Implementation Strategy of the San Francisco Bay Joint Venture

Restoring the Estuary

A Strategic Plan for the Restoration of Wetlands and Wildlife in the San Francisco Bay Area

1 A Framework for Collaborative Action on Wetlands

US FISH AND WILDLIFE SERVICE

Wetlands in the San Francisco Bay Area are among the most important coastal wintering and migratory stopover areas for millions of waterfowl and shorebirds traveling along the Pacific Flyway, which stretches from Alaska to South America. These wetlands also provide economic benefits, offer a range of recreational opportunities, and contribute to a higher quality of life for residents in the densely populated San Francisco Bay Area. They are essential aspects of the Bay region's unique character and, along with the creeks that flow into the Bay, help to define the vibrant and distinctive identities of communities around the Bay. However, despite their value, destruction of these precious natural assets continues. Today's wetlands are only a remnant, perhaps 20 percent of the vast wetlands seen by the first European settlers. Yet the destruction has continued. Likewise, some 95 percent of the Bay Area's riparian habitat has been damaged or destroyed, and some of the five percent remaining is threatened.

Purpose of the San Francisco Bay Joint Venture and Its Implementation Strategy

Responding to the loss of wetlands and their potential functions and values, individuals representing a range of interests—including resource and regulatory agencies, environmental organizations, business, and agriculture—convened the San Francisco Bay Joint Venture **(SFBJV)** in June of 1995. In September 1996, 20 parties representing this diverse wetlands constituency signed a working agreement that identified the goals and objectives of the SFBJV, and the responsibilities of its board and working committees. The agreement also stated that the Implementation Strategy would be developed to guide its parties toward the long-term vision of the restored Bay Estuary. The signatory partners recognized and endorsed the goals of the North American Waterfowl Management Plan. However, they enlarged the goals and objectives of the Plan to include benefits not only for waterfowl, but also for the other wildlife that depends on Bay wetlands and riparian habitats. (See **Appendix A** for the "SFBJV Working Agreement.")

As defined in the Working Agreement, the goal of the SFBJV *"is to protect, restore, increase, and enhance all types of wetlands, riparian habitat, and associated uplands throughout the San Francisco Bay region to benefit waterfowl and other fish and wildlife populations."* Several objectives (or means to accomplish the goals) were defined. In summary, these are:

- Protecting, restoring, and enhancing wetlands, riparian habitat, and associated uplands by funding restoration, applying incentives, and other non-regulatory approaches

Avocets, cormorants, and the San Francisco skyline
MARK RAUZON, 1995

- Strengthening the sources of funding for these efforts
- Providing support for monitoring and evaluation of existing restoration projects
- Preparing an Implementation Strategy for the San Francisco Bay Joint Venture
- Supporting monitoring of habitat restoration projects and research to improve future initiatives.

The SFBJV Implementation Strategy serves as the concept plan for partners to accomplish the Joint Venture's goals and objectives by using an innovative collaborative and non-regulatory approach. It is based on an ecosystem perspective that integrates the range of biological requirements with public health and safety considerations of wetlands. It offers strategies to help fulfill the stated acquisition, enhancement, and restoration goals for wetland habitats. These habitat goals and associated strategies are designed to guide the Joint Venture partners in identifying priorities for wetland and riparian habitat protection and restoration, in determining funding needs and resources, and in recommending actions and partnerships to carry out the habitat goals.

The SFBJV's integrated biological vision is reflected by the Joint Venture's organizational inclusiveness and diversity: its Management Board now consists of 27 agencies, nonprofit conservation organizations, business representatives, and agricultural groups, all working toward the stated goals and objectives. A broad range of roles and abilities is present among these diverse partner organizations **(Table 1-1)**. By joining forces, arriving at common interests, leveraging existing resources, and finding new resources and partners, the Joint Venture intends to protect and restore far more wetland

Table 1-1
Organizations Represented on the Management Board of the San Francisco Bay Joint Venture

Nonprofit & Private Organizations	Public Agencies (Ex-Officio Members)
Adopt-A-Watershed	Bay Conservation and Development Commission
Bay Area Audubon Council	California Department of Fish and Game
Bay Area Open Space Council	Coastal Conservancy
Bay Planning Coalition	Coastal Region, Mosquito and Vector Control District
Citizens Committee to Complete the Refuge	National Fish and Wildlife Foundation
Ducks Unlimited, Inc.	National Marine Fisheries Service
National Audubon Society	Natural Resources Conservation Service
Point Reyes Bird Observatory	Regional Water Quality Control Board, San Francisco Bay Region
PG&E Corporation	San Francisco Estuary Project
Save San Francisco Bay Association	U.S. Army Corps of Engineers
Sierra Club	U.S. Environmental Protection Agency
The Bay Institute	U.S. Fish and Wildlife Service
The Conservation Fund	Wildlife Conservation Board
Urban Creeks Council of California	

habitat than would be possible if all the partners were to work separately.

Policy Foundations of the San Francisco Bay Joint Venture

The groundwork for the SFBJV was laid over a decade ago with the signing of the North American Waterfowl Management Plan. The United States and Canada signed in 1986, followed by Mexico in 1994. The Plan was designed to foster public/private partnerships to increase waterfowl populations to 1970 levels. It designated the San Francisco Bay as one of 34 "Waterfowl Habitat Areas of Major Concern" in the U.S. and Canada. The major emphasis of the Plan was on the restoration and enhancement of wetland ecosystems as the basis for recovery of waterfowl and other associated migratory birds. It called for the formation of cooperative associations or "joint ventures." These joint ventures were formed between federal and state agencies and private organizations to collaborate in planning, funding and implementing projects designed to conserve and enhance wetlands in high priority regions of North America. The Plan created this organizational framework to accomplish waterfowl population goals, and directed that joint ventures prepare their own implementation strategies identifying protection, enhancement, and restoration acreage goals and objectives.

The Plan's overall goal is to ensure habitat for 62 million breeding ducks and a fall flight of more than 100 million. The continent-wide planning effort is being led by 14 regionally oriented joint ventures with region-specific objectives and strategies founded on waterfowl research conducted by federal and state agencies. In the San Francisco Bay Area, this research is contained in the 1989 *Concept Plan for Waterfowl Habitat* prepared by the U.S. Fish and Wildlife Service.

The approach of the North American Waterfowl Management Plan has been enormously successful over the past decade. As of 1998, about 1.8 million acres had been protected, 642,500 acres had been restored and 2.14 million acres had been enhanced by the ten reporting joint ventures in the United States. Partner contributions totaled $1.5 billion from federal, state, and local governments, private organizations, and individuals. For more information about the relationship of the SFBJV to the Plan see Appendix B.

Other conservation planning initiatives on behalf of birds have recognized the success of the Plan and are emulating it. Partners in Flight, a coalition of bird conservation groups, is focusing on neotropical migrants, and has recently prepared a riparian bird conservation plan for California. The Manomet Center for Conservation Sciences recently completed the United States Shorebird Conservation Plan in cooperation with the Point Reyes Bird Observatory, which assumed responsibility for the section regarding shorebirds on the California coast, San Francisco Bay, and in the Central Valley. A continent-wide conservation plan has also been prepared for "colonial waterbirds" (which include terns, gulls, herons, and egrets). Late in 1998, leaders from these separate initiatives began developing a framework to promote cooperative, ecologically based migratory bird conservation throughout the nation. The SFBJV has been coordinating and collaborating with other bird conservation planning efforts and will continue to do so.

A joint venture in the San Francisco Bay Area was also envisioned as a means to implement the *Comprehensive Conservation and Management Plan (CCMP)* for the San Francisco Bay. The CCMP is

The Golden Gate: San Francisco Estuary meets the Pacific Ocean. LISA WOO SHANKS, 1999

Canada geese in flight CENTRAL VALLEY HABITAT JOINT VENTURE, 1995

a plan for the estuary, the product of a five-year consensus-building process known as the San Francisco Estuary Project. It was completed in March 1993, and signed by 42 agencies and organizations. The CCMP specifically called for the formation of a joint venture to increase the acreage of wetlands permanently protected in the San Francisco Estuary.

Wetland characterizations and habitat acreage goals contained in the present Strategy, along with their scientific basis, are derived from the findings and habitat recommendations of the *Baylands Ecosystem Habitat Goals (Habitat Goals)*, a visionary ecosystem management plan for the restoration of the Bay Estuary, published in March 1999. More than 100 scientists and resource managers from many organizations and disciplines collaborated for four years to produce the document in light of comments from public and environmental organizations.

For a closer look at how the CCMP and *Habitat Goals* serve as a foundation for this implementation strategy, see Appendix B.

Geographic Scope

The San Francisco Bay Joint Venture encompasses the San Francisco Bay and the watersheds that drain into the estuary. As shown in **Figure 1-1**, it includes substantial parts of the nine counties surrounding the San Francisco Bay. Flanked to the northwest by the Pacific Coast Joint Venture and to the east by the Central Valley Habitat Joint Venture (CVHJV), the SFBJV is the only joint venture to be found in a major metropolitan area. It extends into the San Joaquin Delta as far as Brentwood along the Contra Costa County shoreline, but does not include all of Suisun Bay, only its uplands. The remaining area, including that portion of the Suisun Marsh below the 10-foot contour line, is within the scope of the Central Valley Habitat Joint Venture. The SFBJV and the CVHJV recognize Suisun Bay and the far eastern part of Contra Costa as "areas of mutual interest." They will coordinate and cooperate, wherever appropriate, on projects within these areas. The geographic scope of the SFBJV also includes coastal San Francisco and San Mateo Counties, although not western Marin and Sonoma Counties, as these are currently part of the Pacific Coast Joint Venture territory. However, it is likely that the SFBJV will annex coastal Marin and Sonoma Counties from the Pacific Coast Joint Venture in the near future.

Accomplishments to Date

The diverse and innovative financial and technical partnerships among the many agency organizations that make up the SFBJV have enabled its partners to undertake wetland projects of significant scope. **(Table 1-2)** Between July 1996 and October 1999, SFBJV partners were involved in 22 separate projects to protect, restore, or enhance wetlands in the San Francisco Bay Area. Over 11,100 acres of wetlands have benefited from SFBJV partnerships.

Achieving protection for existing wetlands is an important first step. The acquisition efforts of SFBJV partners have already protected 3,300 acres, including Bair Island where 1,600 acres have been placed under federal protection and will be restored to tidal action. The Peninsula Open Space Trust and U.S. Fish and Wildlife Service are leading this immense effort. At Hamilton Airfield, tidal action will be restored to 800 acres in a project that is currently in the planning phases. The Army Corps of Engineers, California Coastal Conservancy, Marin Audubon, and the Port of Oakland are partners in this major project.

The number and scale of wetland conservation projects have increased recently. In spring 2000, planning and implementation were under way for over 30,000 acres of wetland and creek projects around the Estuary (as discussed in Chapter 6 of this document). One of the more substantial of the tidal marsh restoration projects, for example, is the almost 14,000 acres of wetlands enhancement, restoration, and protection that will be conducted through the North American Wetlands Conservation Act grant for the San Pablo Bay National Wildlife Refuge.

Figure 1-1
San Francisco Bay Joint Venture Geographic Scope and Subregions

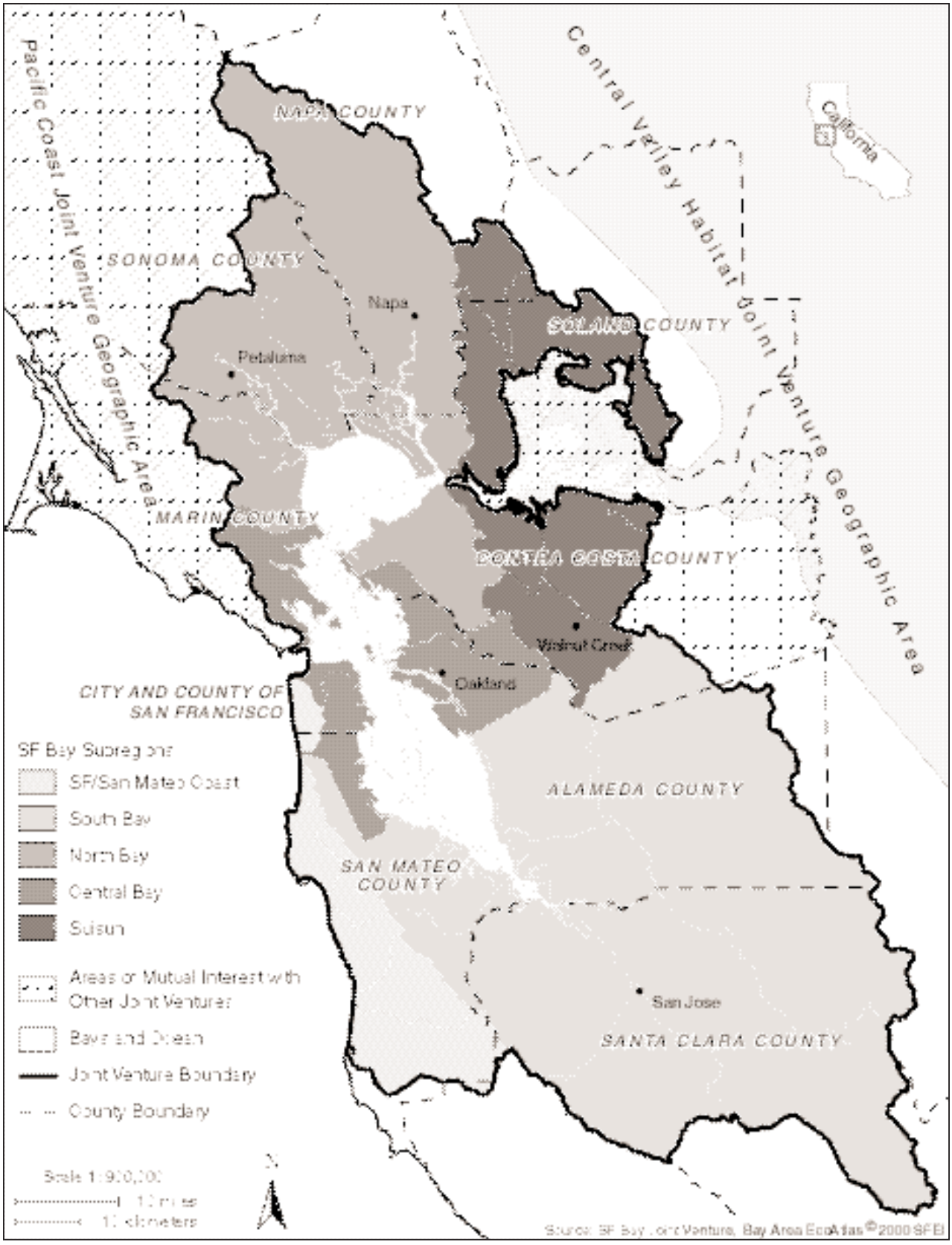


Table 1-2

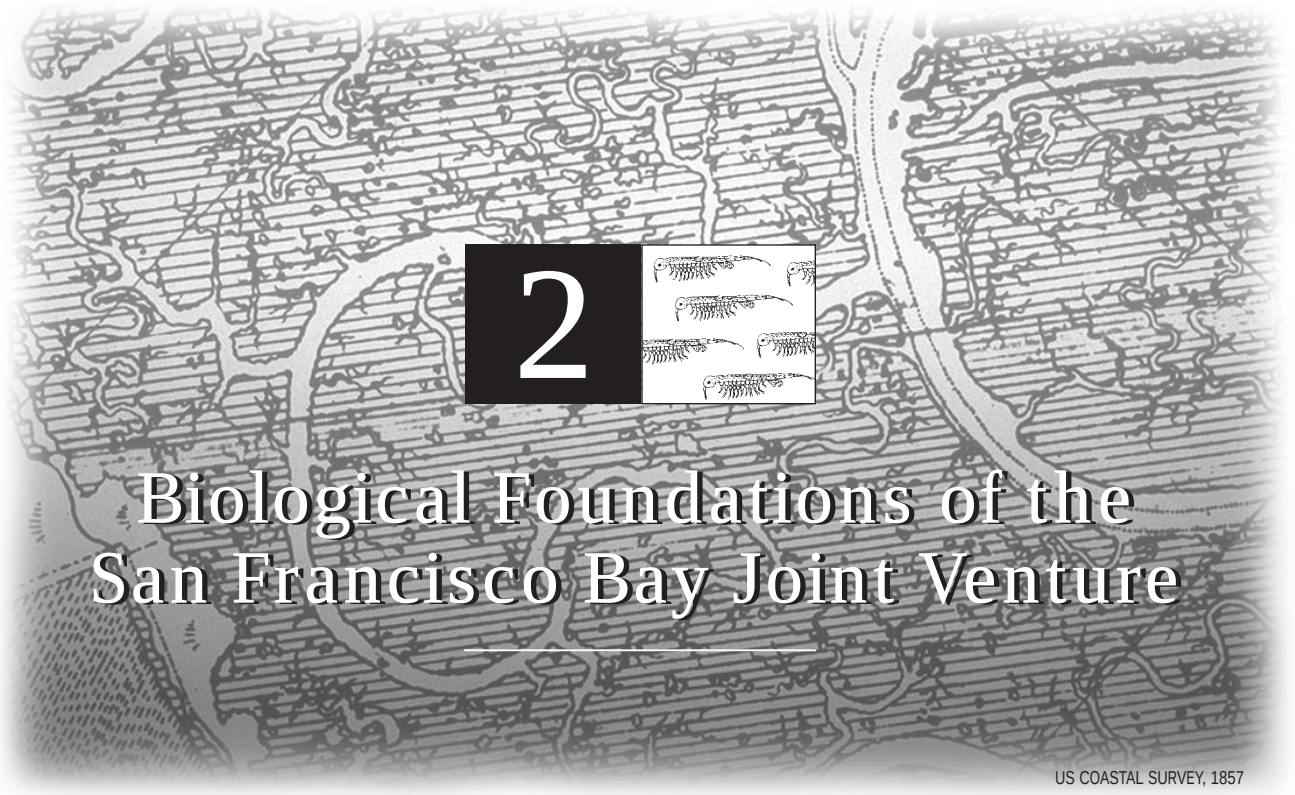
San Francisco Bay Joint Venture Partners' Completed Habitat Protection and Restoration Projects (1996-1999)

Project Name	Lead Partners	Additional Partners	Protected (acres)	Restored (acres)	Enhanced (acres)
Arrowhead Marsh	EBRPD, Port of Oakland	Golden Gate Audubon, STB, Sierra Club	72	72	0
Bair Island*	POST, USFWS	CCC, Citizens Committee to Complete the Refuge, WCB, Audubon	1,600	1,600*	0
Bull Island	NCLT, CDFG	State Lands Commission	109	0	0
Camp Two	WCB, CDFG	STB, SSRCD	608	0	0
Crissy Field	National Park Service	CA Public Utilities Commission, Haas Fund, S.F. International Airport, CCC, City of SF	0	20	0
Eden Landing*	CDFG	Caltrans, Cities of San Jose, Fremont, and Milpitas, EBRPD, WCB	835	600*	345*
Gallinas Creek	Marin Audubon Society	CCC, Gallinas Sanitation District, USFWS, RWQCB	0	5	0
Mark Frelier Property	Natural Resource Conservation Service	landowner, Contra Costa RCD, USFWS	0	437	0
Moseley Tract	City of San Jose	City of San Jose	52	52*	0
Napa/Sonoma Marsh-Pond 2A	CDFG	DU, WCB	0	550	0
Oro Loma	EBRPD	City of Hayward, CCC, DFG, USFWS, WCB, GGAS	0	364	0
Pier 98	Port of San Francisco	BCDC, CCC, GGAS, City of SF	0	0	14
Pillar Point*	San Mateo County	San Mateo County Parks	23	0	0
Point Edith*	CCMVCD	CDFG	0	0	850
Ravenswood*	MPROSD	MPROSD	0	200	0
Roe Island	CDFG	Department of Water Resources	0	67	0
Rush Creek	CDFG, County of Marin	Marin Audubon, CCC, Marin Community Fdn., USFWS, RWQCB	0	0	300
San Pablo Marsh	USFWS, CDFG	CDFG, USFWS	0	0	1,400
Shell Marsh	CCMVCD	CDFG, Caltrans	0	300	0
Shoreline at Mountain View	City of Mountain View	City of Mountain View	0	60	0
Tolay Creek	USFWS	CDFG, DU, EPA, Natural Resource Cons. Service, SSRCD, STB	0	117	318
Triangle Marsh	CCC, Marin Audubon	USFWS, State Lands Commission, CDFG, WCB, Individual Donors	33	0	0
Tubbs Island	DU	USFWS	0	0	125
TOTAL			**3,332**	**4,444**	**3,352**

Source: San Francisco Estuary Project, 1999. Bay - Delta Environmental Report Card; SFBJV November 1999

*Projects with ongoing acquisition, restoration, and enhancement efforts

Abbreviations: CCC—California Coastal Conservancy, **CDFG—**California Department of Fish and Game, **CCMVCD—**Contra Costa Mosquito and Vector Control District, **DU—**Ducks Unlimited, **EBRPD—**East Bay Regional Parks District, **GGAS—**Golden Gate Audubon Society, **MPROSD—**Mid-Peninsula Regional Open Space District, **NCLT—**Napa County Land Trust, **POST—**Peninsula Open Space Trust, **RWQCB—**Regional Water Quality Control Board, **STB—**Save the Bay, **SSRCD—**Southern Sonoma Resource Conservation District, **USFWS—**U.S. Fish and Wildlife Service, **WCB—**Wildlife Conservation Board



Biological Foundations of the San Francisco Bay Joint Venture

US COASTAL SURVEY, 1857

Transforming the Landscape

Before the mid-1800s, the San Francisco Bay was ringed by roughly 190,000 acres of tidal marshes, 50,000 acres of tidal flats, 85,000 acres of seasonal wetlands and associated uplands (including vernal pools), and over 69,000 acres of riparian habitat, as illustrated in **Figure 2-1**, (Historical View of San Francisco Bay, circa 1770–1820). The San Francisco Bay and its adjoining watersheds was one of the richest and most diverse estuaries on the West Coast; it supported populations of fish and wildlife that today seem unimaginable. Early reports of the Bay Area describe vast expanses of wetlands inhabited by millions of waterfowl, schools of salmon so dense that they choked the mile-wide Carquinez Strait, and plentiful numbers of grizzly bears and other big game animals.

Since the late 1800s, the growth of the human population has effected traumatic changes to the natural landscape of the Bay Area. Large tracts of tidal marshes have been filled for urban development or federal and state projects, or diked for salt production or agriculture. Today, only 40,000 acres of tidal marsh remain, as shown in **Figure 2-2,** (Modern View of San Francisco Bay, circa 1998). Much of what remains has been degraded, and less than three percent of original wetland acreage is in relatively pristine condition *(State of the Estuary Report 1992–1997)*. Development pressures have destroyed or significantly altered over 80 percent of the tidal marshes and 40 percent of the mudflats that once rimmed two-thirds of the Bay's shores. During this same period, riparian areas, seasonal wetlands, vernal pools, native grasslands, and coastal scrub have all suffered similar, if not greater, losses due to development pressures.

The destruction or alteration of wetlands is not limited to the forces of urbanization. Pollution, sedimentation, and water diversion have degraded the health of the surviving wetlands. Historic influences such as hydraulic mining also play a role, and their impacts can be persistent over time. The Gold Rush-era mining of the mid-1800s sent enormous sediment loads into the Bay, causing changes in habitat type and location, particularly of mudflats in the North Bay. What remains of the Bay ecosystem is further stressed and modified by the impacts of freshwater diversions for urban uses around the Bay, and agricultural and urban uses in the Central Valley and southern California. Up to 70 percent of the freshwater flows that would naturally enter the Bay through the San Joaquin and Sacramento River Systems is now diverted. This has increased the net salinity of the Bay with a consequent alteration of the plant and animal species residing in many wetland communities. Local land uses have played direct and indirect roles in damaging wetlands: the footprint of new buildings still displaces them; sediment loads and erosion caused by development degrade them. Stormwaters contaminated by auto-

Figure 2-1
Historical View of San Francisco Bay (circa 1770–1820)

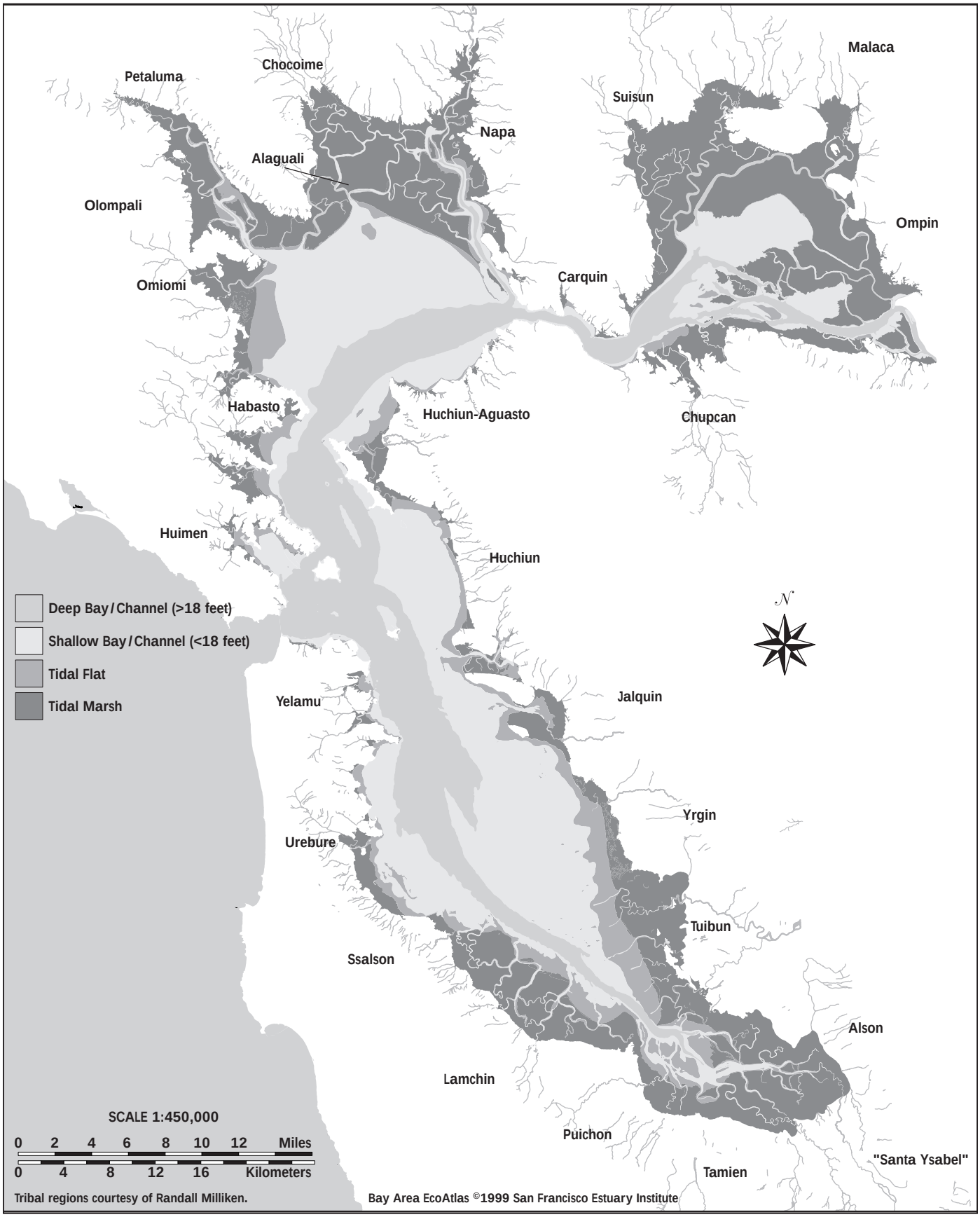
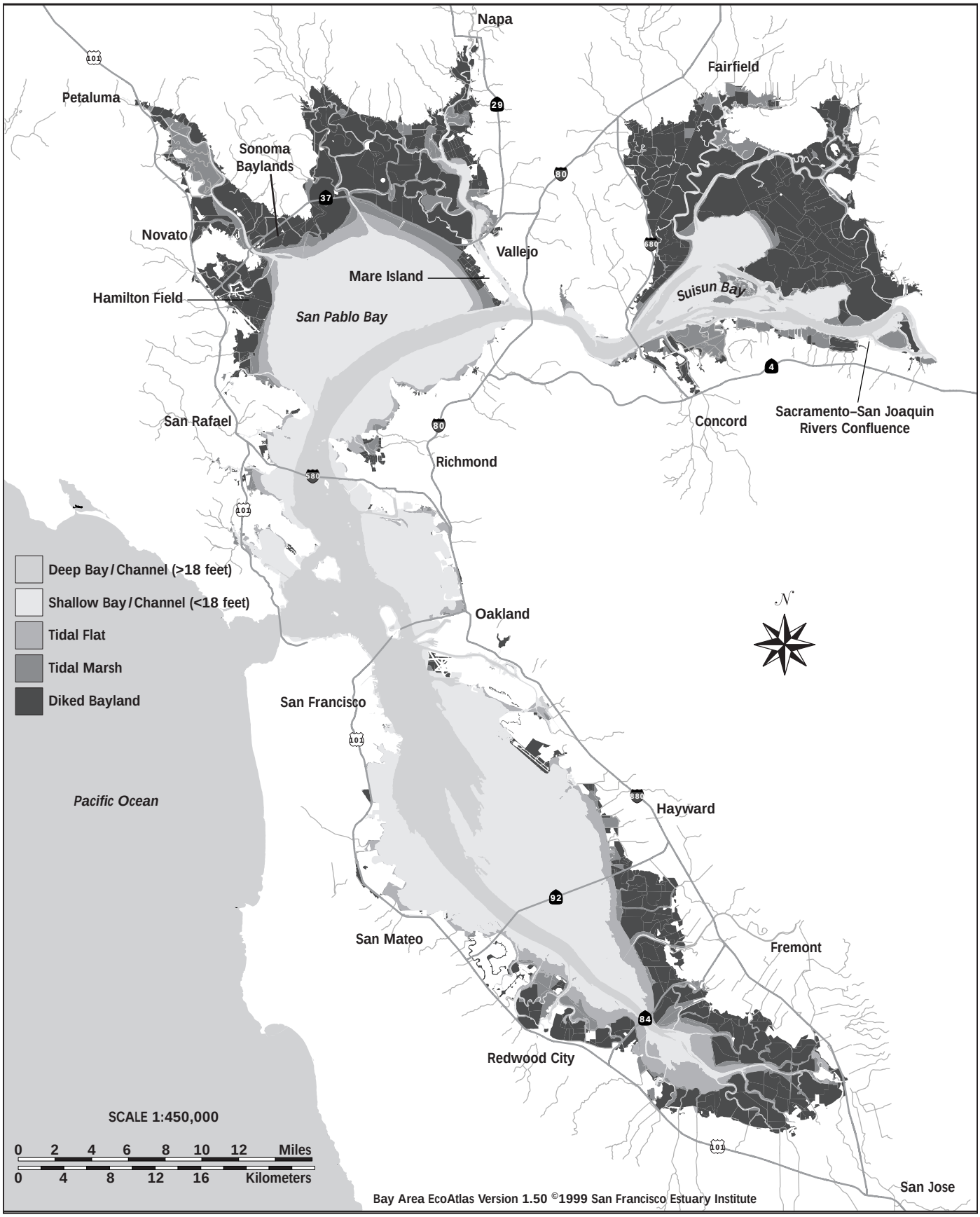


Figure 2-2

Modern View of San Francisco Bay (circa 1998)

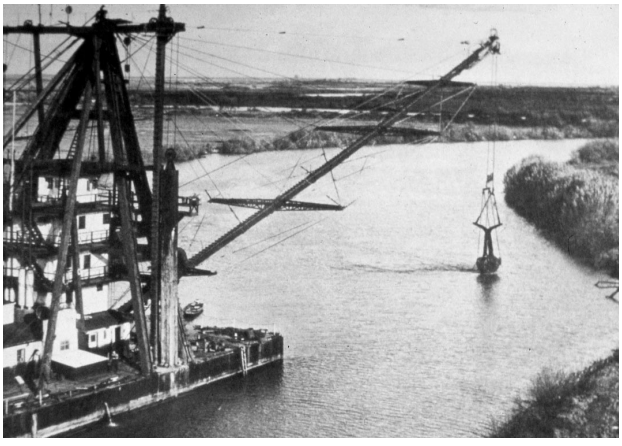


motive metals, pesticides from lawns, and high bacterial counts continue to stress wetlands and pollute the Bay.

Such drastic impacts to the Bay's wetland ecosystem have put fish and wildlife populations, as well as the ecological health of the Bay, at risk. Most of the threatened and endangered species, and almost all of the commercial and recreational fish species in San Francisco Bay depend on wetland and riparian habitat. Numerous adult and juvenile fish species that are dependent on tidal marshes, such as Chinook salmon and delta smelt, have declined dramatically due to the loss of habitat. The loss of a once-thriving fishing industry has also severely impacted the economies of numerous Bay cities.

Wetland losses and degradation would have been even more severe were it not for state and federal regulations, active public and nonprofit acquisition programs, and increased public awareness. The protection and enhancement of wetlands and riparian corridors has been given a tremendous boost with the growth of watershed planning efforts that bring diverse stakeholders together. Approximately 16,300 acres of wetlands were permanently protected in the Bay region between 1992 and 1999. In addition, about 9,040 acres of degraded or former wetland were restored and enhanced during this period of time. (CCMP Workbook, 1996; SFBJV, 1999) While these figures are encouraging, much of the reported acreage is submerged tideland and represents a fraction of the potential. There is a tremendous amount of protection, restoration, and enhancement work remaining for wetlands, riparian areas, and associated uplands.

The establishment of the SFBJV was hastened by the growing realization among all parties that immediate action is needed. The costs of acquiring and restoring the remaining wetlands of San Francisco Bay have skyrocketed over the past decade, and are likely to continue to climb. Restoration work, which often meant only breaching a dike, now may cost from $4,000 to $20,000 per acre, given the need for extensive grading, planting, new dike construction, or temporary irrigation.



Dredging channels and levees have dramatically altered the face of the Estuary and armored its margins.
COURTESY OF BANCROFT LIBRARY, UC BERKELEY

Hydraulic mining in the Sierra foothills during the Gold Rush sent vast amounts of sediment downstream and into San Francisco Bay. COURTESY OF BANCROFT LIBRARY, UC BERKELEY

Wildlife of San Francisco Bay

Waterfowl Use of the San Francisco Bay Area

The San Francisco Bay Area is one of the most important coastal wintering and migrational areas for Pacific Flyway waterfowl populations. Significant numbers of the Pacific Flyway scaup (70%), scoter (60%), canvasback (42%), and bufflehead (38%) were located in the San Francisco Bay/Delta. According to 1998 California Fish and Wildlife surveys, San Francisco Bay held the majority of California's 1999 wintering scaup (85%), scoter (89%), and canvasback (70%) populations. More than 56 percent of the State's 1999 wintering diving ducks were located in the San Francisco Bay proper, which includes the salt ponds and wetlands adjacent to the North and South Bays. Although the San Francisco Bay is most recognized for its importance to diving ducks, large numbers of dabbling ducks like pintail (23,500) and wigeon (14,000) were observed during the 1999 midwinter waterfowl survey. For a more detailed analysis of winter waterfowl surveys for the San Francisco Bay Area, see **Appendix F.**

Regionally, the greatest variation observed in waterfowl numbers between years and seasons

The San Francisco Bay is a key wintering and stopover area along the Pacific Flyway. US FISH AND WILDLIFE SERVICE

was in Suisun Bay, followed by the North Bay and North Bay salt pond regions. Waterfowl use was most consistent in the Central and South Bays, with some variation in the South Bay salt pond region. The greater range of waterfowl use of the North Bay may be due to the variability of salinity and the presence of wetlands in the adjacent delta. San Pablo Bay and Suisun Bay are greatly influenced by outflows from the Sacramento and San Joaquin Rivers.

