same sites where beavers are busy building exemplary structures. Berm formation can be accelerated with organic debris such as hay bales. These produce shallow ponds where wetland plants can colonize or be planted to stabilize ecologically the structures. The surrounding low lands can be impounded by dikes with gradual side slopes (1:5 or more) reinforced with trees, bushes, and grasses. The healthy river and creek flows through a series of porous, natural berms surrounded by low marshes that can be expanded at any time by simply breaching the correct dikes.

2.3.2. Flood Control

Watershed restoration increases flood control many times. For example, restored wetlands can be designed to hold two feet of water and be surrounded by dikes which are four feet tall. The large area of low wetlands provides a tremendous increase in the flood storage capacity of the present ditch system. Watershed restoration is cost effective and highly desirable for flood control alone.

2.3.3. Public Education

Public education is an essential component of successful watershed restoration, including programs in elementary, middle and high school. Communities and schools should be involved in the restoration of local creeks and wetlands while enhancing science and environmental education in area schools through involvement in habitat and wetland restoration.

The Return of the Natives Project has already been established to develop native plant gardens and nature areas on school grounds as a vehicle for teaching science and environmental concepts. Students propagate native plants and take field trips to assist in habitat restoration. Fifteen Salinas schools and two Castroville schools are currently participating in the project. Lead teachers have been through intensive training workshops dealing with native plant ecology, habitat restoration, landscape architecture and curriculum development. Students learn important scientific concepts and processes by propagating and studying native plants, and being involved first-hand in restoration efforts. With Hispanics comprising over 50% of the Salinas student population, this project is an important opportunity to increase minority involvement in science. RON presently exposes hundreds of young students and families to the need and action of watershed restoration. It is also an important existing mechanism for recruiting minority students from local high schools into the environmental scholarship programs at the new CSU campus in Monterey Bay.

2.3.4. Restoration Monitoring

The general restoration process can be easily monitored through a series of photographs at various spatial scales to illustrate key processes such as patterns of plant growth. A number of additional features can be monitored to follow the development of this large-scale restoration experiment, from water quality to wildlife patterns.

Water quality can be monitored in the wetland restoration sites as a highly effective surveillance and source control program for nonpoint source pollution. Water quality can be measured coming into and going out of the wetland, and in both sediment and biological tissues. Pesticide levels can be measured in water during periods of peak input to the watershed as well as in bivalve tissue in a Mussel Watch protocol (Stephenson et. al, 1979, 1980; Ladd et. al, 1984). Bivalves and amphibians accumulate chemicals over a longer period of time as an indicator of problem watershed sites, chemicals, and activities (Stephenson et. al, 1979, 1980; Hall and Kolbe, 1980). The water quality monitoring will indicate clean water or the presence of problems that can be investigated in a research project and/or controlled by cooperative and well directed actions. The monitoring program can be scientifically rigorous, inexpensive, and a model for the nation. Monitoring information will not only influence our understanding about human impacts to the environment and warn of problems, it will influence land use planning and practices through direct and indirect links with government agencies and community organizations.

2.3.5. WEOP-CRMP

The Watershed Ecology Outreach Program (WEOP) is a network of watershed restoration activists dedicated to positive environmental action. Their primary goal in the next decade is to hold freshwater on the landscape and restore the natural

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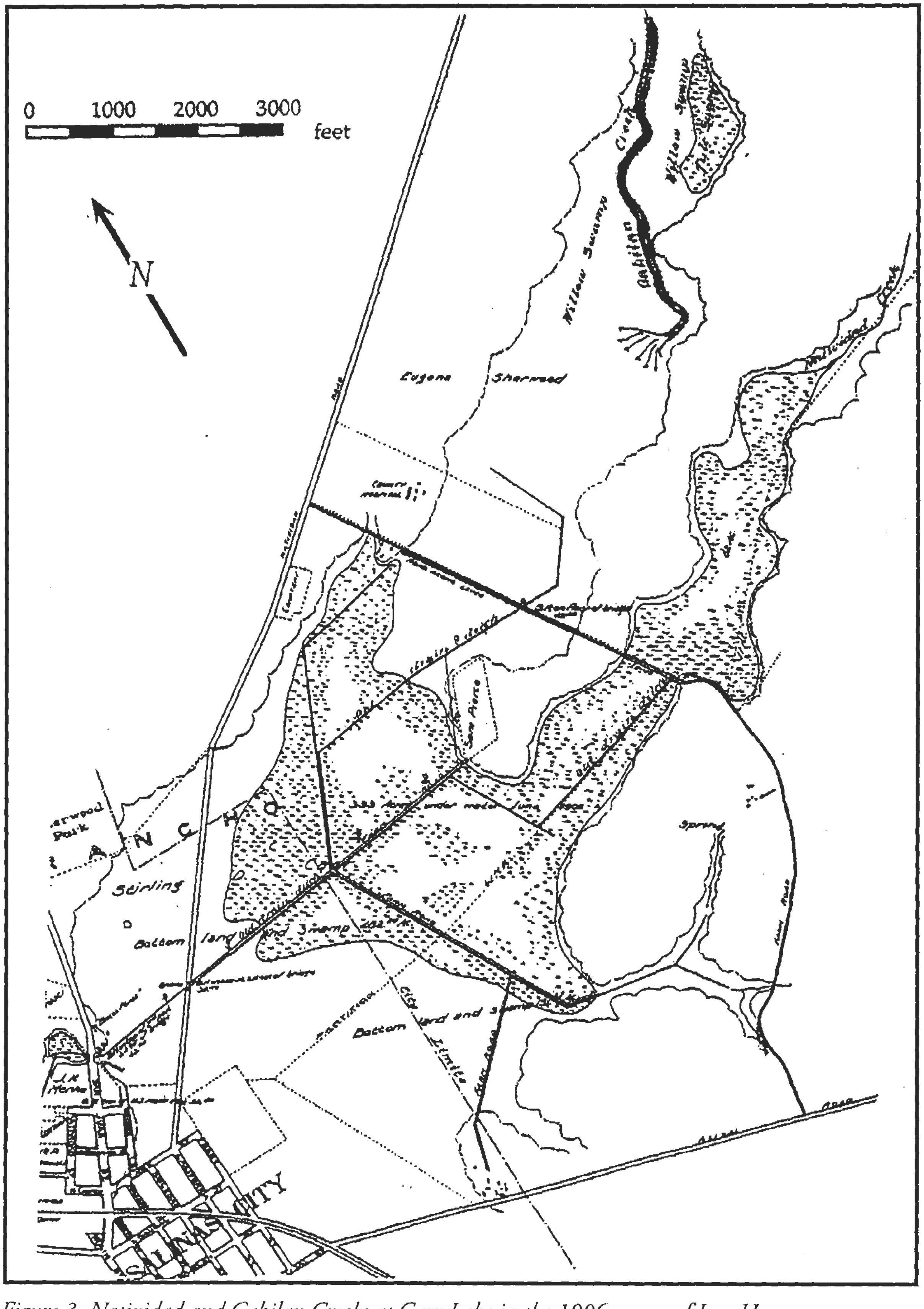
system of river, creeks, and marshes. The WEOP is developing a Coordinated Resource Management and Planning (CRMP) project. The CRMP is a federal and state program designed to bring concerned agencies into a regional program to accomplish watershed management and restoration minimizing redundancy and maximizing appropriate involvement and positive action. The WEOP-CRMP is organized to encompass the geographic area and watershed work in the Monterey Bay, Salinas Valley and Fort Ord, making a large restoration network available for positive environmental action.

2.3.6. Demonstration Projects

The WEOP-CRMP focuses on three major demonstration projects involving three subwatersheds in the Salinas Valley. These include upper Natividad Creek (this plan), lower Natividad Creek (Figure 4), and Fort Ord (Figure 5). The Natividad Creek watershed includes Gabilan and Natividad Creeks which flow into Carr Lake within the City of Salinas (Figure 1). From here they flow into the Tembladero Slough which empties into the Old Salinas River, to Moss Landing Harbor, and finally into Monterey Bay. Moss Landing Harbor is also the mouth of Elkhorn and Moro Cojo Sloughs. The lower Natividad Creek thus includes Moro Cojo Slough, Castroville Slough (flows into Moro Cojo), and the Tembaldero Slough (Figure 4). The Natividad Creek watershed once harbored a magnificent creek, lake and marsh system (Figures 2-3), and is now a highly degraded system of farm drainage ditches. The Fort Ord watershed largely flows into Toro Creek and then into Salinas River (Figure 5). It is another major subwatershed of Salinas Valley with over 15,000 acres of wildland operated by the Bureau of Land Management. This watershed can be almost fully restored into a natural setting.



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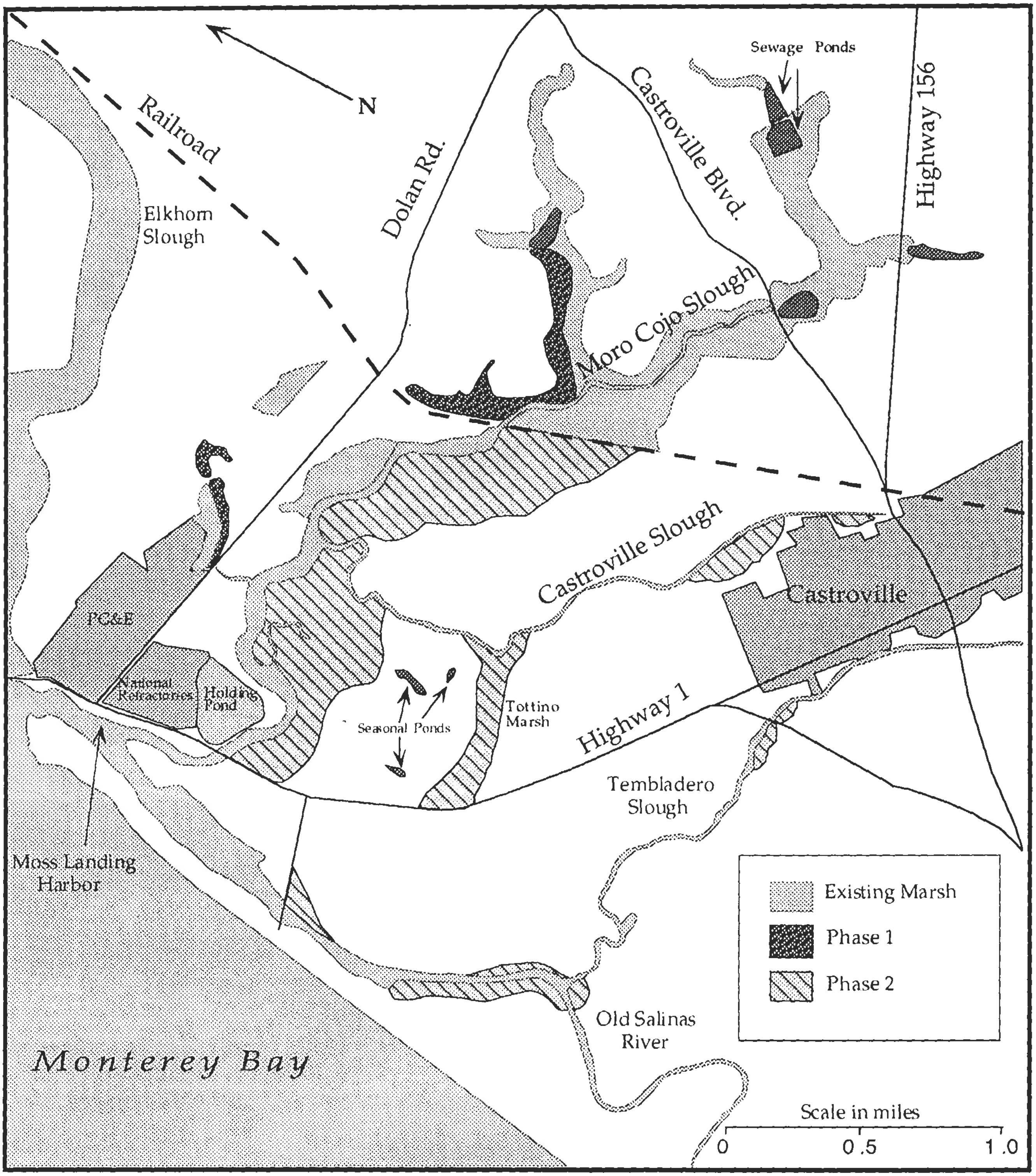


Figure 4. Lower Natividad Creek watershed draining into Moss Landing Harbor, Elkhorn Slough, and Monterey Bay. Phases 1 and 2 are potential wetland restoration sites.

3. NATIVIDAD CREEK RESTORATION SITE

3.1. Restoration Goals

Perhaps the most significant goal of the restoration is to increase the flow of water into the recharge area between the City of Salinas and the Gabilan Mountains. This region may be one of the best aquifer recharge areas in the lower Salinas Valley. The nature area in the Natividad Creek Park will help to slow the flow of water from the recharge area resulting in greater flow into the ground.