Canvasbacks take flight on Suisun Marsh. CENTRAL VALLEY HABITAT JOINT VENTURE,1995

Waterfowl production in the San Francisco Bay Area is typically limited to small numbers of mallards, gadwalls, northern pintails, cinnamon teals, and ruddy ducks. Tidal marshes, diked wetlands, and seasonal wetlands are the primary habitats of nesting waterfowl. In addition, Canada geese have nested in the area in recent years.

The San Francisco Bay is of particular importance to the future of canvasback and other diving duck populations of the Pacific Flyway. San Francisco Bay wetlands can—if protected, restored, and enhanced—play a significant role in meeting NAWMP's overall objective of providing diverse habitats and spreading waterfowl populations over large geographical areas.

Other Important Species in the San Francisco Bay Area

Wetlands and adjoining uplands in the San Francisco Bay Area provide habitat critical to the survival of almost 50 endangered and threatened species (26 animal and 22 plant species) protected by the federal or State Endangered Species Acts. See **Table 2-1** for a complete list of federal and state protected species found in and around the Estuary.

In addition to state and federally listed species, the Bay Area is home to 16 fish and wildlife species and 13 plant species associated with wetlands that are candidate or proposed candidate species for federal endangered or threatened status. Of the fish and wildlife species, 15 of 16 candidates are associated with wetlands. Enhancement and restoration of wetlands throughout the region will benefit the populations of most of these species.

The number of special-status species resident in or using Bay wetlands demonstrates the crucial importance of these areas, their level of degradation, and the overwhelming need to hasten restoration efforts.

Shorebirds. Shorebirds are among the most conspicuous wildlife of the North and South bays. Thirty-eight species of wintering and migratory shorebirds were found in the Bay between 1988 and 1995 on surveys performed by the Point Reyes Bird Observatory (PRBO). Total numbers of shorebirds on these surveys ranged from 340,000–396,000 in the fall, 281,000–343,000 in the winter, to 589,000–838,000 in the spring. Approximately two-thirds of the migrating and wintering shorebirds occurred in the South Bay.

According to the United States Shorebird Conservation Plan, San Francisco Bay is used by higher proportions of wintering and migrating shorebirds within the U.S. Pacific coast wetland system than any other coastal wetland. Depending on the season, San Francisco Bay accounted for the following percentages of shorebirds in the wetlands of the contiguous U.S. Pacific Coast on the PRBO surveys: black-bellied plover, 55–62%; semipalmated plover, 40–52%; black-necked stilt, 58–90%;

Black-necked stilts are among the many shorebirds that winter in the San Francisco Bay Estuary. MARK RAUZON

Table 2-1

Threatened and Endangered Species of the San Francisco Bay Estuary

Plant and animal species listed under the Federal and/or State Endangered Species Acts

Species (T=Threatened, E=Endangered)	Scientific Name
Mammals	
Salt marsh harvest mouse (E)	*Reithrodontomys raviventris*
Steller sea lion (T)	*Eumetopias jubatus*
Birds	
Tule greater white-fronted goose (T)	*Anser albifrons gambelli*
California brown pelican (E)	*Pelecanus occidentalis*
Western snowy plover (T)	*Charadrius alexandrinus nivosus*
California clapper rail (E)	*Rallus longirostris obsoletus*
California black rail (T)	*Laterallus jamaicensis corturniculus*
California least tern (E)	*Sterna antillarum browni*
Aleutian Canada goose (T)	*Branta canadensis leucopareia*
Amphibians and Reptiles	
San Francisco garter snake (E)	*Thamnophis sirtalis tetrataenia*
Giant garter snake (T)	*Thamnophis gigas*
California red-legged frog (T)	*Rana aurora draytonii*
Fish	
Chinook salmon (E)	*Oncorhynchus tshawytscha*
Coho salmon (T)	*Oncorhynchus kisutch*
Steelhead (E)	*Oncorhynchus mykiss*
Sacramento splittail (T)	*Pogonichthys macrolepidotus*
Tidewater goby (E)	*Eucyclogobius newberryi*
Delta smelt (T)	*Hypomesus transpacificus*
Invertebrates	
Behren's silverspot butterfly (E)	*Speyeria zerene behrensii*
California freshwater shrimp (E)	*Syncaris pacifica*
Conservancy fairy shrimp (E)	*Branchinecta conservatio*
Myrtle's silverspot butterfly (E)	*Speyeria zerene myrtleae*
Callippe silverspot butterfly (E)	*Speyeria callippe callippe*
Delta green ground beetle (T)	*Elaphrus viridis*
Valley elderberry longhorn beetle (T)	*Desmocerus californicus dimorphus*
Vernal pool fairy shrimp (T)	*Branchinecta lynchi*
Vernal pool tadpole shrimp (E)	*Lepidurus packardi*
Plants	
Suisun thistle (E)	*Cirsium hydrophilum hydrophilum*
Soft bird's-beak (E)	*Cordylanthus mollis mollis*
Kenwood Marsh checkermallow (E)	*Sidalcea oregana valida*

Source: Baylands Habitat Goals, (1999); Life on the Edge, (1995)

American avocet, 86–96%; greater yellowlegs, 26–41%; willet, 57–69%; long-billed curlew, 45–65%; marbled godwit, 46–68%; red knot, 39–76%; western sandpiper, 54–68%; least sandpiper, 39–73%; dunlin, 24–38%; and dowitcher, 49–72%.

Tidal flats, salt ponds, diked seasonal wetlands, grazed uplands and, to a limited extent, salt marshes are the chief habitats of shorebirds at the San Francisco Bay. Species making the heaviest use of tidal flats include black-bellied plover, willet, long-billed curlew, marbled godwit, western sandpiper, least sandpiper, dunlin, and short-billed dowitcher. Species making heaviest use of salt ponds include snowy plover, black-necked stilt, American avocet, northern phalarope, and Wilson's phalarope. Black oystercatchers nest on the rocky shores of some islands in the Bay. Snowy plover, federally listed as a threatened species, killdeer, black-necked stilt, and

Least bittern SAN FRANCISCO BAY JOINT VENTURE

American avocet nest in the salt ponds. Killdeer, black-necked stilt, and American avocet also nest in the managed diked marshes of Suisun Bay.

Because of the great shorebird numbers, the Western Hemisphere Shorebird Reserve Network has classified San Francisco Bay as a site of "Hemispheric Importance" for shorebirds—the highest possible ranking.

Marsh Birds, Gulls, and Terns. The San Francisco Bay Estuary provides nesting habitat for a variety of marsh birds including snowy egret, great egret, black-crowned night heron, great blue heron, and California clapper rail. In 1990, it was estimated that 350 pairs of great egrets were breeding in the San Francisco Bay, along with 160 breeding pairs of great blue herons.

California clapper rails, a Federally listed species currently found only in San Francisco Bay, are among the most inconspicuous wildlife of the North and South bays, but are a good indicator of the health of Bay wetlands. Clapper rails occur primarily in emergent salt and brackish tidal marshlands having intricate networks of slough channels, and vegetation dominated by pickleweed and Pacific cordgrass. The total population size is currently estimated at around 1,200. Clapper rails were formerly more numerous and ranged more widely.

Numerous human-related factors over the past 150 years have caused their decline. These include hunting in the late 1800s and, more recently, predation by non-native predators and habitat loss. Presently, California clapper rail populations are restricted to fragmented marshes that are small in size, and lack a significant transition zone to terrestrial habitat that would buffer them from nearby urban and industrial development. Habitat goals calling for the restoration of significant amounts of tidal salt marsh habitat in the Bay would immediately and directly benefit clapper rails by allowing movement of individuals between isolated populations and recolonization of unutilized habitat.

An extensive variety of other "colonial nesting birds" are common in the San Francisco Bay Estuary. These include western gull, California gull, Forster's tern, Caspian tern, and double-crested cormorant.

Raptors. Marshes, tidal flats, and grasslands provide excellent feeding habitat for the northern harrier and other raptors. Other wetland-associated raptors include merlin, peregrine falcon, red-tailed hawk, short-eared owl, black-shouldered kite, and burrowing owl. The bald eagle is rare, but it nests near reservoirs and lakes, and preys on waterfowl and coots. Loss of habitat is an enormous threat to raptors in the Bay Area.

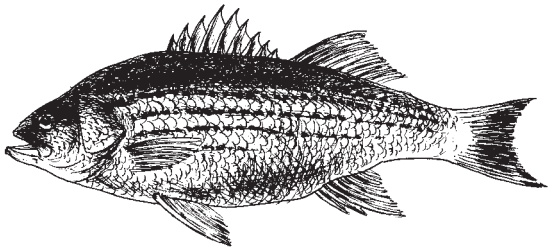
Other Marine Birds. Open waters, large lakes, and salt ponds provide habitat for loons, pelicans, and grebes. Grebes found in the study area are the pied-billed grebe, eared grebe, horned grebe, Clark's grebe, and western grebe. Large open-water habitats of the Estuary such as bays, lagoons, salt ponds, and diked habitats are fall and winter habitats for California brown and the American white pelicans.

Migratory Songbirds. Over 50 species of songbirds make use of the remnant riparian zones around the Bay. Among them are flycatchers, sparrows, thrushes, woodpeckers, warblers, vireos, and swallows. Salt, brackish, and freshwater marshes house the salt marsh yellowthroat. Song sparrows utilize tidal salt and brackish marshes, and the tricolored blackbird is a resident of freshwater wetlands. These birds are also affected by habitat loss; the number of tricolored blackbirds has diminished by 89 percent since the 1930s, and only 6,000 pairs of Suisun song sparrow remain in the Bay Area.

Mammals. The most abundant marine mammal associated with wetlands and deepwater habitats of the Estuary is the harbor seal. This species uses tidal salt marshes and mudflats for breeding and hauling out, and deepwater habitats for foraging. The sea lion is another important marine mammal of the San Francisco Bay, while elephant seals and humpback whales are significant species of the San Francisco/San Mateo coast. Tidal marshes provide habitat for the Suisun shrew, salt marsh wandering shrew, and salt marsh harvest mouse.

Amphibians and Reptiles. Inhabiting Delta channels, small rivers, creeks, lakes, ponds, and seasonal wetlands are a wide variety of amphibians and reptiles. Several federally and/or state listed species are among them, including the California tiger salamander and the California red-legged frog. Among listed reptiles dependent on riparian habitat is the San Francisco garter snake; other riparian residents include the striped racer and the western pond turtle.

Fish and Shellfish. Wetlands and deep waters of the study areas provide important habitat for a wide variety of fish and shellfish. Salt marshes and shallow water areas provide habitat for larval, juvenile, and adult fishes and shellfish including shiner perch, top smelt, staghorn sculpin, striped bass, and bay shrimp. Intertidal and sub-tidal areas of the North Bay serve as important spawning areas for Pacific herring. Important commercial and sport fishes that utilize deepwater habitats include northern anchovy, starry flounder, striped bass, king salmon, sturgeon, steelhead, and American shad.



Striped bass LEE ADAIR

Dungeness crab *(Cancer magister)* JOHN INASE

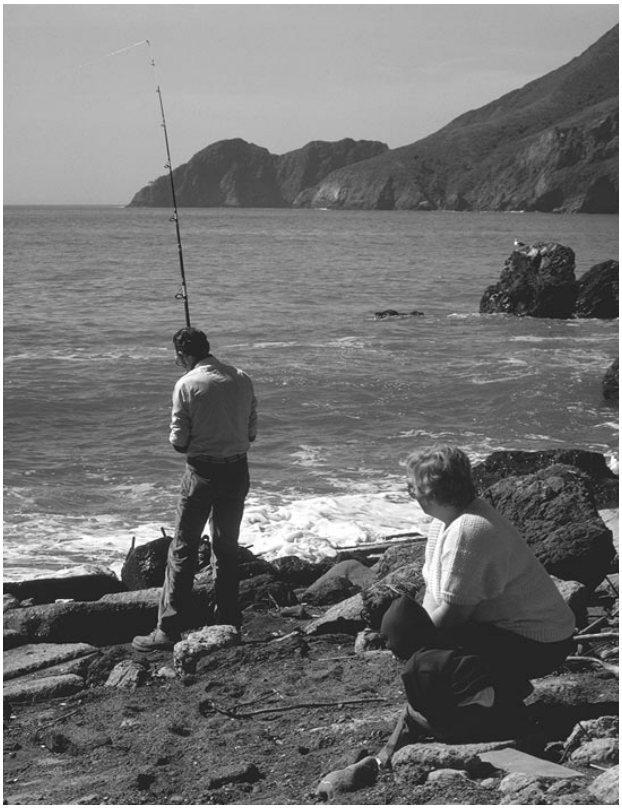
Benefits of Wetland Restoration and Enhancement

Wetlands and riparian areas in the Bay Area are important oases of life set against the backdrop of the arid west. However, the value of wetlands and riparian habitats extends beyond the animal and plant communities they support. And while these are profoundly important, as the prior chapter suggests, there are a myriad of other supportive functions that magnify their significance. These complementary values underscore the rationale and need for protecting and restoring wetlands. Riparian and wetland habitats play key roles in maintaining both a healthy ecosystem and an economically vibrant region. Among these vital "ecological services" are their capacity to absorb or buffer floodwaters, cleanse pollutants from runoff, reduce sediment loads in runoff, recharge overdrawn groundwater supplies, and contribute to a community's identity and recreational amenities. Wetlands offer a broad range of non-biological benefits that include:

- **Reduced flood damage.** Wetlands can not only serve as biofilters but can also slow down and soak up water that runs off the land. This capacity can lower the volume of floodwaters and diminish flood heights, thereby reducing shoreline and stream bank erosion. Preserving natural wetlands can reduce or eliminate the need for expensive flood control structures.
- **Economic values—Food and related industries.** The vast majority of our nation's fishing and shellfishing industries harvest wetland-dependent species. This catch is valued at $15 billion a

year. The economic benefits of wetlands also extend to other forms of commercial harvesting—in the case of the South Bay, shell mining. The South Bay formerly had one of the nation's most productive oyster beds, its harvest serving much of the West Coast.

- **Water quality enhancement.** Wetlands can help improve water quality by filtering nutrients, organic particles, and sediment carried by runoff. Many chemicals—fertilizers, human and household wastes, toxic compounds—are tied to sediments that can be trapped in wetlands. Plants and biological processes in wetlands break down and convert these pollutants into less harmful substances.
- **Increased groundwater availability.** Wetlands can absorb water during and after rainfall. Some of this precipitation percolates into the groundwater supply. Hence, wetlands often do the vital job of recharging groundwater by passively "banking" water for use at a later date.
- **Recreation.** Wetlands also contribute to the economy through recreational activities such as fishing, hunting, and bird watching. It is estimated that the annual economic value of wetlands statewide in California is between $6.3 and $22.9 billion (*Habitat Goals*, page 31). The 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation reported that 3.1 million adult Americans hunt migratory birds including geese, ducks, doves, and other game birds. Nationwide it is estimated that hunters spend about $1.3 billion on travel, equipment, and other associated expenses.
- **Aesthetic and scenic values.** The natural beauty and solitude of wetland areas provide opportunities for bird watching, wildlife photography, painting, hiking, and simply relaxing while appreciating the wonders of nature. Wetlands are a vital part of lives, providing a peaceful place to reflect while offering respite from everyday stresses.
- **Education and research.** Tidal, coastal, and inland wetlands of the Bay Area provide educational opportunities for nature observation and scientific study.
- **Historic and archaeological values.** Some wetlands are of archaeological interest. In the San Francisco Bay region Indian settlements were often located in coastal and inland wetlands, especially at the mouths of creeks. Estuaries were rich sources of fish and shellfish.
- **Community identity and vitality.** The presence of wetlands in a city or town strengthens its sense of identity and place. Wetlands and creeks help to give positive and vivid definition to a community, offering tangible indicators of the "quality of life" values that are increasingly important to the residents of a growing metropolis, yet are degraded by the homogenizing effects of urban sprawl. Likewise, they help define the urban edges by providing physical separators between towns. Collectively, they confer a natural character and presence within an urban area. Wetlands are essential to the identity and vitality of the Bay region and its continued desirability as a place to live and work.
- **Estuary support.** Wetlands provide important nutrients to near-shore waters from decomposing vegetation, which provides support for coastal food webs.

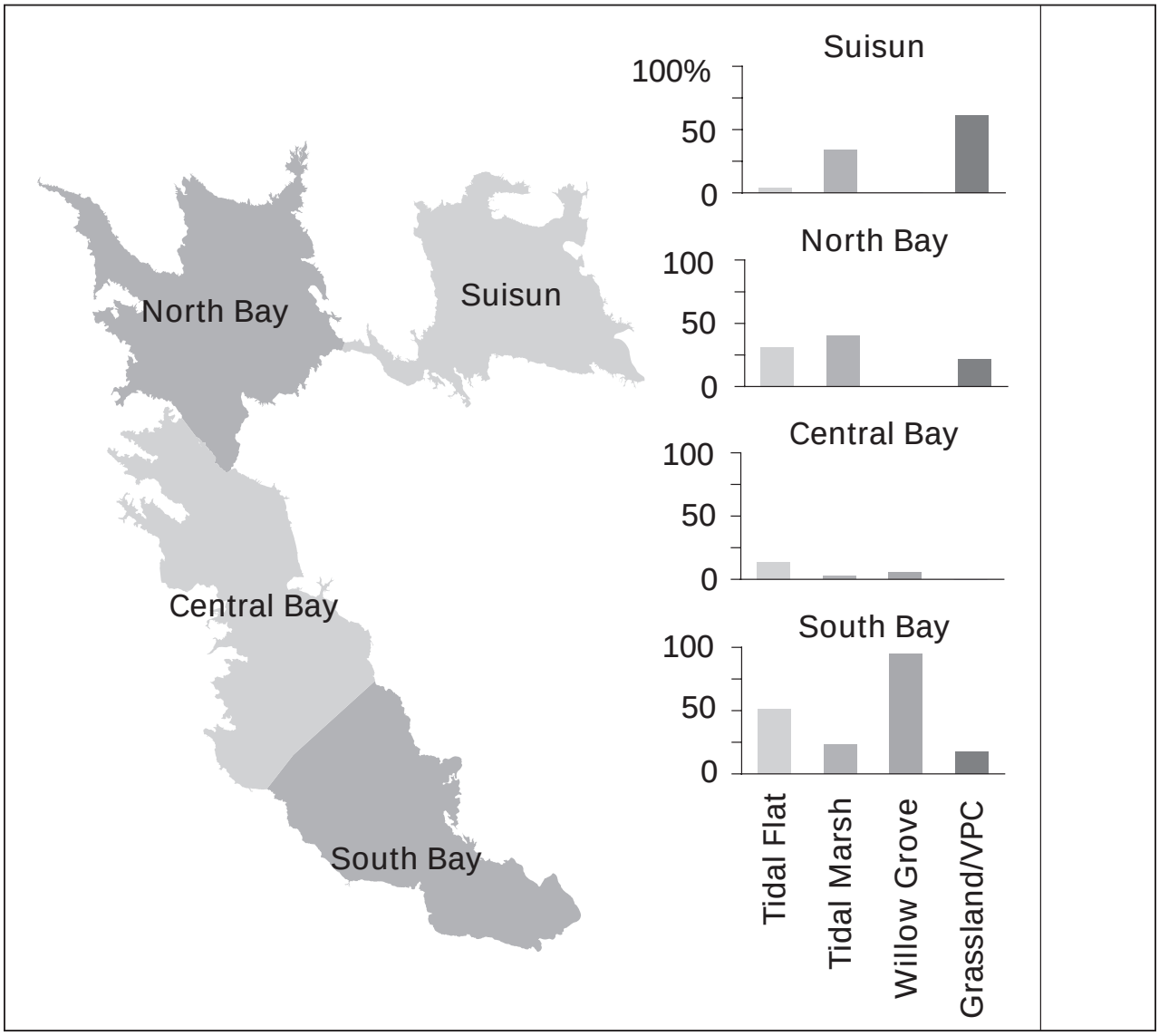


Family fishing at Marin Headlands DON COPPOCK

Subregional Characteristics

As previously described, the SFBJV has divided its geographic scope into five subregions: Suisun, North

Figure 2-3
Habitat Types by Subregion



Source: Bay Area EcoAtlas Modern View ©1999 SFEI

Bay, Central Bay, South Bay, and the San Francisco/San Mateo Coast (Figure 1-1). These subregions coincide with those used by the Habitat Goals Project, with a few exceptions. The fifth subregion is the San Francisco/San Mateo Coast.

The subregions vary greatly in their habitat composition. In general, the North Bay and Suisun Subregions have the greatest areas of tidal marshes and moist grasslands/vernal pools, together possessing more than 70 percent of the region's habitats of these types. The South Bay contains the overwhelming majority of riparian willow groves, and about 50 percent of the mudflats. **Figure 2-3** summarizes the subregional distribution of the estuary's major habitat types.

The following section provides a geographic and ecological overview of each of these five subregions, focusing on characteristics and status of their habitats.

North Bay Subregion

The North Bay subregion consists of the submerged lands, wetlands, and uplands of San Pablo Bay. It is bounded to the east by the Carquinez Strait, which connects it to the Suisun subregion just upstream. Downstream it abuts the Central Bay subregion at Point San Pedro. The boundary climbs to the ridgeline of the East Bay hills and follows the ridgeline of

the watersheds draining north to the Carquinez Strait (a line roughly parallel to and north of Highway 24). Its major watercourses include the Napa River, Sonoma Creek, Petaluma River, Novato Creek, and Gallinas Creek. This subregion includes all of Solano County, and portions of Marin, Sonoma, Napa, and Contra Costa Counties.

Historically, this subregion was characterized by broad expanses of shallow bays and brackish tidal marshes that received substantial amounts of runoff from many local streams draining narrow valleys between ridges of low hills. Major creeks and rivers also ran to the Bay and still do. These include the Petaluma and Napa Rivers in Sonoma and Napa counties, Green Valley Creek in Solano County, and Walnut, Wildcat, and San Pablo creeks in Contra Costa County. The uplands and the relatively flat lands near the Bay often have a high clay content, providing soils suitable for grasslands and oak savannas.

There have been significant changes to the landscape of the North Bay, as elsewhere in the Bay Area. Most of the tidal marsh that once ringed the North Bay has been converted to farmlands or salt ponds. The riparian habitat and water quality of creeks have been degraded by many decades of grazing and woodcutting, but many riparian restoration projects are under way to reduce erosion and enhance habitat values within a farming context. Restoration of major floodplains, such as that of the Napa River, is an emerging hallmark of this region, with even larger projects contemplated in the future. The Bay margins of Marin present significant opportunities to restore diked baylands to tidal action. There are several thousand acres of potential salt marsh restoration among the "Marin Baylands." The former Hamilton Airfield is presently being restored to marshlands. This scale of renewing wetlands within a metropolitan context is unprecedented. Other Marin Baylands also present unique conservation opportunities—particularly as component sites in the expansion of the San Pablo Bay National Wildlife Refuge. The Fish and Wildlife Service is moving forward on plans for this proposed expansion.

Suisun Subregion

The Suisun subregion is located in Solano and Contra Costa counties and extends from near Chipps Island on the Sacramento River downstream to the Carquinez Bridge. Suisun Marsh is on the north side of the Sacramento River. It is important to note that below the 10-foot contour the marsh is part of the Central Valley Habitat Joint Venture's geographic scope. The Contra Costa shoreline is on the south side. Its major watercourses include the Sacramento River, and Green Valley, Solano, and Walnut Creeks.

On the Solano side, there are still vernal pools and moist grasslands on the fringes of Suisun Marsh, particularly to the east and north. A prominent remnant of this seasonal wetland complex is the Jepson Prairie Reserve, east of Fairfield in Solano County.

On the Contra Costa side, brackish tidal marshes along the shoreline extend into the lower reaches of the major tributaries. These marshes are particularly extensive in the Walnut Creek watershed, which also supports some remnant riparian forest in its tributaries.

A Petaluma River bank is the graveyard of a grain scow that plied the waters in the 19th century. JOHN STEERE

Comparing historical to present conditions in this subregion, deep bay and shallow bay habitats have declined from about 41,000 acres to about 34,000 acres. Much of this change is due to sediment deposits from Sierra Nevada mining in the mid-19th century. Some of the deeper areas have become shallow bay, and some of the shallow areas have become tidal flats. Tidal marsh has

A managed marsh meets a riparian willow grove in the South Bay. JOSH COLLINS

also declined significantly in this area. Much of the loss came from tidal marsh being converted to managed marsh to provide habitat for wintering waterfowl. These marshes also provide habitat for shorebirds and other wetland-associated wildlife. The majority of privately-owned managed marshes in the area are used for duck hunting in the fall and winter. Private landowners have taken the lead in assuring the protection of the Suisun Marsh.

Adjacent to the baylands, farming and other activities have affected most of the moist grassland habitat and about one-third of grasslands with vernal pools. Farming and stream channelization have greatly reduced the area of riparian vegetation and willow groves.

On the Contra Costa shoreline, most of the tidal marshes have been diked, initially for farming. Some have been filled for industrial uses such as oil refining and power generation. Riparian vegetation has been stripped from many of the streams. This is most apparent in the heavily urbanized Walnut Creek/San Ramon watershed, where many miles of stream channel have been straightened, widened, and lined with concrete.

Central Bay Subregion

The Central Bay subregion includes submerged lands, wetlands, uplands, and the main body of San Francisco Bay. It extends along the west shore from Point San Pedro to Coyote Point, and along the east shore from Point San Pablo to the San Leandro Marina. It follows the northern edge of the creeks (Crow Creek, Alamo Creek, etc.) that drain the interior of Contra Costa and Alameda Counties south to Alameda Creek. This region includes portions of San Francisco, Marin, Contra Costa, Alameda, and San Mateo Counties.

Historically, steep watersheds draining into broad alluvial fans characterized this region. At their bayside margins, there were small pockets of tidal marshland, sandy beaches, and natural lagoons, all fed by relatively small drainages, with similarly scaled areas of tidal flats and tidal marshes. The near-Bay habitats in this sub-region reflect the proximity of the ocean more than the other subregions, with strong marine influence showing in the subtidal and intertidal plant and animal communities. Historically there were few prairies, as there is less flat land between the old marsh line and the hills, but there were relatively more moist grasslands than in other subregions. The hills, being of mixed geologic origin and receiving coastal fog, were formerly dominated by oak woodlands with occasional stands of redwood.

Today, this subregion is one of the most urbanized, with three-quarters of its baylands filled. Tidal

Many Central Bay wetlands have been filled by industrial, commercial, or residential development. PORT OF OAKLAND

25,000 acres of Cargill Salt Ponds rim the South Bay; 19,000 acres are now available for sale to federal and State agencies. BOB WALKER

marsh acreage has been reduced by over 90 percent, and tidal flat acreage by 70 percent. Large areas of interior open space are protected, e.g. the watershed lands of the San Francisco Water Department and East Bay Municipal Utility District, and the parklands of the East Bay Regional Park District. However, most of the flatland areas of this subregion have been significantly modified. Restoration has occurred on a variety of fronts, but has generally had to adapt to the highly urban influences. Unusual restoration projects have been accomplished, including the "daylighting" (opening) of several culverted streams, and restoration of old sewage sludge ponds into marshes.

South Bay Subregion

The South Bay subregion includes the submerged lands, wetlands, and uplands from the southern edges of the Central Bay subregion south to the limits of the watersheds feeding the Bay. It abuts the Central Bay subregion on the west shore at Coyote Point and on the east shore at the San Leandro Marina. It gets less rainfall than the other subregions, and has few major streams; the largest include Alameda, Coyote, San Francisquito, San Mateo, and Stevens Creeks. This region includes all of Santa Clara County and portions of Alameda and San Mateo Counties.

Historically, this subregion was characterized by broad bands of mudflats and tidal marshes on either side of the Bay. Between the tidal creeks were many salt marsh ponds or pans. Near the mouth of San Leandro Creek on the East Bay shoreline was a complex of large natural salt ponds, named Crystal Salt Pond on historical maps. This feature was apparently formed by a beach ridge or swash bar, and was a precursor of the subregion's man-made salt ponds. Along the periphery of the baylands were wet grasslands, and a large area with vernal pools lay near Warm Springs.

Evaporation exceeds precipitation in the South Bay by a two to one ratio, producing less freshwater runoff and much drier conditions than in the other subregions. The geology of the South Bay also includes more sand and gravel deposits than the other subregions, resulting in broad alluvial valleys, once dominated by giant sycamores and other riparian vegetation. The uplands were dominated by shrubs or, at higher elevations, woodlands.

This subregion still contains broad valleys with flats adjacent to the Bay, but many have been converted to non-habitat uses. Silicon Valley and urbanization have supplanted the orchards that once covered many of the valleys. Nearly all the moist grasslands are gone and much of the riparian vegetation has been removed. Tidal marshes were too saline for agriculture, so they were converted to salt ponds. Sewage treatment facilities, landfills, residential and industrial uses also reduced the area of natural baylands habitats. Restoration projects of many types are taking place in this subregion, from tidal marshes to riparian woodlands. Watershed planning initiatives have been particularly active in this subregion.

San Francisco/San Mateo Coast Subregion

The San Francisco/San Mateo Coast subregion includes the western side of San Francisco and San Mateo Counties, from the submerged and intertidal lands of the Pacific Ocean to the crest of the coastal

range. This subregion has similarities to the Central Bay, in that it is characterized by short, steep watersheds that lead to pockets of tidal marsh with strong marine influences. However, the Pacific coast is distinguished by its beauty, prominent rural qualities, and variety of plant communities and wetlands. Tidal and seasonal wetlands on the coast tend to be smaller in scale than those of the Baylands; they are frequently less than an acre in size. This subregion is a study in dramatic contrasts, with the heavily developed coastal area of San Francisco giving way to the rural and relatively wild segments of coastline in San Mateo County. While coastal wetlands are small, the variable topography of the coastline and the scattering of offshore rocks has led to a complex mosaic of marine habitats in the intertidal zones. Streams lined with willow thickets form into lagoons; these are generally behind beaches that fan out along the margins where the creeks enter the ocean. Inland from the bluffs that characterize the majority of the San Mateo coast, are coastal terraces that are primarily in intensive agriculture, while the adjacent slopes of the coastal range are clad in evergreen and mixed hardwood forests.

An urban wetlands quilt: South Bay salt ponds, looking North toward Bair Island
BRADY AERIAL PHOTOGRAPHY

This portion of the Joint Venture's regional scope retains many intact habitats. Over 75 percent of the land remains wooded—from the redwood and Douglas fir forests found in many of the seaward watersheds, to the hardwoods along the small, but well vegetated streams, to the pocket marshes near the coast, to the patches of coastal scrub communities near the bluffs and creeks. Restoration work has been occurring in some of the watersheds and stream channels. However, grazing and farming practices have been causing excessive sedimentation in the coastal streams, impairing their fisheries capacity, particularly for salmon, causing siltation even in several coastal lagoons and marshes that have been protected in state parks.

Cowell Ranch Beach along the San Mateo Coast DON COPPOCK

Categorizing Wetland Habitats in San Francisco Bay

The habitat categories developed by the SFBJV are based largely on the extensive and historical ecological research for the Estuary that was completed by the San Francisco Bay Area Wetlands Ecosystem Goals Project (Goals Project.) Contributors to this project, led by researchers at the San Francisco Estuary Institute (SFEI), with participating scientists from many disciplines, institutions, and agencies, developed a comprehensive set of habitat categories for the Bay and its environs. These were mapped as habitat types in the Goals Project. They include 14 cat-

egories of wetlands—tidal flats, tidal marshes and muted tidal marshes, beaches, lagoons, salt ponds, agricultural baylands, diked/managed wetlands, moist grasslands, grassland/vernal pool complexes, creeks, perennial ponds, and riparian forests and willow groves. See Appendix D for descriptions of each of these habitat types. The SFBJV has refined these categories into 10 "tracked habitats," which refers to specific groupings of habitat types whose conditions will be periodically monitored. Figure 3-1 in the following chapter shows how the Goals Project classifications translate into the tracked habitats of the SFBJV.

The pattern of habitat simplification over time is indicative of how much wetlands in the Bay Area have been altered by human activity. The human modification of the Baylands (the area once exposed to daily tidal action) that began during the mid-1800s with diking tidal areas to create agricultural lands, salt ponds, managed marshes, and uplands has drastically changed the mix of habitats in the region. It has created a curious patchwork of man-made habitats that do provide some biological value, but lack the diversity found in the complex mosaics of their natural predecessors.

3 Setting Goals for Regional Wetland Protection and Restoration

LIZA RIDDLE

Process and Methodology for Establishing Acreage Goals

The Implementation Strategy is derived from the San Francisco Bay Area Wetlands Ecosystem Goals Project (Goals Project.) Many of the individuals who worked on the *Habitat Goals* also served on the San Francisco Bay Joint Venture Implementation Strategy Committee to shape the SFBJV's acreage methodology and goals. Beginning in mid-1998 members of the Implementation Strategy Committee began working with scientists from the San Francisco Estuary Institute (SFEI) to adapt the Goals Project to the needs of the SFBJV's habitat goals. The idea was to use its carefully derived projections of regional wetlands objectives as a framework for the wetlands classifications and goals of the SFBJV. This required three adaptations of the Goals Project: 1) reduction of its implicit longer-term time frame to a more practical horizon; 2) revision of the geographic scope to accommodate the Joint Venture's geographic boundaries (which exclude the Suisun Marsh and include San Mateo coastal areas); and 3) a simplification of the Goals Project's 14-category classification into the Joint Venture's three habitat categories.

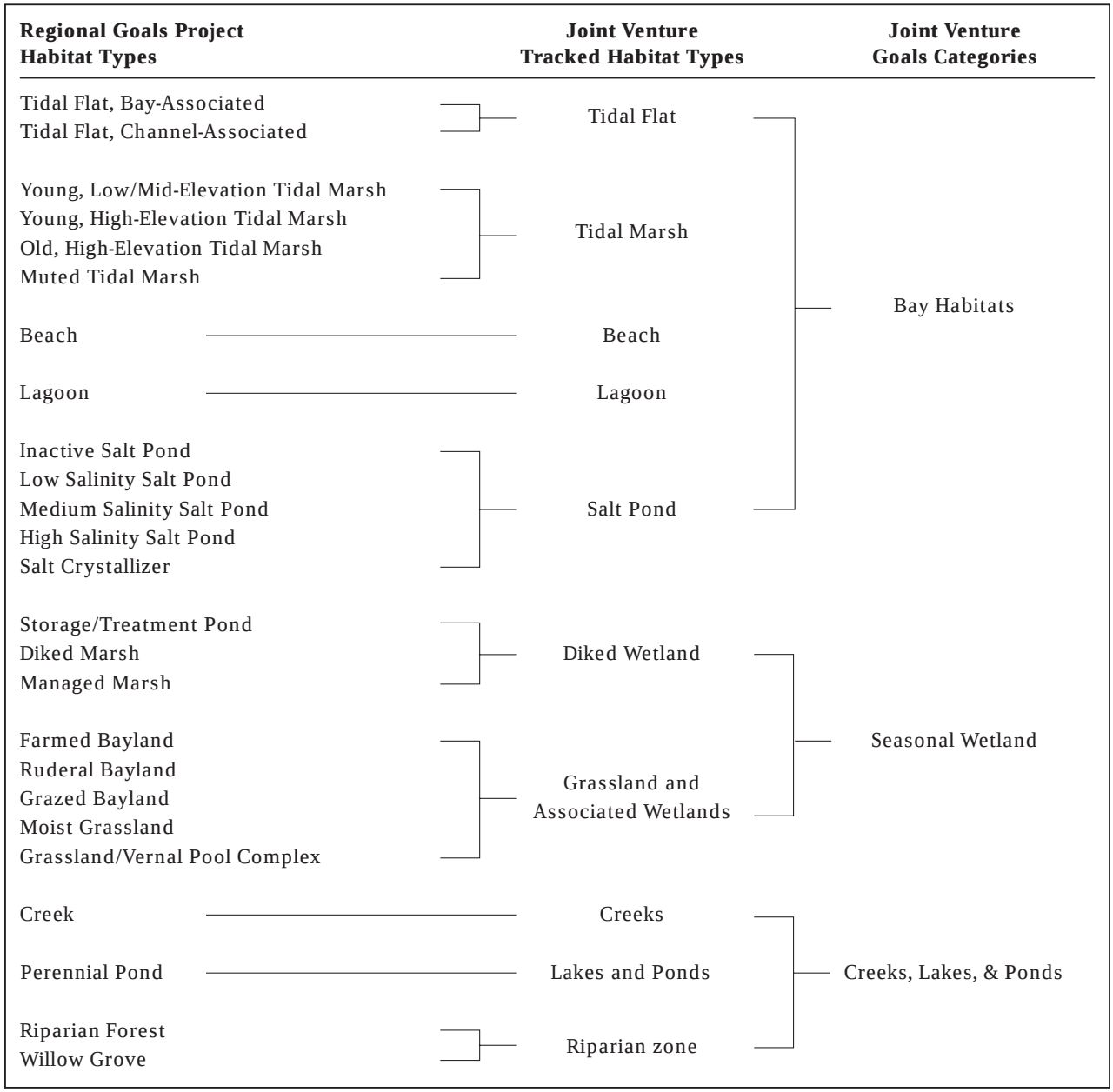
This last adaptation required a two-step process: translating the Goals Project's habitat categories into the Joint Venture's "tracked habitats" and, in turn, combining these to create three habitat goal categories for this Implementation Strategy. The three consist of 1) Bay Habitats, 2) Seasonal Wetlands, and 3) Creeks and Lakes. These categories will serve as the primary measures of SFBJV in meeting its objectives for wetland acquisition, restoration, and enhancement. **Figure 3-1** summarizes this classification process, showing how the Goals Project categories map onto the three Joint Venture habitat goals.

The methodology and process behind the Joint Venture's goals for wetlands acquisition, restoration and enhancement are summarized in the "Goals Setting Worksheets," **Appendix E**.

Habitat Goals for the San Francisco Bay Joint Venture

The long-term vision for wetlands of the San Francisco Bay Estuary presented in *Habitat Goals* has served as an excellent template for defining the Joint Venture's habitat goals, which can also be regarded as milestones of the Goals Project. The Geographic Information System–based mapping and analysis of the historic extent of wetlands in *Habitat Goals* provided a reliable foundation for developing the Joint Venture's habitat goals. SFEI researchers who

Figure 3-1
San Francisco Bay Joint Venture Habitat Classification



Source: SFBJV (1999)

prepared the *Habitat Goals* first identified acreage estimates for historic and current coverage of wetlands. These acreages, displayed in **Table 3-1,** were adapted to determine the "Past" (historic) and "Present" (current) areas of the wetland habitats within the geographic scope of the SFBJV.

The acreages presented in this table are reasonably accurate for the Baylands and within a radius of three miles of the Bay. Beyond this zone, the SFBJV used acreage estimates derived from reviews of topographic and soils maps, so these figures are far less precise. The goals for creek and riparian zones are based on perennial stream lengths, with acreage estimates derived from averaging the widths of riparian forest habitat from eight existing riparian corridors in the North, Central, and South Bays. The average riparian zone was determined to extend approximately 20 meters from each bank. Creek and riparian zone acreage was thus calculated by multiplying a creek's length by 40 meters.

Table 3-1
San Francisco Bay Joint Venture Tracked Habitats Summary

SFBJV Habitat Goals Categories	SFBJV Tracked Habitat Categories	Past (acres)	Present (acres)	Total Present (acres)
Bay Habitats	Tidal Flat	49,000	28,000	
	Tidal Marsh	125,000	32,000	
	Lagoon	80	4,000	**98,070**
	Beach	200	70	
	Salt Pond	1,500	34,000	
Seasonal Wetlands	Diked Wetland	0	18,000	
	Grassland and Associated Wetland	84,000	53,000	**71,000**
Creeks, Lakes and Ponds	Lake	NA	12,000	**14,500**
	Creek & Riparian Zone	69,000	2,500	

Source: SFEI, *Habitat Goals*, (July, 1999)

Table 3-2 presents the habitat goals by the three broad categories of habitats discussed above. These goals were reviewed and revised by the SFBJV's Implementation Strategy Committee, and serve to encompass the tracked habitats and significantly simplify the tasks of monitoring progress toward the goals without misrepresenting the wetland values or functions underlying them. As previously noted, these goals assume a 20-year timeline for accomplishment.

In order to elucidate the SFBJV's habitat goals, it is important to make a clear distinction between *restoration,* defined as the conversion of one habitat type to another (e.g., diked baylands to tidal wetlands), and *enhancement,* which is the improvement in the functioning and biological diversity of an existing habitat.

Table 3-3 displays the future projections for each of the habitat types in the Baylands and nearby areas by subregion, again using the Goals Project as an analytic framework.

The Goals Project uses the past acreage figures displayed in Table 3-1 as target goals for acquisition, restoration, and enhancement within a 50- to 100-year timeframe. To accommodate the SFBJV's 20-year framework, the Implementation Strategy Committee determined that, as a rule for acquisition and restoration categories, the SFBJV would seek to accomplish 75 percent of the long-term goals of the Goals Project. The Committee set goals for enhancement at 50 percent of total habitat goals for the long term. Specific acreage goals were not set for uplands associated with wetlands. However, the Joint Venture recognizes the importance of adjacent upland habitat to provide nesting cover, foraging areas, refuge from predators, and a buffer from incompatible uses. The general rule states that adjacent upland habitat will be protected in the form of buffer zones wherever possible.

Within the SFBJV's 20-year horizon for accomplishing its goals, The Joint Venture will review and revise its Implementation Strategy at approximately five-year intervals.

How Waterfowl Will Benefit from the Implementation Strategy

Introduction. The San Francisco Estuary is an important migration and wintering refuge for waterfowl in the Pacific Flyway. It supports a diverse assortment of waterfowl, including over 20 duck species. More ducks winter in the San Francisco Estuary than in the much larger Chesapeake Bay (Harvey et al. 1992). The North American Waterfowl Management Plan (NAWMP) identified San Francisco Bay as one of 34 "Waterfowl Habitat Areas of Major Concern." According to the *NAWMP Concept Plan for Waterfowl Habitat Protection, San Francisco Bay, California,* ducks in San Francisco Bay comprised five to 13 percent of California's total duck population during midwinter inventories from 1984 to 1989. San Francisco Bay's open waters are of primary importance to diving and sea ducks; almost one-half of California's diving ducks are found in San Francisco Bay (Accurso 1992). Midwinter percentages of Pacific Flyway waterfowl populations using San

Table 3-2
Habitat Goals for the San Francisco Bay Joint Venture

SFBJV Habitats		SFBJV Tracked Habitat Goals (acres)			SFBJV Habitat Goal Categories (acres)[1]		
Habitat Goal Categories	**Tracked Habitats**	**Aquire[2]**	**Restore[2]**	**Enhance**	**Acquire[3]**	**Restore**	**Enhance**
Bay Habitats	Tidal Marshes	43,000	32,000	20,000			
	Tidal Flats	12,000	4,000	6,000			
	Lagoons	1,500	50	1,500	**63,000**	**37,000**	**35,000**
	Beaches	113	60	35			
	Salt Ponds	6,000	1,000	7,500			
Seasonal Wetlands	Diked Wetlands	16,000	6,000	12,000			
	Grasslands and Assoc. Wetlands	21,000	1,000	11,500	**37,000**	**7,000**	**23,000**
Creeks and Lakes	Lakes	3,000	1,000	6,000			
	Creeks and Riparian Zones	4,000	4,000	16,000	**7,000**	**5,000**	**22,000**

Notes: 1. Numbers are to the nearest thousand. **2.** Numbers are double-counted in instances where restoration takes place on acquired land. **3.** SFBJV is a nonregulatory entity, and thus acquisition goals reflect working cooperatively with a willing seller.

Sources and Significance

Tidal Marsh: Based on San Francisco Bay Area Wetlands Ecosystem Goals Project (Goals Project) Historical and Modern Tidal Marsh coverage, Goals Project regional ecological goals, estimate of currently protected lands, and estimate of potential 20-year accomplishments.

Tidal Flat: Based on Goals Project Historical and Modern Tidal Flat coverages, estimate of currently protected lands, assessment of required shorebird support, and estimate of potential 20-year accomplishments.

Lagoon: Based on Goals Project Historical and Modern Lagoon coverages, Goals Project regional ecological goals, estimate of currently protected lands, and estimate of potential 20-year accomplishments. Goal for restoration refers to natural lagoon-beach complexes.

Beach: Based on Goals Project Historical and Modern Beach coverages, estimate of currently protected lands, narrative recommendations of Goals Project, and estimate of potential 20-year accomplishments.

Salt Pond: Based on Goals Project Historical and Modern Salt Pond coverages, Goals Project regional ecological goals, estimate of currently protected lands, and estimate of potential 20-year accomplishments.

Diked Wetlands: Based on Goals Project Historical and Modern Diked Wetland and Storage/Treatment Pond coverages, Goals Project regional ecological goals, estimate of currently protected lands, and estimate of potential 20-year accomplishments.

Grasslands and Associated Wetlands: Based on Goals Project Historical and Modern Moist Grassland and Grassland/Vernal Pool Complex coverages, Goals Project regional ecological goals for Agricultural Baylands, goal of no net loss of existing moist grasslands and grassland/vernal pool complexes, estimate of currently protected lands, and estimate of potential 20-year accomplishments.

Lakes: Based on Goals Project Historical Perennial Pond coverages, modern mapping by National Wetland Inventory, estimate of currently protected lands, and estimate of potential 20-year accomplishments.

Creek and Riparian Zones: Based on estimates of historical amount of natural creek channel using the Goals Project Historical Rivers and Creeks coverage. Estimated from existing channels using USGS 100,000 Digital Line Graph Hydrology Files; estimate of existing natural creek channel using Goals Project Modern Riparian Forest coverage, analysis of average riparian width (of about 20 meters to a side), and estimate of potential 20-year accomplishments. Goal of 4,000 acres represents 25 percent of the approximately 16,000 acres of existing channel on the flatlands, of which 800 acres are estimated to be natural, based upon the amount of existing Riparian Forest (770 acres or 16 acres per mile).

Table 3-3
San Francisco Bay Joint Venture Wetland Habitat Goals by Subregion
Summary goals for the Bay Area as presented in Table 3-2, divided among the acreage objectives for each of the five subregions of the San Francisco Bay Joint Venture.

Subregions by Goals Categories	Bay Habitats (acres)	Seasonal Wetlands (acres)	Creeks and Lakes (acres)	Total by Subregion (acres)
Suisun Subregion				
Acquire	3,000	11,00	250	15,000
Restore	2,000	1,000	1,000	4,000
Enhance	2,000	6,000	4,000	12,000
North Bay Subregion				
Acquire	23,000	18,000	250	42,000
Restore	15,000	4,000	1,000	20,000
Enhance	13,000	12,000	4,000	29,000
Central Bay Subregion				
Acquire	9,000	1,000	250	11,000
Restore	4,000	0	1,000	5,000
Enhance	4,000	1,000	3,000	8,000
South Bay Subregion				
Acquire	28,000[1]	7,000	500	38,000
Restore	16,000	1,000	2,000	19,000
Enhance	42,000[1]	4,000	11,000	57,000
San Francisco/San Mateo Coast[2]				
Acquire	TBD	TBD	TBD	TBD
Restore	TBD	TBD	3,000	3,000
Enhance	TBD	TBD	5,000	5,000
Total Acreage by type	**161,000**	**66,000**	**33,000**	**260,000[3]**

Source: SFEI, Regional Habitat Goals, (July 1999)

Notes: 1. 25,000 acres of salt ponds are included in both acquisition and enhancement; as with other acquisitions, this assumes a willing seller. **2.** The San Francisco/San Mateo wetland acreages appear as TBD or "To Be Determined," since they have not been estimated. This subregion was not part of the Goals Project. **3.** San Mateo/San Francisco Coast acreages for Riparian Restoration and Enhancement are not part of the acreage totals, as they represent very rough estimates that will need to be refined and peer reviewed.

Francisco Bay (mean of 1955–1999 surveys) include 24 percent of surf scoter, 44 percent of canvasback, and 46 percent of scaup. The Bay's coastal wetlands are used to a lesser extent by dabbling ducks, geese, and swans.

This plan reflects a broad restoration and conservation effort developed in part from the *Baylands Ecosystem Habitat Goals (1999)*, but is also intended to be a framework to improve habitat for waterfowl and other waterbirds. According to *Expanding the Vision: 1998 Update, North American Waterfowl Management Plan*, the continental populations of most waterfowl species have increased in recent years, in some cases to record highs. However, three species, northern pintail and two species of scaup, have markedly declined during the same period. All of these species are found in substantial numbers in San Francisco Bay. The Bay is particularly important to scaup, as almost one-half of Pacific Flyway scaup winter in San Francisco Bay (**Table F-1,** in Appendix).

Although San Francisco Bay scaup populations have not declined in recent years, midwinter aerial waterfowl surveys (conducted since the 1950s on open bays and salt ponds) reveal substantial declines in abundance for some species, including canvasback and pintails **(Table F-2)**. Canvasback declines occurred in the early 1960s and mid-1970s. Pintail declines occurred in the mid-1960s, late 1980s, and early 1990s.

The purpose of this section of the Implementation Strategy is to:

- select a set of indicator species to represent the Bay's diverse waterfowl community
- review the significance of San Francisco Bay to the Pacific Flyway and NAWMP
- establish habitat-related waterfowl population goals
- establish priorities for waterfowl habitat management and conservation for the SFBJV
- make habitat management recommendations which help achieve those goals.

Waterfowl Indicator Species

The San Francisco Bay Joint Venture has selected a set of seven key waterfowl indicator species, which collectively represent the 32 native waterfowl species of San Francisco Bay. Within broad categories, such as the diving ducks, there are important differences between species in habitat usage, migratory patterns, and breeding habitat. These subtle differences can be reflected in differences in the population dynamics of the respective species (e.g., **Figures F-1** to **F-3**). Key indicator species identified are mallard, northern pintail, northern shoveler, canvasback, scaup (both greater and lesser), surf scoter, and ruddy duck. The list of indicator species is similar to that found in *Baylands Ecosystem Habitat Goals (Habitat Goals)*. Species were selected to represent the range of habitats used by waterfowl in the Bay. Consideration was also given to whether populations are of Pacific Flyway, and/or local significance.

Geese and Swans

Geese and swans are uncommon in San Francisco Bay. Tule geese were included on the *Habitat Goals* list, but have not been included in the San Francisco Bay Joint Venture indicator list. This is because in the San Francisco Bay Area they utilize only the Suisun Marsh; the Suisun Marsh was part of the focus area for the Goals Project but is not included within the SFBJV because it is part of the Central Valley Habitat Joint Venture. Canada geese comprise the only notable population of geese within the territory of the San Francisco Bay Joint Venture. The resident population includes, but is not limited to, approximately 100 pairs that nest in the Napa-Sonoma Marshes Wildlife Area (Larry Wyckoff, CDFG, personal communication). The wintering population includes a small flock of Aleutian Canada geese which uses a reservoir near Pinole.

Dabbling Ducks

Dabbling ducks comprise almost one-half of the waterfowl in San Francisco Bay in early fall. This includes the resident birds and early migrants such as pintail. After the wintering diving ducks arrive, dabbling ducks account for only 8–30 percent of Bay waterfowl (Accurso 1992). Mallards use diked baylands and managed mashes extensively, and are the most abundant locally nesting ducks. Mallards are also the species most prized by hunters. Mallard populations are representative of other locally breeding dabbling ducks, such as gadwall and cinnamon teal. Northern shoveler and northern pintail do not nest locally in significant numbers, but are two of the most abundant wintering dabbling duck species **(Table 3-4).** They are representative of other com-

Male pintail duck US FISH AND WILDLIFE SERVICE

Table 3-4
Peak Fall–Winter Aerial Survey Counts for Waterfowl Species in San Francisco Bay[1]

Species[2]	1987–88	1988–89	1989–90
Geese			
Canada goose	64	76	183
Dabbling Ducks			
Gadwall	3,413	2782	1,526
American widgeon	7,320	6096	3,701
Mallard	506	695	702
Blue-winged teal	0	0	2
Cinnamon teal	333	317	174
Northern shoveler	26,746	38,711	48,079
Northern pintail	12,415	5,242	8,771
Green-winged teal	1,989	313	430
Diving Ducks			
Canvasback	20,235	24,153	29,818
Redhead	1	3	3
Ring-necked duck	0	0	1
Scaup	89,599	131,448	139,214
Scoter	53,763	43,263	61,248
Bufflehead	2,780	7,094	5,373
Goldeneye	97	920	909
Merganser	102	140	107
Ruddy duck	19,163	23,686	24,073
Total Waterfowl	**201,846**	**260,858**	**284,439**

Source: Accurso 1992[3]

Notes:
1. Survey area does not include Suisun Marsh and Sacramento Delta.
2. Species in italic type are key indicator species.
3. This study was the most comprehensive waterfowl survey ever performed in San Francisco Bay, and comprised biweekly aerial surveys.

mon wintering species, such as American widgeon and green-winged teal. In San Francisco Bay, northern shovelers are salt and sewage pond specialists. They are extremely abundant during December and January, outnumbering all other dabbling ducks combined (Accurso 1992). Northern pintails use a broad range of habitats within the Bay, including diked wetland, open bay, salt ponds, and seasonal wetlands.

Diving and Sea Ducks

Diving ducks are the most numerous type of waterfowl in San Francisco Bay, and are what the Bay is renowned for among waterfowl enthusiasts. Canvasback and scaup represent the large diving ducks that winter on the Bay. Scaup are the most abundant ducks on San Francisco Bay **(Table 3-4);** through the course of the winter, they total 36–68 percent of the total Bay waterfowl population (Accurso 1992). The two species of scaup (greater and lesser) are lumped together because of their similar appearance as it is difficult to identify scaup to the species level during aerial surveys. Although similar in size, canvasback and scaup have different habitat requirements. Most canvasbacks are found in salt ponds, particularly those in the North Bay, while scaup more commonly utilize shallow open bay habitats (Accurso 1992). Ecologically similar larger diving ducks include common goldeneye, redhead, and ring-necked ducks. The ruddy duck represents the small diving ducks that use managed marshes and salt ponds. The bufflehead is also in this group. The surf scoter is by far the most abundant species of sea duck in the Bay, and the second most abundant waterfowl species overall (Accurso 1992). Ecologically similar species include white-winged and

Goldeneye, a diving duck relatively common to salt ponds. SAVE THE BAY

black scoters, as well as red-breasted mergansers, smaller populations of which occur in the Bay.

San Francisco Bay Waterfowl and the NAWMP

The North American Waterfowl Management Plan (NAWMP), written in 1986, set an ambitious goal of returning North American waterfowl populations to the levels of the 1970s. The goal was based on breeding populations during average environmental conditions. Wintering populations were not explicitly considered. This presents challenges for establishing goals in San Francisco Bay, which is overwhelmingly a waterfowl wintering rather than breeding area. The implementation strategy of the SFBJV will not significantly impact geese or swans, since usage of the Bay by these birds is very limited. The ducks of San Francisco Bay, however, are significant at the Flyway scale and thus important to the NAWMP.

Continental scaup populations are substantially lower than the NAWMP goals; even more disturbing is the fact that scaup are the only duck whose continent-wide population trend from 1986–1998 was decreasing *(Expanding the Vision: 1998 Update, North American Waterfowl Management Plan)*. Almost one-half of all scaup in the Pacific Flyway use San Francisco Bay, so the importance of this habitat cannot be overstated. Even as scaup decline continentally, they appear to be increasing in San Francisco Bay **(Figure F-1)**. The 1990s had the highest decade average since mid-winter counts were initiated in 1955 **(Table F-2)**. The migratory habits of scaup are not well documented. We do not know where most of the Bay's scaup are breeding (John Takekawa, USGS-BRD, personal communication), nor do we know much about their habitat usage patterns during migration. Thus, wintering is the only phase of their life cycle where habitat usage is well documented. It is critical that we maintain and enhance that wintering habitat.

Pintails are locally abundant in San Francisco Bay **(Table 3-4)**, especially in salt ponds. There is a history of pintail use in the South Bay. They are one of the earliest arriving migrant species, so their use of the Bay is longer than most. There appears to be little interchange of South Bay pintails with the much larger Central Valley population; thus the South Bay pintails may represent a distinct subpopulation (Miller in *Habitat Goals*). It is important to conserve such within-species metapopulation diversity. However, the total contribution of San Francisco Bay to the Pacific Flyway pintail populations is minor.

Populations of several other diving duck species are of regional importance and concern. Though continentally canvasbacks are increasing *(Expanding the Vision: 1998 Update, North American Waterfowl Management Plan)*, the Pacific Flyway population has been decreasing since the mid-1970s **(Figure F-2)**. The decline of the San Francisco Bay population has been even more pronounced, suggesting a decline in habitat quality relative to other wintering areas. The decline in habitat associated with the closing of Leslie Salt's North Bay salt ponds is one possible explanation. A shift in the Bay's benthic fauna to exotic species, especially the Asian clam *Potamocorbula amurensis*, may also have contributed. More exotic species have been introduced to San Francisco Bay than any other body of water on the West Coast.

San Francisco Bay is also an important wintering area for surf scoters. They are the second most

abundant wintering waterfowl species **(Table 3-4)**. Recent midwinter Bay indices have approached historic highs **(Figure F-3, Table F-2)**, but this may simply reflect improved survey technique following a restructuring of the methods in 1988 (John Takekawa, USGS-BRD, personal communication). Like scaup, scoters present problems with identification, especially during aerial surveys. However, ground surveys have revealed that surf scoter represent 99 percent of scoter in the Bay (Accurso 1992; John Takekawa, USGS-BRD, personal communication); thus misidentification is not a significant problem. It is clear that an increasing portion of Pacific Flyway scoters is wintering in San Francisco Bay. Sea duck populations are also of concern. According to the Sea Duck Joint Venture, continental sea duck populations are substantially lower than they should be, and may be suffering from contaminants in Bay sediments. High concentrations of selenium and other metals have been found in scoters from San Francisco Bay (Ohlendorf et al. 1986), and these may negatively impact survival and/or reproduction. Water quality improvement and pollution reduction initiatives could benefit sea ducks and other benthivorous species. Restoration of riparian and coastal wetlands should reduce the bioavailability of the Bay's contaminant load by sequestering contaminants in accreted wetland sediments.

Setting Waterfowl Population and Habitat Restoration Goals

Diving ducks in San Francisco Bay represent 25–50 percent of Pacific Flyway populations, thus the Bay is absolutely essential to the continued health of these populations. The habitat needs of these species will not be met elsewhere in the Pacific Flyway. The activities of the Central Valley Habitat Joint Venture primarily benefit geese and dabbling ducks. The Pacific Coast Joint Venture is working in diving duck wintering areas such as Puget Sound and Humboldt Bay, but these areas are much less significant than San Francisco Bay. San Francisco Bay is the single most important estuary on the Pacific Coast for waterfowl and many other taxa (Fritz Reid, Ducks Unlimited, personal communication).

The activities of the SFBJV will effect a modest increase in the quantity of overall wetland habitat **(Table 3-5),** but significant changes in the quantity of specific habitat types. The major benefits to waterfowl will not accrue from the modest increase in habitat area, but rather the improvement of existing habitat via restoration, better management, and improved water quality. Wetland habitat shifts will be from the categories of "Salt Pond" and "Grassland and Associated Wetland" to "Tidal Wetland." Salt

Table 3-5

Anticipated Changes in San Francisco Bay Habitat Quantity Resulting from SFBJV Activities. (Goals partially derived from *Habitat Goals*)

Habitat Type	Present Habitat Area (acres)	Projected Change in Habitat (acres)	Percentage Change in Habitat Area
Tidal Flat	28,000	4,000	+14
Tidal Marsh	32,000	32,000	+100
Lagoon	4,000	-750	-19
Beach	70	60	+86
Salt Pond	34,000	-14,250	-42
Diked Wetland	17,000	6,000	+35
Grasslands and Associated Wetland[1]	53,000	-24,000	-45
Lake	12,000	1,000	+8
Creek and Riparian Zone	2,500	4,000	+160
TOTAL	**182,570**	**+8,060**	**+4**

Source: *Habitat Goals*, 1999

1. Category includes 30,000 acres of "Agricultural Baylands" (farmed lands), which have lower and unpredictable habitat value.

pond acreage "lost" to restoration will be primarily high salinity ponds, including crystallizers and bittern ponds (Carl Wilcox, CDFG, personal communication). These ponds do not support significant waterfowl use. Ponds retained will generally be more preferred by waterfowl, and in some cases will be managed expressly as diving duck habitat (Carl Wilcox, CDFG, personal communication). Grasslands and associated wetlands are diked and drained wetlands used for agriculture, and they are managed expressly to minimize ponding. The ponding which does occur on such land is generally only from January–March, and it does not provide reliable, high-quality habitat. Diked wetlands managed specifically for waterfowl provide much better habitat.

To achieve the habitat restoration objectives of the Joint Venture, salt pond acreage may be reduced by as much as 40 percent **(Table 3-5)**. This could have a significant deleterious effect on waterfowl in general and diving ducks in particular as salt ponds have become critical habitat for a number of species over the past century. The importance to waterfowl of salt ponds, both active and inactive, is demonstrated in **Table 3-6**.

The change in salt pond acreage should be a guideline for the SFBJV, rather than an absolute goal. Therefore, all projects conducted through the partners of the SFBJV shall consider potential impacts on waterfowl, as well as on other biota in the Bay. Given the magnitude of this habitat change, populations of these species merit careful observation and monitoring before, during, and after the restoration. An adaptive management approach to wetland restoration and management will be necessary to maintain waterfowl habitat in the long term. Losses of salt pond habitat will be offset by enhancement of remaining salt ponds, and increases in other habitat types used by diving ducks, such as tidal flat, diked wetland (managed seasonal marsh), muted tidal marsh, and deepwater (see **Table 3-5**). As noted previously, much of the salt pond acreage lost will be in high salinity ponds of low waterfowl habitat value. Also, large open ponds will be incorporated into large-scale tidal marsh restorations. Ponds about a meter in depth were a common, natural feature in the Suisun Marsh of the late 1800s, and supported large numbers of canvasback (where dabbling ducks now dominate). Loss of salt pond habitat can be partially offset by creating more seasonal wetlands, and by including muted tidal habitat in tidal marsh restorations. The muted tidal marsh at Tolay Creek, San Pablo NWR, supports large numbers of pintails during the fall (J. Jasper Lament, personal observation). Tidal marshes are an important resource for waterfowl, because, unlike many seasonal wetlands, they persist even during drought years *(NAWMP Concept Plan for Waterfowl Habitat Protection, San Francisco Bay, California)*.

One of the key attributes of the salt pond habitat is the lack of disturbance. There is little to no boat traffic on the salt ponds, thus they provide a refuge from human disturbance for rafting waterfowl. The ever-increasing boat traffic on the Bay may exact an energetic toll on wintering birds. There is probably little that can be done by the SFBJV to reduce traffic on the open Bay, but efforts can be made to provide secure, alternative roosting and feeding sites in peripheral waters.

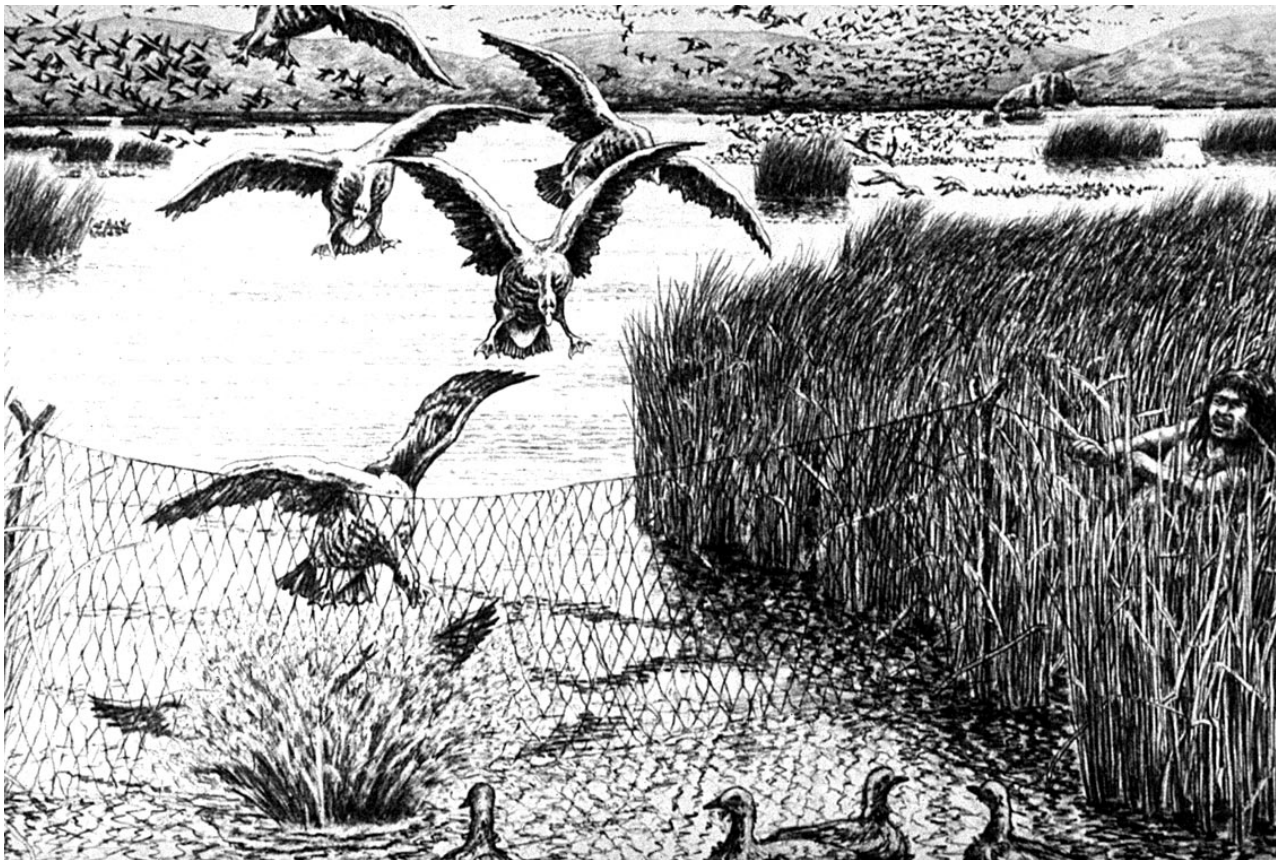
Certain diving duck species use salt ponds extensively (Accurso 1992), thus it has been suggested that maintaining recent diving duck populations **(Table 3-4)** could be a challenge if salt ponds are converted to tidal marshes. The North Bay salt

Table 3-6

Wintering Waterfowl Usage of Salt Pond Regions as a Percent of San Francisco Bay Regional Wintering Population

Species	North Bay Salt Ponds 1988–89	North Bay Salt Ponds 1989–90	South Bay Salt Ponds 1988–89	South Bay Salt Ponds 1989–90	Mean Total Salt Ponds Usage
Northern shoveler	8	10	91	88	98.5
Northern pintail	19	13.6	66	67	82.8
Canvasback	59	38	17	17	65.5
Scaup	11	2.4	2.6	1	8.5
Scoter	<0.2	<0.2	<1.2	<1.2	<1.4
Bufflehead	30	38	50	46	82
Ruddy duck	25	30	67	55	88.5

Source: Accurso, 1992



The Bay Area's original inhabitants, the Ohlone, hunted ducks with nets. FROM *THE OHLONE WAY*

ponds accounted for 15 percent of the Bay's total diving duck population in 1988–89 and eight percent in 1989–90, while the South Bay salt ponds held 11 percent and eight percent respectively (Accurso 1992). Salt pond usage by scaup, the Bay's most abundant diving duck, and scoter is quite low. Usage is much higher for canvasback, bufflehead, and ruddy duck **(Table 3-6)**. However, during winter storms, more than 50 percent of all scaup and canvasback may be found on North Bay salt pond habitats. This demonstrates the subtle differences in habitat requirements of the various diving duck species, and the need to intensively manage the salt ponds that will be maintained in their current condition.

Certain waterfowl populations will benefit from an increase in diked (managed) wetland acreage **(Table 3-5)**. The 35 percent increase in diked wetlands will benefit dabbling ducks, such as mallard, widgeon, and pintail, but also diving ducks. For example, a 90-acre diked wetland at Viansa Winery (Sonoma County) supports 30,000+ canvasbacks and pintail at a time (John Nagel and Fritz Reid, Ducks Unlimited, personal communication). Canvasback usage is especially common during periods of rough weather on the Bay, and they probably feed heavily on the submerged aquatic vegetation. This particular wetland also provides excellent dabbling duck wintering habitat.

The limited usage of the Bay by dabbling ducks, geese, and swans could be significantly expanded by restoration of tidal and freshwater marshes, riparian systems, lakes, ponds, and associated uplands. Restoration of these critical habitats would also benefit shorebirds, passerines, wading birds, and other types of wetland-dependent wildlife, including several special status species.