A major goal of the restoration is to restore as much of the historical model for the creek as possible. The major constraint to restoring the historical model is the radically modified and fragmented natural watershed which now surrounds the Natividad Creek restoration site. The historical creek depended on natural processes in the larger watershed such as water flow and retention and the complex interactions among plant and animal communities in both wetland and upland habitats. Much of the surrounding historical watershed is covered by the City of Salinas.

Another major goal is to restore the creek within the Natividad Creek Park nature area. The restoration site will thus border on park facilities, existing and future residential neighborhoods, and roads. The restoration edges must integrate into the human developments acting as border markers, physical barriers, and natural habitat.

Another goal of the restoration is to maximize the biodiversity of the site. Local and regional wetlands have been nearly extirpated by urban and agricultural development and consequently biodiversity of these systems has been severely diminished. Fragmentation of natural areas by human activities has had dramatic adverse impacts on biodiversity (Herkert 1993). The natural system of the project area was once a large interconnecting wetland mosaic with a complement of diverse plant and animal species. Since the city was built over historic wetland habitat, it will be impossible to restore all of the rivers, creeks and marshes. The biodiversity of the site can be enhanced, however.

The restoration site encompasses a small section of the creek flowing through the city (Figure 6). It is surrounded by nonnative habitats, primarily urban and park. The creek system below and above the restoration site is essentially a farm drainage ditch with little natural habitat value. The project will enhance the habitat value of the creek. In addition, a few continuous riparian corridors and patches of wetland habitat can be restored around the city as well. These will be along the existing

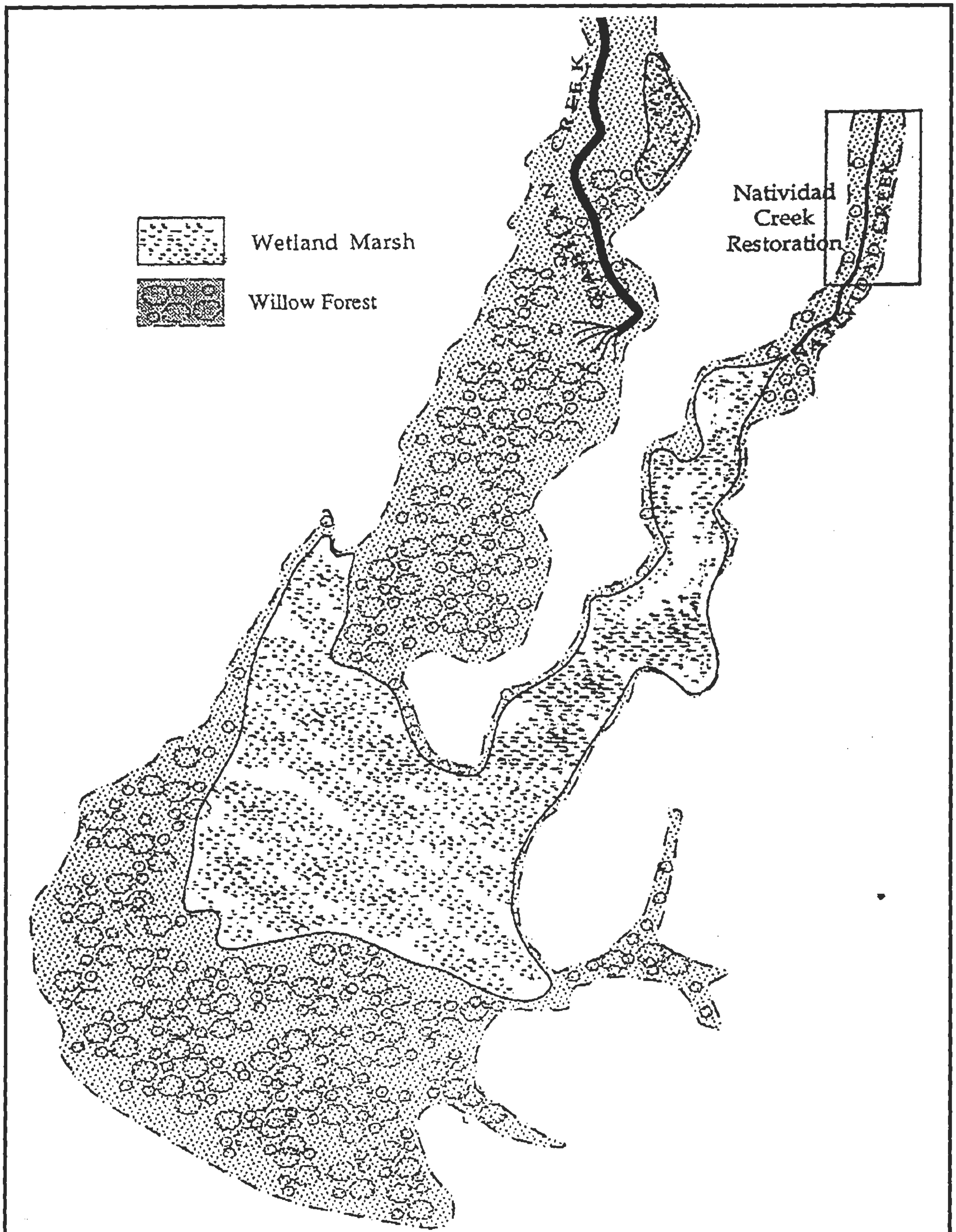


Figure 6. Historical model of wetland habitats along Natividad Creek and Gabilan Creek in the Ctituy of Salinas

drainage ditches. These restored wetland areas should be habitat refuges for as many appropriate species as possible (Franklin 1993, Orians 1993).

The choice of species to be used in the restoration will be directed by historical models and on ecological criteria such as the likelihood of a species being present in the regional wetland and upland habitats during the last few hundred years. The surviving patches of local wetland habitats and communities within the project area are not the best and only source to provide species for recolonization. They do not harbor enough species to meet the restoration goal of maximizing biodiversity. There was undoubtedly great dispersal of species among watersheds, and watersheds outside the project area are ecologically appropriate systems from which to select species for restoration.

Finally, a major goal of the project is to involve the public in watershed restoration through programs like the Return of the Natives (see 2.2.7 Public Education).

3.2. Historical Model for the Site

The best historical model for restoration is the most recent natural description of the system before human activities, especially wetland reclamation, modified the movement of water (Gordon 1979). The wetland landscape was not grossly modified in the Salinas Valley until after California became a state, with the most widespread reclamation efforts beginning in the late 1800's (ABA Consultants 1989). The best early accounts of Natividad Creek come from the early 1900's, thanks to the outstanding surveys done by Lou Hare in 1906 (Figures 2-3). His maps contain more useful information about wetland habitats of the Salinas Valley than any made before or since. Even the maps from the Coast and Geodetic Survey, which only depict a narrow zone along the coast, contain less detail about natural vegetation and water flow than Hare's maps.

Figure 6 shows an extension of the wetland habitats in Hare's map along natural topographic features into the likely wetland area before the City of Salinas was developed. Natividad and Gabilan Creeks flowed into a large marsh complex forming a seasonal lake which often persisted for much of the year. This is Carr Lake which is now largely filled and drained for agricultural uses. The low marshes were probably dominated by rushes or tules as shown in sections of Hare's map (Figure 3). They were surrounded by willow forests including box elders, cotton woods, and other riparian tree species. A single stand of this riparian forest still persists along Gabilan Creek under the stewardship of the Big Sur Land Trust and the City of Salinas.

The section of creek in the restoration area was probably a riparian forest dominated by willow trees (Figure 6). Other riparian trees were surely present and patches of low marsh were probably present here and there. Smaller habitats within the broad wetland type probably existed on higher ground. The current grassland remnants on the site may represent one kind of these smaller habitats. This is the general historical model for the wetland habitat and vegetation of the Natividad Creek Park (Figure 6).

3.3. Natividad Creek Park

Ed Piper and his colleagues in City Parks designed Natividad Creek Park for a broad spectrum of recreational activities (Figure 7). The park includes several large playfields for soccer, baseball, football and general recreation. There are other large grass areas for picnics and family enjoyment. The park also contains tennis courts, basketball courts, a BMX bicycle course, a skateboard course, and a recreation center. The entire upper end of the park is the nature area, the main site of the Natividad Creek restoration (Figure 7). Through the Return of the Natives project, the nature area will be an outdoor classroom for many of the schools (K-12) in the city as well as a center of community involvement in action for the watershed (see 2.2.7 Public Education).

The restoration site is within a public park with many recreational uses and within the city itself. The borders between the parks and nature area and the nature area and the city neighborhoods will be planted with appropriate plants. All efforts should be taken to use native species over non-natives. While some non-natives chosen may be chosen for their value as wildlife habitat and ability to resist drought, the emphasis should always swing toward the use of native species where ever possible. Beyond the borders the nature area will be restored with native species only. Public safety is a critical consideration. Therefore, certain viewsheds will be open to keep park visitors safe from crime and all plant selection will minimize fire hazards.

3.4. Existing Habitats and Communities

3.4.1. Plant Patterns

Mercurio's (1992) report defines the flora around the Natividad Creek restoration site as components of three communities described by Holland (1986): riparian forest, freshwater marsh, and non-native grassland. Mercurio provides a comprehensive species list of the plants he found on the site. Most of the characteristic plants of the three communities are present, but some were not found.

Restoration will enhance and encourage those desirable species present and restore some of the constituents not present.

Central coast arroyo willow riparian forest is a dense, low, closed-canopy broadleafed winter-deciduous riparian forest. It is dominated by arroyo willow which grows as a large tree-like shrub. It occupies moist to saturated sandy or gravely soil, especially on bottom lands within the coastal fog incursion zone. Characteristic species include alder, bay, and red and yellow willows. Riparian community species on the site are mainly the three species of willows. They occur only immediately adjacent to the watercourses, and almost completely along the upper portion of the site (Figure 8 and 10) with a few young willows on the lower portion (Figures 9 and 10). These willows represent a small fragment of the historical grove which once occupied this part of the Natividad Creek drainage (Figure 6).

Coastal and valley freshwater marsh is dominated by perennial emergent monocots sometimes exceeding 15 feet in height and often forming closed canopies. The community typically occupies quiet sites, lacking significant current, permanently flooded, and on deep, peaty soils. Plants include sedges, rushes, spike rushes, bulrushes, pennywort, mudwort, burrweed and cattails. This community is restricted to the narrow permanently wet channel not dominated by willows, and in small fragments along areas maintained wet by agricultural runoff where they are mixed with weeds. The degraded condition and extremely limited area covered by this community is illustrated by comparing Figures 6 and 10.

Non-native grassland is a dense to sparse cover of annual grasses one to two feet tall often co-occurring with showy-flowered annual forbs. Germination occurs during the late fall rains and flowering and seed-set take place in winter through spring. Most plants are dead in summer and fall. Non-native grassland community may occur on deep, fine-grained and rich soils characteristic of native perennial grasslands but also occupies poor dry soils which previously supported scrub or brush communities. The main grass species of exotic annual grasslands are ryes, bromes, barleys, oats and fescues. The main forb is the non-native filaree, but there are also annual and perennial native flowers such as lupines, poppies, gilia, owl's clover, baby blue-eyes, peppergrass, phacelia, tarweeds, goldfields and layia. The amount of coverage by native species is relatively low. The site as a whole is by far dominated by annual weed species, primarily grasses and forbs. The cover of weed species grades from the dry soil of hillside upland habitats to the richer moister soil in the low areas. While the species composition varies between these habitats, the plant communities are still largely non-native weeds.