Shovelers and pintails both use salt ponds extensively **(Table 3-6)**. For these species, creation of new managed freshwater wetlands (6,000 acres) will help offset the reduction in salt pond acreage. Managed freshwater wetlands would be particularly sensible at sites where tidal marsh restoration is not feasible due to human activities. Management of vegetation and water levels is key to maintaining habitat diversity, and helps avoid cattail monocultures. Large stands of cattail that lack open water provide poor habitat for waterfowl and shorebirds. Seasonal wetland habitat should also be incorporated into tidal marsh restorations by designing an elevational salinity gradient. Some dabbling ducks, such as pintail and green-winged teal, will benefit from the

planned restoration of tidal flats (4,000 acres), while others, such as wood ducks and mallards, will benefit from the restoration and enhancement of riparian zones (20,000 acres). An increase in local mallards is foreseeable if a significant amount of breeding habitat is created. Local mallard production could be further enhanced through improved management of natural grasslands. Nesting structures and predator control would help reduce the impact of predation by introduced red foxes. Finally, shovelers would benefit from any new sewage lagoons, which though not part of the SFBJV Implementation Strategy, are a likely byproduct of continued human population growth in the Bay Area.

Waterfowl Population Goals

A primary waterfowl goal of the SFBJV is to provide enough high quality wetland habitat to consistently support wintering populations of key Bay waterfowl species at recent peak population levels. Key Bay waterfowl species are canvasback, scaup (greater and lesser), and scoters. More specifically, the goal for these species is to sustain populations in every year at the peak levels recorded in 1989–90 **(Table 3-4)**. Levels for 1989–90 were the highest recorded during three years of intensive surveying by Accurso (1992). This was the most comprehensive waterfowl survey conducted for San Francisco Bay waterfowl.

A secondary goal of the SFBJV is to provide enough habitat to consistently support wintering populations of other Bay indicator waterfowl species at recent peak population levels. Other Bay indicators are: mallard, northern pintail, northern shoveler, and ruddy duck. More specifically, the goal for these species is to sustain populations in every year at the peak levels recorded in 1987–90 **(Table 3-4)**. However, achieving this goal would not be an acceptable substitute to attaining the primary diving duck goals.

Other Habitat Issues

Transitional Habitat

Tidal marsh restoration is an extended process, which creates transitional habitat (in the form of large, brackish ponds) favored by diving ducks. The Tolay Creek Project in San Pablo Bay NWR is an example of a tidal marsh restoration that created diving duck habitat. The restoration of tidal action in the creek created a 53-acre brackish pond from diked, farmed baylands. This pond received immediate usage by rafts of both dabbling and diving ducks. This pond will persist for years, before bay sediments accumulate sufficiently for the area to return to tidal marsh. These projects demonstrate that better management can enhance diked baylands for the benefit of both dabbling and diving ducks. These transitional habitats, while valuable in the short term, cannot be counted on for long-term waterfowl habitat contributions.

Clean Water and Aquatic Vegetation

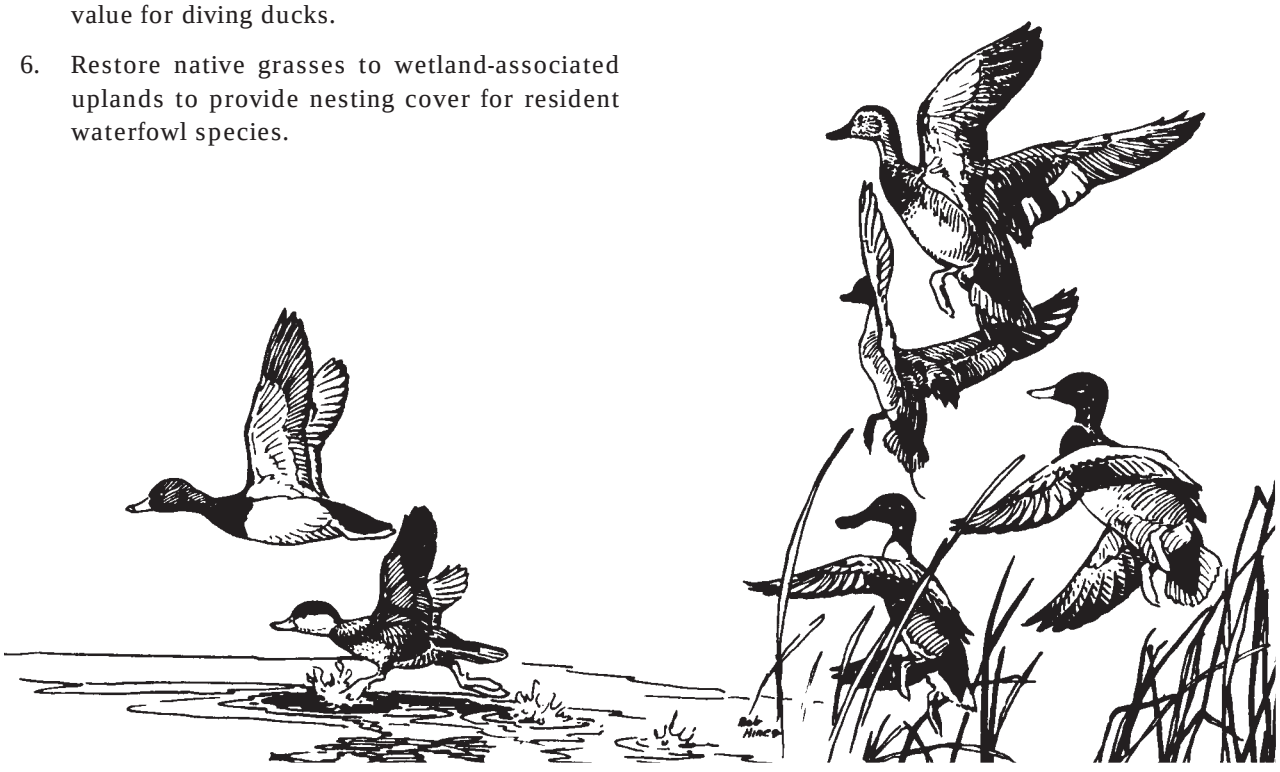
Habitat values in the open shallow bay should also improve due to better water quality. Riparian and tidal marsh restoration will reduce contaminants and sediment in runoff. Tidal marshes will filter sediments resuspended by wind and wave action on mudflats (Carl Wilcox, CDFG, personal communication). This will lead to cleaner water in the Bay. Cleaner Bay water should produce more submerged aquatic vegetation. Aquatic vegetation provides nutritional value to diving ducks superior to the mollusks that are currently available (Jorde et al. 1995). It is a particularly important dietary item for canvasbacks (Yocom and Keller 1961; Bellrose 1980). Though historic records are scarce, it seems likely that aquatic vegetation was more abundant historically, when water clarity was better. Diving and sea ducks will benefit significantly from this change, as has been observed in Chesapeake Bay. Reduced salinity due to excessive discharge of freshwater treated sewage is causing localized problems for aquatic vegetation, especially near San Jose in the South Bay. This problem should be addressed to restore ambient Bay salinity.

Exotic Aquatic Species

As the benthic invertebrate fauna of the Bay gradually shift to exotic species, it is unknown what the effect will be on molluskivorous species like scaup, scoter, and canvasback. Little is known of the nutritive value of the native or the exotic invertebrate species. For example, in the Great Lakes, it appears that diving ducks are exploiting the abundant exotic zebra mussel, but it is unknown what the effect of this dietary shift has been on survival or contaminant bioaccumulation.

Actions to Benefit Waterfowl

1. Protect, enhance, and restore diving duck wintering habitat, especially shallow open water, and ensure the maintenance of at least the peak population levels of diving duck populations recorded in 1989–90. Top priority species are canvasback, scaup, and scoter.
2. Ensure provision of sufficient habitat to consistently support at least the peak levels of resident and wintering populations of the other indicator waterfowl species recorded in 1987–90.
3. Preserve historic composition of waterfowl community relative to dabbling, diving, and sea ducks.
4. Improve management of existing habitat (especially water circulation) in active and inactive salt ponds to increase production of invertebrates and submerged aquatic vegetation (especially widgeon grass, *Ruppia maritima*).
5. Develop seasonal and riparian wetland restoration and enhancement projects that will restore filtration functions and contribute to improved water quality throughout San Francisco Bay. Improved water quality will lead to healthier aquatic vegetation, and provide higher habitat value for diving ducks.
6. Restore native grasses to wetland-associated uplands to provide nesting cover for resident waterfowl species.
7. Encourage minimal disturbance zones in shallow bay habitats favored by diving and sea ducks.
8. Encourage conservation and enhancement of shallow bay habitats favored by diving and sea ducks.
9. Where appropriate, preferentially restore higher salinity salt ponds (>70 ppt) and crystallizer ponds to tidal marsh or dry playa, rather than low and moderate salinity ponds (which have higher waterfowl habitat value).
10. Where consistent with other goals, reserve or develop large (200 to 550 ha) salt ponds of moderate salinity (20 to 30 ppt) for large diving ducks, and manage those ponds for production of widgeon grass, *Ruppia maritima*. Retain the same relative acreage of moderate salinity salt ponds within both North and South Bay.
11. Where consistent with other goals, reserve or develop medium (50 to 175 ha) salt ponds of variable salinity (<70 ppt) for small diving ducks and dabbling ducks (especially northern shoveler).
12. If industrial salt production ceases in South Bay, explore possibility of maintaining some



US FISH AND WILDLIFE SERVICE

high salinity ponds through alternative water management strategy, in order to maintain production of brine shrimp and brine flies (important food resources for some waterfowl species).

13. Restore riparian habitat to expand habitat for dabbling ducks. Plant native hardwood trees (especially oaks) and develop nest box programs in creek and riparian restoration projects where wood duck habitat potential exists.

14. Incorporate side channels and floodplain enhancement into creek and riparian restoration projects.

15. Where consistent with other goals, manage some diked seasonal wetlands for diving ducks by keeping large expanses of open water and minimizing emergent vegetation.

16. Expand waterfowl monitoring program at both Bay-wide and project-specific scales, to support enactment of adaptive management programs.

The Role of Research, Monitoring, and Evaluation

Waterfowl monitoring at the scale of the entire Bay is currently inadequate. A single midwinter survey provides only a snapshot of waterfowl use: it does not provide enough information to measure the effects of this Implementation Strategy. The addition of early and late season surveys to the existing midwinter survey would represent a great improvement. Ideally, the protocol of Accurso (1992) would be adopted, i.e., aerial surveys every two weeks from October through April. This would provide a much more complete picture of waterfowl usage in the Bay.

A substantial waterfowl-monitoring program is already being conducted by the staff of the US Geological Survey Biological Research Division, San Francisco Estuary Field Station. Monthly waterfowl ground surveys are conducted on the former North Bay salt ponds, which are now part of the California Department of Fish and Game Napa-Sonoma Marshes Wildlife Area. As habitat restoration progresses on this site, the impact on waterfowl will be tracked, facilitating the development of an adaptive management program. Over a period of one year, new management practices could be tested, the impact on waterfowl usage tracked, and feedback derived for the following year's management program. This type of program has been extremely successful in breeding habitat areas such as the Prairie Habitat Joint Venture.

We do not yet understand the mechanisms that limit wintering populations of waterfowl. This makes it very difficult to link habitat restoration goals with the population-based goals of NAWMP. Energetics-based models are a promising new approach to estimating wintering habitat requirements. However, data on food production in tidal habitats is insufficient to support such an approach in the Bay. Feeding ecology is much more complex in the Bay than in the rice country of the Central Valley. Dietary items are more diverse and dispersed, and they change in availability seasonally, and even daily. All we know at present is that food availability in the Bay is correlated with shallow bay acreage. But data on prey availability and nutritional value is insufficient to establish a direct link to the birds. More research is needed on consumption, density, and production of prey, as well as changes in diet between and within years. Until habitat needs can be determined, it is best to take a conservative approach and maximize habitat quantity and quality.

Therefore, it is an objective of this Implementation Strategy to monitor and evaluate the effects on waterfowl of the implementation of the habitat goals and make recommendations to ensure viable waterfowl populations. This objective is included with the Monitoring Objectives of Chapter 5. In light of the factors discussed above, waterfowl monitoring as part of wetland restoration should be conducted using an adaptive management approach.

4 Objectives and Strategies for Accomplishing the Vision

LIZA RIDDLE

With a vision of more than doubling tidal wetlands and more than tripling riparian habitats around the Estuary through restoration and enhancement in the next two decades, the partners of the SFBJV are seeking to accomplish ambitious, but well-researched and achievable goals. The next two chapters offer specific strategies for undertaking this vision.

In this chapter, eight sets of objectives are recommended to accomplish the Joint Venture's acreage goals. The objectives are shown at the outset of each section in italicized text and are followed by a series of proposed strategies that are designed to guide Joint Venture partners in implementing them.

Acquisition, Restoration, and Enhancement Objectives and Strategies

The Joint Venture has developed acreage objectives for permanently protecting, restoring, and enhancing wetland habitats. These goals have been developed for each of the five subregions identified within the Joint Venture boundaries. Specific strategies to accomplish these objectives are identified for each subregion, reflecting the unique qualities of each area. To further respect regional differences, watershed working groups within each subregion have been or will be established to inform Joint Venture activities with local knowledge and to carry out responsive recommendations.

Joint Venture partners will work with landowners in the pursuit of their collective objectives. Fee acquisition of private property from willing sellers will continue to be used as the primary method for acquisition where practical, and will make use of conservation easements as a major land protection tool. Conservation easements can reduce the cost of permanently protecting habitat by purchasing only the development rights while allowing the property to remain in private ownership. The fact that SFBJV is a non-regulatory entity means that its acreage objectives assume working cooperatively with willing landowners. This does not preclude the ability of agencies to condemn land in extreme cases.

The partners also recognize the importance of working with both public and private landowners in accomplishing the restoration/enhancement objectives. Many public agencies have purchased habitat but have had difficulty finding the resources to restore and enhance these properties. Many private landowners have been good stewards and would like the opportunity to do more if they had more funding and technical assistance. The SFBJV would like to build on these initiatives.

North Bay Subregion Acreage Objectives and Strategies

objectives

***A**cquire 23,000 acres of bay habitats, 18,000 acres of seasonal wetlands, and 1,000 acres of habitat associated with creeks and lakes in the North Bay Subregion using fee or permanent easement acquisition.*

***R**estore 15,000 acres of bay habitats, 4,000 acres of seasonal wetlands, and 1,000 acres of habitat associated with creeks and lakes in the North Bay Subregion on both public and private lands using non-regulatory techniques.*

***E**nhance 13,000 acres of bay habitats, 12,000 acres of seasonal wetlands, and 4,000 acres of habitat associated with creeks and lakes in the North Bay Subregion on both public and private lands using non-regulatory techniques.*

The North Bay counties of Solano, Napa, and Sonoma host a mixture of large tracts of publicly owned wildlife lands and privately owned agricultural lands presenting the opportunity to protect, restore, and enhance a large mosaic of wetlands, riparian habitat, and associated uplands of close to 40,000 acres. Marin County's shoreline and watersheds are somewhat more developed; however, 5,000 acres of undeveloped baylands remain in private ownership. Some wetland sites are under significant pressure for development, including the St. Vincent's and the Silveira properties. The western Contra Costa Shoreline has limited restoration opportunities because the area is lined with heavy industry and the neighboring community is highly urbanized. The East Bay Regional Park District has protected large tracts of shoreline and watershed properties. A few large marshes are still in private ownership, such as Wildcat and San Pablo Marshes.

The Joint Venture has already undertaken steps to expand the San Pablo Bay National Wildlife Refuge to the Marin shoreline. This expansion is the first step toward permanently protecting large tracts of shoreline properties, and gives Joint Venture partners greater access to another funding source—the Land and Water Conservation Fund.

Strategies to Acquire, Restore, and Enhance Wetland Habitat in the North Bay Subregion

Acquisition. The North Bay Subregion has several public refuges and wildlife areas owned by the Department of Fish and Game (Napa-Sonoma

Petaluma Marsh from the air. At 3,000 acres, it is the Estuary's largest remaining tidal wetland and is ripe for expansion through restoration of former tidelands. US FISH AND WILDLIFE SERVICE

Marshes, Petaluma Marsh), the U.S. Fish and Wildlife Service (San Pablo Bay National Wildlife Refuge), and the East Bay Regional Park District (Contra Costa). Fee title acquisitions in the North Bay Subregion will be completed by either public agencies or nonprofit conservation organizations including:

- U.S. Fish and Wildlife Service
- Wildlife Conservation Board/California Department of Fish and Game
- Coastal Conservancy (Bay Area Conservancy Program)
- State Lands Commission
- East Bay Regional Park District
- Marin Open Space District
- Marin Audubon Society
- Napa County Land Trust
- Sonoma Land Trust
- Sonoma County Agricultural Preservation and Open Space District.

The San Pablo Bay National Wildlife Refuge will be expanded to include most of the Marin baylands and possibly reaches of the Sonoma shoreline that are not already part of the refuge. Conservation or agricultural easements will be purchased where appropriate by public agencies or nonprofit conservation organizations including:

- U.S. Fish and Wildlife Service
- Wildlife Conservation Board/Department of Fish and Game
- Coastal Conservancy (Bay Area Conservancy Program)
- Natural Resources Conservation Service (Wetlands Reserve Program, Farmland Protection Program)
- Sonoma County Agricultural Preservation and Open Space District
- Napa County Land Trust
- Sonoma Land Trust
- Marin Agricultural Land Trust
- Department of Conservation—Agricultural Land Stewardship Program.

If these easement programs are not adequate, a conservation/agricultural easement program specific to the needs of North Bay farmers and other landowners should be developed to fill the gaps.

Restoration and Enhancement. There are numerous opportunities to complete restoration and enhancement of lands already in public ownership in the North Bay. For example, the California Department of Fish and Game and the U.S. Fish and Wildlife Service have acquired close to 15,000 acres over the past ten years. Several actions can be taken to further this objective.

1. Assist with securing funding or partners to facilitate restoration and enhancement of public lands such as Cullinan Ranch and Napa-Sonoma Marshes.
2. Encourage organizations such as Ducks Unlimited and California Waterfowl Association to continue and expand existing partnerships with public agencies.
3. Develop new sources of public and private funding that will cover the cost of planning as well as implementation for restoration and enhancement projects.
4. Support expansion of the boundaries of the San Pablo Bay National Wildlife Refuge to include Marin County baylands and sites in Sonoma adjacent to the Petaluma River and, in Napa and Solano, to ensure maximum protection of important habitats as part of the North Bay ecosystem.
5. Endorse and aid efforts by the Marin Audubon Society, Marin Baylands Advocates, and Sonoma Land Trust to acquire, restore, and enhance baylands.

In the San Francisco Bay Area, the North Bay counties of Marin, Sonoma, and Napa hold the most potential for restoration and enhancement on private lands. Many of the diked historic baylands remain in agriculture. These agricultural lands are an important part of the economy and provide various degrees of wildlife habitat. The Joint Venture partners need to continue to work with these landowners and encourage restoration on these agricultural lands by taking the following steps:

1. Implement the Stewardship Plan drafted by the San Pablo Baylands Partnership.
2. Implement watershed management plans that have been developed or are being completed for the Napa River, Sonoma Creek, Petaluma

Re-creating tidal channels at Tolay Creek (1998) DUCKS UNLIMITED

River, and others as they are identified and completed.

3. Encourage the development of watershed management plans for creeks and streams that are not currently within a watershed planning area.

4. Work with private landowners to develop habitat enhancement projects appropriate for cost-sharing programs such as the U.S. Fish and Wildlife Service Partners for Wildlife Program and the Natural Resources Conservation Service Wildlife Habitat Incentives Program (WHIP).

5. Develop a cost-sharing habitat restoration program for private landowners in the North Bay patterned after Partners for Wildlife and WHIP.

6. Work with urban creek groups to restore riparian habitat.

7. Cultivate and/or enhance Watershed Working Groups within the North Bay, particularly for the Petaluma River and Sonoma Creek watersheds.

Suisun Subregion Acreage Objectives and Strategies

(area includes Contra Costa shoreline and uplands)

objectives

***A**cquire 3,000 acres of bay habitats, 11,000 acres of seasonal wetlands, and 1,000 acres of habitat associated with creeks and lakes in the Suisun Subregion using fee or permanent easement acquisition.*

***R**estore 2,000 acres of bay habitats, 1,000 acres of seasonal wetlands, and 1,000 acres of habitat associated with creeks and lakes in the Suisun Subregion on both public and private lands using non-regulatory techniques.*

***E**nhance 2,000 acres of bay habitats, 6,000 acres of seasonal wetlands, and 4,000 acres of habitat associated with creeks and lakes in the Suisun Subregion on both public and private lands using non-regulatory techniques.*

The Suisun Subregion incorporates lands both north and south of the Carquinez Strait, but excludes the Suisun Marsh itself, which is part of the Central Valley Habitat Joint Venture's geographic scope. Lands above the 10-foot contour line surrounding Suisun Marsh are included in the San Francisco Bay Joint Venture. The areas separated by the Strait are very different in terms of habitat types and land use. The Solano County area includes duck clubs, open agricultural land (primarily grazing), and urban and residential development. The Contra Costa shoreline is heavily industrialized, and land uses beyond the shoreline include dense residential development, urban areas, and some range land in the hills along the Strait and on the flanks of Mt. Diablo. There are numerous agencies and nonprofits working on either side of the Strait, and it is recommended that two watershed working groups be established to represent these areas.

One of the largest opportunities on the Contra Costa side is working cooperatively with the Concord Naval Weapons Station and adjacent landowners to restore and enhance several thousand acres of wetlands in public and private ownership.

Strategies to Acquire, Restore, and Enhance Wetland Habitat in the Suisun Subregion

Acquisition. The Suisun Subregion has several agencies and nonprofits that can assist with the implementation of the Joint Venture's acquisition objective including:

- Wildlife Conservation Board/California Department of Fish and Game
- Coastal Conservancy (Bay Area Conservancy Program)
- State Lands Commission
- California Department of Parks and Recreation
- East Bay Regional Park District
- Contra Costa County Flood Control District
- Solano County Farmlands and Open Space Foundation
- Muir Heritage Trust (formerly Martinez Regional Land Trust)
- Agricultural Land Trust of Contra Costa County
- Save Mt. Diablo.

Conservation or agricultural easements will be purchased where appropriate by public agencies or nonprofit conservation organizations including:

- Wildlife Conservation Board/California Department of Fish and Game
- Coastal Conservancy (Bay Area Conservancy Program)
- Natural Resources Conservation Service (Wetlands Reserve Program, Farmland Protection Program)
- Department of Conservation's Agricultural Land Stewardship Program
- Solano County Farmlands and Open Space Foundation
- Muir Heritage Land Trust
- Agricultural Land Trust of Contra Costa County
- California Waterfowl Association.

Restoration and Enhancement. Restoration and enhancement goals can be accomplished on both public and private lands in the Suisun Subregion. Strategies to complete more restoration and enhancement projects on lands already in public ownership include:

1. Assist with securing state, federal, local, and private funding or partners to facilitate restoration and enhancement of public lands.
2. Increase existing and develop new sources of public and private funding that will cover the cost of planning as well as implementation for restoration and enhancement projects.
3. Encourage organizations such as Ducks Unlimited and California Waterfowl Association to build and expand partnerships with public agencies.
4. Work with flood control districts to design and construct nonstructural flood control projects and to restore riparian corridors.
5. Promote tidal restoration projects involving partnership with Mosquito and Vector Control Districts to effect multiple benefits.
6. Facilitate the development of a management plan for the Point Edith/Concord Naval Weapons Station region of Contra Costa County to encourage the restoration, enhancement, and cooperative management of wetland habitats in public and private ownership.

To encourage restoration and enhancement on private lands, the following steps should be taken:

1. Assist with the implementation of watershed management plans that have been completed or are in process, such as Alhambra Creek's.
2. Encourage the development of watershed management plans for creeks and streams that are not currently within a watershed planning area.
3. Work with private landowners to develop habitat enhancement projects appropriate for cost-sharing programs such as the U.S. Fish and Wildlife Service Partners for Wildlife Program and the Natural Resources Conservation Service Wildlife Habitat Incentives Program.
4. Work with resource conservation districts to identify enhancement opportunities.
5. Work with organizations such as Ducks Unlimited and California Waterfowl Association to expand their private lands programs.
6. Seek private funding sources for habitat enhancement projects on private lands.
7. Work with urban creek groups to restore riparian habitat.
8. Cultivate and enhance partnerships within the Suisun subregion, particularly for the Walnut Creek and Marsh Creek watersheds.

Central Bay Subregion Acreage Objectives and Strategies

objectives

A*cquire 9,000 acres of bay habitats, 1,000 acres of seasonal wetlands, and 1,000 acres of habitat associated with creeks and lakes in the Central Bay Subregion using fee or permanent easement acquisition.*

R*estore 4,000 acres of bay habitats, and 1,000 acres of habitat associated with creeks and lakes in the Central Bay Subregion on both public and private lands using non-regulatory techniques.*

E*nhance 4,000 acres of bay habitats, 1,000 acres of seasonal wetlands, and 3,000 acres of habitat associated with creeks and lakes in the Central Bay Subregion on both public and private lands using non-regulatory techniques.*

The Central Bay, which includes the cities of San Francisco and Oakland, is the region's most highly urbanized section. This places great constraints on the opportunities for acquisition, restoration, and enhancement. Nonetheless, there are a number of innovative and prominent examples of habitat projects. These include recently completed efforts to restore wetlands at Crissy Field and at Pier 98 in San Francisco. Among projects in progress are re-establishing wetlands around Oakland's Lake Merritt, riparian restoration on Codornices Creek in Albany and Cerritos and Wildcat Creeks in Richmond, the decades-long creation of Eastshore State Park, and the transfer of several hundred acres of Alameda Naval Air Station to the U.S. Fish and Wildlife Service.

There are also many opportunities to work with urban creek groups to protect, restore, and enhance the many creeks that flow into wetlands at the Bay's edge. Higher potentials for restoration exist in less urbanized portions of the Central Bay at the Corte Madera Ecological Reserve and Golden Gate National Recreation Area (GGNRA) lands in southern Marin County. It would make sense for coordinating efforts in the Central Bay to have one Watershed Working Group for the east side and another for the northwest side, such as the Aquatic Outreach Institute and the North Bay Riparian Station respectively.

Strategies to Acquire, Restore, and Enhance Wetland Habitat in the Central Bay Subregion

Acquisition. Fee or title acquisitions can be secured by several agencies and organizations in the Central Bay in spite of the relatively limited opportunities.

- U.S. Fish and Wildlife Service
- National Park Service
- Wildlife Conservation Board/California Department of Fish and Game
- Coastal Conservancy (Bay Area Conservancy Program)
- State Lands Commission
- Marin County Open Space District
- East Bay Regional Park District
- Hayward Area Parks and Recreation District

Conservation or agricultural easements will be used if the opportunity arises. Potential agencies

and nonprofits that could purchase easements are:

- U.S. Fish and Wildlife Service
- Coastal Conservancy (Bay Area Conservancy Program)
- Natural Resources Conservation Service Wetland Reserve Program, Farmland Protection Program

Hoffman Marsh near Albany Hill is visible to commuters on Interstate 80.

Restoration and Enhancement. The restoration and enhancement of lands already in public ownership in the Central Bay can be completed by taking the following actions:

1. Assist with securing funding and partners to facilitate restoration and enhancement of public lands such as Eastshore State Park and Alameda Naval Air Station.

2. Encourage organizations such as Ducks Unlimited, Audubon Society, and the California Waterfowl Association to continue to build and expand working partnerships with public agencies.

3. Work with flood control districts to design and construct nonstructural flood control projects and to restore riparian corridors.

4. Work with the Ports of San Francisco and Oakland on the use of dredge spoils for tidal wetland restoration.

5. Develop new sources of public and private funding that will cover the cost of planning as well as implementation and management of restoration and enhancement projects.

Restoration and enhancement opportunities on private lands are highly constrained by urbanization in the Central Bay. In fact, most privately held wetlands in the Central Bay are riparian. Given these factors, habitat benefits can be accomplished through the following strategies:

1. Work with groups engaged in community-based restoration, including "friends of creeks" organizations, and with resource conservation districts in Alameda and Contra Costa Counties to restore riparian habitat, as is being undertaken in Albany, Berkeley, Richmond, and Oakland.

2. Support creation of regional and sub-regional watershed councils to provide supportive forums for sharing technical information among agencies and with the many "friends of creeks" organizations, and to coordinate their strategies, activities, and projects.

3. Identify a comprehensive list of riparian projects and prioritize them by need, scope, and multiplicity of objectives.

4. Develop a wetlands and riparian "extension service" to work with private landowners to encourage better land stewardship through enhancing wetlands and creeks on their properties.

5. Encourage the development of watershed plans or coordinated resource management plans to identify sources of erosion and other impacts, and to provide "bio-technical" solutions.

6. Promote the creation of creek restoration and stewardship groups wherever there are interested residents living along the channel.

7. Develop creek restoration and monitoring programs involving schools located along creeks.
8. Work with the Watershed Assessment Resource Center to improve subregional and regional watershed planning and monitoring.

South Bay Subregion Acreage Objectives and Strategies

objectives

***A**cquire 28,000 acres of bay habitats, 7,000 acres of seasonal wetlands, and 3,000 acres of habitat associated with creeks and lakes in the South Bay Subregion using fee or permanent easement acquisition.*

***R**estore 16,000 acres of bay habitats, 1,000 acres of seasonal wetlands, and 2,000 acres of habitat associated with creeks and lakes in the South Bay Subregion on both public and private lands using non-regulatory techniques.*

***E**nhance 42,000 acres of bay habitats, 4,000 acres of seasonal wetlands, and 11,000 acres of habitat associated with creeks and lakes in the South Bay Subregion on both public and private lands using non-regulatory techniques.*

The South Bay shoreline has a complex pattern of land uses: industrial, residential, former landfill sites, wildlife habitat and, predominantly, salt ponds. Opportunities for acquisition and restoration along the South Bay shoreline have, until recently, been limited. Cargill Salt owns over 25,000 acres that are in active salt production. Joint Venture activities along the shoreline will focus on restoring parcels already owned by the San Francisco Bay National Wildlife Refuge, such as Mayhew's Landing and the Knapp Tract. However, recently and significantly, they will also include developing partnerships for purchasing Cargill's salt ponds; the company announced in October 2000 its intention to sell 19,000 acres of its holdings, preferably for wetlands restoration. The SFBJV strongly supports acquisition of the ponds.

Away from the Bay's edge, there are a number of watershed and riparian restoration efforts, such as the San Francisquito Coordinated Resource Management Plan. There are also ongoing restoration plans and projects for scores of miles of Coyote Creek and the Guadalupe River in San Jose, some of which have existed for over a decade.

Strategies to Acquire, Restore, and Enhance Wetland Habitat in the South Bay Subregion

Acquisition. Fee title acquisitions from willing sellers can be completed by public agencies or nonprofit conservation organizations including:

- U.S. Fish and Wildlife Service
- Wildlife Conservation Board/California Department of Fish and Game
- Coastal Conservancy (Bay Area Conservancy Program)
- State Lands Commission
- East Bay Regional Park District
- Mid-Peninsula Regional Open Space District
- Peninsula Open Space Trust
- Santa Clara County Open Space Authority
- Santa Clara County Land Trust.

Alviso's marina has reverted to tidal wetland. JAY JONES

Conservation easements will be purchased where appropriate by public agencies or nonprofit conservation organizations including:

- U.S. Fish and Wildlife Service
- Wildlife Conservation Board/California Department of Fish and Game
- Coastal Conservancy (Bay Area Conservancy Program)
- Natural Resources Conservation Service (Wetlands Reserve Program, Farmland Protection Program)
- Peninsula Open Space Trust (POST)
- Mid-Peninsula Regional Open Space District
- Santa Clara County Open Space Authority
- Santa Clara County Land Trust.

Restoration and Enhancement. Restoration and enhancement of lands already in public ownership can best be accomplished by:

1. Securing funding and partners to facilitate restoration and enhancement of public lands.
2. Encouraging organizations such as Ducks Unlimited and California Waterfowl Association to build and expand partnerships with public agencies in the South Bay.
3. Developing new sources of public and private funding that will cover the cost of planning as well as implementation for restoration and enhancement projects.
4. Working with flood control districts to design and construct nonstructural flood control projects and to restore riparian corridors.

Restoration and enhancement on private lands can be accomplished by taking the following steps:

1. Work with Cargill to explore ways to enhance the habitat values of the salt ponds for waterfowl and shorebirds.
2. Implement watershed management plans that have been developed or are in process for San Francisquito and Alameda Creeks, and others as they are identified and completed.
3. Encourage the development of watershed management plans for creeks and streams that are not currently within a watershed planning area.
4. Work with private landowners to develop habitat enhancement projects appropriate for cost-sharing programs such as the U.S. Fish and Wildlife Service Partners for Wildlife Program and the Natural Resources Conservation Service Wildlife Habitat Incentives Program.
5. Work with Regional Water Quality Control Boards to integrate SFBJV goals and strategies into Watershed Management Initiatives within the South Bay, particularly for the Coyote Creek and Guadalupe Creek watersheds.

San Francisco/San Mateo Coast Subregion Acreage Objectives and Strategies

Acquisition, enhancement, and restoration objectives for wetlands of this subregion have not yet been defined, but are likely to be small given their small size and limited number.

objectives

D*etermine the total acreage for acquisition of bay habitats, seasonal wetlands, and habitat associated with creeks and lakes in the San Francisco/San Mateo Coast Subregion largely using acquisition of permanent easements.*

D*etermine total acreages for restoration of bay habitats and seasonal wetlands. Restore 3,000 acres of habitat associated with creeks and lakes in the San Francisco/San Mateo Coast Subregion on both public and private lands using non-regulatory techniques.*

D*etermine total acreages for enhancement of bay habitats and seasonal wetlands. Enhance 5,000 acres of habitat associated with creeks and lakes in the San Francisco/San Mateo Coast Subregion on both public and private lands using non-regulatory techniques.*

The San Francisco and San Mateo coastal areas contain a few small coastal wetlands at the mouths of substantial stream watersheds. There are many ongoing habitat projects along this scenic coast. A community-based watershed stewardship initiative is active on San Pedro Creek. The California Department of Parks and Recreation has been implementing a hydrologic and habitat enhancement plan for Pescadero Marsh. Pillar Point Marsh has been acquired by the San Mateo County Parks Department for addition to the adjacent Fitzgerald

San Mateo coast CAROL ARNOLD

Reserve, and a master plan for this area is currently in process to identify habitat restoration opportunities. Since the relatively few wetlands on the coast tend to be small, freshwater/brackish lagoons, and most of them are already protected in state or county parks, they have not been identified among the SFBJV's acreage goals.

The majority of the Joint Venture's opportunities for habitat acquisition, restoration, and enhancement will be found in the numerous watersheds that drain to the Pacific Ocean. There are about 275 miles of streams that flow through this area into the ocean. Several watershed assessments are under way—notably for Pescadero, Butano, San Pedro, and Pilarcitos Creeks (the last having been completed)—to determine the conditions of, and project types required for these watersheds. These assessments will also help to prioritize stream projects. Given these factors, the acreage goals are quite generalized, based on the assumption that 70 percent of San Mateo coastal streams are impaired and in need of enhancement, particularly to reduce sedimentation, and that 30 percent are in need of restoration. Many of the projects would need to involve measures to reduce sedimentation and erosion in the channels, particularly serious problems degrading habitat quality for a number of threatened and endangered species, such as coho salmon, steelhead trout, tidewater goby, San Francisco garter snake, and red-legged frog.

Unlike the other four subregions in the SFBJV, there has been no biological baseline established for the historical extent of wetlands in the San Francisco/ San Mateo Coast Subregion. To rectify this, the historic and current extent of wetlands will need to be identified as a foundation for developing valid habitat objectives for this subregion.

Strategies to Acquire, Restore, and Enhance Wetland Habitat in the San Francisco/San Mateo Coast Subregion

Acquisition. Fee title acquisitions on the San Francisco/San Mateo Coast will be completed by public agencies or nonprofit conservation organizations including:

- National Park Service (Golden Gate National Recreation Area)
- U.S. Fish and Wildlife Service

- Wildlife Conservation Board
- Coastal Conservancy (Bay Area Conservancy Program)
- State Lands Commission
- California Department of Parks and Recreation
- Peninsula Open Space Trust (POST)
- Save the Redwoods League
- Sempervirens Fund
- Mid-Peninsula Regional Open Space District.

Conservation or agricultural easements will be purchased where appropriate by public agencies or nonprofit conservation organizations including:

- National Park Service
- U.S. Fish and Wildlife Service
- Wildlife Conservation Board
- Coastal Conservancy (Bay Area Conservancy Program)
- Natural Resources Conservation Service (Wetland Reserve Program, Farmland Protection Program)
- Peninsula Open Space Trust (POST)
- Pacifica Land Trust
- Mid-Peninsula Regional Open Space District.

Restoration and Enhancement. To complete restoration and enhancement of lands already in public ownership, the following steps will be taken:

1. Secure funding and partners to facilitate restoration and enhancement of public lands.
2. Encourage organizations such as Trout Unlimited and other organizations interested in fisheries enhancement to build and expand partnerships with public agencies.
3. Conduct regional biological assessments, connecting and extending watershed-level assessments, that will help to prioritize actions and practices to enhance habitat conditions for threatened and endangered species throughout their range.
4. Develop new sources of public and private funding that will cover the cost of planning as well as implementation for restoration and enhancement projects.

To encourage restoration and enhancement of riparian corridors and downstream lagoons on private lands, the following steps can be taken:

1. Encourage the development of watershed management plans for creeks and streams that are not currently within a watershed planning area, such as San Vicente, Denniston, and San Gregorio Creeks.
2. Implement watershed management assessments and plans that have been developed or will shortly be completed for key watersheds such as Pilarcitos, Pescadero, Butano, and San Gregorio Creeks.
3. Work with private landowners to develop habitat enhancement projects appropriate for cost-sharing programs such as the U.S. Fish and Wildlife Service Partners for Wildlife Program and the Natural Resources Conservation Service Wildlife Habitat Incentives Program.
4. Cooperate with the agricultural community and with organizations such as the San Mateo Farm Bureau and the County's Resource Conservation District to develop incentives for maintaining buffer areas around creeks.
5. Identify opportunities for applying conservation easements to riparian corridors, working with the agricultural community and land trusts such as POST. The intention is to provide landowners with tax credit incentives for establishing defined setbacks from creeks for conservation purposes.
6. Work with those organizations and schools that have community-based environmental stewardship programs to initiate cooperative ventures with landowners for the purpose of planting and/or maintaining buffer strips in coastal terraces and in upstream riparian corridors.
7. Use incentives for protection of recently federally listed endangered Coho salmon and threatened steelhead trout that are being developed in the Fishery Network of Central California Coastal Counties program. Employ identified best management practices (BMPs) to promote fisheries restoration in streams where sedimentation has become a significant problem.

8. Establish pilot projects within sub-watersheds to work with the agricultural community, San Mateo Farm Bureau, Monterey Bay National Marine Sanctuary, Regional Water Quality Control Boards, San Mateo RCD, and/or San Mateo County Agricultural Committee. Pilot programs should use BMPs to reduce polluted run-off and sediments, to enhance fishery habitat potential.
9. Assess historic and current extent and condition of coastal wetlands as a basis for determining more defensible objectives for acquisition, enhancement, and restoration. Assess current coverage in acres.
10. Cultivate and/or enhance the establishment of Watershed Working Groups within the San Francisco/San Mateo Subregion, particularly for the San Gregorio and Pescadero Creek watersheds.

Refinement and Facilitation of Habitat Goals Objectives and Strategies

objectives

I*mplement all of the acreage goals of the Goals Project within thirty years.*

P*romote and assist local organizations and agencies in developing and implementing habitat restoration projects.*

D*evelop subregional partnerships or watershed councils to evaluate and implement recommendations contained in the* Habitat Goals.

C*onvene a collaborative process to define acreage goals for wetlands and creeks within the San Francisco/San Mateo subregion.*

The high pace of urbanization in the Bay Area creates a greater urgency for accomplishing the wetland/ riparian acreage goals set forth in the *Habitat Goals*. Opportunities for acquisition, enhancement, or restoration will become increasingly limited with time. It is for this reason that the SFBJV will strive to attain the *Habitat Goals* targets within a decade of fulfilling the Implementation Strategy's goals. As previously noted, the Strategy represents 75 percent milestones of the *Habitat Goals'* goals.

The San Francisco Bay Joint Venture Board deliberates on the Implementation Strategy, October 1999. JOHN STEERE

The San Francisco/San Mateo Coast, while an integral subregion of the SFBJV, lacks the same level of biological assessment that was performed for the *Habitat Goals* for the other four subregions. Thus, goals for wetlands need to be established and creek goals refined using a collaborative process and ecological assessment comparable to that of the *Habitat Goals*.

Strategies to Refine and Facilitate Implementation of Habitat Goals

1. Initiate a collaborative assessment process for identifying wetland and creek acreage objectives for the San Mateo Coast, particularly for determining enhancement and restoration goals. Acquisition goals will be centered almost entirely on easements for riparian corridors.
2. Assemble and analyze existing watershed assessments to refine riparian habitat objectives.
3. Develop standards and criteria for what constitutes adequate riparian "buffer zone" width(s) for water quality, wildlife, and fisheries protection, working with urban creek groups and the Regional Water Quality Control Board.
4. Seek to protect riparian areas within the geographic scope of the SFBJV through promoting the application of adequate setbacks and through purchase of conservation easements for streamside buffer zones.
5. Wherever possible, prioritize projects within subregions based on commonly accepted criteria

such as urgency, availability of funds and ready partners, habitat critical to ESA-listed species, and level of existing biological diversity.

6. Cultivate establishment of watershed councils or watershed-based partnerships to refine and implement recommendations specific to individual watersheds/reaches of the Estuary as defined in the *Habitat Goals*, as well as strategies contained in *Restoring the Estuary*.

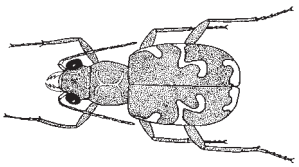
Habitat Management Objective and Strategies

objective

***I**mprove management of bay habitats, seasonal wetlands, and creeks, lakes, and associated uplands on both public and private lands.*

Thousands of acres of wetland habitat are currently found in both public and private ownership with varying degrees of management. A chronic problem for public agencies is a lack of adequate funding for operations and maintenance of their refuges and wildlife preserves. Levees cannot be maintained, biologists cannot complete basic inventories, and wardens cannot be hired. The inability to manage public lands effectively and efficiently has been the complaint of public land managers, adjacent landowners, and critics of public ownership. These problems need to be addressed if the Joint Venture wants to maximize the productivity of the habitats already in protective ownership and add to these holdings.

Youth and community involvement is a key to successful riparian renewal projects. SAN FRANCISCO BAY JOINT VENTURE



Tiger beetle *(Cicindela senilis senilis)* WES MAFFEI

Management problems on private lands frequently stem from a lack of knowledge of the best techniques that can maximize habitat benefits while also managing for agricultural purposes.

Strategies to Improve Management of Wetlands and Riparian Habitat

1. Seek federal, state, and private funding for maintenance and management.
2. Encourage the development and use of "management endowments" as part of construction budgets for restoration/enhancement projects.
3. Ensure that enhancement and restoration projects are designed to minimize need for management. Design naturally functioning systems that avoid or minimize management and that evolve to provide a range of ecosystem functions in the shortest period of time.
4. Develop partnerships with environmental organizations that can implement or help with management (removing non-native plants, replacing tide gates, restoration, monitoring, erecting signs, etc.). For example, Marin Audubon completes wetland restoration projects, and the National Audubon Society has an Audubon Refuge Keeper (ARK) program.
5. Develop guidelines for healthy riparian systems and marshes that can be used to educate private and public landowners about management techniques that improve ecosystems. These guidelines should address such issues as the interface with adjacent uplands, what healthy riparian zones look like and why they are important, where to locate trails, etc.

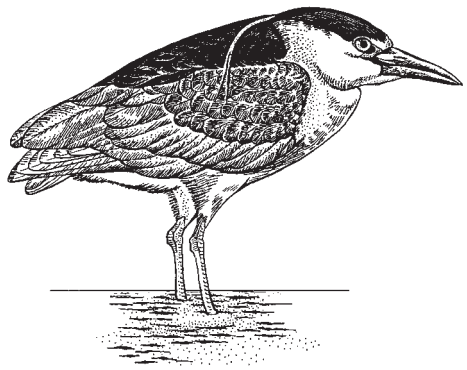
6. Encourage watershed management planning.
7. Encourage the removal of invasive species.
8. Encourage the use of native plants adjacent to wetlands and creeks.
9. Develop a program to connect ranchers with state and federal programs to enhance creeks and wetlands on agricultural lands.
10. Encourage the Regional Water Quality Control Board to evaluate all sections of the Bay, and establish and enforce Total Maximum Dissolved Loads (TMDLs) for impaired water bodies.
11. Ensure that enhancement and restoration projects are designed to minimize risks of mosquito production, flooding, and other threats to public health and safety.

Funding Objective and Strategies

objective

***S**trengthen existing and promote new funding sources for wetlands acquisition, restoration, enhancement, monitoring, and management programs.*

The Joint Venture partners have estimated the cost of reaching its objectives over the next 20 years at $1.7 billion, or $83.4 million per year for 20 years. The common theme running throughout the Implementation Strategy is the need to increase the amount of funding available for acquisition, restoration, enhancement, and management of habitat in public and private ownership. The Joint Venture partners felt that the issue was so central to its success, that a separate objective regarding funding was warranted.



Black-crowned night heron ELISE HILLEND

Strategies to Accomplish the Funding Objective

1. Promote and review existing state, federal, and private programs that can provide funding for habitat projects.
2. Leverage existing resources, and coordinate efforts with other agencies, nonprofits, corporations, and landowners.
3. Find new partners to assist with Joint Venture objectives.
4. Develop a funding package to cover the cost of implementing the SFBJV Strategy with one-third each coming from state, federal, and private sources.
5. Increase funding to existing programs such as Coastal Conservancy, Wildlife Conservation Board, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, National Park Service, Natural Resources Conservation Service.
6. Develop new state, federal, and local programs that provide funding for acquisition, restoration, enhancement, and management.
7. Coordinate with Caltrans' mitigation needs to maximize habitat restoration benefits.
8. Explore additional applications of Administrative Civil Liabilities (fine monies), and coordinate with agencies and organizations, such as the Regional Water Quality Control Board, that can use fine monies to ensure that priority projects are funded from these sources.

Programmatic Linkages Objective and Strategies

objective

***E**ncourage programmatic connections between the Joint Venture's goals and other regional initiatives that have the potential to positively effect watershed and wetland management and restoration.*

The challenges posed by the relatively high cost of wetland/riparian protection and restoration in the Bay Area can be overcome by the talents and tools of a wide array of organizations and agencies that have an interest in habitat preservation. Many of

The San Francisco Bay Joint Venture is coordinating with various partners to improve the effectiveness of shorebird conservation initiatives. SAN FRANCISCO BAY JOINT VENTURE

these are represented on the 27-member SFBJV Board of Directors. These entities can bring diverse and innovative means, and have the capacity to establish creative partnerships to accomplish the Joint Venture's objectives. The preservation, funding, and monitoring objectives can be more fully realized where linkages are made to potentially supportive programs or activities that may serve to leverage financial resources and enhance utilization of technical expertise and public outreach or involvement. Several sets of strategies to accomplish the programmatic linkage objective are enumerated below.

Coordination among Other Conservation Programs

Introduction. The power of partnerships to accomplish the Joint Venture's goals goes beyond various combinations of organizations on the present Management Board. Partnering for the sake of information exchange, legislative support, and joint grant requests and requested budget allocations extends into other conservation planning initiatives, particularly within the growing network of bird conservation programs. The following strategies apply:

1. Support the emerging framework for cooperative bird conservation in the United States through promoting an integrative and landscape approach to bird conservation and an increased coordination among separate bird conservation initiatives, notably:
   - Riparian Bird Conservation Plan for California (Partners in Flight—a coalition of migratory bird interests)
   - United States Shorebird Conservation Plan (Western Hemisphere Shorebird Reserve Network)
   - North American Waterbirds Conservation Plan.
2. Integrate riparian study areas of Partners in Flight into a regional wetlands monitoring plan database being developed for the Bay Area by San Francisco Estuary Institute and into volunteer-monitoring websites initiated by the North Bay Riparian Station and the Friends of the Estuary.

3. Work with the Riparian Habitat Joint Venture to select significant riparian habitat projects in the SFBJV geographic scope that support habitat protection recommendations of the Riparian Bird Conservation Plan.

4. Encourage coordination among different bird conservation organizations and experts in the design of large-scale tidal wetland restoration to help maximize diversity of habitat so as to meet foraging needs of both waterfowl and shorebirds, where desirable.

Berkeley's Strawberry Creek before restoration. (1980) GARY MASON

Watershed Management Planning and Implementation

Introduction. Wetland and riparian restoration and enhancement projects in the San Francisco Bay Area occur within the context of complex land use patterns and a rapidly growing urban area. Joint Venture goals can only be accomplished with increased recognition of the need for environmental planning and habitat protection at the municipal and landowner levels. In addition to leveraging financial and technical resources, the Joint Venture and its partners should "leverage" societal trends to promote implementation of a restorative vision for the Bay Area. This means promoting measures that harness and extend the influence of "watershed approaches" to planning and the "land stewardship ethic" being advanced by a wide array of organizations such as the U.S. Environmental Protection Agency, resource conservation districts, and the Regional Water Quality Control Board. Taking a watershed approach to planning involves a collaborative process and the participation of stakeholders, along with the consideration of an array of resource management concerns and the education of participants about resource and water quality issues. The following two sets of recommended actions apply:

Watershed Planning Strategies

1. Refine creek goals for acquisition, restoration, and enhancement contained in the Implementation Strategy through a collaborative process similar to that of the Goals Project. Bring riparian baseline for the San Francisco Bay region to a level consistent with the wetlands baseline assessed in *Habitat Goals*. Clarify criteria for the three stewardship categories for riparian habitats (acquisition/ restoration/ enhancement).

2. Encourage greater integration of best management practices (BMPs) for erosion control, and for floodway and riparian setbacks in land use development and municipal planning through the efforts of the Regional Water Quality Control Board.

3. Enhance riparian corridors that drain into San Francisco Bay identified by SFBJV partners, and work with community-based creek groups toward completing habitat projects that fulfill multiple objectives, (i.e., that incorporate biological, public safety, access, and/or recreational values).

4. Develop a Bay Area–wide Geographic Information System (GIS) online that combines important biological and land use data as a digital tool for promoting the integration of conservation planning with general and specific plan development. Downloadable maps should represent overlays of habitat types of the Bay Area "Ecoatlas" with digital aerial photographs. (Sponsoring agencies could include Association of Bay Area Governments, Coastal Com-

The same spot on Strawberry Creek after restoration (1990), a dramatic example of "daylighting" (bringing a buried creek back into the open). GARY MASON

mission, and Bay Conservation and Development Commission).

5. Support the development of a region-wide Volunteer Monitoring Watershed Assessment Resource Center through the Friends of the Estuary, in cooperation with the Bay Area Stormwater Management Agencies Association, and the Regional Water Quality Control Board. Promote participation by a broad range of educational institutions and community-based organizations in its formation and program implementation.

6. Promote the increase of watershed-level planning initiatives in the form of Coordinated Resource Management Program plans (CRMPs), such as the CRMPs in Napa and Santa Clara Counties, to enhance the potential for habitat preservation in concert with water quality protection.

Private Lands Stewardship Strategies

1. Support efforts of Resource Conservation Districts (RCDs) throughout the Bay Area in implementing private lands stewardship programs that preserve and enhance riparian corridors and wetlands through landowner education and assistance.

2. Using private lands stewardship initiatives, seek to cultivate common understandings with local landowners, along with the development of strategies that include cooperative agreements, conservation easements, and grazing management sufficient to protect riparian and wetland habitats.

3. Work cooperatively to enhance waterfowl habitats through active management to extend seasonal inundation of low-lying pasture lands.

4. Encourage the integration of complementary land uses that also offer a mosaic of habitats, through modification of agricultural practices (integrated pest management, cover crops, BMPs, etc.) and the restoration of riparian and wetland communities.

5. Develop cooperative programs, working with RCDs and the Natural Resources Conservation Service, to manage grazing and restore

riparian wetlands through fencing and grazing practices.

6. Work one-to-one with cooperating landowners to complete a range of habitat enhancement demonstration projects. Such projects should be chosen on the basis of: a) site suitability, b) landowner cooperation, c) availability of labor, materials, and funds, and d) likelihood of success.

Clean Water Programs

Introduction. Clean Water Programs are an outgrowth of the 1987 revisions to the federal Clean Water Act (CWA). They place greater emphasis on controlling non-point source pollutants to improve water quality throughout the nation's streams, rivers, lakes, and bays. While "point source controls" have been effectively addressed through sanitary treatment plants, success in non-point source controls remains elusive in most parts of the nation. Non-point sources of pollution contribute 75 percent of pollutants to our waterways, including bacteria, siltation, metals, pesticides, oil/grease, and organic chemicals. As a result the EPA enhanced CWA Sections 319 (non-point source) and 320 (estuary) grants for financing water quality projects to abate non-point sources, and has promoted watershed approaches to improving water quality. Wetland and riparian loss are major factors contributing to this pollution, since they serve as "biofilters" for non-point sources. Significant opportunities exist for coupling Clean Water Programs with wetland restoration, particularly through the SFBJV developing partnerships with stormwater and waste treatment utilities and in designing innovative estuary programs financed through the Clean Water/ State Revolving Funds, the major implementing mechanism of the CWA. Constructed wetlands are widely used in Europe (500+ facilities) to treat stormwater or wastewater, and there are over 200 examples in the United States.

Gum plant JACK LAWS

The following strategies apply:

1. Develop an estuary wetlands restoration program that incorporates Clean Water Program requirements for reduction of non-point sources for appropriate subregions, and design wetland and riparian projects to incorporate "biofilter" concepts.

2. Encourage partnership with the Bay Area Stormwater Management Agencies Association (BASMAA) and others to conduct demonstration projects for design and implementation of constructed wetlands to treat stormwater runoff from urban uses (e.g., on Treasure Island and at the mouth of Strawberry Creek in Berkeley).

3. Coordinate with the Bay Area Regional Water Recycling Program partners to develop appropriate demonstration projects that utilize recycled water to restore or enhance wetland communities in the North and South Bays, without altering wetland community types from tidal to freshwater.

4. Explore the potential for financing estuary wetlands restoration programs around the Bay using State Revolving Funds (SRF), with repayment of SRF loans through stormwater or utility fees, other fees, and/or Park or Water Bonds.

5. Take innovative approaches to financing wetland projects through the SRF by:

   - developing flexible institutional arrangements;
   - leveraging funding sources, such as the U.S. Bureau of Reclamation's Title XVI, Public Law 102-575, CALFED, the Water Resources Development Act, and/or new legislation;
   - integrating the public safety and biological objectives of the project through planning and design process;

This levee was breached to reopen a tidal wetland at San Francisco's Crissy Field (November 1999). CHARLOTTE FIORITO

- focusing on developing complementary relationships among participating partners.

Base Closures and Realignment

Introduction. The closure of military bases around the Bay Area presents significant opportunities for wetland enhancement and restoration. As most of the bases being closed are adjacent to the estuary and are partially built on fill, they contain substantial wetland resources—cumulatively almost 7,000 acres (source: Bay Area Defense Conversion Action Team, March 1997). In addition, the Public Trust Doctrine and Tidelands Trust Act suggest that wetlands retention and enhancement be given high consideration in base reuse plans. The potential partnerships can yield important projects. Over 700 acres of tidal marsh restoration at Hamilton Air Force Base and over 2,000 acres of wetland protection at Mare Island Naval Shipyard represent two of the most extensive urban wetland projects in the nation. Base "realignment," where an operation is reduced or where one branch of the military replaces another, as at the Concord Naval Weapons Station, can also provide positive results. Military services have no mandate to improve wetland habitats, only not to fill or degrade them. Thus incentives are usually needed. Furthermore, soil contamination on bases presents great challenges to proceeding with wetland projects.

Among the potential strategies for incorporating wetland projects into base closure or realignment programs are the following:

1. Develop wetlands programs in conjunction with high-level base staff. Seek to meet multiple objectives such as toxic cleanup and environmental stewardship, and to provide incentives. These can include:
   - improved financial feasibility of reuse through open space amenity value of wetlands
   - enhancement of public safety through reduced flood hazards or seismic risks.
2. Work with base staff to identify sources of funding for wetland projects that do not draw on their operational budgets. Look for sources that can accomplish multiple objectives such as toxic cleanup and environmental steward-

ship funds for integrated resource management planning efforts.

3. If feasible and timely, identify and recommend inclusion of selected wetland areas in base reuse plans, through a) the study of habitat values on bases by the Arc Ecology and the Military Base Closure Environmental Network, and b) the *Habitat Goals*.

4. Secure consideration of wetland restoration and/or constructed wetlands projects (see Clean Water Program strategies) in the base reuse as part of the "master development agreements" using a multiple objective approach.

5. As part of an incentive program, identify opportunities for wetland construction under selective circumstances that could be coupled with toxic cleanups through bioremediation, that is, where remediation does not involve persistent heavy metals contamination (e.g., Point Molate and Mare Island where contamination is largely from petroleum-based distillates).

Planting crib walls on Strawberry Creek, at the University of California Berkeley Campus. JOHN STEERE

6. Promote criteria for cleanup of base facilities that allow for a probable future hydrology (i.e., restoration of historic wetlands). This would provide a higher and more beneficial threshold than reliance on current hydrology as a criteria.

7. Ensure protection of wetlands and wildlife resources in developing public access plans for bases.

Communications Objective and Strategies

objective

D*evelop an inclusive, collaborative, and broad-based public outreach program to communicate the vision of* Restoring the Estuary.

Introduction. Communications are essential to building and implementing a long-term vision to restore the Estuary and its watersheds. Accomplishing this vision through the objectives of the Implementation Strategy will require extensive communications, both externally and internally among SFBJV partners. This means developing broad-ranging and innovative outreach to the public, coupled with open and constructive interchange among Joint Venture partners. Internal communications are focused on information sharing and mutual assistance, and are directed toward improving the level of cooperation between the SFBJV partners. Public outreach includes education and awareness building, which, if done well, will translate into the public support that is key to completing wetland projects of regional significance. This support, based on understanding the value of wetlands and the need for their restoration, can engender new funding sources and improved cooperation between non-governmental organizations (NGOs), agencies, and the private sector. Effective outreach will also cultivate more volunteers for community-based stewardship and restoration groups. The more varied and creative the communication tools, the more widely the message of "Restoring the Estuary" will be disseminated, and the greater the collective capacity will be to initiate and maintain wetland projects.

Among communication strategies for Joint Venture partners to pursue individually and collectively are the following:

1. Employ a collaborative approach to both public outreach and communications among partners to create a more inclusive climate, which is con-

ducive to broadening the range of partnerships for wetlands.

2. For habitat enhancement and restoration projects or monitoring programs, develop partnerships with schools having field-based education programs, with NGOs that offer ecological educational services, and/or with community-based groups that participate in biological monitoring/stewardship efforts.

3. Wherever feasible, link environmental education programs of schools and appropriate NGOs with the implementation of monitoring of riparian and wetland projects.

4. Conduct high-visibility pilot projects and programs to test, refine, and encourage the use of partnerships to accomplish habitat goals. To enhance their outreach effectiveness, seek to distribute these widely around the Bay.

Volunteers build support for restoration at the grass roots. JOHN STEERE

5. Encourage the creation and maintenance of watershed councils or estuary restoration groups as partnerships for habitat improvements. They can help design education, enhancement, and stewardship programs for specific subregions or segments within those subregions (potentially using the recommendations for these segments in the *Habitat Goals* as a framework for action).

6. Develop a website that identifies all habitat projects on the "EcoAtlas" map of the region according to key information about the project, contacts, and acreage involved. Link to web pages of participating partners.

7. Ensure continuance of SFBJV committees—notably Acquisitions and Restoration, Public Outreach, and Creeks Committees—to promote project coordination and information sharing on a region-wide basis.

8. Promote informal liaisons with "friends of" wetlands/creeks organizations, and encourage them to adopt the goals and objectives of the SFBJV as the context for their individual actions.

9. Develop a documentary film that expresses the biological vitality of the Bay, and illustrates the habitat goals through computer simulation of the past and potential Estuary.

10. Stage a "Restoring the Estuary Festival," composed of SFBJV partners and civic and arts organizations, around the theme of the renewal of the San Francisco Bay and its watersheds. Consider conducting it on an annual or biannual basis as a regional awareness-building festival of films, tours, exhibitions, and performances about wetlands and the many benefits of living by an estuary, recognizing the role of artists and writers in communicating and animating the restorative vision, and in cultivating a sense of place.

11. Develop and maintain contacts with local officials, professional societies, and special interest groups to communicate the goals and objectives of the Joint Venture.

12. Promote extension education regarding ecological restoration and related fields through organization with the Society of Ecological Restoration; UC Berkeley and Davis; Hayward, San Francisco, San Jose, and Sonoma State Universities, and other universities and colleges.

13. Support locally organized workshops and field tours that seek to educate the public about the Estuary and its watersheds.

14. Participate in local events such as watershed tours, harvest festivals, and Earth Day programs.
15. Publicize San Francisco Bay Joint Venture projects and accomplishments in local and regional media outlets including newsletters, newspapers, and television.
16. Conduct legislative tours for state and congressional representatives and their staffs in various subregions of the Bay to promote the habitat project opportunities and needs.
17. Work with relevant agencies and nonprofit groups to develop and implement regional wetland and riparian monitoring protocols. See Chapter 5 for details.

Legislative Objective and Strategies

Introduction. The Joint Venture established a Legislative Committee with two objectives: 1) to develop and conduct a legislative strategy to secure funding and otherwise support projects promoted by the Joint Venture; and 2) to track legislative issues and advise Management Board on appropriate action as needed. In 1999, the Legislative Committee expanded to include representation from the Central Valley, Intermountain West, and Pacific Coast Joint Ventures, in order to better coordinate these purposes on a statewide basis. The following strategies summarize the near-term (five-year) aspects of legislative agendas that are annually adopted by the Management Board and which define the SFBJV's legislative priorities. These strategies reflect the perspectives of the nongovernmental organization members of the Board and exclude the public agency members who are unable to take positions on legislative issues.

State

1. Secure an annual allocation for appropriate state agency budgets for the San Francisco Bay Joint Venture.
2. Work closely with the Bay Area Open Space Council to create the Transportation Fund for Clean Water, a new vehicle license fee for use in wetland and riparian projects that reduce pollutant levels and improve water quality.

Federal

3. Support full funding for the Land and Water Conservation Fund.
4. Support full funding of the North American Wetlands Conservation Act.
5. Support legislative efforts that fulfill the goals of the North American Waterfowl Management Plan.
6. Support the passage of and full funding for the Estuary Habitat Restoration Partnership Act.
7. Maintain efforts to increase funding levels for ecosystem restoration in the Bay. Also support funding from both state and federal levels.
8. Support legislative efforts to increase funding for other migratory bird projects.

Operations and Maintenance

9. Strengthen existing and promote new funding sources for the management of public lands through working with organizations such as the Bay Area Open Space Council, and consider developing tools such as management endowments.

5 Monitoring and Evaluation of Habitat Goals Accomplishments

KENNETH GARDINER

The Need for Monitoring

Wetland restoration is a relatively new field, and the results are anything but certain. Studies conducted to determine the success rates of wetland restoration projects in California have indicated that end results often do not meet expectations. Sometimes, expectations for success are met by some performance criteria, but not by others. Because of a lack of consistent measurements and standards for wetland restoration, "success" is often ill-defined. Wetland systems are complex and can require decades to reach equilibrium as ecosystems. Because of this complexity, project goals and objective performance criteria need to be properly defined if the success of any restoration project is to be accurately measured.

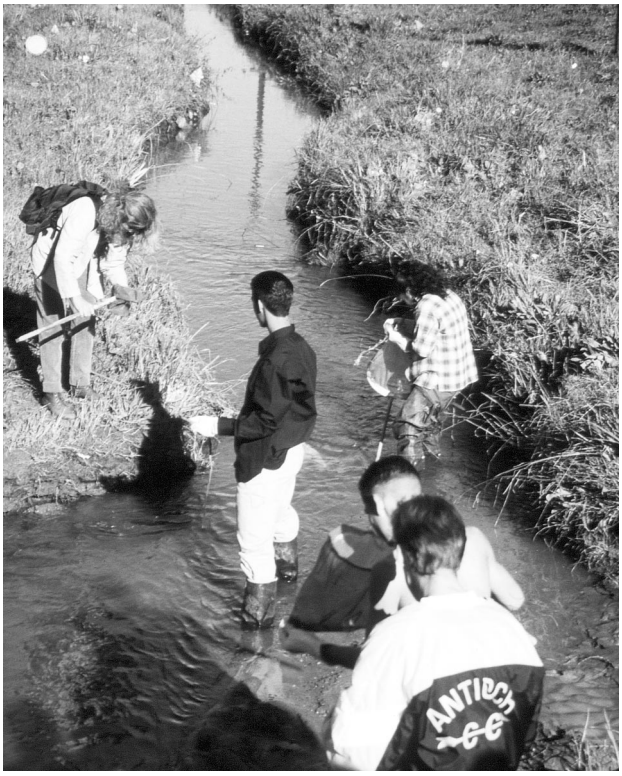
Restoration of "historic" wetlands in the San Francisco Bay Estuary is often difficult to achieve. The difficulty is a direct result of the large-scale human disturbances that have altered the watersheds and baylands of the region. These changes have caused fragmentation among the Bay Area's wetlands, leaving few if any historic wetland complexes intact. Present-day restoration projects commonly aim to create wetland systems that function within modern natural physical and biological processes, which practitioners recognize as different from pre-European conditions. In light of the uncertainties surrounding wetland restoration outcomes, many restoration programs are recommending an adaptive management approach. The CALFED Ecosystem Restoration Program, for example, combines regular monitoring and review as a basis for modifying projects throughout the lengthy restoration process. The need for this kind of approach is particularly evident in developing a realistic waterfowl monitoring program, as outlined in the "Waterfowl Benefits" section of Chapter 3.

There are many ongoing and proposed tidal restoration projects throughout the San Francisco Bay Estuary. Perhaps the largest issue limiting the success of these projects is the inability to understand the various restoration techniques and their effects on wetland habitats and the species utilizing them. It is difficult to gauge the effectiveness of managing for special status and native species if one lacks basic knowledge of habitat functions, species requirements, and complex ecological interactions. Tidal wetland restorations can be difficult to design and there are few projects that can be used as models. In addition, intricate geomorphological and hydrological details must be properly addressed if success is to be attained.

Because most wetland restoration projects are complex, few are considered to be complete when construction has concluded. Documentation of how a wetland ecosystem is changing, in which direction, and by what magnitude, is necessary to

determine long-term success. Despite its vital role, monitoring has traditionally received little attention in pre- or post-project planning. Funding amounts for monitoring are often less than one to two percent of total project costs. This figure is much less than the 10–20 percent level of funding needed for comprehensive monitoring coverage through the life of a project. Monitoring, with sufficient funding to complete the task, will be a critical component of all Joint Venture restoration projects.

The San Francisco Bay Regional Monitoring Program for Wetlands (WRMP) is being designed to provide the framework necessary to monitor the success of the Joint Venture habitat projects. The WRMP is a cooperative undertaking by the U.S. Environmental Protection Agency, the San Francisco Estuary Institute, the California Coastal Conservancy, and several regulatory and resource agencies and nongovernmental organizations. The WRMP represents the next step, following the *Baylands Ecosystem Habitat Goals,* in implementing the 1993 Comprehensive Conservation and Management Plan for the San Francisco Estuary. The WRMP will provide a comprehensive set of protocols for field data collection and quality assurance/quality control, as well as the management, interpretation, and dissemination of monitoring data. The WRMP will prepare two components, one for monitoring "ambient" conditions in existing wetlands and the other for monitoring restoration projects.



Volunteers monitor invertebrates in a streambed.
JOHN STEERE

Monitoring Objectives and Strategies

objectives

***A**pply general guidelines for monitoring as defined by the Regional Monitoring Program for Wetlands and promote their use at a project level throughout the region.*

***I**nclude monitoring as part of all habitat restoration and enhancement projects.*

***E**valuate the effects on waterfowl of implementing the SFBJV habitat goals and make recommendations to ensure viable populations.*

***P**rovide for regional coordination and communication of monitoring and evaluation of results to enable adaptive management of existing projects and to foster improved design for future projects.*

***W**herever feasible, include monitoring costs in construction budgets for habitat projects through monitoring endowments or other means.*

There are many participants in the various projects currently taking place throughout the Estuary. Various governmental agencies, nongovernmental organizations, businesses, and individuals are involved in design, construction, and monitoring of wetland restoration, creation, or enhancement projects. Because each project is unique, the problems encountered and successes achieved vary greatly. Biophysical monitoring is a way to measure the progress of a project towards achieving its intended goals. But many different approaches to monitoring and project evaluation exist, as does a wide variety of project goals. Criteria for which parameters to monitor, how to monitor them, and how frequently or how long they should be monitored also vary widely. Consequently, there are no standard guidelines for monitoring parameters and protocols, both of which are needed to measure project success.

Two of the most important roles of the SFBJV will be to promote goals and to standardize guide-

lines for biophysical monitoring in wetland restoration. Neither area has received sufficient emphasis in past restoration projects. Success will require 1) funding, 2) preconstruction monitoring to determine existing natural resource values, and 3) carefully designed, repeatable postconstruction monitoring that reveals trends from construction through the completion of the restoration process, decades later. The SFBJV will serve both as a focus for wetland restoration in the local community and as a resource for sharing information about problems encountered and results achieved in wetland projects.

The following are strategies to accomplish the monitoring and evaluation objectives.