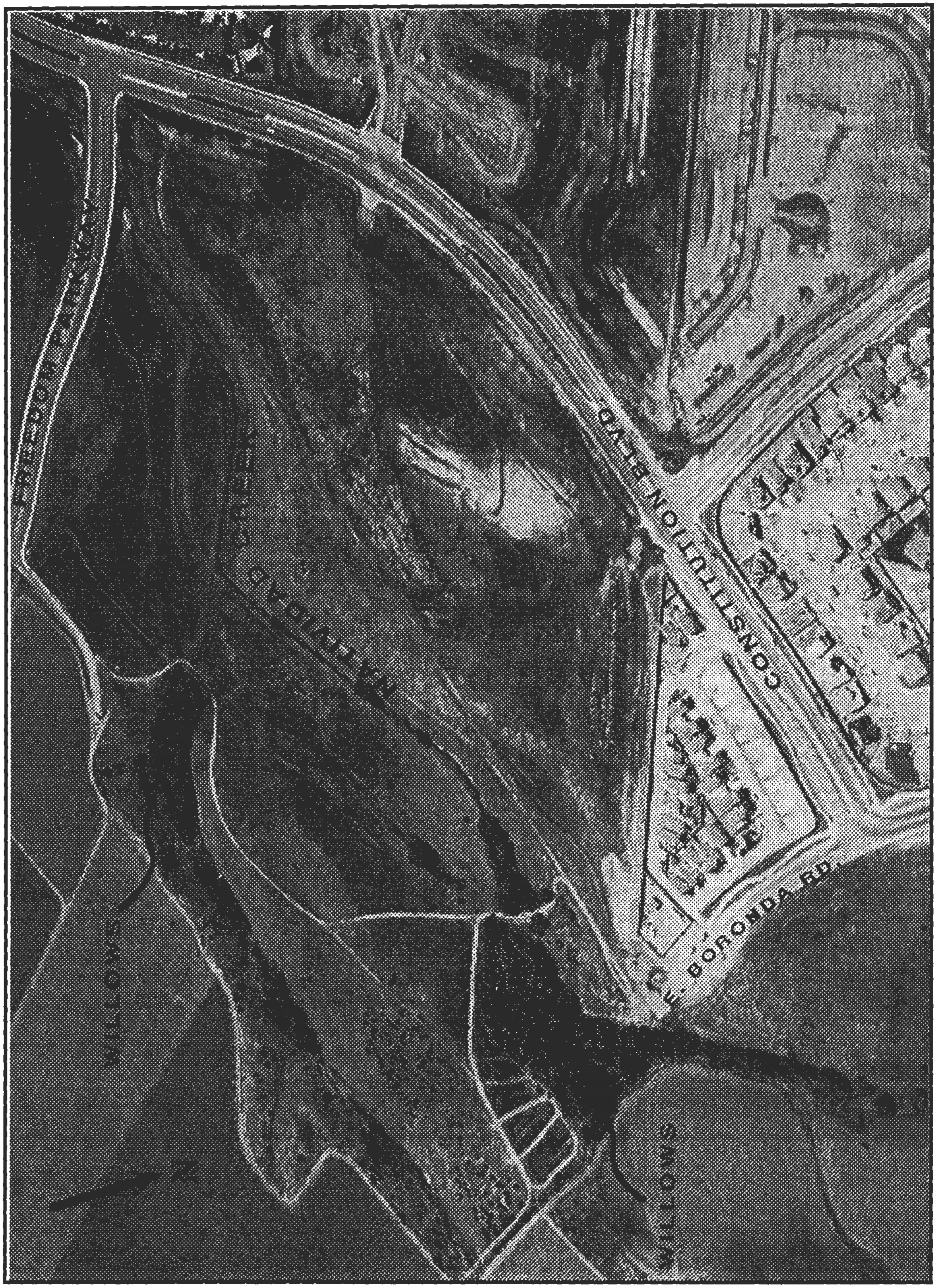


Figure 8. Aerial photograph taken April 22nd, 1994 of upper section of Natividad Creek restoration site.

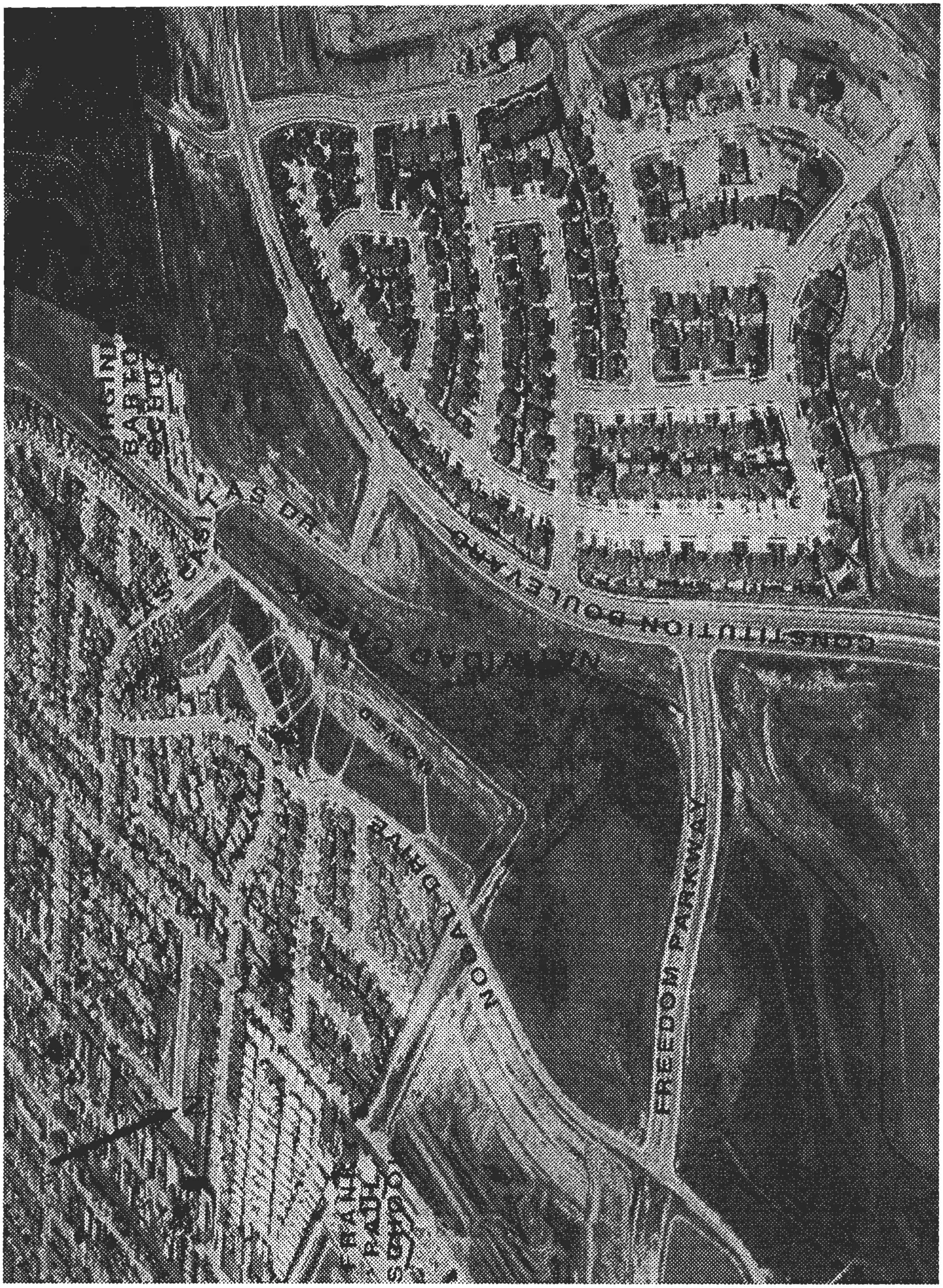


Figure 9. Aeral photograph taken April 22nd, 1994 of the lower section of Natividad Creek restoration site.

In addition to the three primary plant communities (riparian forest, freshwater marsh, and non-native grassland), there are fragments of a fourth type, Coastal terrace prairie. This perennial grassland assemblage characteristically occupies sandy loam soils on coastal terraces within the zone of fog incursion (Holland 1986). California oat grass is the main species. Just as riparian and wetland communities have suffered enormous destruction, coastal prairie has been extirpated over large areas and the opportunity to manage remnants for protection and enhancement is valuable. Small elements of this native perennial grassland grow on the north aspect slopes (Figure 10), mainly along the northeast part of the upper site (Figure 8). These community elements grade into non-native grassland. The primary native perennial species present are California oat grass, blue-eyed grass, California poppy, blue wild rye and alkali rye grass. The presence of these species in relatively healthy community fragments, albeit very small and diluted with weeds, is probably a response to relief of disturbance by grazing.

3.4.1.1. UPLAND SITES

The three upland restoration sites are at the northwest, northeast and southeast corners of the site, and named respectively Constitution, Rider and Nogal (Figure 11). Two sites are on slopes and one a relatively flat area. The northwest area (Constitution) is relatively flat and is essentially barren of native plants and completely covered with weeds. The two slopes (Rider and Nogal) support remnant patches of native perennial grassland community which should be conserved and enhanced. They are on north-aspect settings.

3.4.1.1.1. Constitution Site

Constitution is slightly sloping with a south aspect (Figure 8). The site is a transitional area between slopes and the bottom of drainage. The soil is relatively loose, mainly sands with some gravel. The present vegetation cover is a virtually solid monoculture of overstory mustard and understory soft chess grass, excepting a few poppies and morning-glory around two coyote bushes. Small rodent burrows, probably voles, were very numerous in spring within the undercover of matted grass. Restoring this area to a more natural setting will reduce the number of voles, and enhance biodiversity.

3.4.1.1.2. Rider Site

The Rider site, on the north east corner (Figure 8 and 11), is on a north aspect slope and displays excellent remnant coastal prairie elements: California oat grass plants, which are large and robust, and associates, alkali rye grass, blue-eyed grass, sanicle, morning glory, and poppies which also appear to be vigorous. An interesting fragment of an intergrading community grows at the base of the Rider area. Upland species, well developed coyote bush cover are associated with a seep and several rushes and other moisture preferring species. The best developed native plant community grows on the steep slopes. More weeds integrate into the community on the upper and lower flat areas.

3.4.1.1.3. Nogal Site

The Nogal site, on the southeast corner (Figure 9 and 11), is similar to the Rider site in that it is a north aspect slope which includes a small area of remnant coastal prairie plants. However, it is very degraded and not nearly as large or well developed as the Rider site. The steep slope supports mostly annual weeds, very dense cover on the lower slopes with better and moister soil, and sparser cover on the drier higher slopes. The dense grass cover on the lower slopes had been mowed once in the spring, but by late May plants had become robust and produced seed. That mowing activity underscores the need to be able to mow more than once during a season, which in other restorations has eliminated extremely dominant weeds such as poison hemlock.

3.4.1.2. RIPARIAN

The robust willow population in the upper area is comprised of three species: red, yellow and arroyo. The willows form dense groves at the upper area near Boronda Road (Figure 8). However soils supporting the groves have been thoroughly trampled in many places and little understory vegetation has been able to establish. The habitat within the groves is at the enhancement stage; that is passive management with some weed control and perhaps some planting will allow a full community, including understory and vines, to begin to develop. Willows have begun to establish themselves along stretches of the watercourse. Freed of disturbance these plants will grow and probably spread into groves comparable to those at the upper end.

3.4.1.3. MARSH

The marsh community is relatively simple. The plants are few in number, have simple grass-like form and are taxonomically related. The community occupies quieter waters than riparian forests, and withstands or prefers permanent flooding. The basic species for this community are present on the site: cattails and various rushes, bulrushes, spike rushes. They grow in lower, wetter areas. The strip of marsh vegetation in and along the channel is the main representative of the community. However, some rushes grow where there is water input from agriculture runoff. Flooding eliminates most weeds and provides habitat for marsh species which rapidly colonize flooded ground.

3.4.1.4. OTHER RESOURCES

3.4.1.4.1. Mycorrhizae

Mycorrhizae are fungal associates with hair roots of vascular plants. Mycorrhizae are recognized to aid the uptake of soil nutrients by plants. However their specific functions are very poorly known and mycorrhizae are often difficult to work with. It is not clear that they are necessary for successful, or apparently successful, restoration. Mycorrhizae are often species specific and local forms may be necessary to form successful associations with the plants on site. While mycorrhizae were undoubtedly functioning members of the pristine flora on the site, their presence there today has not been established. Use of mycorrhizae for restoration could be potentially valuable but would be experimental.

3.4.1.4.2. Salvage Material

Valuable native plants currently grow on soils which will be re-contoured. Those plants will be destroyed during park construction. Some perennial grassland species such as Californian oat grass, blue wild rye and blue-eyed grass and poppies grow on slopes which will be altered. Stands of alkali rye grass grow in lower areas. Marshy material, such rushes, spike rushes and bulrushes, may be destroyed by the park and restoration construction. Some of this material may be salvaged by collecting root masses or rhizomes, or divisions of some grasses. The material can be collected and transplanted directly. It may also be returned to the greenhouse to be grown out to larger sizes and transplanted at the correct time of year. Seed material can also be salvaged.

3.4.1.4.3. Endangered Species

Papoose spikeweed, or Congdon's tarplant (*Hemizonia parryi* var. *congdonii*), is listed by the California Native Plant Society as status 1B, rare, threatened or endangered in California and elsewhere. The plant is not given formal status by the state. However, because of the CNPS listing it is mandatory that the plant be fully considered under CEQA requirements. The federal status of the plant is C1, a candidate for listing with enough information about the species to list it as endangered or threatened. It is an annual species found on alkaline and heavy grassland soils dominated by exotic annual species. A map and description of its distribution and its population size and dynamics on the site were presented in Mercurio's (1992) biological assessment. Two populations were identified, one adjacent to Freedom Parkway, in the middle of the park, and another southeast of the Rider restoration site, well out of the park boundaries. A third population, of many thousands of individuals, also grows in the area, south of Constitution Boulevard, also out of the park boundary. The species is probably extending its population due to the current dry conditions, since it grows on dry, disturbed soils with reduced competition. Restoration through weed control will favor it.