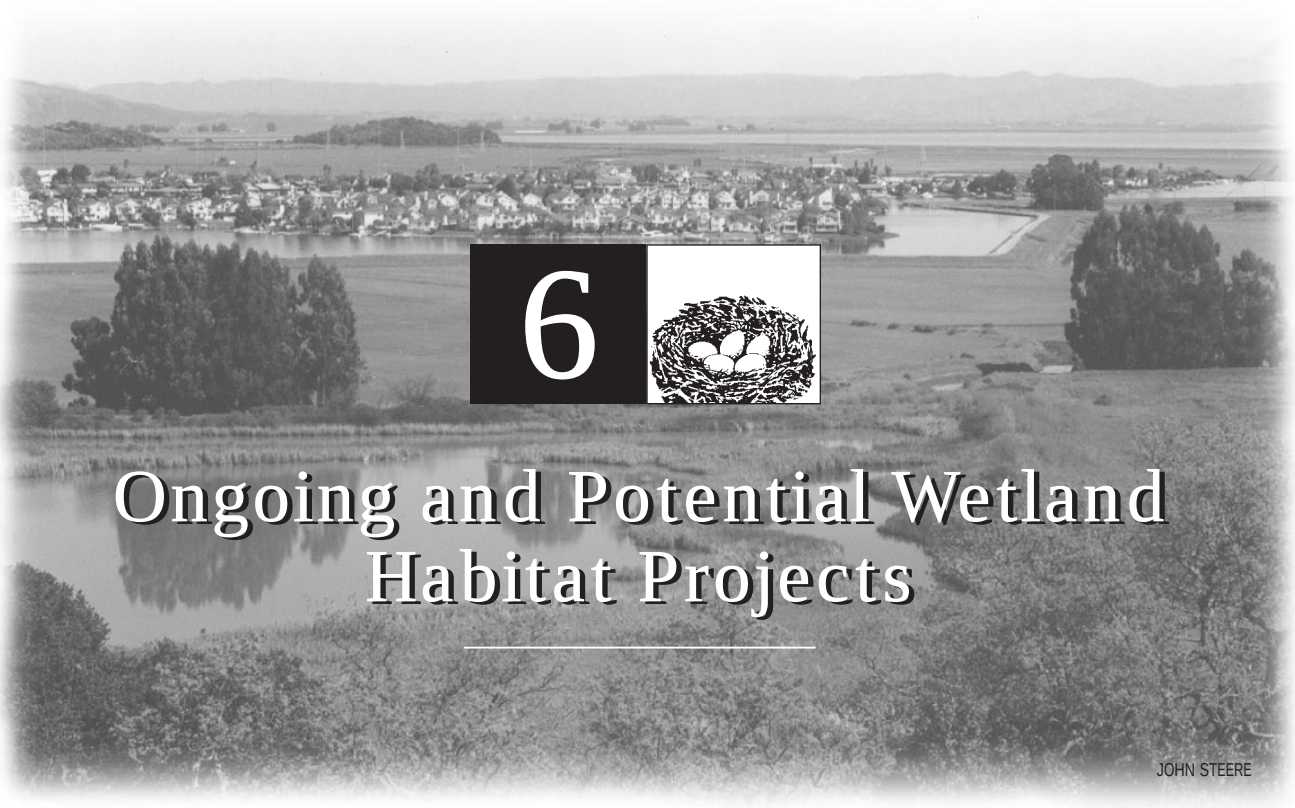
In-stream water quality monitoring JOHN STEERE

Monitoring and Evaluation of Restoration Projects

1. Establish and maintain a list of projects, agencies, or individuals in charge of projects, monitoring techniques used, and the source for monitoring results for wetland projects within the Joint Venture region.
2. Determine and evaluate past or existing monitoring programs or guidance documents for proposed Joint Venture projects, and ensure that sufficient monitoring and evaluation funding is included in all funding requests for all Joint Venture projects.
3. Work with the wetland restoration community to establish standardized wetland monitoring recommendations. Include cost estimates for each step of the monitoring process.
4. Support an annual meeting of restoration practitioners and wetland researchers to present monitoring results and evaluation of individual projects.
5. Establish and maintain a list of universities, schools, and other groups interested in adopting projects or portions of projects for long-term monitoring.

Research

6. Develop a summary of information on wetland restoration topics within different disciplines (e.g., hydrology, wildlife, fisheries) relevant for understanding regional wetland diversity and for individual restoration projects.
7. Create a list of research needs to support a better understanding of the function of wetlands of the region and to support individual restoration projects. Review annually.
8. Prioritize research projects, estimate costs for funding by Joint Venture partners, and encourage funding support.
9. Support pilot restoration projects to develop monitoring techniques and evaluate such wetland design features as size, salinity, habitat elements, and minimizing human disruption.



6 Ongoing and Potential Wetland Habitat Projects

The San Francisco Bay Joint Venture partners have been undertaking a wide array of wetland projects throughout the region. The following listing of their habitat projects comprises 43,000 acres of ongoing and potential initiatives. It demonstrates both the great level of activity and the promise for wetland and riparian restoration and enhancement throughout the geographic scope of the Joint Venture. To underscore the reality and the potential of the SFBJV's efforts, this listing is divided between "Ongoing and Pending Habitat Projects" and "Potential Projects for 2001 and Beyond." These categories serve to distinguish near-term initiatives from long-term opportunities.

The projects listed below are keyed to **Figure 6-1,** "San Francisco Bay Joint Venture Habitat Projects: 2000." These are partnership-based and are grouped by subregion, beginning with the North Bay, moving clockwise around the Bay. The project codes refer to these subregions, where "N" means North Bay, "CB" equals Central Bay, etc. Project descriptions are also keyed to this figure; they are a reasonable representation of the projects that are being undertaken or contemplated around the Bay Area. While this listing is intended to be comprehensive, it is not exhaustive. In addition, not all projects shown in Figure 6-1 are described here. For identification purposes, "High Activity" wetlands and creek projects shown on the map have been denoted in the project title. The term "High Activity Project" represents habitat projects where the Joint Venture is active.

Ongoing and Pending Habitat Projects

The projects below are well distributed among acquisition, enhancement, or restoration. They can be regarded as *in process* or partially completed, but generally in need of additional funding for completion. Together, these habitat projects constitute roughly 31,400 acres.

North Bay Subregion (N)

N2. Triangle Marsh, Marin County. The 31-acre Triangle Marsh property, near Corte Madera, is a remnant tidal area (with a tidal panne) along the Marin Baylands. Marin Audubon initiated the project and it was recently purchased with grants from the Coastal Conservancy and Marin Open Space District. The marsh provides habitat for the endangered California clapper rail and shorebirds and waterfowl migrating along the Pacific Flyway. It will become a part of the expanded San Pablo Bay National Wildlife Refuge (Project N9).

N7. Hamilton Wetlands Restoration, Novato, Marin County. The Coastal Conservancy and Bay Conservation and Development Commission are taking the lead on securing the transfer of 700 acres from the former Hamilton Army Airfield to a public resource agency. The commission is completing a plan for the

restoration of tidal and seasonal wetlands. With the purchase of the adjoining 1,600-acre Bel Marin Keys parcel in process, the project can be expected to restore 2,300 acres of habitat.

Corte Madera Marsh in Mill Valley prior to restoration (May 1992) BARBARA SALZMAN

N9. San Pablo Bay National Wildlife Refuge Expansion, Marin County. *(High Activity)* The San Pablo Bay National Wildlife Refuge expanded its boundaries in 1996 by approximately 7,000 acres. The Marin Audubon Society and the Joint Venture are working with the U.S. Fish and Wildlife Service to expand the refuge to the Marin Baylands where numerous restorable properties are proposed for development. Once added to the Refuge, these properties can be restored to tidal and seasonal wetlands.

N10. San Antonio Creek—George Googins Project, Sonoma County. The Southern Sonoma County Resource Conservation District is overseeing the enhancement of 50 acres of stream bank along San Antonio Creek. The project will apply various techniques including revegetation to control sediment in order to improve salmon rearing and spawning habitat.

N11.1 Petaluma River, Marin and Sonoma County. *(High Activity)* The City of Petaluma has been active in the acquisition and restoration of riparian habitat and diked baylands along the portions of the Petaluma River within its limits. The SFBJV is working with the Southern Sonoma Resource Conservation District (RCD), which completed a Watershed Plan in 1999, in convening a broad public-private partnership to foster riparian and land stewardship, and tidal restoration projects all along the river.

N12. Petaluma Marsh Expansion, Marin County. Marin Audubon Society and the Coastal Conservancy are coordinating the acquisition and restoration of 180 acres of diked land on the Marin side of the Petaluma River.

N13. Rush Creek/Cemetery Marsh Enhancement, Novato, Marin County. Marin Audubon Society has raised funds through the Marin Conservation Foundation, the Coastal Conservancy, and the FWS to enhance wetlands through improved tidal inflow to adjoining properties totaling 300 acres. The land is owned by the California Department of Fish and Game and Marin Open Space District.

N14. Scottsdale Marsh, Novato, Marin County. The City of Novato has been restoring a 41-acre marsh consisting of emergent, seasonal, riparian, open water, upland transitional habitat, and a 14-acre pond.

N15. Parcels at Olive and Atherton Avenues, Marin County. This project comprises 144 acres of critical wetland acquisition that will help preclude urban expansion into upland transitional marshes that surround San Pablo Bay. Restoration activities include constructing levees, designing and constructing wetlands, and installing water-control structures.

N16 North Parcel, Sonoma County. This is a 470-acre former agricultural parcel located in Sonoma County. The project will restore and enhance seasonal wetlands, with modifications to activities including installing water control systems and recontouring wetland pond bottoms. The restored parcel will provide alternative roosting and foraging habitat for wintering shorebirds and waterfowl.

N17.1 Schellville Restoration and Flood Control Project, Sonoma County. The Southern Sonoma

Corte Madera Marsh in Mill Valley after restoration (Sept. 1992) BARBARA SALZMAN

County Resource Conservation District is working to acquire and restore 700 acres of tidal wetlands along lower Sonoma Creek. The multi-objective restoration and flood protection project would provide protection for light and commercial industry, and residential and local infrastructure.

N17.2 Carriger Creek, Sonoma County. The Southern Sonoma County Resource Conservation District is working with property owners to restore 500 acres of riparian habitat along Carriger Creek. The Creek, which has historically provided good spawning habitat for steelhead, has experienced severe erosion and is down-cutting rapidly.

N17.3 Sonoma Creek (Various Sites), Sonoma County. The Sonoma Ecology Center, The Southern Sonoma County Resource Conservation District, and various public and private agencies are working on the restoration and enhancement of numerous sites along Sonoma Creek. A restoration and enhancement plan will focus on creek restoration, vineyard demonstration projects, and habitat monitoring.

N18. Camp Two, Sonoma County. The Wildlife Conservation Board recently acquired two Camp Two properties totaling 608 acres. These properties are being restored for floodplain and wetlands habitat.

N19. Tolay Creek, Sonoma County. This project returned tidal flows to Tolay Creek, restoring 435 acres to tidal marsh. The U.S. Fish and Wildlife Service is the lead agency, but many partners have contributed to the completion of this project.

N20. Lower Tubbs Island Restoration, Sonoma County. The U.S. Fish and Wildlife Service is restoring 72 acres of diked agricultural baylands to wetlands, high salt marsh, and transitional uplands with assistance from Ducks Unlimited. The parcel is immediately adjacent to San Pablo Bay and when restored will provide critical roosting and foraging habitat for wintering shorebirds. Restoration activities include engineering and design, building a new levee inland from the Bay, then breaching the bayside levee.

N23. San Pablo Bay North American Wetland Conservation Act Grant Sites, North Bay Counties. *(High Activity)* Under this grant, 13,874 acres of varied wetland habitat types critically important for migrating and wintering waterfowl will be enhanced and restored. Newly constructed lagoon areas will provide protected open water habitat for waterfowl until those areas revert to tidal marsh. Managed and seasonal wetlands will increase the available habitat for foraging and roosting waterfowl. Among the restoration and enhancement sites included in the grant are the following: North Parcel/Leonard Ranch (Project N16); the Lower Tubbs Island Setback Levee project (Part of Project N20), and Ringstrom Bay, Camp 2, Pond 8, and Huichica Creek Units of the Napa-Sonoma Marshes Wildlife Area. These last four habitat enhancement projects are being undertaken by the California Department of Fish and Game and Ducks Unlimited in order to enhance 4,691 acres of a mosaic of wetlands via improved water control.

N25. Cullinan Ranch, Vallejo, Solano County. This 1,500-acre ranch was purchased by the U.S. Fish and Wildlife Service for the San Pablo Bay National Wildlife Refuge several years ago. The Service is working with Ducks Unlimited to complete the first phase of tidal restoration.

N27. Mare Island and North Bay Discovery Center, Vallejo, Solano County. The U.S. Fish and Wildlife

Service will acquire 162 acres of tidal and seasonal marsh from the closed Mare Island Naval Station. The Service will lease approximately 2,000 additional acres from the State Lands Commission. The Service is also working with the community to develop the North Bay Discovery Center.

Gallinas Creek prior to restoration (Spring, 1992) BARBARA SALZMAN

N29. Napa River Flood Control Project, Napa, Napa County. The Napa County Flood Control District, working with the community, Coastal Conservancy, Department of Fish and Game, Napa County Land Trust, Army Corps of Engineers, and several other agencies, has completed a flood control/habitat restoration plan that will restore approximately 950 acres of wetland habitat along the Napa River as part of an environmentally oriented approach to flood control. With funding matches from federal, state, and local sources established, the project has begun implementation.

N30. American Canyon Acquisition and Restoration, American Canyon, Napa County. *(High Activity)* The City of American Canyon and the Department of Fish and Game have recently completed the purchase of 460 acres from the Port of Oakland. This will permit a floodplain connection to the Napa River and provide a foundation for tidal and seasonal wetland restoration.

N37.2. Lower Wildcat Creek, San Pablo, Contra Costa County. *(High Activity)* County Flood Control, Urban Creeks Council, and other organizations are working on a habitat restoration plan for 100 acres of disturbed habitat along the lower regions of Wildcat Creek. The plan would include restoration of fisheries, floodplain management, and an environmental youth program.

Suisun Subregion (S)

S3. Martinez Regional Shoreline Marsh Restoration, Martinez, Contra Costa County. The East Bay Regional Park District (EBRPD), Caltrans, Contra Costa Mosquito and Vector Control District, and the City of Martinez have begun implementation of restoration and enhancement of 50 acres of tidal marsh within the Martinez Regional Shoreline.

S5. McNabney (Shell) Marsh, Martinez, Contra Costa County. The McNabney Marsh Management Advisory Committee, with the Contra Costa Mosquito and Vector Control District as the lead agency, is restoring and enhancing the 200-acre Shell Marsh by improving tidal flushing. The project provides ancillary benefits for flood reduction and mosquito control.

S7. Point Edith Wetlands Project, Contra Costa County. The Contra Costa County Mosquito and Vector Control District (CCCMVD), California Department of Fish and Game, and the U.S. Navy are restoring tidal action to portions of 3,000 acres of private and public land, including the Concord Naval Weapons Station. Current activities include wetland restoration pilot projects and feasibility studies.

S9. North Contra Costa County Shoreline. *(High Activity)* This subregional ecological initiative is primarily focused on joint use resource management proposals for tidal wetlands and riparian restoration on the Concord Naval Weapons Station, that involves a variety of federal and state agencies, as well as special districts such as the EBRPD and CCCMVCD. It also incorporates the partnerships

Gallinas Creek after restoration (Fall 1992) BARBARA SALZMAN

and geographic scope of other major wetland sites along the south Shore of Suisun Bay including the Martinez Regional Shoreline (S3), Point Edith (S7), and Bay Point (S10).

S10. Bay Point Restoration Project, Bay Point, Contra Costa County. The East Bay Regional Park District is nearing completion of a plan for tidal marsh restoration on this 150-acre site near Pittsburg.

S13. Big Break Acquisitions, Oakley, Contra Costa County. The East Bay Regional Park District has acquired 2,000 acres of Delta wetlands. A land use plan has been prepared and funding for wetlands restoration is being sought.

S14. Delta Science Center Wetland Restoration, Oakley, Contra Costa County. The East Bay Regional Park District, Mt. Diablo Audubon, Contra Costa Mosquito and Vector Control District, and the Ironhouse Sanitary District are the major partners in creating the Delta Science Center. The center has been envisioned as a nonprofit research and educational facility offering visitors an opportunity to learn more about the Delta and participate in developing solutions to Delta problems. The Center has the potential to restore tidal and riparian habitat to approximately 3,500 acres.

S23.1 Lower Walnut Creek Restoration, Contra Costa County. *(High Activity)* Contra Costa County Flood Control District is working with a range of federal and state agencies, municipalities, and the Friends of the Creeks to initiate a pilot project to restore a riparian ecosystem on the creek. Corps of Engineers support is being sought for a number of potential actions including removal of fish barriers (drop structures), creation of a low-flow channel, resolution of sedimentation problems, and restoration of tidal action at the mouth of the creek.

S23.3 Walnut Creek, Walnut Creek, Contra Costa County. Friends of the Creeks and the City of Walnut Creek have completed a master restoration and enhancement plan for the downtown section of Walnut Creek. The plan includes a trail along the entire downtown section of the creek, removal of invasive plant species, and subsequent revegetation.

Central Bay Subregion (CB)

CB13. Sausal Creek, Oakland, Alameda County. *(High Activity)* The Aquatic Outreach Institute, Friends of Sausal Creek, the City of Oakland, and other public and private entities have undertaken two actions to enhance this urban creek. The first is to develop an exotics eradication program, which includes the development of an Exotic Species Management Plan and the restoration of areas most in need of preservation, slope stabilization, and revegetation. The second major activity consists of developing a watershed management plan for this 2,656-acre watershed. Currently, restoration work is occurring on six acres. The overall watershed plan will focus on natural resource and public access assessments, defining appropriate management actions and time frames to ensure the plan is a success.

CB16. Alameda Naval Air Station, Alameda, Alameda County. The U.S. Fish and Wildlife Service in conjunction with Golden Gate Audubon are requesting transference of 565 acres of land from the decommissioned naval air station. If successful, the

Key to San Francisco Bay Joint Venture Habitat Projects (by Subregion)

ID	Habitat Project Name	Acreage
North Bay (N)		
N1	Arroyo Corte Madera (Mill Valley)	4
N2	Triangle Marsh - Corte Madera	31
N3	Corte Madera Creek	NS
N4	Madera Bay Park	5
N5	Canalways (San Rafael)	85
N6	North Bay Riparian Station	NA
N7	Hamilton Wetlands Restoration	900
N8	Bel Marin Keys	1,600
N9	San Pablo Bay NWR Expansion (among sites are Bahia and Silveira Ranch)	8,000
N10	San Antonio Creek - George Googins Project	NS
N11	Petaluma River Watershed Plan	NA
N11.1	Petaluma River	NS
N12	Petaluma Marsh Expansion	180
N13	Rush Creek/Cemetery Marsh Enhancement	300
N14	Scottsdale Marsh	41
N15	Parcels at Olive and Atherton Avenues	144
N16	North Parcel	430
N17	Sonoma Creek Watershed Plan	NA
N17.1	Schellville Restoration and Flood Control Proj.	NS
N17.2	Carriger Creek	NS
N17.3	Sonoma Creek (Various Sites)	NS
N18	Camp Two	608
N19	Tolay Creek	435
N20	Lower Tubbs Island Restoration	72
N21	Tubbs Island Expansion	NA
N22	San Pablo Bay Watershed Study	NA
N23	San Pablo Bay North American Wetland Conservation Act Grant Sites	13,874
N24	Partnership for the San Pablo Baylands	NA
N25	Cullinan Ranch	1,500
N26	Napa/Sonoma Marsh Restoration	9,000
N27	Mare Island and North Bay Discovery Center	2,162
N28	Napa River Watershed Plan	NA
N28.1	Napa River Habitat Assessment	NA
N29	Napa River Flood Control Project	950
N30	American Canyon Acquisition and Restoration	460
N31	River Park	48
N32	Rodeo Creek	NS
N33	Pinole Creek	NS
N34	Point Pinole Wetlands Enhancement	400
N35	San Pablo Bay Wetlands Restoration	100
N36	San Pablo Creek	NS
N37	Wildcat Creek Watershed	175
N37.1	Wildcat Creek - San Pablo	NS
N37.2	Lower Wildcat Creek	NS
Suisun (S)		
S1	Elkhorn Creek Habitat Restoration	2
S2	Benicia Creek and Wetland	4
S3	Martinez Regional Shoreline Marsh Restoration	100
S4	Alhambra Creek Watershed Plan	NA
S5	McNabney (Shell) Marsh	200
S6	Pacheco Marsh	140
S7	Point Edith Wetlands Project	2,000
S8	Concord NWS Wetlands Restoration	700*
S9	North Contra Costa County Shoreline	NS
S10	Bay Point Restoration Project	150
S11	Delta Channel Islands	NS
S12	Julia Cox Freeman Wetland Preserve	8
S13	Big Break Acquisitions	1,000
S14	Delta Science Center Wetland Restoration	3,500
S15	Marsh Creek Restoration Master Plan	NA
S15.1	Lower Marsh Creek - Oakley	NS
S15.2	Marsh Creek Griffith Park	7
S15.3	Upper Marsh Creek - Brentwood	NS
S16	Kellogg Creek	NS
S17	East Antioch Creek	NS
S18	Kirker Creek	NS
S19	Mt. Diablo and Galindo Creeks	NS
S20	Mt. Diablo Creek	NS
S20.1	Lower Mt. Diablo Creek	NS
S21	Mitchell Creek	4
S22	Gallindo Creek	NS
S23	Walnut Creek - Pacheco Slough	NS
S23.1	Lower Walnut Creek Restoration	NS
S23.2	Walnut Creek - Pleasant Hill	NS
S23.3	Walnut Creek - Walnut Creek	NS
S23.4	Tice Creek	NS
S23.5	San Ramon Creek - Walnut Creek	NS
S23.6	San Ramon Creek - Alamo	NS
S23.7	San Ramon Creek - Danville	NS
S23.8	Grayson Creek	NS
S23.9	Lafayette Creek	NS
S23.10	Las Trampas Creek - Walnut Creek	NS
S23.11	Las Trampas Creek - Lafayette	NS
S23.12	Grizzly Creek	NS
S23.13	Old Jonas Hill Creek	NS
S23.14	Green Valley Creek	NS
S23.15	Sycamore Creek	NS
S24	Pine Creek	36
S24.1	Lower Pine Creek	NS
S25	Chupcan Preserve Wetlands Restoration	NS

ID	Habitat Project Name	Acreage
Central Bay (CB)		
CB1	Baxter Creek	7
CB2	Cerrito Creek	2
CB3	Village Creek	NS
CB4	Codornices Creek	5
CB5	Schoolhouse Creek	NS
CB6	Strawberry Creek	NS
CB7	Derby Creek	NS
CB8	Potter Creek	NS
CB9	Claremont Creek	NS
CB10	Temescal Creek - Emeryville	NS
CB10.1	Temescal Creek - Oakland	NS
CB11	Glen Echo Creek	NS
CB12	Eastshore State Park	100
CB13	Sausal Creek	NS
CB14	Leona Creek	NS
CB15	Lake Merritt	NA
CB16	Alameda Naval Air Station	565
CB17	Courtland Creek	NS
CB18	Arroyo Viejo Creek	NS
CB19	San Leandro Creek	NS
CB20	San Lorenzo Creek	NS
CB21	Oyster Bay	90
CB22	Yosemite Creek - Candlestick Point	25
CB23	Bayview Hunters Point Shipyard	18
CB24	India Basin - West and East	3.4
CB25	Islais Creek - Yosemite Creek	NS
CB25.1	Islais Creek - Glen Canyon	NS
CB26	Pier 94 North	4
CB27	Mission Creek - San Francisco	NS
CB28	Treasure Island	40
CB29	SF Bay and Delta Estuary Center at Pier 45	NA
CB30	Crissy Field	20
CB31	Tennessee Hollow	NS
CB32	Lobos Creek	NS
CB33	Mountain Lake	1
CB34	Golden Gate Park Lakes	4
CB35	Lake Merced	12
South Bay (SB)		
SB1	Alamo Creek - Danville	NS
SB1.1	Alamo Creek - San Ramon	NS
SB2	Martin Canyon Creek	8
SB3	Tehan Creek	16
SB4	Oliver Property	324
SB5	Whale's Tail	49
SB6	Eden Landing Ecological Reserve	835
SB7	Southern Alameda Creek Watershed Plan	NA
SB7.1	Alameda Creek Restoration	NS
SB8	Triangle Marsh - Newark	3
SB9	Mayhews Landing	108
SB10	Laguna Creek Restoration	NS
SB11	Mission Creek	NS
SB12	Don Edwards SF Bay NWR	NS
SB13	Knapp Tract	450
SB14	New Chicago Marsh	90
SB15	Ulistac Natural Area	40
SB16	Lower Guadalupe River	NS
SB17	Coyote Creek	NS
SB18	Saratoga Creek	NS
SB19	Stevens Creek	NS
SB20	Cargill Salt Enhancement	NS
SB21	Palo Alto Harbor Point	7.2
SB22	San Francisquito Creek CRMP	NA
SB23	Ravenswood Preserve	200
SB24	Bair Island	1,600
SB25	Burlingame Waterfront Park	8.8
San Mateo Coast (C)		
C1	San Pedro Creek Flood Control Project	15
C1.1	San Pedro Creek Watershed Plan	NA
C2	Pillar Point Marsh	23
C3	Pillarcitos Creek Watershed Plan Implementation	NA
C4	San Gregorio Creek Riparian Restoration	NA
C5	Pescadero Marsh	345
C6	Pescadero/Butano Watershed Plan	NA
Regional Projects		
WARC	Watershed Assessment Resource Center	NA
SFBRWMP	SF Bay Rgnl. Wetlands Monitoring Program	NA
Spartina	Support for Invasive Spartina Control Efforts in San Francisco Bay	NA
Arundo	Support for Arundo Donax Control	NA

NA = Not Applicable, NS= Not Specified
*700 acres in S8 are part of S7 acres.

NOTES:

1. *Projects are numbered according to their subregion within the SF Bay Joint Venture geographic scope and are generally arranged in a clockwise direction.*
2. *Habitat projects include acquisition, enhancement, and restoration, and include watershed planning initiatives and regional ecological education facilities.*
3. *Multiple creek habitat projects within the same watershed are noted by decimal points after the whole number.*
4. *Project points in the bay refer to projects with multiple sites or that are regional in nature.*

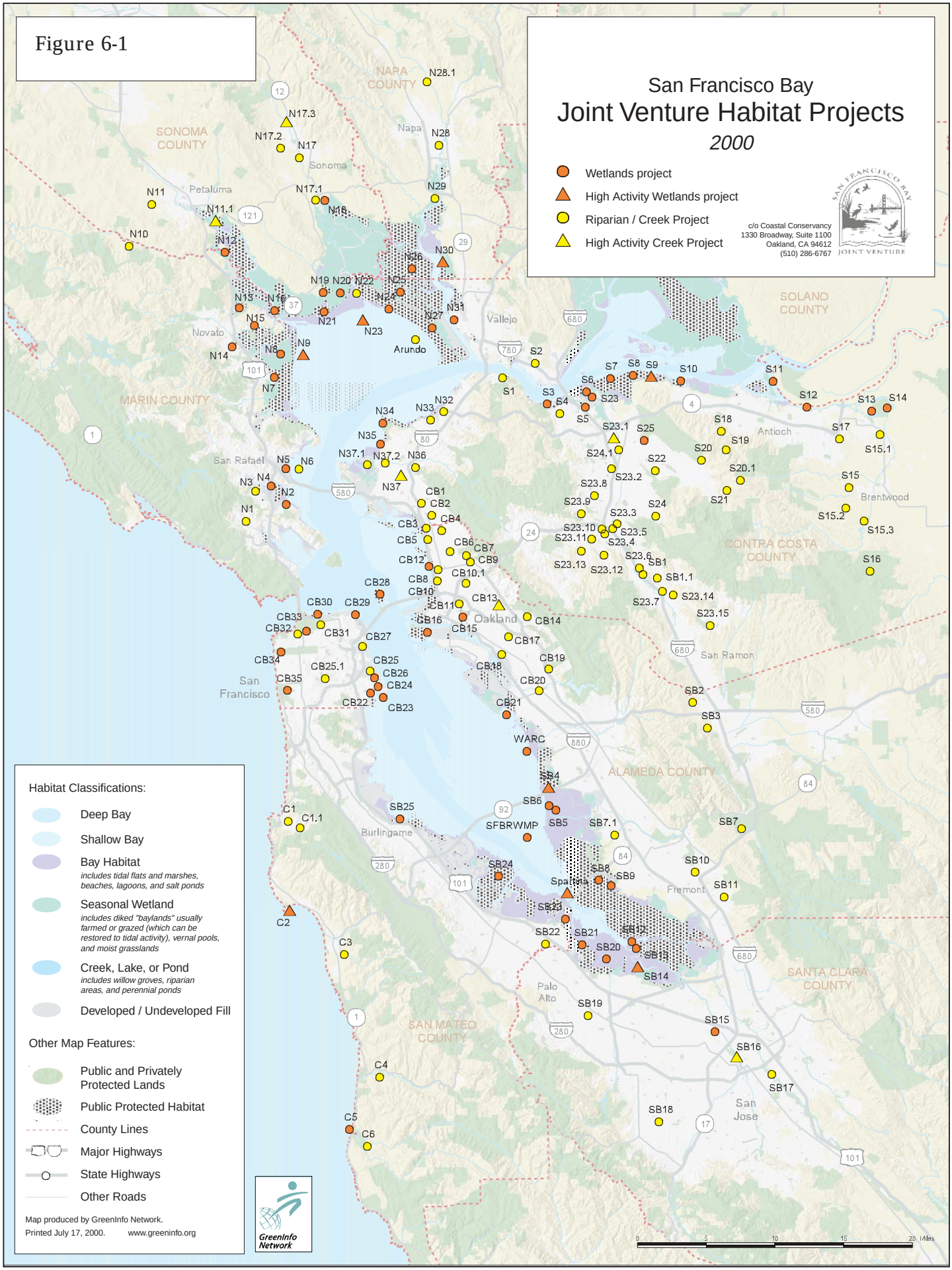


Figure 6-1
San Francisco Bay
Joint Venture Habitat Projects
2000
Wetlands project
High Activity Wetlands project
Riparian / Creek Project
High Activity Creek Project
c/o Coastal Conservancy
1330 Broadway, Suite 1100
Oakland, CA 94612
(510) 286-6767
SAN FRANCISCO BAY JOINT VENTURE
NAPA COUNTY
SONOMA COUNTY
SOLANO COUNTY
MARIN COUNTY
CONTRA COSTA COUNTY
ALAMEDA COUNTY
SANTA CLARA COUNTY
SAN MATEO COUNTY
Petaluma
Sonoma
Napa
Novato
Vallejo
Arundo
San Rafael
Oakland
San Francisco
Burlingame
Palo Alto
Fremont
Antioch
Brentwood
San Ramon
San Jose
Habitat Classifications:
Deep Bay
Shallow Bay
Bay Habitat
includes tidal flats and marshes, beaches, lagoons, and salt ponds
Seasonal Wetland
includes diked "baylands" usually farmed or grazed (which can be restored to tidal activity), vernal pools, and moist grasslands
Creek, Lake, or Pond
includes willow groves, riparian areas, and perennial ponds
Developed / Undeveloped Fill
Other Map Features:
Public and Privately Protected Lands
Public Protected Habitat
County Lines
Major Highways
State Highways
Other Roads
Map produced by GreenInfo Network.
Printed July 17, 2000. www.greeninfo.org
GreenInfo Network
0 5 10 15 20 Miles

transfer will protect 49 acres of tidal and non-tidal marsh, as well as upland habitat for the least tern.

CB23. Bayview Hunters Point Shipyard, San Francisco, San Francisco County. Golden Gate Audubon, Port of San Francisco, Coastal Conservancy, Save San Francisco Bay Association, and several community groups are restoring 15 acres of tidal and seasonal wetlands in Bayview Hunters Point.

CB30. Crissy Field, San Francisco, San Francisco County. The National Park Service is restoring 20 acres of tidal marsh located within the historic Presidio and adjacent to the mouth of San Francisco Bay.

South Bay Subregion (SB)

SB6. Eden Landing Ecological Reserve, Hayward, Alameda County. The California Department of Fish and Game and East Bay Regional Park District are close to completing the restoration plan for this 835-acre property, purchased in 1996. Restoration will include both tidal and seasonal habitat.

SB7. Southern Alameda Creek Watershed Plan, Alameda County. The Alameda County Resource Conservation District has completed a watershed plan and has begun riparian restoration and erosion control projects along Alameda Creek and its tributaries.

SB8. Triangle Marsh, Newark, Alameda County. Ducks Unlimited is partnering with the Fish and Wildlife Service in implementing the restoration of tidal and seasonal wetlands for this 3-acre parcel within the Don Edwards National Wildlife Refuge.

SB14. New Chicago Marsh, Santa Clara County. *(High Activity)* The Santa Clara Valley Audubon Society is leading a campaign to protect 70 acres of tidal wetlands, as well as to restore to salt marsh another 20 acres that had been illegally filled. Once accomplished, both areas would become part of the San Francisco Bay National Wildlife Refuge.

SB15 Ulistac Natural Area, Santa Clara, Santa Clara County. This 40-acre project involves the City of Santa Clara, the county open space authority, and Santa Clara Audubon in restoring wetland and riparian habitat along the Guadalupe River. A restoration master plan that includes public access and education has been adopted; riparian and oak woodland planting is underway.

SB16. Lower Guadalupe River, Santa Clara County. *(High Activity)* The Santa Clara Valley Water District is currently exploring restoration and enhancement options to the Lower Guadalupe River. The design and construction of this flood protection project is expected to be completed by 2001 and will encompass more than 10 miles of shoreline and 84 acres of wetlands and aquatic habitat.

SB24. Bair Island, Redwood City, San Mateo County. The Peninsula Open Space Trust (POST), U.S. Fish and Wildlife Service (FWS), Wildlife Conservation Board (WCB), and others have completed the acquisition of 1,600 acres for addition to the Refuge. The FWS and WCB have acquired it from POST. FWS has initiated a public process for preparing the master plan for Bair Island's restoration and management.

San Mateo Coast Subregion (C)

C2. Pillar Point Marsh, San Mateo County. *(High Activity)* The San Mateo County Parks Division and the California Habitat Fund purchased 17 acres of marshland in 1996. Since then, the Parks Division has completed a master plan for the restoration of the marsh area. In addition, there are 42 acres of surrounding land that could be acquired but to date have been retained by the owners. Much of the Pillar Point Marsh area has been adversely impacted by an access road, the Half Moon Bay County Airport, and the U.S. Army Corps of Engineers Breakwater at Pillar Point Harbor.

Regional Projects

Support for Invasive Spartina Control Efforts in San Francisco Bay. *(High Activity)* The Coastal Conservancy is coordinating the Invasive Spartina Project, a comprehensive Bay-wide effort to eradicate four species of the exotic cordgrass from the San Francisco Bay Estuary. To date, more than 1,000 acres of exotic *Spartina* (primarily eastern cordgrass, *Spartina alterniflora*) have become established in the Bay's marshes and tidal flats, particularly in the South Bay. *Alterniflora* is considered an "ecological engineer" and could significantly alter the estuary ecosystem, compromising the success of tidal restoration efforts if not controlled.