No mitigation is required since the proposed work is itself devoted to benefiting native species and their habitat. The project will enhance and help protect the on-site spikeweed colony. The project will enhance spikeweed habitat and the population will have opportunity to increase. Permits from regulatory agencies to handle or "take" spikeweed plants or parts, such as collecting seeds and propagating plants, are not necessary at this time since the species has not yet been formally designated as threatened or endangered.

3.4.2. Wildlife Patterns

Mercurio's (1992) report presents complete lists of mammals, birds and herptiles (reptiles and amphibians) observed on the site and possibly occurring on the site with a ranking of the possibility. He distinguishes between alien (also referred to as introduced, exotic and non-native) and native species. Generally, restoration of disturbed areas to native vegetation will rehabilitate habitat favorable to native animals and encourage their populations to return or increase. Conversely, alien species will usually be put at disadvantage if not eliminated by habitat improvement. The following section reviews two categories of important species, those with a potential to be pests, mainly exotics, and those warranting special consideration because of their rarity or vulnerability to population decline.

3.4.2.1. EXOTIC/PEST SPECIES

3.4.2.1.1. Invertebrates

Potential pest insects from farm and agricultural sources will most likely be checked or eliminated by native plant-insect systems. The diversity of species provided by native assemblages contrasts to the monoculture of domestic plants which favors large populations of pest species.

3.4.2.1.2. Fish

No less than 10 species of alien fish species have been introduced to the Salinas River - Pajaro River drainage system (Moyle 1976), of which Kukowski (1975) documented six species in the lower Salinas River. Alien species often displace natives by predation or competition, or by altering native habitat. Fish were not discussed in the biological assessment and no fish were observed in the shallow, often stagnant water on the restoration site. However, as restoration proceeds and habitat becomes increasingly suitable for native species, some consideration may need to be given to controlling alien pest species and reintroducing natives.

3.4.2.1.3. Herptiles

Bury and Luckenbach (1976) documented seven alien species of reptiles and amphibians which have established breeding populations in the state. In addition native species have been transplanted outside their natural range. Tiger salamanders, native to other areas in the western United States, have been transplanted to the Salinas River watershed. However, the only clearly alien herptile to live in the Natividad watershed is the bullfrog. The species is the largest frog in the western United States. It spread rapidly upon introduction, and has become highly successful (Strebbins 1954). It is strictly aquatic and requires permanent standing pond water in contrast to the two related native species, red-legged and yellow-legged frogs. However, some concern must be given to monitoring the bullfrog and controlling its population as a potential threat to the other two species. Farm pond water which warms to temperatures that allow bullfrog reproduction are the most likely centers of invasion by this species.

3.4.2.1.4. Birds

Two alien bird species were identified in the biological survey, starlings and house sparrows. House sparrows are strictly human commensal, limited to the immediate vicinity of inhabited areas (Roberson and Tenney 1993). Starlings, however, aggregate in large numbers and are cavity-nesters. They can displace native bird species. Brown-headed cowbirds, native to southern California, moved into Monterey County about 60 years ago as a result of agricultural development. Cowbirds are nest parasites and have caused severe population declines of several riparian bird species, and were a major cause of the total extirpation of the willow flycatcher in Monterey County.

3.4.2.1.5. Mammals

Probably the most potentially harmful mammal is the red fox. This species has become numerous in the bay area within the last two decades. It is notorious for its destruction of wildlife, especially bird nests. Mercurio observed this species on the project site. Feral or stray dogs and cats could destroy wildlife. Cats prey on birds and small mammals and dogs prey on or harass mammals such as woodrats and other small to medium-sized animals. The impact of both animals is likely to be minimal, especially if local residents manage their pets responsibly. Public education on this matter will allow another opportunity for interactions between community organizations and the restoration project.

Mercurio (1992) lists three species of old world rodents, mice and rats, as having a high likelihood of occurring on the property. While all three are pests, they will probably not maintain significant populations in natural settings.

Two other species, beaver and muskrat, are "introduced natives", that is native to the western United States but not naturally occurring in the Monterey Bay area. Both live at least within a few miles of the property, but were not seen on it. It is unlikely but possible that they could occupy the site and become nuisance species by burrowing and undermining channel banks. It is more likely that their colonization would be a positive addition to the local wetland communities.

3.4.2.2. SPECIAL SPECIES

3.4.2.2.1. Invertebrates

No studies and few observations on invertebrates on the project site were made. However, no listed invertebrates are expected to occur within the aquatic or terrestrial habitats on the site. Invertebrates, mainly insects, are vital as a food source for fish as either aquatic residents or as they fall from overhanging vegetation. Insects also feed the many species of riparian and other birds. Obviously the roles of insects as pollinators are vital to the life cycles of many plants . Healthy vegetation will support healthy insect populations.

Native species of earthworms may be present on the site or may be available from nearby sources from which to reintroduce them to the site. Workers at the Agroecology Center, University of California at Santa Cruz, have experience with earthworm biology and could help with their restoration. Aquatic invertebrate such as crayfish may have been historically present. Their reintroduction therefore could be desirable if the correct species could be identified, located and properly brought back to recovered habitat.

3.4.2.2.2. Fish

Steelhead historically used Monterey Bay tributaries for spawning. They are still occasionally observed in local watersheds such as the Elkhorn Slough and lower Salinas River. Rearing ponds for steelhead have been established on upper Gabilan Creek by agreement between private property owners and the California Department of Fish and Game. Much work would be required to reestablish steelhead migrations to the Natividad drainage. The restoration of riparian plant communities will be consistent with returning steelhead habitat and could provide leverage for other projects along the drainage.

Several other species of native freshwater fish occur in the Salinas River (Kukowski 1975) and could become reestablished on Natividad Creek. They are often small, inconspicuous and generally considered to be unimportant (McGinnis 1984). Native fish have been subjected to severely degraded or destroyed habitats and face competition, predation and displacement by introduced alien species which often prosper in severely altered waterways (Minckley and Deacon 1993). The restoration of riparian habitats will generally be beneficial to native fish. As the natural stream hydrology is restored, enhancement of fish can be addressed on a species by species basis, including the control of aliens.

3.4.2.2.3. Herptiles

Yellow-legged frog and red-legged frog deserve special consideration. Both are listed by the state as species of special concern and by the federal government as candidate species for listing as endangered or threatened. Yellow-legged frogs tend to prefer riffles, rocks and sunny banks. In contrast red-legged frogs prefer ponds and thick willow overgrowth, but may occur in grasslands, especially as they migrate during rain. Both species were given a low potential of occurrence on the site. However, both would benefit from the restoration of appropriate habitat in the project.

3.4.2.2.4. Birds

The vast destruction of riparian and other wetland plant communities has had a profound effect by reducing many bird populations because so many species are completely or partially dependent on riparian habitats (Barbour et al 1993). For example the yellow-billed cuckoo and least Bell's vireo were lost from Monterey County as breeding species (Roberson and Tenney 1993). Of the birds that were listed by Mercurio (1992), the species presented below have special status, legal recognition by conservation agencies of the state or federal governments, or both. The common name of each bird species is followed by a code representing its special status: CSC - California species of special concern; * - California species of other concerns; SE - listed by state government as threatened, FE - listed by federal government as threatened; 2 - listed as federal government as candidate for threatened or endangered status).

A. Species for which riparian habitat is essential or at least very important. Populations of some of these species are so reduced, such as least Bell's vireo, that the project will not have any immediate benefit.

Willow flycatcher SE
Tricolored blackbird CSC, 2
Yellow warbler CSC
Common yellowthroat CSC, 2
Yellow-breasted chat CSC
Loggerhead shrike CSC, 2
Least Bell's vireo SE, TE

Long-eared owl CSC
Burrowing owl CSC
Cooper's hawk CSC
White-tailed kite
Northern harrier CSC
Great egret*
Great blue heron*

B. Species for which riparian habitat is important.

Bank swallow ST
Purple martin CSC

C. Species for which restoration may only be of marginal help.

Bell's sage sparrow CSC, 2

3.4.2.2.5. Mammals

The wooded cover on Fremont Peak provides habitat for a good diversity of large and mobile mammals. Wooded habitats on the restoration site are adjacent, though not contiguous. Mountain lions are known from the area, and occasionally kill livestock. Recently a mountain lion was reported at Las Casitas Drive. Bears are not common but sometimes occur on the Salinas Valley floor. Twenty elk were introduced onto the slopes of Fremont Peak within the Gabilan Creek watershed in 1983, and now number about 45 to 50. Elk were historically abundant in California, especially in wetlands, and the Salinas Valley would have provided prime habitat (McCollough 1969). While these large mammals are not expected to directly utilize the restoration area, they illustrate the good condition of the nearby area and underscore the value of the restoration site by adding more habitat.

Many small mammals were listed by Mercurio (1992). Some of these small mammals, principally voles, respond well to the monoculture of annual grasslands, where they may be very abundant. Restoration will greatly reduce or eliminate annual grasslands and the populations of voles will correspondingly decrease. The diversity of vegetation replacing the relatively monotonous habitat of annual grassland will provide for more faunal diversity. There will be fewer voles but more woodrats, deer mice, and other species.

Three species of mammals listed by Mercurio (1992) have special status. They include: Monterey dusky-footed woodrat (*Neotoma fuscipes luciana*), CSC, 2: Monterey Ornate shrew (*Sorex ornatus salarius*), CSC, 2; and Salinas pocket mouse (*Perognathus inornatus psammophilus*), CSC, 2. While these are listed with a low likelihood of occurring on the site, restoration will benefit them, particularly the woodrat.

3.5. Restoration Plans

3.5.1. General Considerations

A main goal of the restoration is restore the historical habitat and community model for the site as much as possible (Figure 6). The historical model cannot be completely restored. This would require restoration of the entire wetland complex along Natividad Creek and Gabilan Creek where they flow into Carr Lake (Figure 6). This plan only involves a small geographic area, about 14 acres, within the whole Natividad Creek Park project (Figure 7). Although much more wetland may be restored along both creeks in the future, it will still be possible to restore only a small fraction of the historical wetland complex (Figure 6). Moreover, the extensive creek, lake and marsh system of the larger watershed (Figure 2) can only be partially restored at best. A large number of perennial species are proposed to be introduced to the area, perhaps more than may naturally have occurred within an area that size. Therefore, the actual restoration model for the site is radically limited in space and is constrained by the other major goals of the project: to integrate with the new park, to maximize biodiversity, and to involve the public.

The actual restoration model accommodates these major goals (see 3.1 Restoration Goals) which set the basic constraints on the physical and biological setting. The basic form and process of the restoration are described below. The restoration area and major restorable units are shown in Figures 7 and 11.

Five sites are to be restored including three upland areas named for adjacent city streets: Constitution Boulevard, Nogal Drive and Rider Avenue (still undeveloped) (Figures 11 and 12); and two riparian sites: upstream of Freedom Boulevard = upper stream course, and downstream of Freedom Boulevard = lower stream course.

The plants recommended for the restoration sites are all species native to the Salinas Valley watershed and are not fire risk species. Native grasslands remain green throughout the year and are far less susceptible to ignition or to carrying a blaze than the present annual grasses. Native shrubs and trees, especially those in the riparian, are noteworthy for not burning. In fact, the kind of native vegetation recommended within this plan, coast live oaks as an example, have been shown to actually retard structure fires. Viewsheds will not be compromised by the vegetation recommended. Riparian plants will grow to be tall and in fact provide a very favorable view. Upland areas are planned to support mostly lower growing species of grasslands. Shrubs within grasslands and along the perimeters will not grow tall enough nor be dense enough to interfere with views. The upper restoration areas, Constitution, Rider and upper stream course, are contiguous with each other and separate from designated activity areas and therefore no access is necessary. In fact access through restoration areas should be limited. The naturally robust growth of riparian vegetation along the upper restoration area should serve as protection from vandalism. Grassland and shrub communities, likewise, should be protected from heavy foot traffic, by perimeter shrubs. Viewshed and access constraints are applicable within the lower stream course and Nogal restoration sites.

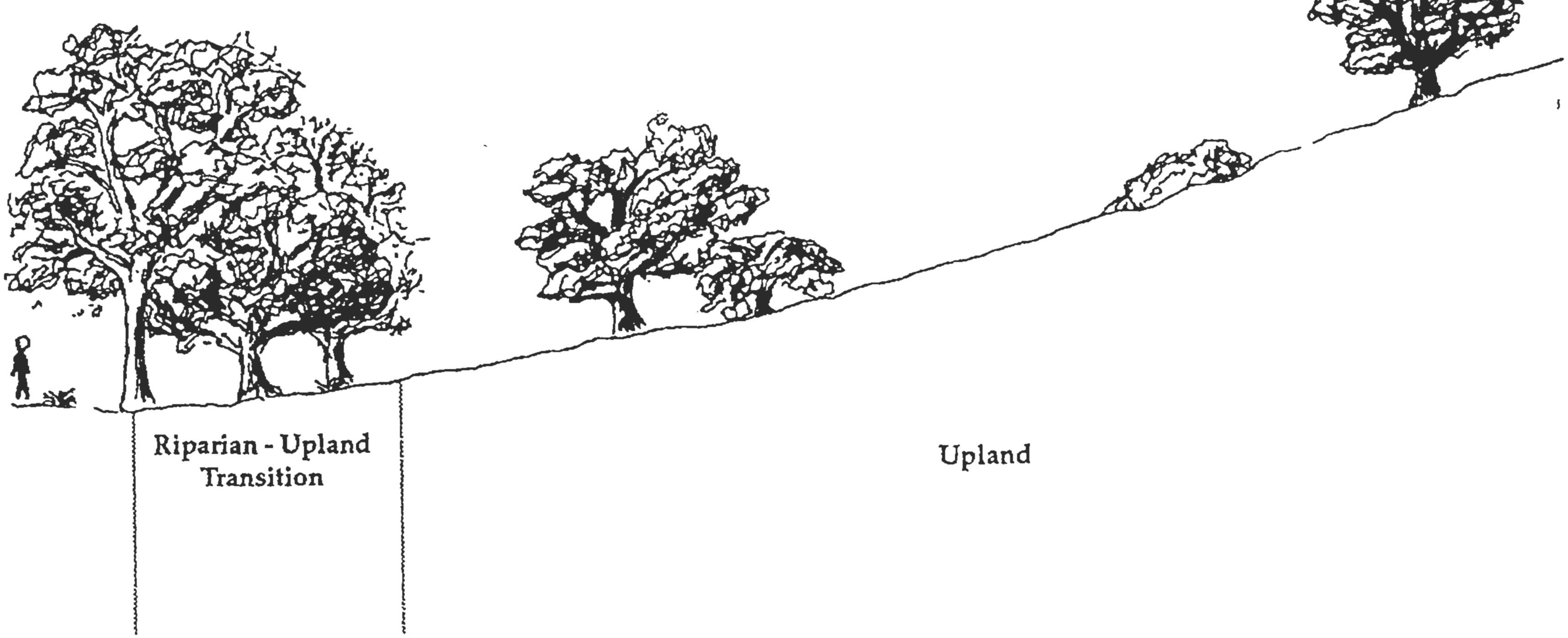
3.5.1.1. CONSTITUTION

The Constitution site has very altered slopes, covered almost completely with non-native weeds, with coyote bush and poppies among the weeds. At this site the riparian community grades into upland habitat, an intergraded zone to support open riparian species such as sycamores and perhaps oaks as well as bushes such as California sage and black sage (Figure 13).

The Constitution site will not remain permanently saturated near the surface, but ground water will be closer to the surface here than at the other two upland sites. Vegetation should comprise a type transitional to riparian or characteristic of open riparian areas. Larger trees such as cottonwoods, box elders, sycamores and perhaps oaks would be appropriate. Trees should be interspersed with shrubs such as elderberry, mule fat and seep willow nearer the riparian area and drier species such as California sage, black sage, blackberry, coyote bush back from the water channel. Some of those shrubs are short-lived, particularly coyote bush, and their presence will begin the establishment of a native community. They will be replaced by longer lived species such as manzanitas as the community matures and stabilizes. This may be a good site on which to plant several species of oak. If it is determined that coastal humidity on the site, especially fog, precludes interior live, blue, valley or black oaks from successfully growing with coast live oak then only the latter would be suitable. However, different species adjacent to each other will provide information on restoration methods by demonstrating the compatibility of oak diversity.

Weed control will be a relatively straightforward since the site is homogeneously covered with a few species of weeds. Virtually no native plant resources need to be protected. The soil appears relatively rich and probably supports a rich and viable seed bank. Therefore the soil should be disturbed as little as possible to minimize activating the weed seeds. Soft chess and mustard may be eliminated without the use of herbicide by spring mowings before seed set. However herbicide would probably be more effective than mowing. Herbicide should be applied to kill grasses after several weeks growth, probably late December or early January. Then one or more later applications might be needed depending on subsequent germination of different species. Mustards will grow later than soft chess, for example. Mowing or

Upland Restoration: South-facing Slopes



Selected candidate plant species:

	Riparian - Upland Transition	Upland
Trees and tree-like shrubs	Sycamore, Big leaf maple, Coast live oak, Buckeye	Coast live oak
Shrubs	Coffeeberry, Gooseberries, Currants	Black sage, Bush monkey flower, Bush lupines, California sagebrush
Perennial herbs	Blue wild rye, Sedges, Rushes	Purple needlegrass, California poppy

Figure 13. Sample cross-section of south-facing slopes.

the application of herbicide should be anticipated to control unpredictable sets of weed species if and as they appear.

Planting of native trees and bushes can proceed concurrently with weed control. The caveat is that weed control must accommodate the native plants by avoiding them. Protective stakes and/or protective covers may be installed. Hand weed control would be necessary near the propagules. The efficiency of machine mowing or herbicide application would be greatly compromised. The easiest approach, in respect to weed control, would be to delay planting until at least after the first year's weed control, after spring of 1995. For two or three years after that weed control may be difficult - desirable outplants will have to be avoided but the invasive weeds will need to be controlled. After a few years, as trees and bushes mature, their shade will continue to help reduce annual grass density. It must be noted that soils of the site have been greatly altered to the advantage of annual grasses which have long dominated them, so these weeds may never be completely eliminated. The current strong dominance by weeds needs to be broken, best by short term intense efforts, and then domination by native perennials will reduce weed populations,

Since the Constitution upland site is relatively low and intergrades with the upper riparian area, visual access will not be a problem, no views will be obstructed since riparian trees will form the border. This area is away from picnic and play areas and therefore does not need to accommodate access between formally designated activity sites. In fact limited access would be to the advantage of restoration and would not hinder any park activity. Maintenance of the restoration effort should be relatively low once initial weed control has succeeded and native flora has been established.

3.5.1.2. RIDER

The prime resource on the Rider site is the California oatgrass community remnant. The species present, California oat grass, blue wild rye, alkali rye grass, blue-eyed grass, sanicle, morning glory, poppies, provide a good basic model and a large nucleus from which to expand recolonization. The community remnant is best developed on the slope. The flatter areas above and below the slope are nearly completely impacted by weeds - mostly plantain and annual grasses. These weeds are also well integrated within the oatgrass community and become dominant along the edges. The restoration effort needs to expand the perimeter of the oat grass community and reduce the dominance and presence of weeds within and without the native community. The areal extent of the oatgrass community is large enough, a few acres, that it can probably be left un-manipulated and remain viable. However, the community may be effectively managed by conserving the plants present and using carefully managed weed control efforts.

Little or no outplanting should be initially attempted around the remnant, rather the present plants should be conserved and allowed to expand. Therefore protection against disturbance can be effective by merely preventing dumping, plowing and other physical insults. Weeds should be mowed high above ground level, about 8 inches, and early in the year to stop their seed production but not damage native plants. Selective poisoning of perennial weeds such as plantains may be feasible with great care, by using accurate spot sprayers operated by experienced workers, to avoid damaging native plants. However, much of the management effort of the remnant should be directed to monitoring and carefully developing techniques. Long term measures include collecting seeds, divisions and bulbs of the native species of grasses and sowing and outplanting in upper and lower areas where weeds have been controlled.

Above and below the remnant where weed cover is total or nearly so weeds should be aggressively controlled by mowing or poisoning, probably several times, during the first spring. The second year, when weeds have been greatly reduced, material gathered and propagated from the remnant area should be outplanted. Concentrations of natives should be planted in discrete areas to form nuclei from which they may radiate out. It is important that weed control in the outplant area be effective in order to allow a few years for the native plants to become established without facing much competition. Further, weed control among low native species, especially young ones, will be difficult. It will be much easier and more effective to do a thorough weed control initially, even waiting an extra year if need be, than trying to integrate weed control with relatively delicate young natives.

A small patch of coyote bushes forms a good nucleus of natives on the steepest part of the slope. Little need be done with these plants. However, they could be supplemented with other and longer-lived bush species. Since the slope is north facing, shrubs such as coffee berry and blackberry would be appropriate. And they will integrate well with the low area of the Rider site where the soil is moist. The community there will be the margin of riparian community. Initial weed control there should be followed by planting trees and large bushes - willows, cottonwoods, box elders, elderberries.

Rider view, access and maintenance considerations are the same as for the Constitution site: it is peripheral to designated recreation areas and need not serve pedestrian traffic, it borders the riparian restoration, and should require little or no maintenance once established. Initial successful weed control should be sufficient to allow the native species to maintain themselves.

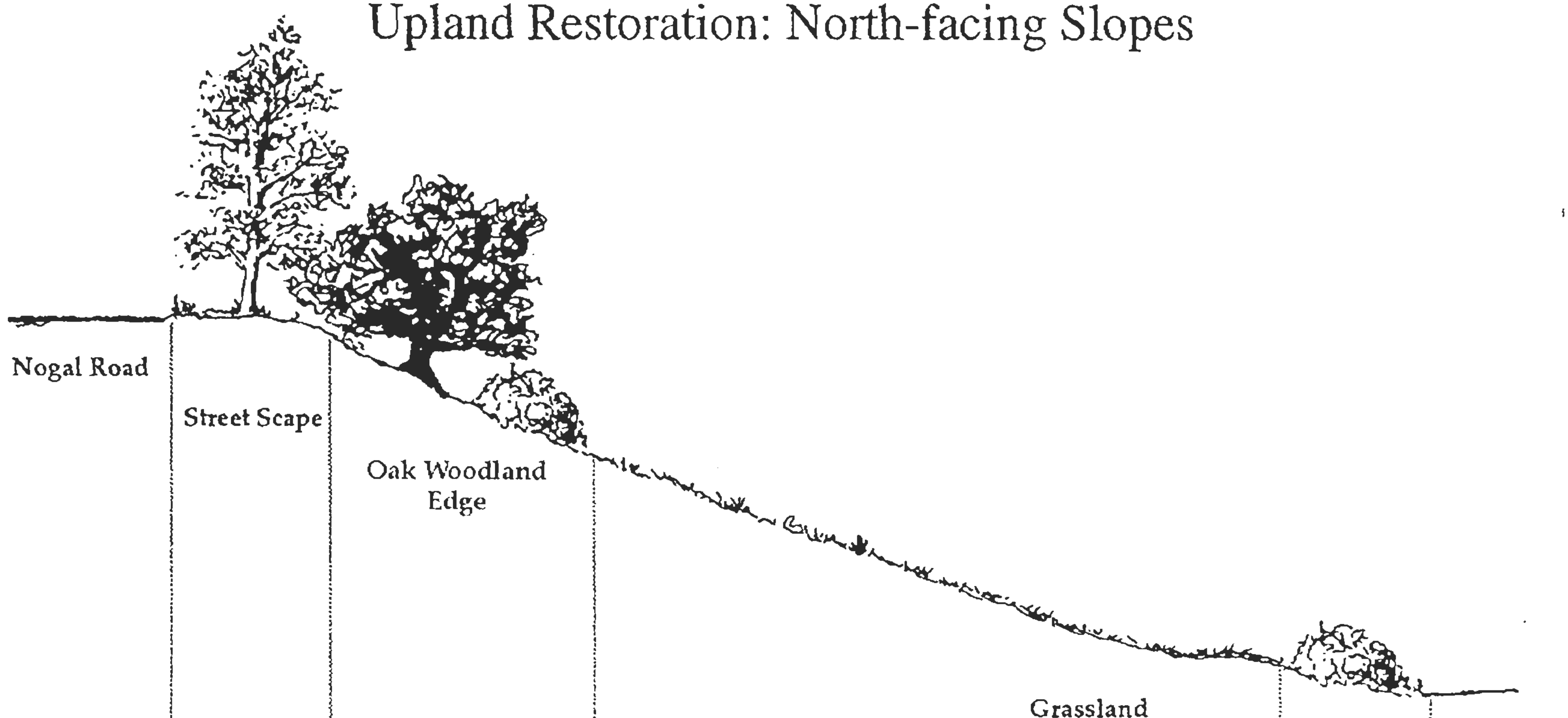
3.5.1.3. NOGAL

Nogal Site has a small and degraded remnant of the California oatgrass community. The site is close to roads, proposed access trails and activity centers, and the native vegetation is in fairly poor condition. Weeds dominate even in the small area where native cover is highest. However, the remnant is worth protecting and being allowed to spread. The site may benefit from a perimeter of protective shrubs, such as manzanitas, to limit access. To enhance the native plants present intense weed control will be necessary, with mowing or herbicide use on the lower area and with mowing on the upper area. The upper area is steep and may not allow mowing by wheeled vehicle. Because this area is relatively small, outplanting propagules may be a feasible way to hasten the spread of desirable natives such as oat grass and blue-eyed grass. Seeding over weed controlled areas would also be feasible.