Support for *Arundo donax* Control. Team Arundo Del Norte is a coalition of government managers, sci-

entists, and environmentalists formed in 1996 to battle this invasive reed. The team, led by scientists from the USEPA, San Francisco Estuary Institute, and the Sonoma Ecology Center, has conducted eradication efforts on the Russian River and Sonoma Creek, and has several other removal projects in the works. It is also mapping the spread of *Arundo* and educating the community about this dangerous plant.

Corte Madera Ecological Reserve at the outset of restoration (Fall 1990)
BARBARA SALZMAN

Watershed Assessment Resource Center. The center, sponsored by the Regional Water Quality Control Board and the Coastal Conservancy, is housed at the Friends of the Estuary headquarters, and provides technical assistance to grassroots creeks organizations. It is also working to develop regional, scientifically based protocols for volunteer monitoring and to assist with cooperative agreements.

San Francisco Bay Regional Wetlands Monitoring Program. The Coastal Conservancy, San Francisco Estuary Institute, San Francisco Bay Regional Water Quality Control Board, and U.S. Environmental Protection Agency are part of this new interagency initiative. The Wetlands Regional Monitoring Program (RMP) is intended to provide the scientific understanding necessary to create, restore, and enhance wetlands of the San Francisco Bay Estuary through objective monitoring, research, and communication. Starting with a pilot program, researchers will conduct both ambient monitoring and project monitoring. To guide the program's development, organizers have convened a Wetlands RMP steering committee (composed of senior staff of the wetlands agencies of the region), and focus teams (of scientists).

Potential Projects for 2001 and Beyond

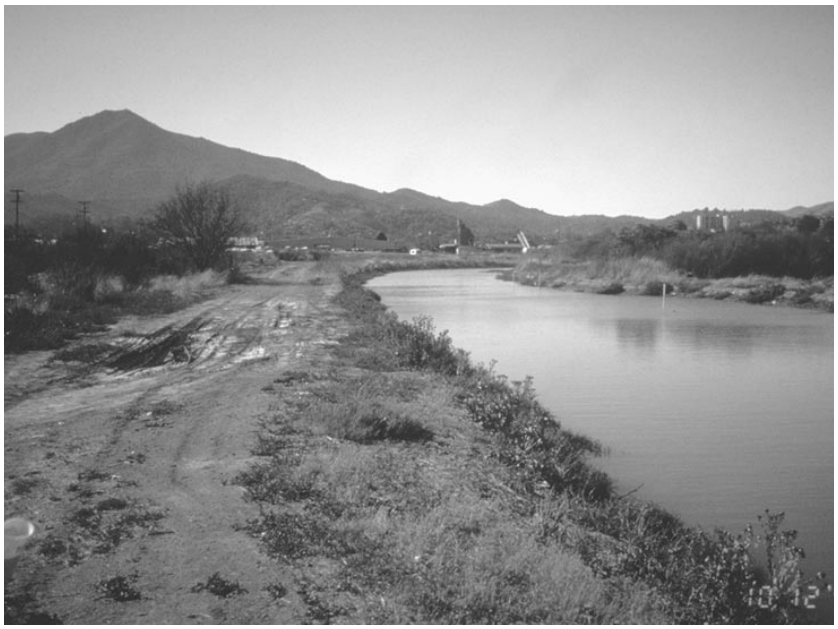
This set of habitat projects includes more riparian projects, and plans for a range of wetland acquisitions, enhancements, and restorations. As "potential projects," these should be seen as near-term to long-term opportunities. Many projects are in some stage of planning, but with much work and funding still needed to implement them. Together these habitat projects comprise about 12,000 acres.

North Bay Subregion (N)

N5. Canalways, San Rafael, Marin County. The San Rafael Canalways is an 85-acre marsh of pickleweed, mudflats, and shallow water which provides wildlife habitat for the endangered salt marsh harvest mouse and over 100 species of resident or migrating birds, as well as public access, through a segment of the Bay Trail. The Friends of Canalways Wetlands is working with the City of San Rafael and the Audubon Society to provide funding and support for site protection through donations, the Park Bond, and the federal Land and Water Conservation Fund.

N6. North Bay Riparian Station, Marin County. The recently created riparian station is a cooperative project of The Bay Institute, Wildlife Conservation Board, the Army Corps of Engineers Bay Model, and several others. The focus of this project will be on the monitoring and restoration of watersheds in Marin and Sonoma Counties.

N22. San Pablo Bay Watershed Study, North Bay Counties. The U.S. Army Corps of Engineers is undertaking a study of ecological restoration opportunities in San Pablo Bay including Marin, Sonoma,



Corte Madera Ecological Reserve immediately after restoration (Spring 1991)
BARBARA SALZMAN

Napa, Solano, and Contra Costa Counties. Once the study is completed, additional federal, state, and private funds will be sought to implement restoration recommendations.

N24. Partnership for the San Pablo Baylands, Sonoma County. The Save San Francisco Bay Association, funded by the San Francisco Bay Regional Water Quality Control Board, established a partnership among agencies and landowners that resulted in a Stewardship Plan. The plan balances the needs of agriculture with wildlife protection in the watersheds of Marin, Sonoma, and Napa Counties.

N26. Napa/Sonoma Marsh Restoration, Napa County. The California Department of Fish and Game and the Coastal Conservancy are working with state, federal, and private partners to restore and/or enhance 9,000 acres of salt ponds.

N28. Napa River Watershed Plan, Napa County. The Napa Resource Conservation District facilitated the development of this stakeholder plan. Implementation of the plan's recommendations has been progressing steadily, including riparian restoration, erosion control, and vineyard demonstration projects.

N31. River Park, Vallejo, Solano County. The Greater Vallejo Recreation District is planning to restore 22 acres of tidal marsh and 26 acres of upland habitat along the Napa River.

N34. Point Pinole Wetlands Enhancement, Pinole, Contra Costa County. The East Bay Regional Park District has purchased close to 400 acres of shoreline property that can be restored to tidal marsh.

N35. San Pablo Bay Wetlands Restoration, Contra Costa County. The East Bay Regional Park District has purchased 100 acres of San Pablo Bay shoreline that will be restored to tidal marsh.

Suisun Subregion (S)

S4. Alhambra Creek Watershed Plan, Contra Costa County. The Contra Costa Resource Conservation District is coordinating the development of a watershed plan for Alhambra Creek involving landowners, agencies, and interested citizens.

S6. Pacheco Marsh, Martinez, Contra Costa County. The Muir Heritage Land Trust, the Coastal Conservancy, Contra Costa Mosquito and Vector Control District, and the Joint Venture are pursuing the acquisition of this 140-acre parcel for tidal and seasonal wetland restoration.

S12. Julia Cox Freeman Wetland Preserve, Antioch, Contra Costa County. Mt. Diablo Audubon and Contra Costa County are working cooperatively to restore 7.5 acres of tidal marsh.

Central Bay Subregion (CB)

CB4. Codornices Creek, Albany, Alameda County. The Cities of Albany and Berkeley are working with Friends of Five Creeks and the Waterways Restoration Institute to restore five acres of riparian habitat along segments of Codornices Creek, including at University Village.

CB12. Eastshore State Park, Alameda County. East Bay Regional Park District has purchased 1,700 acres along the Emeryville, Berkeley, and Albany waterfronts for the Eastshore State Park. Approxi-

mately 100 acres of tidal marsh will be restored in the Park; seasonal wetlands may also be constructed.

CB15. Lake Merritt, Oakland, Alameda County. The City of Oakland, the Lake Merritt Institute, and the Coastal Conservancy are exploring the means and options for restoring wetlands at three locations in Lake Merritt, the first wildlife refuge in the U.S.

CB21. Oyster Bay, San Leandro, Alameda County. East Bay Regional Park District is currently remediating and will eventually restore 90 acres of tidal marsh.

CB22. Yosemite Creek–Candlestick Point, San Francisco County. The Department of Parks and Recreation is partnering with Audubon in plans to restore 34 acres of tidal marsh at the mouth of this creek.

South Bay Subregion (SB)

SB4. Oliver Property, Alameda County. *(High Activity)* The Hayward Area Recreation and Park District (HARD) has applied for permitting from the U.S. Army Corps of Engineers for enhancing 324 acres of former salt pond along Hayward Shoreline. The project, which includes mudflats and wetlands, will enhance tidal circulation and water control in both HARD Marsh and the East Bay Regional Park District's salt marsh harvest mouse preserve.

SB9. Mayhews Landing, Newark, Alameda County. Planning is underway to restore 108 acres of tidal and seasonal wetland habitat.

SB12. Don Edwards San Francisco Bay National Wildlife Refuge, Alameda County. The U.S. Fish and Wildlife Service has numerous restoration and enhancement projects located within the refuge boundaries, (e.g., see projects SB9 and SB13).

SB13. Knapp Tract, Alviso, Santa Clara County. Tidal marsh restoration is planned for this 450-acre site that is already part of the San Francisco Bay Refuge.

SB20. Cargill Salt Enhancement, Santa Clara County. The San Francisco Bay Joint Venture and Cargill are exploring opportunities to enhance shorebird and waterfowl habitat provided by Cargill's salt ponds, as well as partnerships for the purchase of 19,000 acres of salt ponds.

SB22. San Francisquito Creek Coordinated Resource Management Plan, San Mateo County. The Plan pulled together many stakeholders and was completed last year. It recommends numerous actions including flood and erosion control, public education, monitoring, evaluation, and pollution prevention.

SB23. Ravenswood Preserve, East Palo Alto, San Mateo County. The Mid-Peninsula Regional Open Space District is overseeing the tidal marsh restoration of this 200-acre salt pond.

San Mateo Coast Subregion

C1. San Pedro Creek Flood Control Project, Pacifica, San Mateo County. The City of Pacifica is designing an innovative flood control project that incorporates tidal marsh restoration on approximately 15 acres. In order to restore steelhead habitat and riparian values, funding is needed to remove fish barriers and stabilize the channel within the County Park and at two bridge crossings.

C3. Pilarcitos Creek Watershed Plan Implementation, San Mateo County. The Pilarcitos Creek Watershed Plan is in the implementation phase, with several fish passage projects pending or under construction by the San Mateo Resource Conservation District.

C4. San Gregorio Creek Riparian Restoration, San Mateo County. The San Mateo Resource Conservation District is developing a riparian restoration project that will also protect agricultural land from further erosion.

C5. Pescadero Marsh, Pescadero, San Mateo County. The California Department of Parks and Recreation has been gradually restoring the 345-acre Pescadero Marsh. The project includes the restoration of tidal wetlands at the mouth of Pescadero Creek and the restoration of both Pescadero and Butano Creek watersheds.

C6. Pescadero/Butano Watershed Plan, San Mateo County. The San Mateo Resource Conservation District is guiding the development of a watershed plan for Pescadero and Butano creeks, which drain into Pescadero Marsh.

7

Funding San Francisco Bay Joint Venture Habitat Goals

SAVE THE BAY

Regional and Subregional Costs of Goals Implementation

A high level of funding for wetland and riparian projects will be essential to the success of the San Francisco Bay Joint Venture. Securing public and private funding to implement the SFBJV management strategies remains the shared responsibility of Joint Venture's partners, including Federal and State governments and private conservation organizations. Additional funding should be obtained through corporations and individuals who appreciate or benefit from the region's wetlands and can embrace the importance of revitalizing them, together with their wildlife populations.

Means of Funding the Goals. Many steady and large funding sources must be harnessed for accomplishing the Joint Venture's habitat goals. The North American Wetlands Conservation Act (NAWCA) will continue to be a major source of funding for SFBJV projects, as it is for other joint ventures. Other potential sources of federal funding include the Land and Water Conservation Fund, the Estuary Habitat Restoration Partnership Act, the Conservation and Reinvestment Act, and National Fish and Wildlife Foundation grants. In addition to past sources of state funding such as Wildlife Conservation Board and Coastal Conservancy grants, statewide park and water bonds can provide substantial sources of funding. Entirely new fee or tax-based resources that can be linked with Clean Water Act implementation are also needed. These include vehicle license fees dedicated to water quality/wetland projects as proposed in new legislation, "Transportation Fund for Clean Water." Another option is to develop an "estuary wetlands restoration program" using the EPA State Revolving Funds (SRF) in coordination with the Bay Area Stormwater Management Association as a means to finance habitat projects. (Repayment of SRF loans could be secured through stormwater, or other utility fees, and/or park or water bonds.)

Clapper rail

US FISH AND WILDLIFE SERVICE

SFBJV conservation partners such as the National Audubon Society, Bay Institute, Save the Bay, Ducks Unlimited, Sierra Club, Point Reyes Bird Observatory, and Urban Creeks Council should promote increased funding for projects that address the goals and objectives of the SFBJV. They are encouraged to use this Implementation Strategy to justify a suite of systematic implementation funding programs to support the fulfillment of the San Francisco Bay Joint Venture Habitat Goals.

Cost Summary of SFBJV Goals. A cumulative cost summary is described below. **Table 7-1** shows the summary goals for the Bay Area divided into specific cost objectives for each of the five subregions of the SFBJV. However, it should not be seen as a rigid economic analysis but basic preliminary cost estimates provided to assist Joint Venture partners in grasping the financial commitment needed to reach the goals. No attempt was made to adjust for inflation costs over the 20-year goals' horizon. However, just as some costs will increase due to inflation and other unforeseen factors, other costs can also be reduced through economies of scale for large restoration projects.

The total cost of accomplishing the habitat

Table 7-1
San Francisco Bay Joint Venture Wetland Habitat Costs by Subregion

Subregions	Bay Habitats (millions)		Seasonal Wetlands (millions)		Creeks and Lakes (millions)		Total by Subregion (millions)	
	20 yrs	Annually	20 yrs	Annually	20 yrs	Annually	20 yrs	Annually
Suisun Subregion								
Acquire	15	0.75	55	2.75	—	—	70	3.5
Restore	10	0.5	9	0.45	40	2.0	59.0	2.95
Enhance	2	0.1	6	0.3	80	4.0	88	4.4
North Bay Subregion								
Acquire	115	5.75	90	4.5	—	—	205	10.25
Restore	75	3.75	36	1.8	20	1.0	131.0	6.55
Enhance	13	0.65	12	0.6	40	2.0	65	3.25
Central Bay Subregion								
Acquire	45	2.25	5	0.25	—	—	50	2.5
Restore	20	1.0	0	0	52.5	2.635	72.5	3.625
Enhance	4	0.2	1	0.05	157.5	7.875	162.5	8.125
South Bay Subregion								
Acquire	140[1]	7.0	35	1.75	—	—	175	8.75
Restore	80	4.0	9	0.45	92	4.6	181.0	9.05
Enhance	42[1]	2.1	4	0.2	253	12.65	299	14.95
San Francisco/San Mateo Coast[2]								
Acquire	TBD	—	TBD	—	—	—	TBD	—
Restore	TBD	—	TBD	—	60	3.0	60	3.0
Enhance	TBD	—	TBD	—	50	2.5	50	2.5
Total Costs by Type	**561.0**	**28.05**	**262**	**13.1**	**845**	**42.25**	**1,668**	**83.40**
Monitoring = Extra 3 percent	**577.83**	**28.89**	**269.86**	**13.49**	**870.35**	**43.52**	**1,718.04**	**85.9**

Source: SFBJV (1999)

Notes: 1. 25,000 acres of salt ponds are included in both acquisition and enhancement; as with other acquisitions, this assumes a willing seller. **2.** The San Francisco/San Mateo wetland acreages appear as TBD or "To Be Determined," since they have not been estimated. This subregion was not part of the Goals Project.

Table 7-2

Average Cost Rates for the San Francisco Bay Joint Venture Implementation Strategy

	Bay Habitats	Seasonal Wetlands	Creeks and Lakes
Suisun Subregion			
Acquire	$5,000 per acre	$5,000 per acre	ND[2]
Restore	$5,000 per acre	$900,000 per 100 acres	$40,000 per acre
Enhance	$1,000 per acre	$1,000 per acre	$20,000 per acre
North Bay Subregion			
Acquire	$5,000 per acre	$5,000 per acre	ND[2]
Restore	$5,000 per acre	$900,000 per 100 acres	$20,000 per acre
Enhance	$1,000 per acre	$1,000 per acre	$10,000 per acre
Central Bay Subregion			
Acquire	$5,000 per acre	$5,000 per acre	ND[2]
Restore	$5,000 per acre	$900,000 per 100 acres	$52,500 per acre
Enhance	$1,000 per acre	$1,000 per acre	$26,000 per acre
South Bay Subregion			
Acquire	$5,000 per acre	$5,000 per acre	ND[2]
Restore	$5,000 per acre	$900,000 per 100 acres	$46,000 per acre
Enhance	$1,000 per acre	$1,000 per acre	$23,000 per acre
San Francisco/San Mateo Coast[1]			
Acquire	TBD	TBD	ND[2]
Restore	TBD	TBD	$20,000 per acre
Enhance	TBD	TBD	$10,000 per acre

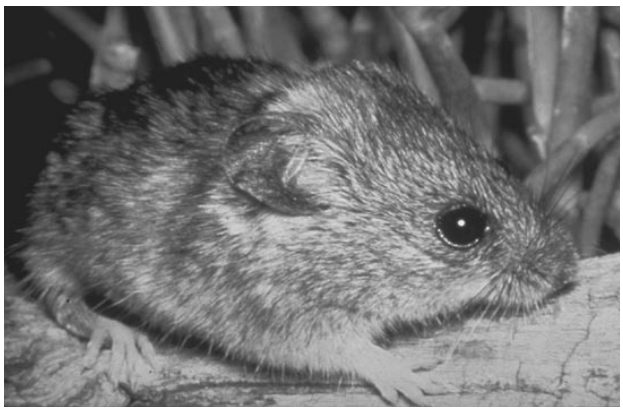
Source: SFBJV (1999)

Notes: 1. The San Francisco/San Mateo wetland acreages appear as TBD or "To Be Determined," since they have not been estimated. This subregion was not part of the Goals Project. **2.** ND = Not Determined. Costs for riparian acquisition are too variable; it was also assumed for the sake of practicality that protection strategies focus on conservation easements for riparian buffers, which can be procured without cost in some instances.

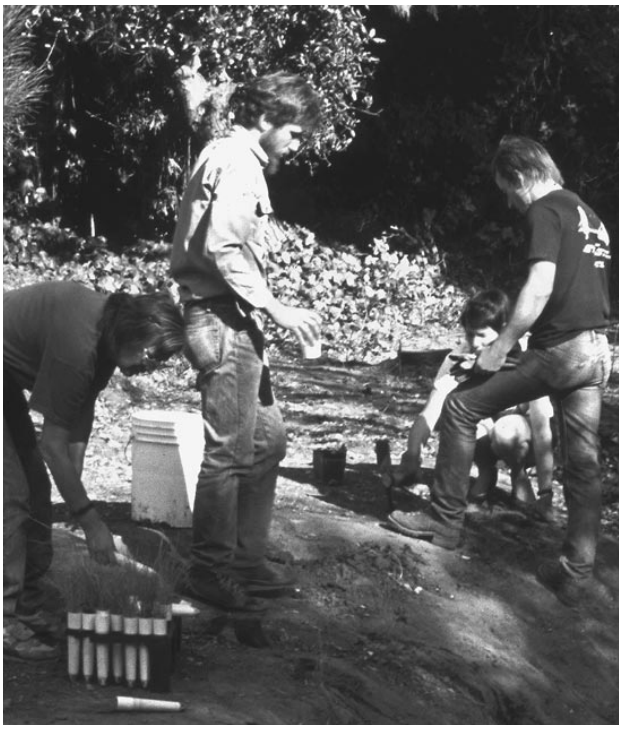
goals contained in the Implementation Strategy is roughly $1,668,000,000 or $83,400,000 per year for 20 years. The total cost estimate rises to $3.8 billion if a less conservative wetlands restoration cost average of $20,000 per acre is used.

Assumptions and Average Unit Costs

Estimating and compiling the cost of an Implementation Plan intended to last at least 20 years is not a simple calculation, and it is important to note the many assumptions that were made while estimating the costs of the SFBJV Implementation Strategy. The average rates for unit costs of acquisition, restoration, and enhancement projects for each of the three habitat categories within each subregion are displayed in **Table 7-2.** These computations reflect a conservative estimate for construction costs, and were reviewed by resource managers and scientists with extensive experience in restoration and enhancement.



Salt marsh harvest mouse TOM TUTT



With knowledgeable guidance, volunteers can reduce costs and increase "community ownership" of creek projects.
JOHN STEERE

Acquisition. Land acquisition costs vary greatly in the Bay Area, with an average range of $1,000 to $15,000 per acre in 1999. For the purposes of this document, an average rate of $5,000 per acre was used for the acquisition of both bay habitats and seasonal wetlands. This estimate is merely a calculation tool, recognizing that actual land costs will vary from project to project and from year to year. This rate remains constant regardless of a parcel's location within the Bay, its current level of development, and fluctuations of land value from one reach of the Bay to another. This estimate does not account for conservation easements, where only the development rights of a property are purchased, usually creating a far less expensive alternative to outright acquisition. Acquisition costs for creek and lake habitats were not calculated, given the practical consideration that creek corridors rarely correspond to parcels, but generally bisect or border larger parcels.

Restoration. Restoration costs can vary widely, and are largely determined by the target wetland type to be restored. The simplest restorations can cost as little as $2,750 an acre, while more complex restorations can cost tens of thousands of dollars per acre. For the purposes of this document, we chose to use a conservative average of $5,000 per acre for region-wide tidal wetlands restoration costs. This rate incorporates a conservative level of permitting, planning, and engineering costs. However, this estimate does not account for variations caused by sediment removal and regrading. If these factors are considered, a more typical average would be $20,000 per acre.

The estimated cost for seasonal wetland restoration is $900,000 per 100 acres. It is important to note that this figure represents large-scale restoration. A simple reduction to cost per acre would not account for the effects of economies of scale. This figure includes such services as excavation, revegetation, permitting, planning, and engineering.

The estimated cost of creek and lake habitat restoration is fairly complex, and ranges from $20,000 per acre to $52,500 per acre. The primary consideration was the habitat's location within the Joint Venture's geographic scope. A project's location describes an approximate level of development, which in turn, specifies the possible project width. Two riparian corridor widths were used: 1) 40 meters for all riparian zones in rural and suburban areas (see page 24 in Chapter 3 for discussion of how this average was determined); and 2) 50 feet for

Workers remove *Arundo donax*. This giant cane is particularly invasive and can overtake riparian zones.
SONOMA ECOLOGY CENTER

urban riparian corridors. The wider corridor was assumed for all of the North Bay and Suisun subregions and for one-half of the South Bay and San Francisco/San Mateo subregions. The 50-foot corridor was used for the other half of the South Bay and San Francisco/San Mateo subregions and all of the highly urbanized Central Bay subregion.

Enhancement. The cost for enhancement of Bay habitat and seasonal wetlands is estimated to be $1,000 per acre. This rate remains constant regardless of location within the Estuary, and includes such individual costs as revegetation, exotics removal, limited irrigation, and moderate management.

The process of calculating enhancement costs for creek habitat is comparable to that for restoration estimates in its complexity. The same considerations of location, levels of development, and riparian corridor are accounted for in the estimated averages for enhancement. Creek enhancement is assumed to include such services as native revegetation and exotics removal, maintenance of existing channel meanders, bank stabilization, and erosion control. Factors that can add to the general cost of a project, such as earth moving, extensive irrigation, and long-term management are not included.

Monitoring. While long-term monitoring is an essential component of any restoration or enhancement project, it was not factored into the projections shown in Table 7-1. Monitoring varies individually from project to project, making it difficult to estimate the total cost for an effort like the San Francisco Bay Joint Venture. One method of approximating long-term monitoring costs uses a cost per acre per a number of years (e.g., $550 per acre for five years). Another common method is to create a long-term "monitoring endowment" from an equivalent of three percent of the construction costs. If the three percent rule were applied to the estimates in Table 7-1, the total cost for the Implementation Strategy would rise by $50 million to approximately $1,718,000,000.

Roles of Partners in Implementation

If the San Francisco Bay Joint Venture is to be successful in meeting its habitat goals, the roles and responsibilities must be shared by its partners. With this intent member agencies and organizations of the Joint Venture have committed to participate actively in fulfilling the acreage goals set forth in the Implementation Strategy.

Each partner's projected roles toward realizing the habitat acreage goals are shown in **Table 7-3**. The list of organizations does not recognize the many individuals and organizations that contributed to the development of this plan, nor the many entities who will help to implement specific projects, as it is limited to the members of the Joint Venture Management Board. See the first section of Chapter 4 for a listing of specific organizations and agencies that will be involved in public and private lands programs by subregion, i.e., for purchase of fee title (public lands) and/or conservation easements (private lands).

Monitoring birds at Remillard Pond LIZA RIDDLE

Table 7-3
Agency and Organization Involvement in SFBJV Goals Implementation

San Francisco Bay Joint Venture Partner	Funding		Project Implementation[1]		Outreach and/or Advocacy[3]	Education[3]	Monitoring and Evaluation[4]
	Acquisition[2]	Restoration/ Enhancement	Acquisition[2]	Restoration/ Enhancement			
Federal (F) and State/Regional (S/R) Agencies							
Bay Conservation and Development Commission	X	X					
California Coastal Conservancy (S)	X	X	X	X			X
California Department of Fish and Game (S)	X	X	X	X		X	X
Coastal Region, Mosquito and Vector Control District (R)		X	X	X			X
National Fish and Wildlife Foundation (F)	X	X					
National Marine Fisheries Service (F)		X		X			X
Natural Resource Conservation Service (F)		X		X		X	X
Regional Water Quality Control Boards, SF Bay (S)				X			X
Resource Conservation Districts (R)		X		X		X	X
SF Estuary Project (R)				X		X	X
U.S. Army Corps (F)	X	X	X	X			
U.S. Environmental Protection Agency (F)	X	X		X		X	X
U.S. Fish & Wildlife Service (F)	X	X	X	X		X	X
Wildlife Conservation Board (S)	X	X	X				
Nongovernmental Organizations (includes affiliates of organizations)							
Bay Area Open Space Council					X		
Bay Planning Coalition	X	X	X	X	X		X
Citizens Committee to Complete the Refuge					X	X	
Ducks Unlimited, Inc.		X	X	X	X	X	X
National Audubon Society/Bay Area Audubon Council	X	X	X	X	X	X	X
Point Reyes Bird Observatory			X	X	X	X	X
Save the Bay				X	X	X	
Sierra Club					X	X	
The Bay Institute			X	X	X	X	X
The Conservation Fund			X		X		
Urban Creeks Council				X	X	X	
Private Industry	X	X	X	X	X		X

Source: SFBJV (1999)

Notes: 1. Refers to staff time and other in-kind technical support for implementation. **2.** Includes both public lands and private lands programs—for acquiring fee title and for conservation easements. **3.** Both governmental and nonprofit organizations may conduct outreach, which includes education, communication of goals, enlistment of additional partners, and the solicitation of funding sources. Governmental entities that do "outreach" are listed in the "education column of the table. **4.** Activities designed to track success of restoration/enhancement projects (see Chapter 5).

References

Accurso, L.M. 1992. *Distribution and abundance of wintering waterfowl on San Francisco Bay 1988–1990.* M.S. Thesis, Humboldt State University.

Bay Area Defense Conversion Action Team. 1997. *Open Space, Wetlands, and Maritime Facilities on the Bay Area's Closing Bases.* 1 pg.

Bellrose, F. 1980. *Ducks, Geese, and Swans of North America.* 3rd edition. Stackpole books, Harrisburg, Pennsylvania. 543 pp.

Brady/LSA. 1999. *Fitzgerald Marine Reserve Draft Master Plan.* pp. 67–116 and appendices.

Brown, S. 1998. *National Shorebird Conservation Plan: Progress Report.* Manomet Center for Conservation Sciences, Manomet, Massachusetts. 9 pp.

Brown, S. 1999. *United States Shorebird Conservation Plan Fact Sheet.* Manomet Center for Conservation Sciences, Manomet, Massachusetts. 12 pp.

Central Valley Habitat Joint Venture Implementation Board. 1990. *Central Valley Habitat Joint Venture Implementation Plan: A Component of the North American Waterfowl Management Plan.* California Department of Fish and Game, California Waterfowl Association, Ducks Unlimited, U.S. Fish and Wildlife Service, Sacramento, California, 104 pp.

Gersib, R.A., K.F. Dinan, J.D. Kauffeld, M.D. Onnen, P.J. Gabig, J.E. Cornely, G.E. Jasmer, J.M. Hyland, and K.J. Strom. 1992. *Rainwater Basin Joint Venture Implementation Plan.* Nebraska Game and Parks Commission, Lincoln, Nebraska. 56 pp.

Goals Project. 1999. *Baylands Ecosystem Habitat Goals: A Report Of Habitat Recommendations Prepared by the San Francisco Bay Area Wetlands Ecosystems Goals Project.* U.S. Environmental Protection Agency, San Francisco, California, S.F. Regional Water Quality Control Board, Oakland, California. 209 pp. and appendices.

Harvey, T.E., K.J. Miller, R.L. Hothem, M.J. Rauzon, G.W. Page, and R.A. Keck. 1992. *Status and Trends Report on Wildlife of the San Francisco Estuary.* U.S. Department of the Interior, Fish and Wildlife Service, Sacramento, California. 283 pp. and appendices.

Houghten, C., K. Miller, and K. Foerster. 1989. *Concept Plan for Waterfowl Habitat Protection, San Francisco Bay, California.* U.S. Department of the Interior, Fish and Wildlife Service, Region 1, Portland, Oregon. 54 pp. and appendices.

Intermountain West Joint Venture Management Board. 1995. *Intermountain West Joint Venture Implementation Plan.* Salt Lake City, Utah. 24 pp. and appendices.

Jorde, D.G., G. M. Haramis, C. M. Bunck, and G. W. Pendleton. 1995. *Effects of diet on rate of body mass gain by wintering canvasbacks.* Journal of Wildlife Management 59:31–39.

Levy, K., T.F. Young, R.M. Fujita, and W. Alevizon. 1996. *Restoration of the San Francisco Bay–Delta–River System: Choosing Indicators of Ecological Integrity.* Environmental Defense Fund, Bay Institute of San Francisco, and The Center for Sustainable Resource Development, Berkeley, California. 66 pp. and appendices.

Little, Tim (ed.). 1994. *Environmental Principles for Military Base Closures.* ARC/Arms Control Research Center, San Francisco, California. 11 pp.

Loesch, C.R., K.J. Reinecke, and C.K. Baxter. 1994. *Lower Mississippi Valley Joint Venture Evaluation Plan.* North American Waterfowl Management Plan, Vicksburg, Mississippi. 34 pp.

Lower Mississippi Valley Joint Venture Management Board. 1990. *Conserving Waterfowl and Wetlands: The Lower Mississippi Valley Joint Venture.* North American Waterfowl Management Plan, Vicksburg, Mississippi. 32 pp.

Miller, M.R., M.R. McLandress, and F.A. Reid. 1996. *Central Valley Habitat Joint Venture Evaluation Plan.* North American Waterfowl Management Plan, Sacramento, California. 65 pp.

North American Waterfowl Management Plan Committee. 1994. *North American Waterfowl Management Plan Implementation Plan Guidelines 88-05*. Washington, D.C. 34 pp.

North American Waterfowl Management Plan Committee. 1994. *North American Waterfowl Management Plan Update: Expanding the Commitment*. U.S. Department of the Interior, SEDESOL Mexico, Canadian Wildlife Service. 30 pp. and appendices.

North American Waterfowl Management Plan Committee. 1998. *North American Waterfowl Management Plan: 1998 United States Progress Report*. U.S. Fish and Wildlife Service, Laurel, Maryland. 28 pp.

North American Waterfowl Management Plan Committee. 1999. *North American Waterfowl Management Plan Update 1998: Expanding the Vision*. U.S. Department of the Interior, SEMARNAP Mexico, Canadian Wildlife Service. 32 pp.

Ohlendorf, H.M., R.W. Lowe, P.R. Kelly, and T.E. Harvey, 1986. *Selenium and heavy metals in San Francisco Bay diving ducks*. Journal of Wildlife Management 50: 64–71.

Pacific Coast Joint Venture Management Board. 1995. *Pacific Coast Joint Venture Strategic Plan*. Vancouver, Washington. 191 pp.

Prairie Pothole Joint Venture Implementation Plan Update Committee. 1995. *U.S. Prairie Pothole Joint Venture Implementation Plan*. U.S. Department of the Interior, Fish and Wildlife Service, Region 6, Denver, Colorado. 26 pp. and appendices.

San Francisco Bay Area Regional Water Recycling Program. 1999. In: Regional Master Plan Update, Lafayette, California. 10 pp.

San Francisco Estuary Project. 1992. *Comprehensive Conservation and Management Plan for the San Francisco Bay–Sacramento/San Joaquin River Delta Estuary*.

San Francisco Estuary Project. 1993. *Managing Freshwater Discharge to the San Francisco Bay–Sacramento/San Joaquin River Delta Estuary: The Scientific Basis for an Estuarine Standard*. Alonzo Printing Co. 17 pp. and appendices.

San Francisco Estuary Project. 1996. *CCMP Workbook: Comprehensive Conservation and Management Plan for the Bay-Delta Implementation Progress* 1993–1996. 68 pp.

San Francisco Estuary Project. 1997. *State of the Estuary 1992–1997, Vital Statistics, New Science, and Environmental Management*. Regional Water Quality Control Board, Oakland, California. 64 pp.

San Francisco Estuary Project. 1999. *Bay-Delta Environmental Report Card: CCMP Workbook*. Oakland, California. 28 pp.

Thelander, C. (ed.). 1994. *Life on the Edge*. Biosystems Books, Santa Cruz, California. 549 pp.

U.S. Department of the Interior, Fish and Wildlife Service and Canadian Wildlife Service. 1986. *North American Waterfowl Management Plan, A Strategy for Cooperation*. U.S. Fish and Wildlife Service, Washington, D.C. 19 pp.

U.S. Department of the Interior, Fish and Wildlife Service. 1990. *Concept Plan for Waterfowl and Wetland Habitat Protection for Upper Mississippi River and Great Lakes Region Joint Venture*. U.S. Department of the Interior, Fish and Wildlife Service, Twin Cities, Minnesota. 49 pp.

Vicencio, L. 1998. U.S. Department of the Interior, Fish and Wildlife Service unpublished data.

Yocom, C.F., and M. Keller. 1961. *Correlation of food habits and abundance of waterfowl in eastern Washington*. Journal of Wildlife Management 24: 237–250

Young, T.F., and M. Fujita. 1999. *Developing Essential Ecological Indicators for the San Francisco Bay/Delta/River System*. In: *4th Biennial State of the Estuary Conference: The Rehabilitation of the Estuary and Its Watersheds—Abstract Book*. Page 37.

Personal Communications:

Josh Bradt, Urban Creeks Council, Berkeley.

Jeff Haltiner, Phillip Williams and Associates, Ltd., Corte Madera.

Gary Mason and Jorgen Blomberg, Wolfe Mason Associates, Oakland.