Because of its small area the site will require close weed control which should be adjusted or continued according to need. For example, along the fringe of native plants, a relatively small area, spot-spraying herbicide on individual weed plants would be effective, particularly against the perennial plantains. Farther from the native plant patch, over larger areas, several mowings in late winter and spring will interrupt seed production of the annual grass weeds. The steep areas which are dominated by weeds have shallow soils and could be sprayed to kill most or all vegetation and revegetated with outplants of oat grass and blue-eyed grass. The latter is labor-intensive and not feasible for large areas but would be worthwhile over small areas. Outplants should be generated from material collected on site: seeds and divisions of oatgrass, and seeds and bulbs of blue-eyed grass. Patience over a number of years will be required for the slow growth and dominance on relatively harsh soils by natives over weed species.

The richer, wetter soils on the lower part of the site support robust weed growth, have a well established weed seed bank, and few native species. This weed patch should be poisoned with herbicide (Round-up) early in the growing season, January or February, and thereafter two or three times in order to kill later maturing species and individuals. Mowing could be a feasible second choice on this area if it effectively cut the grasses (not simply pushed them down) and could be carried out a number of times to prevent weeds from producing seeds. The small patch of blue wild rye should be spared mowing and poisoning. There is no guarantee that one year's control will sufficiently control the weeds. Herbicide should again be applied after the germinating rains the second year. The second year's weed control should also be early enough in the season to leave sufficient time and rainfall for native barley to be seeded and to germinate in order to occupy the bare soil. Thereafter, the blue wild rye could spread and shrubs then introduced among the native barley. Shrubs such as Ceanothus would be appropriate at the interface of this site and the

Upland Restoration: North-facing Slopes



Selected candidate plant species:

	Nogal Road	Street Scape	Oak Woodland Edge	Grassland	Parking Lot Border	Driveway to Parking Lot
Trees and tree-like shrubs			Coast live oak			
Shrubs			Manzanitas, Ceanothus spp., Bush lupines		Manzanitas, Ceanothus spp., Bush lupines	
Perennial herbs			Purple needlegrass, Blue wild rye, California oat grass, Blue-eyed grass, California poppy, Sky lupine	Purple needlegrass, Blue wild rye, California oat grass, Blue-eyed grass, California poppy, Sky lupine		

Figure 14. Sample cross-section of North-facing slopes depicting the northeast corner of Freedom Parkway and Nogal Drive.

in
lower left corner

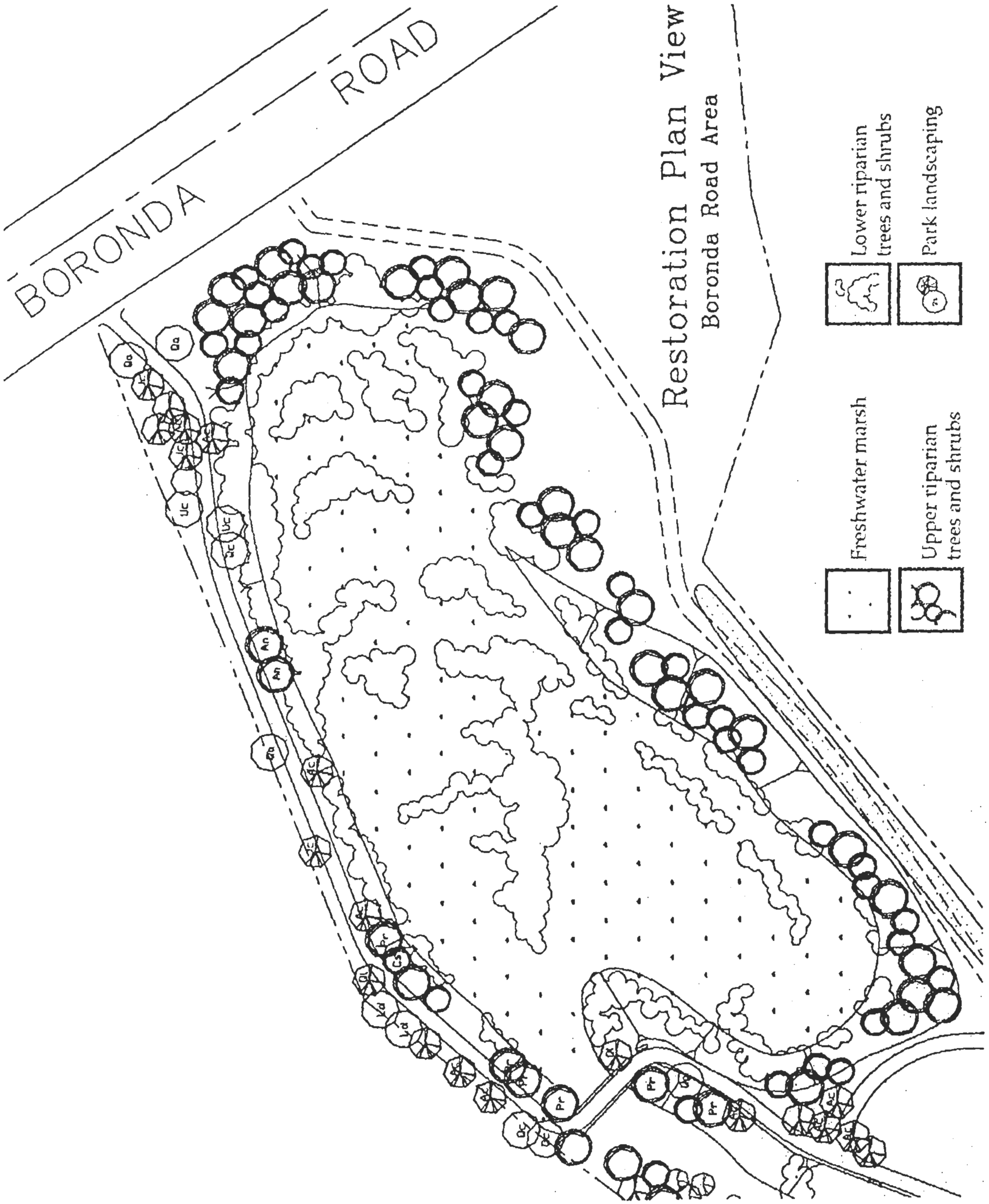


Figure 16. Enlargement of plan view for Boronda Road area.

primarily flooding. Larger and longer-lived tree species eventually replace willows as the water course becomes stable. Other riparian tree and bush species on the restoration site will grow slower than willows, and can be planted adjacent to them along the outer edges of the channel. Shade-tolerant understory species including native vines may be planted in the dense willow groves. Understory associates on more open areas should be shrubs which favor sun, such as mule fat, seep willow, and blackberry. These shrubs will also provide wildlife habitat - cover, food, and nesting resources.

The other wetland community type, marshes (Figure 16), are contiguous with riparian areas. Restoration of marsh will not be difficult because of the presence of native species with good colonizing ability. Colonization of wet ground may be hastened by planting root stock or propagules of marsh plants from the site or from other parts of the watershed.

The new marsh and riparian habitat created by excavation will be seeded with a mixture of native grass seeds from Elkhorn Ranch and planted with riparian trees and bushes from cuttings and greenhouse pots. Although enhancement may be desirable but not necessary along sections of the marsh, many trees and bushes will be planted in the riparian area that will help make the marsh habitat more ecologically complex and diverse.

Wetland communities are typically of dense vegetation. They occupy muddy soils, and support few or no weeds. Therefore trespass is unlikely and no maintenance is necessary. Formal access routes would not be advisable. The upper stream course is contiguous with the upland restoration sites and therefore part of a larger area without viewshed or access problems (Figure 15). The lower stream course includes borders with formal park activity areas (Figure 17). Here riparian plants will be spaced to consider view and access. Sycamores, cottonwoods, box elders are medium large trees and provide quality habitat without necessarily interfering with pathways or other access. In fact these larger trees and other smaller species such as dogwood and elderberry will make graceful interfaces between the moist to wet riparian channel area and formally designated recreation areas. These trees will require maintenance only at the outset during their establishment (Table 1).

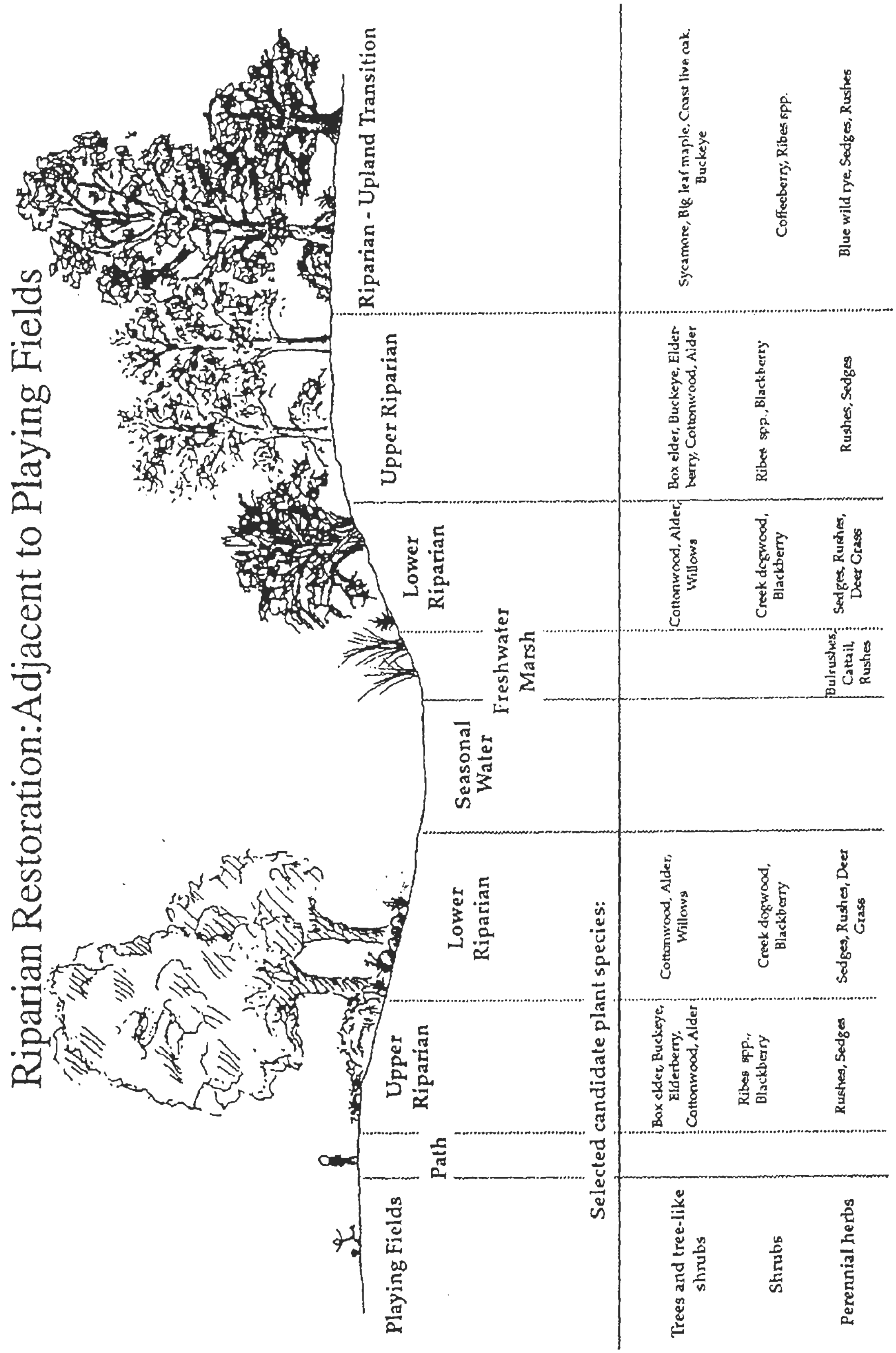


Figure 17. Sample cross-section of lower stream course.

3.5.2. Restoration Tasks

3.5.2.1. WEED CONTROL

Nearly three quarters (59 of 84) of the species of plants reported from the site were alien, and nearly all are weeds (Mercurio, 1992). However, most are not strongly invasive nor tenacious. Fortunately no pernicious perennials such as French broom or pampas grass occur on the site. If the weeds are controlled, soil and other habitat conditions will improve for natives. As the soil is improved by ending disturbance and with native species planted and encouraged, most alien species will decrease in cover.

Control and elimination of weeds is accomplished by three main techniques: mowing, poisoning and competition by desirable species. The first two techniques rely on active physical and chemical means, require technical abilities, and are relatively costly and relatively immediate. The last is passive, slow and inexpensive. Ultimately the last technique comes into play because native plant cover will keep out weeds. Use of combinations of the three techniques depends on the kinds of weeds and resources to control them.

3.5.2.1.1. Mowing

Most weeds on the site are annuals and therefore similar techniques may be used across the site. Mowing may disturb the soil, and if done at the wrong time of year may actually help the weeds by churning and pressing them into the soil. Mowing must be timed correctly in order to cut plants after they have committed their resources to producing seeds but before the seeds have matured. Mowing plants with seeds already set is of minimal value or even counterproductive. Most annual grasses are of Mediterranean origin and grow in winter and bloom in early spring. These annuals should be mowed in early spring (Tables 1 and 2). Since grasses may often re-flower even from very short stalks, more than one mowing per season should be planned. Mowing one season's seed crop will not eliminate the weeds. In rich soil with heavy cover, a strong seed bank will be present. Mowing will be required over several seasons to control grasses and, even then, merely mowing will not eliminate them.

Mowing on the site must be carried out according to the schedules of plant flowering. Different species of alien grasses flower at different times of the year. Oats may bloom in February, later the bromes, then rye may flower even into June in lower wet areas. Other annual and biennial weeds such as mustards and radishes may bloom late into the summer. Once mowing is initiated it should be followed through more than one season, otherwise mowing activities could invigorate rather than control weed colonies by disturbing the soil and helping plant the seeds.

t2

Mowing the annual grasses in a perennial grassland can be an effective way to control these weeds because their annual replenishment of seeds will be depleted or eliminated. The perennial grasses are not dependent on a year to year supply of seeds. In addition, perennial grasses may benefit from growth stimulation caused by mowing. These areas could be "custom mowed" with hand held weed-eaters at a carefully timed schedule.

Another mowing technique, pruning, could be used to stimulate willow growth. This would not be necessary, but the technique was undoubtedly used by Indians to stimulate willow growth in a way that produced canes for basketry, quite possibly on this very site (Blackburn and Anderson 1993). This kind of activity could be incorporated into educational programs integrating natural history with Indian culture.

3.5.2.1.2. Herbicide

Poisoning through herbicide would be very effective since it kills the plants and because it results in less physical disturbance than mowing. Round-up has been widely and successfully used, and is generally approved by conservation and restoration groups as well as agricultural agents. It should be used on the site, by experienced personnel under proper conditions.

Pre-emergent chemicals kill seeds and are worth considering for sites with persistent weed cover such as lower areas with dense stands of annual rye grass. Pre-emergent herbicides are highly toxic and may not discriminate satisfactorily between desirable dicots and weedy monocots. They should be used with great care around wetlands. However, some pre-emergents especially target annual rye grass and are therefore effective, particularly for local infestations. Pre-emergent poisons should be considered if mowing and other herbicide treatments do not satisfactorily control weed infestations.

3.5.2.1.3. Competition

There will be competition by weed species with desirable native species. For example, willows grow fast and will shade and crowd out lower herbaceous species. On drier sites coyote bush will grow slower and not quite so dominantly, but will also crowd and reduce weeds. Other native shrubs may be planted for the same result. While replacement of non-natives by more dominant natives is a slow process and may not purge all weeds, it is cost effective. Competition on upland sites by the California oat grass community has already been successful, evidenced by the viable community on the Rider site, the presence of weed notwithstanding. That process should be allowed to continue, though supplemented in some cases by mowing.

Native species can be given a competitive advantage by the correct mowing schedule.

3.5.2.2. ENHANCEMENT OF EXISTING NATIVE COMMUNITIES

All three habitat types, marsh, riparian and upland, are occupied by patches of appropriate native plants (Figure 10). These communities may be enhanced by spreading the plants into existing and newly formed habitats. Seeds and vegetative material can be collected and grown in the greenhouse to provide propagules for out-planting. Seeds, cuttings or root material may also be collected and directly planted on site in adjacent areas. Enhancement may also consist of eliminating or reducing the influence of weeds.

3.5.2.2.1. Riparian

Willows are successfully planted by simply pushing three foot long willow branches into moist soil. In areas with well established willow groves, the understory flora may be enhanced. The grove adjacent to East Boronda Road (Figure 8) is subject to trash dumping and vandalism. However, it is comprised of tall mature trees and would be an appropriate site to begin enhancement with understory species.

3.5.2.2.2. Marsh

Marsh plant material is easy to propagate from rhizomes and root masses as well as seed. This material may be collected and immediately replanted on appropriate nearby sites. However, even if left alone the basic marsh species will readily colonize favorable habitats- heavy and wet soils. There is little weed problem for the wet marsh. Clot-bur can be an invasive weed and was listed on site (Mercurio 1992), but is not abundant or spreading. Water grass is present. Although a non-native, its seeds are good bird food and are not easily spread. It is likely to be crowded out by maturing native marsh community.

3.5.2.2.3. Upland

The best enhancement technique of the remnant native perennial grasslands will be to continue to prevent destructive disturbance. Overgrazing and destructive trampling probably damaged the community in the past. These communities are on sites of poorer soil where weed species are at a disadvantage. In order to allow the native grasses to spread onto richer soil, weed control may be necessary. Mowing at the correct time of year would be the best technique. Selective poisoning may also be effective. Some areas are heavily covered with perennial alien plantains which may not be controlled by mowing. These plants could be killed with selective and accurate applications of Round-up. Supplemental seeding onto areas of relatively open soils, cleared of weeds, would hasten the spread of the native grass community. This technique would require significant effort to collect seed and provide clearings. Out-planting propagules would also require significant effort but would be an effective enhancing technique.

3.5.2.2.4. Spikeweed

Spikeweed is an annual which grows on thin, exposed and dry soil. Because it occupies relatively unfavorable habitat it is probably better able to tolerate harsh physical conditions than to compete with other plants. Consequently, markedly altering its habitat with so-called improvements of increased soil moisture or fertility could jeopardize the spikeweed population by subjecting it to displacement by weeds or even native plants. Spikeweed depends on an annual cycle of seed production, germination, and growth of recruits for each generation. However, there may be a viable seed bank which could carry the colony through a bad seed year. Reestablishing the Freedom Boulevard spikeweed colony (Figure 11) on adjacent soils of similar quality should be feasible. Since the soils of the present colonies support minimal populations of competing plants, that is probably key to reestablishing another colony.

Spikeweed colonies may be monitored in order to ascertain variability of the population from year to year. If changes in abundance are observed the changes may be correlated with environmental variables as much as possible, particularly the amount and distribution of rainfall. Since spikeweed is relatively weedy (an annual on disturbed ground) it can be appropriately treated as an annual wildflower. Seeds should be collected and the plants propagated in other areas of the park. Seeds will be available from the two colonies adjacent to the park and both much larger than the one at Freedom Boulevard. Suitable sites would be those to be maintained as relatively weed free but not intensively gardened, such as pathway edges, building perimeters, roadsides and other border habitats. The plants would provide a valuable educational lesson by being a rare species that is easily visible.

Propagating the species may be easy, however the specific techniques will need to be mastered. Seed collection dates need to be established, probably mid to late fall. Stratification trials, different durations, should be carried out on seed batches to determine the need and optimal times. Success of direct seeding should be compared to that of greenhouse propagated outplants. The latter will probably be more successful but more labor-intensive. Seeds should be sown on soil relatively weed-free, the main maintenance consideration for the Freedom Boulevard colony.

3.5.2.3. SELECTION OF PLANT MATERIAL

Table 3 presents a list of 83 species as candidate plants for the restoration site. The list is not exhaustive. Emphasis was placed on larger perennial species. Other species may be selected, especially small herbaceous plants. Nor will all species listed necessarily be used. Species were selected using several criteria: local occurrence, habitat requirements, likelihood of successful propagation, and educational value. All naturally occur within the Salinas Valley watershed, and all grow in comparable habitats. Most occur on the site or on adjacent or nearby habitats. Some species may not have grown on the site within the last few centuries, for example several of the oaks. The oaks in particular were selected, in addition to the above criteria, because of their educational value, to make a kind of watershed botanic garden.

The species in Table 3 are listed according to their growth form and habitat requirements. Marsh species are restricted to moist to very wet soil conditions. Most marsh species are herbaceous, inconspicuously flowered and linear-leafed monocots, that is with a grass-like growth form. Riparian species may grow on a soil moisture gradient, nearer or farther from water source. They may also demonstrate seral stages with some species growing on soils recently disturbed by flooding events, such as willows, with others growing on more stable soils, such as sycamores. Understory species, such as elk clover and vines, are dependent on larger overstory species for shade. Other upland group include grasses, herbs, bushes, and trees (Table 3).

As noted previously, the choice of species for the restoration site depends on ecological criteria such as the likelihood of a species being present in the regional wetland and upland habitats during the last few hundred years or more. The species listed in Table 3 are ecologically appropriate to maximize biodiversity while also approaching the historical model for the site. Millar and Libby (1989) discuss a series of excellent criteria for selection of restoration species based on genetic arguments. Their arguments concern large areas to be returned to pristine conditions. This project, by contrast, attempts to integrate native plant species into an intensively developed area which will continue to be highly modified by human activities. This restoration is therefore conditional on many artificial influences including time. The natural succession of incoming species colonizing the site at a normal rate would be much too slow for this project.

3.5.2.4. PLANT PROPAGATION

Propagation is carried out by two methods, germinating seeds and stimulating vegetative growth. The materials required usually do not need to be sophisticated or complicated. Materials and facilities required for propagation include a greenhouse to provide young plants stabilized moisture, temperature conditions, and irrigation. Soils must be prepared to accommodate germinating seeds, cuttings, or root material. Pots and other containers are necessary for different sizes, and ages of plants.

Table 3. Candidate plant species for the Natividad Creek restoration. Some scientific names used here are more easily recognized older ones; updated names may be found in Hickman (1993).

*Indicates species that may not be native to the drainage but are related either systematically or ecologically to species currently present, would complement species groups and would be valuable educationally and for wildlife habitat.

TREES

Riparian Trees

Arroyo willow
Salix lasiolepis
Yellow willow
Salix lasiandra
Red willow
Salix laevigata
Coulter willow
Salix coulteri
Sand bar willow
Salix exigua
Red Alder
Alnus rubra
White Alder
Alnus rhombifolia
Black cottonwood
Populus trichocarpa
Fremont's cottonwood
Populus fremontii
Blue elderberry
Sambucus mexicana
Red elderberry
Sambucus racemosa
Big leaf maple
Acermacrophyllum
Box elder
Acer negundo var. *californicum*
Creek dogwood
Cornus californica
Northern California black walnut
Juglans californica var. *hindsii*
Sycamore
Plantanus racemosa
Buckeye
Aesculus californica
California bay
Umbellularia calfiornica

Upland trees

California live oak
Quercus agrifolia
Interior live oak
Quercus wislizenii
Valley oak
Quercus lobata
Black oak
Quercus kelloggii
Scrub oak
**Quercus berberidifolia*
Leather oak
**Quercus durata*
Blue oak
Quercus douglasii

BUSHES

Riparian Bushes

Fuschia-flowered currant
Ribes speciosum
Snowberry

Symphoricarpos albus
California rose
Roas californica
Blackberry
Rubus ursinus
Mule fat
Baccharis viminea
Seep willow
Baccharis douglasii

Upland Bushes

Manzanitas
Arctostaphylos spp.
Ceanothus
Ceanothus spp.
Black sage
Salvia mellifera
California sage
Artemisia californica
Bush monkeyflower
Mimulus aurantiacus
Lupines
Lupinus spp.

VINES

Riparian Vines

Twinberry
Lonicera involucrata
Honeysuckle
Lonicera hispidula var. *vacillans*
Clematis
**Clematis ligusticifolia*
Dutchman's pipe
**Aristolochia californica*

HERBACEOUS

Riparian Herbaceous Flowers

Bleeding heart
Dicentra formosa
Fairy bells
Disporum hookeri
False Solomon's seal
Smilacina stellata
Elk clover
Aralia californica

Upland Herbaceous Flowers

Gilia
Gilia spp.
Layia
Layia spp.
California poppy
Eschscholzia californica
Sky lupine
Lupinus nana
Owl's clover
Othocarpus spp.
Baby blue-eyes,
Nemophila menziesii
Peppergrass
Lepidium dictyotum
Phacelia
Phacelia spp.
Layia
Layia spp.
Goldfields
Lasthenia spp.
Papoose spikeweed
Hemizona parryi var. *congdonii*
Quail bush
Atriplex sp.
Milkweed
Aescelepis spp.
Brodiaea
Brodiaea spp.

Native thistles
Cirsium spp.
Blue dicks
Dichelostemma capitatum
Lily
Calachortus spp.
Blue-eyed grass
Siyrinchium bellum

Marsh Herbaceous Flowers

Marsh pennywort
Hydrocotyle verticillata

Riparian Grasses

Meadow barley
Hordeum brachyantherum
California vanilla grass
Hierochloe occidentalis
Pacific reed grass
Calamagrostis nutkaensis
Leafy bent grass
Agrostis diegensis
Blue wild rye
Leymus glaucus

Upland Grasses

California oat grass
Danthonia californica
Deer grass
Muhlenbergia rigens
Tufted hair grass
Deschampsia caespitosa
Alkali rye grass
Leymus triticoides
Giant rye grass
Elymus condensatus
Purple needle grass
Nassella pulchra
Nodding needle grass
Nassella cernua
Slender needle grass
Nassella lepida
California fescue
Festuca californica
Western melic
Melica californcia

Marsh Rushes and Sedges

Rushes
Juncus spp.
Sedges
Carex spp.
California bulrush
Scirpus californica
Praries bulrush
Scirpus robustus
Three-square
Scirpus americanus
Cattail
Typha latifolia
Bur-reed
Sparganium eurycarpum
Spike rushes
Eleocharis spp.

bordering recreation area on the lower, richer soil (Figure 14). Shade and space domination of shrubs will be a good deterrent against the return of annual grass weeds.

The Nogal site will border picnic areas and other facilities of the park, including access trails. However, the prime resource of the Nogal site is the remnant native grassland community, a habitat type of low and open vegetation (Figure 14). No viewshed nor access problems will accompany this kind of community. However, access into the restoration area should be controlled by perimeter shrubs which will not be high enough to interfere with views, but should form a barrier to trespass. Maintenance along the border of this restoration area should be less than along non-native landscaped areas. Weed control due to trampling of pathway borders would be the main problem.

Below is a list of plant species that are appropriate to the Constitution, Rider, and Nogal upland areas. [Note: where Constitution borders riparian areas, sycamores and buckeyes would also be appropriate].

<u>Upland trees</u>

California live oak
Quercus agrifolia
Interior live oak
Quercus wislizenii
Valley oak
Quercus lobata
Black oak
Quercus kelloggii
Scrub oak
**Quercus berberidifolia*
Leather oak
**Quercus durata*
Blue oak
Quercus douglasii

<u>Upland Bushes</u>

Manzanitas
Arctostaphylos spp.
Ceanothus
Ceanothus spp.
Black sage
Salvia mellifera
California sage
Artemisia californica
Bush monkeyflower
Mimulus aurantiacus
Lupines
Lupinus spp.

<u>Upland Herbaceous Flowers</u>

Gilia
Gilia spp.
Layia
Layia spp.
California poppy
Eschscholzia californica
Sky lupine
Lupinus nana
Owl's clover
Othocarpus spp.
Baby blue-eyes,
Nemophila menziesii
Peppergrass
Lepidium dictyotum
Phacelia
Phacelia spp.

Layia
Layia spp.
Goldfields
Lasthenia spp.
Papoose spikeweed
Hemizona parryi var. *congdonii*
Quail bush
Atriplex sp.
Milkweed
Aescelepis spp.
Brodiaea
Brodiaea spp.
Native thistles
Cirsium spp.
Blue dicks
Dichelostemma capitatum
Lily
Calachortus spp.
Blue-eyed grass
Siyrinchium bellum

Upland Grasses

California oat grass
Danthonia californica
Deer grass
Muhlenbergia rigens
Tufted hair grass
Deschampsia caespitosa

Alkali rye grass
Leymus triticoides

Giant rye grass
Elymus condensatus

Purple needle grass
Nassella pulchra

Nodding needle grass
Nassella cernua

Slender needle grass
Nassella lepida

California fescue
Festuca californica

Western melic
Melica californcia

3.5.1.4. RIPARIAN AND MARSH

The upper riparian site is well covered by large mature trees forming a good riparian forest. The willow grove should be expanded, using the present one as a model for restoring a dense vegetation of desirable native species (Figures 15 and 16). The community is not complete, however. Willows characteristically represent a seral stage, that is a relatively early stage of vegetation colonization (Holland 1986, Barbour et al 1993). That appears to be the case at the restoration site, which has been subject to long and intensive disturbance, especially to more fragile lower herbaceous species. Riparian and marsh communities rebound vigorously after disturbances and the ones in the park will continue to develop naturally if protected from the destructive disturbances of the past. We will supplement and hasten riparian development by planting additional species from the surrounding watershed in the various subhabitats of the site (Figures 15 and 16).

Willows grow fast and colonize aggressively. Initial plantings of them will ensure a viable base from which a more complete plant community may be developed. In nature, willows colonize open areas of water courses after disturbance events, List of candidate plant species for the riparian and marsh areas:

Riparian Trees

Arroyo willow
Salix lasiolepis

Yellow willow
Salix lasiandra

Red willow
Salix laevigata

Coulter willow
Salix coulteri

Sand bar willow
Salix exigua

Red Alder
Alnus rubra

White Alder
Alnus rhombifolia

Black cottonwood
Populus trichocarpa

Fremont's cottonwood
Populus fremontii

Blue elderberry
Sambucus mexicana

Red elderberry
Sambucus racemosa

Big leaf maple
Acermacrophyllum

Box elder
Acer negundo var. californicum

Creek dogwood
Cornus californica

Northern California black walnut
Juglans califonica var. hindsii

Sycamore
Plantanus racemosa

Buckeye
Aesculus californica

California bay
Umbellularia calfiornica

Riparian Bushes

Fuschia-flowered currant
Ribes speciosum

Snowberry
Symphoricarpos albus

California rose
Roas californica

Blackberry
Rubus ursinus

Mule fat
Baccharis viminea

Seep willow
Baccharis douglasii

Riparian Vines

Twinberry
Lonicera involucrata

Honeysuckle
Lonicera hispidula var. vacillans

Clematis
**Clematis ligusticifolia*

Dutchman's pipe
**Aristolocha californica*

Riparian Herbaceous Flowers

Bleeding heart
Dicentra formosa

Fairy bells
Disporum hookeri

False Solomon's seal
Smilacina stellata

Elk clover
Aralia californica

Marsh Herbaceous Flowers

Marsh pennywort
Hydrocotyle verticillata

Riparian Grasses

Meadow barley
Hordeum brachyantherum

California vanilla grass
Hierochloe occidentalis

Pacific reed grass
Calamagrostis nutkaensis

Leafy bent grass
Agrostis diegensis

Blue wild rye
Leymus glaucus

Seeds need to be collected at the correct time of year, before seed heads have shattered or broken and scattered seeds. Some species may produce seeds only under certain conditions and not be available each year. Seeds may be stored according to their longevity, depending on the species. Seeds may be directly sown onto soil surface at the time of year appropriate to the species, usually sometime in the wet cycle, a method typically used for annuals or short-term perennials. The soil surface may be prepared by disturbing or scratching before sowing and tamped after sowing in order to gain good soil-seed contact.

Propagation from seeds can also be carried out by germinating the seeds. Seeds may need to be treated in certain ways, stratified, for example in order to simulate natural stimulation to initiate germination. Seeds can be sprouted in a greenhouse and raised to the seedling stage or beyond, for several months or more to a size accommodated in a one gallon container, or, in a few cases, a five gallon container. Generally the larger the plant when out planted the better the success rate. One gallon size plants have high success rates. Seed propagation of herbaceous species may require grow-out only to plug size, much smaller than a gallon.

Some plant species may produce little or no viable seed and must be propagated from cuttings or root material. Propagation of willows from cuttings or bundles of canes is very effective and efficient. The canes need only be cut and placed in moist soil. Most other species require more sophisticated techniques: such as treating the cutting to stimulate it to root in light soil, transplanting to better soil in larger container, and providing proper temperature, light and moisture. Native grasses may be rooted in proper soil from divisions, portions of tissue from the stem/root part of the plant. Propagation from rhizomes or root material is a good technique for propagating marshy and wet soil species.

Each species to be propagated on the site has its own requirements. However, in general most seeds should be collected on site during late spring to summer. Most seeds will probably require little stratification, but propagationists will determine the necessity, type and duration of stratification. Generally, a large percentage of the collected seeds will be directly hand-sown the following winter such as poppies, oat grass, blue-eyed grass, most of the marshy species of rushes and sedges. A smaller percentage of seeds will be retained for germination and propagation of out-plant material. In rare cases, perhaps spikeweed as an example, only a small amount of seeds may be collected in which case a high percentage would need to be retained for greenhouse germination. Many trees will be contract grown from acceptable (local) genetic material. Willows will be propagated simply by installing canes into moist soil.

3.5.2.5. LONG-TERM RESTORATION MAINTENANCE

Maintenance of restoration projects fall into three main categories: watering, weed control, and protection. Watering will be in the initial stages and will be discontinued as plants are able to send root growth deep enough to provide their own water (Tables 1 and 2). However if new plants are to continue to be added they will need initial help in establishment. Weed control must continue at a maintenance level in order to prevent outbreaks and to continue to eradicate invasive weeds. Protection against damage from grazing, trampling and vandalism can be prevented by controlled access and education outreach. Damage from natural forces such as herbivory, inclement weather and other natural forces is part of the natural history.

Drip irrigation is probably the most effective, most efficient and cheapest way to provide water to plants. Drip systems are inexpensive to purchase, easy to install and need little maintenance themselves. They may be left for two to three years and used less and less as plants become more independent. A drip system can be left in place even longer to provide insurance against unusually dry periods when even well established plants could be harmed.

Long-term continuity in weed control may be the most important maintenance task. Weeds must be controlled to prevent or minimize on-site weed reservoirs. However, off-site weed sources may not be controllable and colonizing weeds need to be eradicated. As soils stabilize and native species become established and increase in size and area covered, weed habitat will diminish. At a certain point weed species stop being weeds and become members of a mixed community. That point is when the species is not a threat to increase its population greatly, when it is being out competed by or at least doing no more than holding its own against native species, and when the soil will not be easily invaded by weeds. If no disturbances occur after that point, then weed control may not be necessary. That point is theoretical and probably many years after restoration has begun. In the meantime soils should be allowed to stabilize by preventing disturbance and weeds should be prevented from the area.

Most disturbance would be from human trampling. Protection against this disturbance is a function of controlling access by fencing, signs, and providing alternative walkways. Bicycle trespass can be readily controlled by fences, including temporary structures pending maturation of plant growth. Also, on-site education programs not only teach people but provide a presence of caring people who will discourage trespass. Damage by trespass should be immediately tended in order to prevent further damage and to demonstrate an active presence and concern which should also discourage trespass).

There may be a need to collect seeds and propagate material to colonize problem areas on the restoration site. For example, plants may die or be killed in weed control. Open areas of low vegetation might need to be closed by taller vegetation barriers such as shrubs for safety or other reasons, e.g. control pedestrian traffic routes.

3.5.3. Restoration Monitoring Program

The function of monitoring will be to provide information on the condition of plants and communities. This information will allow decisions to be made as to whether restoration progress is acceptable or should be modified. In some cases expected results may not occur, and the alternative is unacceptable, while in other cases unexpected but desirable progress may occur. Monitoring will allow preventive weed control to be applied before potential problems become big. Restoration has known positive impacts on wildlife in general. For example revegetation provides habitats and food for birds (Anderson and Ohmart 1985) and benthic invertebrates (Gore 1985), which in turn benefit fishes (Wesche 1985).

Monitoring will be dependent on a regular schedule of observation. The schedule need not be rigid, but should depend on seasonal events such as rainfall, growth patterns, windows of opportunity for weed invasion, and seed collection of desirable species. Much monitoring will be carried out through volunteer participation, especially through education programs including the Return of the Natives. Marine Lab staff will help to coordinate and design the final monitoring programs involving records of simple visual observations, mapping, counting, and photography.

3.5.4. Public Education and Access

Public access to the restoration site or nature area has been designed into the Natividad Creek Park (Figure 7). The main public education program is the Return of the Natives (see 2.2.7 Public Education). The Salinas Valley branch of the Sierra Club, Friends of Gabilan Creek, and the Monterey Bay Salmon and Trout Project are also involved in public education, watershed outreach and volunteer programs that will be part of the park restoration activities. These and other education components of the restoration will be developed through Return of the Natives.

3.6. Implementation

A detailed implementation schedule for the restoration has been developed by the city parks, ~~and a more conceptual schedule is~~ For more details are presented in ~~Table 2~~ Tables 1 and 2. Much of the primary work is underway. The major creek and creek-side excavation will occur this summer and fall. The first major planting effort will begin as soon as the construction is completed. Mowing, seed collection, and plant propagation have already begun and will continue throughout the project. The first major cleanup days for volunteer removal of garbage and debris are scheduled for the summer.

The restoration is designed as an example for the entire Salinas Valley. It will help to guide and stimulate restoration further along Natividad Creek and beyond. The Natividad Creek Park restoration has begun. The activities there may be more effective at implementing new restoration work throughout the watershed than additional planning or any other process.

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