A.L Riley, Waterways Restoration Institute, Berkeley.

Louise Vicencio, U.S. Fish and Wildlife Service, Mare Island

Carl Wilcox, California Department of Fish and Game, Yountville

Appendix A—
San Francisco Bay Joint Venture Working Agreement

September 1996

The San Francisco Bay Joint Venture is a partnership of public agencies, environmental organizations, hunting and fishing groups, the business community, local government, and landowners working cooperatively to protect, restore, increase, and enhance wetlands and riparian habitat in the San Francisco Bay Watershed. Using a non-regulatory approach and an ecosystem perspective, the Joint Venture will work through its partners to complete on-the-ground habitat projects benefiting waterfowl and fish and wildlife populations by leveraging resources, developing new funding sources and creating partnerships.

The partners of the Joint Venture recognize the vital role wetland and riparian habitats play in maintaining a healthy ecosystem because of their functions in buffering the impact of floodwaters, cleansing pollutants from runoff, recharging overdrawn water supplies, and providing critical habitat for waterfowl and hundreds of fish and wildlife species. Fifty percent of threatened and endangered species in the Bay Area depend on wetland and riparian habitat, and up to 90 percent of commercial and recreational fish species use these areas for spawning grounds in San Francisco Bay. Wetlands and riparian habitat also provide economic benefits, recreational opportunities, and generally contribute to a higher quality of life for residents in the densely populated San Francisco Bay Area.

Goal

The goal of the San Francisco Bay Joint Venture is to protect, restore, increase, and enhance all types of wetlands, riparian habitat, and associated uplands throughout the San Francisco Bay region to benefit waterfowl and other fish and wildlife populations.

Background

Waterfowl numbers in North America have experienced long-term declines due to the loss or degradation of critical wetland and associated upland habitat. Reversal of this loss is essential to the future of waterfowl, shorebirds, and all other wetland-associated wildlife. The North American Waterfowl Management Plan (NAWMP) is an international agreement between the U.S., Canada, and Mexico to address these losses. The NAWMP is a federal, state, and private cooperative initiative designed to protect wetland habitat and increase wetland wildlife populations while improving water quality, reducing soil loss and addressing many other wetland ecosystem issues. Implementation of the NAWMP occurs through the formation of multi-level partnerships (known as joint ventures) between diverse public and private organizations who share common interest in the conservation, maintenance, and management of key wetland ecosystems.

The NAWMP identifies 34 “waterfowl habitat areas of major concern” and targets these areas for the establishment of joint ventures. The San Francisco Bay region is recognized as one of the areas of major concern.

The San Francisco Bay Joint Venture also implements state and federal wetlands protection policies including the California Wetlands Conservation Policy and federal Executive Order 11990.

San Francisco Bay Joint Venture Objectives

1. Secure wetlands, riparian habitat, and associated uplands through fee or permanent easement acquisition.

2. Restore and enhance wetlands, riparian habitat, and associated uplands on both public and private lands using non-regulatory techniques.
3. Improve habitat management on publicly and privately owned wetlands, riparian habitat, and associated uplands through the use of cooperative management agreements and voluntary incentive programs.
4. Develop an Implementation Strategy using existing data on wetlands, riparian habitat, and associated uplands to guide Joint Venture protection and restoration efforts from an ecosystem perspective including public health and safety considerations.
5. Strengthen existing and promote new funding sources for wetlands acquisition, restoration, enhancement, and management programs.
6. Support monitoring and evaluation of existing restoration projects, as well as pertinent research studies, to improve the results of future restoration projects.

San Francisco Bay Joint Venture Structure

The San Francisco Bay Joint Venture is composed of a Management Board, an Advisory Board, an Implementation Strategy Committee, and several other Working Committees established to accomplish specific Joint Venture objectives. These units shall include diverse representation from state and federal agencies, environmental organizations, hunting and fishing groups, the business community, landowners, public utilities, and local government. Members of each of these units are expected to assist with external communications at national, state, and local levels, help secure funding for projects supported by the Joint Venture, and bring new initiatives to the Joint Venture.

Joint Venture Management Board

The Management Board will consist of approximately fifteen members who agree to support and promote the goal and objectives of the Joint Venture and who represent the diversity of wetlands interests found in the San Francisco Bay Region. Members of the Management Board will be landowners or land managers, or have the ability to provide expertise in wetland science and/or policy, or have the ability to contribute or help secure funding for projects supported by the Joint Venture.

The Management Board will:

1. Set direction and policy for Joint Venture activities.
2. Solicit, select, and prioritize projects that may be undertaken by the Joint Venture partners.
3. Set direction for external communications at national, state, and local levels.
4. Secure funding for projects supported by the Joint Venture.
5. Set direction for legislative matters that affect funding for the NAWMP or projects supported by the Joint Venture.
6. Oversee development and completion of the Implementation Strategy.
7. Provide direction for the Joint Venture Coordinator who reports to the Chair.
8. Assign tasks to the Working Committees.
9. Review forthcoming wetland and riparian habitat initiatives and determine appropriate action.
10. Track accomplishment of objectives, review and approve suggested changes to Implementation Strategy.
11. Oversee management of Joint Venture funds, as appropriate if established pursuant to a separate agreement.
12. Appoint Advisory Board members.

A chair and vice chair will be appointed by the Management Board and will rotate on an annual basis. The Management Board will meet every other month.

Advisory Board

The Advisory Board will consist of up to 30 members with an interest in wetlands protection and restoration in the San Francisco Bay region. The Advisory Board members will be appointed by the Management Board.

The role of the Advisory Board will include advising and assisting the Management Board in the following areas:

1. Direction and policy for Joint Venture activities.
2. Task assignments for Working Committees as appropriate.
3. New initiatives with potential impacts on projects supported by the Joint Venture.
4. External communications at the national, state, and local levels.
5. Helping to secure funding for projects supported by the Joint Venture.
6. Legislative matters that affect funding for the NAWMP or the Joint Venture.

The Advisory Board will meet at least twice a year.

Working Committees

Working Committees are established to accomplish specific objectives of the Joint Venture, and can be established at any time by the Management Board. Working Committee members do not have to be on the Management Board. Working Committees report to the Management Board and make recommendations for the Management Board's review and approval. Working Committees meet every other month, alternating their meetings with the Management Board meeting schedule. Initial Working Committees and their responsibilities are as follows:

Implementation Strategy Committee.

This committee will consist of ten people with technical expertise reflecting the diversity of the Management Board. Once the Implementation Strategy has been completed, this committee will be convened on an ad hoc basis. The roles of the Implementation Strategy Committee will include:

1. Draft Implementation Strategy to guide acquisition and restoration activities.
2. Recommend to the Management Board the creation of new Working Committees as need arises.
3. Provide technical information to the Management Board to set and achieve habitat objectives.
4. Perform work assignments as directed by the Management Board.
5. Coordinate Joint Venture Implementation Strategy with Regional Wetlands Ecosystem Goals Project.

Legislative/Fiscal Committee.

1. Develop and implement a legislative strategy to secure funding and otherwise support projects promoted by the Joint Venture.
2. Track current and developing legislative issues and advise Management Board on appropriate action.

Public Affairs Committee.

1. Develop and implement a public outreach strategy for external communications at national, state, and local levels.
2. Design a Joint Venture brochure and other publications as directed by the Management Board.

Acquisition and Restoration Committee.

1. Develop a list of potential acquisition, restoration, and enhancement projects that will further the goals of the Joint Venture.
2. Identify acquisition and restoration opportunities.
3. Develop project selection criteria.
4. Review potential acquisition and restoration projects and make recommendations to the Management Board.
5. Track accomplishment of Joint Venture objectives.

Joint Venture Fund Committee.

1. Determine feasibility of establishing a Joint Venture Fund that can be used for Joint Venture partners' acquisition, restoration, or enhancement projects. In order to establish such a fund, all parties to this agreement must consent through a formal, legally sufficient agreement or contract which establishes such fund.

Joint Venture Coordinator

The Joint Venture Coordinator reports to the Chair of the Management Board and the responsibilities are:

1. Chair Implementation Strategy Committee.
2. Primary liaison between Management Board, Advisory Board, and Working Committees.

3. Carry out work plan and Implementation Strategy as directed by the Management Board.
4. Coordinate and provide staff direction to Working Committees.
5. Act as principal spokesperson for Joint Venture activities.
6. Assist in creating and facilitating partnerships that accomplish Joint Venture goals.
7. Oversee development and completion of the Implementation Strategy.
8. Maintain contact with media to increase public awareness about Joint Venture and wetlands issues.
9. Serve as liaison to other Bay Area wetlands coordination efforts.
10. Seek new public and private funding sources for Joint Venture partners' projects.
11. Provide coordination and information to Joint Venture partners on wetlands protection strategies and methods.
12. Provide partnership or project management guidance as needed.
13. Assist partners in completion of grant applications.

Intended Use of Implementation Strategy

The San Francisco Bay Joint Venture Implementation Strategy will be used as a blueprint to implement actions that protect, restore, and enhance wetlands, associated uplands, and riparian habitat. It will be used to assist signatories in setting priorities for wetland and riparian habitat protection efforts and be a focal point for agencies, organizations, and the public who want to contribute to wetland and riparian area protection, restoration, and enhancement. The San Francisco Bay Joint Venture Implementation Strategy will be used to identify funding needs, funding sources, and collaborators for accomplishing the goals, objectives, and actions in the Strategy.

In pursuit of this Agreement:

1. The parties to this Agreement will begin working toward the goals of the Agreement upon the signing below of at least five parties. Those parties will continue to work towards the Agreement's goals unless the number of signatories becomes less than five.
2. The members of the Management Board and other participants shall work together in a cooperative and collaborative manner. In cases of disputes over Joint Venture projects, members shall engage in a good faith effort at resolving disagreements.
3. Amendments to this Agreement may be proposed to the Chair of the Management Board at any time by any party and shall become effective upon approval by a quorum of the Management Board. However, any amendment to this Agreement which particularly affects the interests of a party or parties may not be approved by the Management Board without consent by the affected party or parties. Further, the disclaimers below may not be amended without the written consent of all parties.
4. Upon agreement from the Management Board, other agencies or organizations may join the San Francisco Bay Joint Venture Management Board, Advisory Board, and Working Committees. Any party may terminate its participation in this agreement by giving written notice to the Chair of the Management Board.
5. A quorum will consist of a simple majority of all parties on the Management Board, and is necessary to approve any action.
6. All Management Board members have the right to vote. Management Board members are required to recuse themselves from voting on issues with potential conflict of interest concerns (see Attachment A).

Disclaimers:

1. This document is intended to accomplish the stated goals by bringing public agencies, environmental organizations, hunting and fishing groups, local government, the business community, and landowners together to develop strategies to further wetlands protection. The strategies generated by these parties may then lead to the separate creation of future agreements or contracts to accomplish these goals. This document is not intended to be a

binding contract for any reason. The words and phrases used in this document such as "partner," "joint venture" and "agreement" are not intended to be understood in the legal sense. No legal consideration has been or will be given by any party becoming involved with this Agreement.

2. Nothing herein alters the existing authorities or responsibilities of any party nor shall be considered as obligating any party in the expenditure of funds or the future payment of money or providing services.

3. No party to this Agreement shall be liable for any injuries or damages to persons or property resulting from acts or omissions by any other party or by related parties in carrying out activities pursuant to this Agreement.

4. No party to this Agreement shall be held as a party to any contract entered into by any other party (or other party's agents) to this Agreement in carrying out the activities pursuant to this Agreement, unless that party agrees in writing to be a part of any such contract.

IN WITNESS WHEREOF, the parties hereto have joined into this Agreement by affixing their signatures:

Signatories:

Daniel Taylor, *Executive Director*
National Audubon Society, California

Barry Nelson, *Executive Director*
Save San Francisco Bay Association

Alan Wentz, *Regional Manager*
Ducks Unlimited, Inc.

Michele Perrault, *International Vice President*
Sierra Club

John Woodbury, *Program Director*
Bay Area Open Space Council

Mike Rigney, *Watershed Program Coordinator*
Bay Area Regional Watershed Network

Arthur Feinstein
Citizen's Committee to Complete the Refuge

Barbara Salzman
Bay Area Audubon Council

Ellen Johnck, *Executive Director*
Bay Planning Coalition

Robert D. Testa, *Vice President for Government Relations*
Pacific Gas & Electric Corporation

Douglas Wheeler, *Secretary*
California Resources Agency

Michael Fischer, *Executive Officer*
California Coastal Conservancy

Loretta Barsamian, *Executive Officer*
Regional Water Quality Control Board, San Francisco Bay Region

Will Travis, *Executive Director*
San Francisco Bay Conservation and Development Commission

Brian Hunter, *Regional Manager, Region 3*
California Department of Fish and Game

W. John Schmidt, *Executive Director*
Wildlife Conservation Board

H. Dale Hall, *Assistant Regional Director for California and Klamath Ecoregions*
U.S. Fish and Wildlife Service

Alexis Strauss, *Division Director*
Water Management Division, Region IX
U.S. Environmental Protection Agency

Maxine Durney, *President*
Council of Bay Area Resource Conservation Districts

Karl Malamud-Roam
Coastal Region, Mosquito and Vector Control Districts

Attachment A

San Francisco Bay Joint Venture
Working Agreement Conflict of Interest
and Disclosure Policy

All management board members are required to disclose any personal or organizational interest in a transaction or project under consideration by the Joint Venture. In addition, all potential conflicts of interest must be disclosed so that decisions made by the Joint Venture are not interpreted to be influenced by the appearance or fact of personal material financial benefit to individuals.

Definition. A conflict of interest exists whenever a member of the management board (including a spouse, sibling, parent, or child of a board member) has a personal material financial interest in a transaction or project under consideration by the management board.

Board Members Obligation. Each board member has the obligation to avoid a conflict of interest and must disclose to the board the existence of any real or potential conflict of interest.

Board Obligations. If the board determines that a transaction or project of the Joint Venture involves a conflict of interest, whether real or apparent, by a member of the management board, the board shall, at a minimum, require the board member to abstain from voting on any such issue.

The board may approve of such project or transaction only if the board makes specific findings that the transaction or project is:

(a) fair and benefits the Joint Venture and its objectives; and

(b) approved with full knowledge of the economic benefit to the board member involved in the conflict of interest.

Attachment B

San Francisco Bay Joint Venture Working Agreement Mitigation Policy

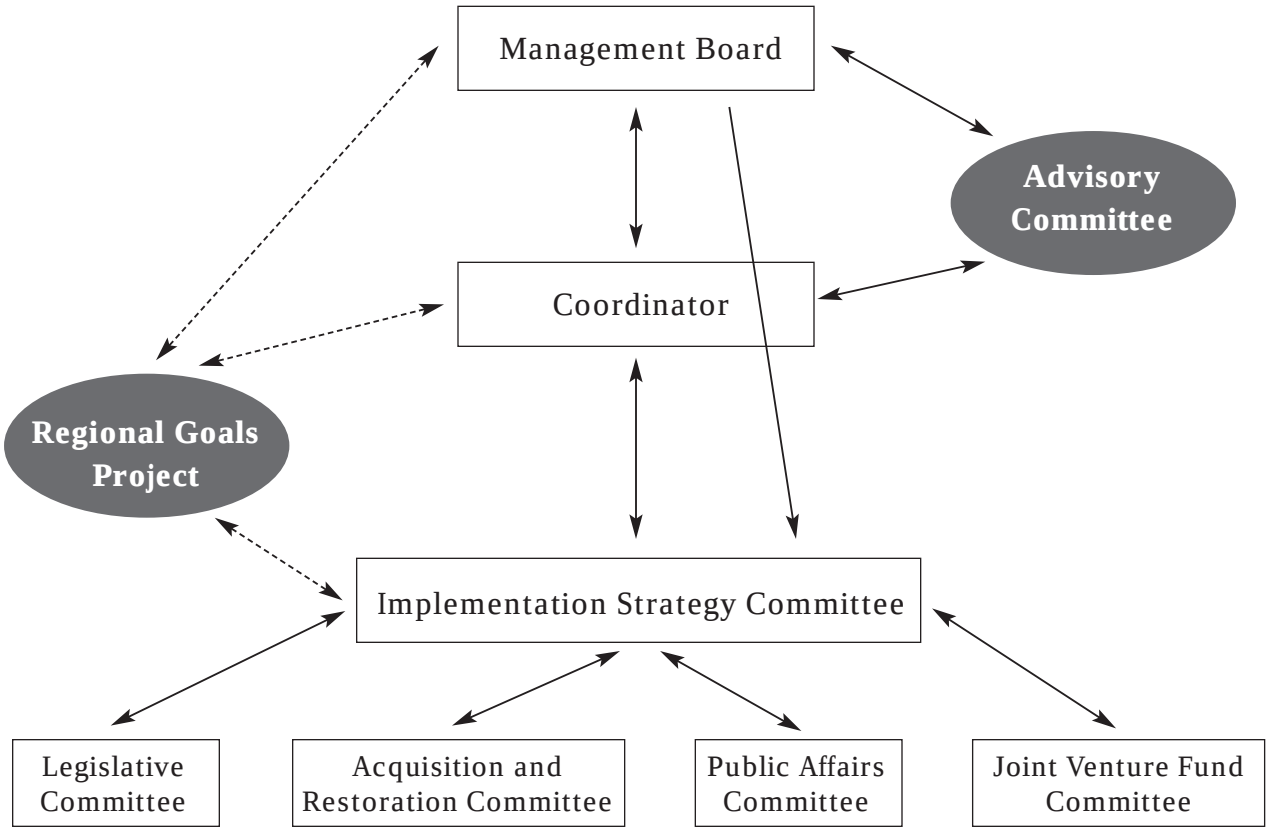
The San Francisco Bay Joint Venture is a non-regulatory project whose purpose is the protection, restoration, and enhancement of wetland habitats. The Joint Venture will not participate in permit actions requiring mitigation for wetlands degradation caused by proposed or permitted activities whose primary purpose is something other than the enhancement, restoration, or creation of wetland habitat.

This policy shall not preclude the Joint Venture from exploring opportunities to work with permit holders to further enhance, restore, or create wetlands beyond permit-specified levels, provided that all project-related permits and mitigation have been finalized and secured before the Joint Venture's involvement is solicited.

If a formal mechanism is established to allow the Joint Venture to receive monies, the Joint Venture may elect to receive fines, such as administrative civil penalties, levied as part of an effort to redress past violations for unauthorized environmental degradation, and to use those fine monies to undertake the enhancement, restoration, or creation of wetlands habitats.

Attachment C

San Francisco Bay Joint Venture Structure



Appendix B—
Policy Foundations for Ecosystem Protection and Restoration

The North American Waterfowl Management Plan: Waterfowl Goals

The North American Waterfowl Management Plan (The Plan) is an international strategy to protect, restore and enhance wetlands in Canada, the U.S., and Mexico for waterfowl through the use of partnerships between public and private organizations called joint ventures. The NAWMP identified 34 major habitats used by waterfowl, one of which is the San Francisco Bay Area.

Specific waterfowl population goals have been developed for North American waterfowl. The Plan's primary goal is to restore and maintain waterfowl diversity and abundance to levels occurring in the 1970s. Population declines observed in the 1980s prompted the development of the Plan. The Plan identifies factors in declines in duck populations. These include habitat loss, land use changes, disease, competition with other ducks, predation, and hunting.

The Plan's first goal is 62 million breeding ducks to support a fall flight of at least 100 million ducks and six million wintering geese and swans under average environmental conditions. Secondly, the Plan's objective is to reach or exceed mid-continent breeding duck population goals for the 10 most common duck species. Since 1986, eight of 10 of these species have seen an increase in their populations, and some have exceeded those goals. Lesser and greater scaup and gadwall are duck species that have not seen an increase since 1986. The Plan also calls for a black duck midwinter population index of 385,000. Black duck population has decreased especially in the Mississippi Flyways. Goals for goose populations aim to bring their populations to sustainable levels. Efforts to reduce Snow goose and Ross' goose populations are being considered.

The Plan was intended to be updated every five years to reassess its targets and strategies. The recently released 1998 Update to the Plan has three visions for improving the status of North America's waterfowl and the wetlands that support them. These visions consist of:

1. **Enhancing the biological foundation:** This means employing sound biology to plan the enhancement of the landscape's ability to support waterfowl and other wetland species.
2. **Using a landscape approach to sustain species:** Participate in developing conservation, economic, management, and social policies that promote the ecological health of landscapes that sustain and benefit waterfowl and other wetland species.
3. **Collaboration with other partnerships:** Forge a broader alliance with other conservation efforts, such as shorebird and migratory bird initiatives.

The San Francisco Bay Concept Plan for Waterfowl Habitat Protection

The Plan called for the development of a concept plan for each of 34 Waterfowl Habitat Areas of Major Concern. The 1989 Concept Plan for Waterfowl Habitat Protection was completed under the guidance of the NAWMP.

The Concept Plan gives primary importance to the restoration and enhancement of waterfowl populations, but also recognizes the significance of nongame species, at least partially in recognition of the loss of wetlands in the region. The Concept Plan notes that, between 1984 and 1989, about 220,000 ducks used San Francisco Bay wetlands, almost eight percent of the total found in California. Most of these

birds use the open water of the Bay or the deeper salt ponds. For example, about 135,000 diving and sea ducks used the Bay, about 67 percent of the total waterfowl seen that year. These birds represent almost 40 percent of the State total. Only about 42,000 dabbling ducks, waterfowl that use tidal and freshwater marshes, were seen that year; these represent somewhat less than three percent of the State total, and may indicate the extent of losses to these habitats in the region.

The Plan also lists and briefly describes the 16 federally listed and 29 candidate species that require wetland habitats. Since the publication of that report, several other species have been listed, and State and regional work has added even more species to those considered of special status. The Concept Plan also notes the importance of the region to shorebirds, wading birds, fish, and shellfish, and describes wetlands as important for flood control, shoreline anchoring and dissipation of erosive forces, maintenance of water quality, and recreational uses.

Based on these factors, the Concept Plan provides the following objectives: (1) protect an existing area of 366,000 acres of wetlands and deep water habitats; (2) increase the acreage of habitat available for waterfowl, endangered species, shorebirds, and other wetland resources, especially seasonal wetlands and tidal salt marshes; and (3) enhance the value and diversity of existing wetlands, at least partially through improvements to habitat and water quality.

The San Francisco Bay Area Wetlands Ecosystem Goals Project

The San Francisco Bay Area Wetlands Ecosystem Goals Project (Goals Project) has spent over three years developing goals for the numerous wetland habitat types found within the baylands or the lands within the historical and modern boundaries of the tides. Goals Project participants included over 100 scientists from local, state, and federal agencies, nonprofit organizations, private consulting firms, and universities. The Project was sponsored by nine state and federal agencies including the National Marine Fisheries Service, San Francisco Bay Conservation and Development Commission, San Francisco Bay Regional Water Quality Control Board, Coastal Conservancy, Department of Fish and Game, Department of Water Resources, Resources Agency, U.S. Environmental Protection Agency, and the U.S. Fish and Wildlife Service. The San Francisco Bay Joint Venture and many of its partners participated in the Goals Project.

The goals produced by the Goals Project are a vision of the types, amounts, and distribution of wetlands and related habitats needed to sustain diverse and healthy communities of fish and wildlife in the San Francisco Bay Area. The Joint Venture has used these goals as the biological foundation for the development of this Implementation Strategy. The Implementation Strategy has taken the goals, expanded them to incorporate a larger geographic region extending beyond the baylands, and developed specific actions that can be taken to meet the expanded goals of the Joint Venture.

Habitat Goals should be considered an appendix to the Joint Venture Implementation Strategy because it contains detailed information about species and habitat needs, and makes specific recommendations for restoration of wetlands sites around the Bay. It also addresses technical considerations for habitat restoration, monitoring, and research and implementation issues. The Joint Venture will look to *Habitat Goals* to guide the restoration activities of its partners.

Appendix C—
Waterfowl Use of San Francisco Bay Subregions

Wintering waterfowl use of San Francisco Bay is extensive. More than 250,000 birds have been counted during the last several midwinter January waterfowl surveys. Generally, early migrants show up in September, peak numbers occur in December or January and use continues through May. In order to document the importance of the Bay to wintering waterfowl, the U.S. Fish and Wildlife Service conducted twice-monthly surveys between October and April of 1988–89 and 1989–90. Six geographically distinct regions were used to delineate the Bay. Four open water regions included the North Bay (San Pablo Bay), Central Bay (San Francisco Bay), South San Francisco Bay, and Suisun Bay. Two wetland regions primarily comprised of salt evaporation ponds included the North Bay salt ponds and South Bay salt ponds.

Although the 1998 midwinter survey indicated wintering waterfowl were distributed fairly equally among the six regions, each holding from 13 percent to 23 percent of the total, the 1999 midwinter survey showed a larger proportion of birds using the Central (36%) and North Bay (28%) regions. Suisun Bay was not surveyed in 1999 due to poor weather. Certain regions are typically used more extensively by certain species than others. For example, in 1999, the North (San Pablo) Bay accounted for over 60 percent of the Bay's wintering canvasbacks. The North Bay and South Bay salt ponds were also important with 20 percent and 12 percent of the canvasbacks, respectively. Scaup were observed primarily in the Central Bay (55%), North Bay (25%) and South Bay (17%) regions. Buffleheads were primarily concentrated in the North Bay (38%) and South Bay salt ponds (30%), as well as in the Central Bay (24%). In 1998 and 1999, ruddy ducks accounted for more than 90 percent of the use of both salt pond regions.

The more comprehensive winter surveys from 1988 to 1990 reveal less seasonal, regional, and annual distribution of waterfowl use in the San Francisco Bay. Overall, diving ducks made up the majority of all waterfowl in the four open Bay regions. In both years, the South San Francisco Bay and Central Bay regions had similar use patterns. Less than 2,000 were present in October; their numbers peaked at 36,000–55,000 in December/January, and their numbers declined slowly through early April, with more than 10,000 still present. In both the North and Suisun Bays, diving duck use fluctuated widely between years and throughout the season. In the North Bay, few birds were present in early October, but in one year, large concentrations (140,000) were observed by mid-October. Waterfowl populations remained high into spring, with up to 70,000 birds still present in March. The North Bay received high use both years, accounting for 30 percent of the Bay's totals. North Bay salt ponds had three to four times more diving ducks than dabbling ducks, while the South Bay salt ponds conversely had two times more dabblers than divers. In both regions, dabblers began appearing in August, while divers arrived later in November. Dabbler use was consistent between years in the North Bay salt ponds and fairly consistent in the South Bay salt pond region, while diver numbers were less consistent. The majority of both diving and dabbling ducks were observed in salt ponds with salinity levels equal to or less than 64 parts per thousand.

Appendix D—
Description of Habitat Types

Habitats within the Baylands

Open Water

Open water areas include all areas that are below the line of mean lower low water (MLLW) and thus not exposed during daily tides: deep bay, shallow bay, deep major channel, and shallow major channel habitats. These habitats are tremendously valuable for wintering waterfowl, especially diving and sea ducks, and provide migratory corridors through which anadromous fish, such as salmon, reach freshwater spawning grounds.

During the last century, the open waters of the Bay have not been reduced to as great an extent as other habitats, but they have been greatly modified. Hydraulic gold mining sent millions of cubic yards of silt washing down from the mountains of the Sierras. Much of this sediment load settled out in the Bay, greatly reducing water depths. For example, 45,000 acres in the North Bay were once more than 60 percent deep waters; they are now almost 70 percent shallow waters.

The effect of this modification on waterfowl and other wildlife is not clear, but the capability of the watershed to deliver significant amounts of pollutants to the Bay estuary is obvious. Restoration of open water in the Bay will be difficult because it would require excavation of wetlands and uplands. Open waters could be enhanced, however, by the planting of eelgrass or by other strategies.

Mudflats

Mudflats include those lands above MLLW but below the mean tide level (MTL), where marsh vegetation begins to grow. These habitats are often described as tidal flats, due to the great variety of types of flats; sand and shell flats are not uncommon in the Bay, and the substrate character can be very important for different wildlife. Tidal flats are extremely important for wintering waterfowl and shorebirds.

Tidal flats have been greatly reduced in extent since the early part of the last century. The reduction is primarily due to the sediment loads deposited by hydraulic mining, which also shifted the flats inward toward the center of the Bay. Essentially, the upper edges of the old flats became marsh while the outer edges of the open water became flats. As with the changes in open water depth, the impacts of these shifts on wildlife use are difficult to assess, and restoration would require significant excavation of uplands and wetlands. Enhancement could be of value, though. For example, flats are being colonized by an exotic cordgrass *(Spartina alterniflora)* that increases sedimentation among these plants and a gradual conversion of the flat to marsh; removal of this invasive species could reduce or reverse mudflat losses.

Tidal Marshes

Tidal marshes are found along the Bay edge between MTL and just above mean higher high water (MHHW). They consist primarily of areas completely open to tidal influence but also include areas of muted tidal marsh, that is, areas where culverts or other obstructions reduce the range of tides but still allow frequent inundation and exposure. They may be dominated by cordgrass *(Spartina foliosa)* and pickleweed *(Salicornia virginica)* in saline areas, and several species of bulrush (*Scirpus* spp) in fresher zones. The values of tidal marshes are numerous. The Concept Plan for Waterfowl Habitat Protection (hereafter, "Concept Plan") states that these areas provide "significant habitat for both migratory birds

and resident wildlife." Aside from providing important waterfowl and shorebird habitat, these areas support the entire Estuary through production of organic nutrients, which form the basis for the open water and mudflat food chains. They also reduce shoreline erosion by damping wave action, and act as nursery and refuge areas for many fish species.

The extent of tidal marshes in the Bay region has declined by almost 80 percent. As with mudflats, marshes were shifted bayward by sediment loading in the late 1800s. Marshes are also threatened by pollutants carried by runoff (wetlands tend to be deposition areas at the ends of stormwater pipes), and by the spread of exotic species. The Bay region has a relatively lengthy history of tidal marsh restoration; a number of restoration projects have converted filled or diked lands to tidal marsh since the mid-1970s, and a variety of newer projects are underway or planned.

Diked Marshes

Diked marshes are areas within the Baylands now cut off from tidal action but dominated almost entirely by marsh. These areas consist primarily of managed marsh (often managed by duck clubs in the North Bay), and diked marsh, typically former tidal marsh that was diked and possibly converted to other uses, but now reverting to marsh. These areas are often very valuable for waterfowl, especially dabbling ducks and shorebirds, and may be used by listed species, such as the salt marsh harvest mouse, as a substitute for more natural habitats.

Diked marshes are an artifact of the diking of the Baylands. Their current habitat values are generally due to the effect of shallow ponded water on the marsh plain. Where water levels are not managed, however, highly variable conditions and wildlife values may occur. Much of the tidal marsh restoration that has occurred in the region has taken place in diked marshes, although there is significantly more debate now than in the past on the wisdom of this conversion.

Agricultural Baylands

Agricultural baylands are those former tidal wetlands that were converted to, and have remained in, some form of farming activity. These include grazed baylands, farmed baylands, and "ruderal" (weed-dominated) baylands. The extent of wetlands in these areas is open to question. Typically, the area of any particular field defined as wetlands for regulatory purposes ranges from five to 30 percent. However, these lands may pond over larger areas during wet periods and, coupled with the extent of low-lying flat ground, be good habitat for waterfowl and shorebirds. These areas, as implied by the name, can also provide important farm and other benefits (employment, silage for dairy herds, and open space, for example).

Agricultural baylands are also an artifact of the diking of Bay wetlands. As open space, they are often subject to competing pressures from other uses, from development to tidal wetland restoration. The future uses of these lands, especially those in the North Bay subregion, are subject to a great deal of scrutiny from a number of agencies, environmental organizations, and agricultural interests. Assuming that 25 percent of these lands is wetland, the remaining 75 percent, 22,250 acres in the entire region, is potentially restorable to some form of wetland.

Salt Ponds

Salt ponds are baylands that have been diked and converted to salt production uses. These ponds are tremendously important for shorebirds and for several species of waterfowl, especially canvasback and scaup. The highly saline conditions of the ponds can produce significant populations of invertebrates that become prey for flocks of shorebirds and waterfowl. Birds are also attracted by the variety of depths and the lack of vegetation that elsewhere provides cover for predators.

These areas are almost all former tidal wetlands, mudflats, or open water. Salt ponds are extensive in the South Bay and their varying colors are among the most noticeable artifacts of the Bay edge. Salt production has been an economically viable concern, and only a few of these ponds have been restored to tidal wetlands.

Ponds and Lagoons

Ponds and lagoons are areas of confined open water, sometimes influenced by tides. These include natural ponds; ponds built for habitat purposes, such as Pacheco Pond in Marin County; artificial lagoons, such as those found in Bel Marin Keys or Foster City; and constructed storage or treatment basins. The

values of these areas are highly variable. Some ponds are used by large numbers of waterfowl, especially diving and sea ducks, while others are seldom used. The Concept Plan notes that these areas provide important "habitat for a variety of species including waterfowl" (p. 14), but also notes that further research and consensus-building are needed for a better definition of these values.

These habitats are generally artifacts of development; less than 100 acres of ponds occurred around the Bay prior to the historic period. Most of these areas could be enhanced, however, and because of the general shortage of freshwater marshes near the Bay, could provide improved wildlife habitat.

Beaches

The Bay region once had extensive beaches along its edges. Assuming a 50-foot width, 200 acres of beach would be 33 miles long. These were probably significant as shorebird roosting and nesting sites, haul-outs for seals and other marine mammals, and refuges for other wildlife.

The loss and modification of beaches has been significant. It is not surprising that the snowy plover and least tern—two wildlife species dependent on beaches—should be endangered. There is little work on the restorability of the current beaches. Given their recreational use and the modifications that have so drastically changed shoreline hydrology and sediment transport, restoring or even enhancing existing beaches may be difficult.

Uplands

Prior to the 1800s, there were almost 5,000 acres of uplands within the Baylands, primarily islands. Today, uplands within the Bayland zone include the remnants of those islands, undeveloped fill, and developed fill and islands. Uplands near or adjacent to wetlands can be tremendously valuable as refuges during high water events, foraging habitat, and as buffers to treat runoff. Many dabbling ducks and shorebirds prefer upland areas adjacent to wetlands for nesting.

The uplands within the Bayland zone may have been modified more during the past centuries than any other habitat type. Most uplands in the Baylands were dominated by native grasses or, more rarely, by woodlands. Today, little undeveloped native upland remains and very few stands of native grasses survive. Most were replaced by the non-native annual grasses and forbs brought in during the Mission period.

There is little information on the extent of native uplands needed as buffer or refuge for wetlands, and little experience in restoring native uplands. Although the current extent of uplands within the Baylands is significant, most uplands are developed. About 6,500 acres of uplands are presently undeveloped, and could be restored to a mix of wetlands and uplands.

Habitats outside the Baylands

Riparian

Riparian wetlands include both woodlands and forb-dominated swales on sites that do not support trees. These areas can be very important for certain species of waterfowl, such as wood ducks, and significant in pollution-reduction, buffering, nutrient production, and habitat for other wildlife. The Concept Plan notes that this community often supports the greatest variety and density of resident and migratory wildlife.

Riparian habitats have been greatly reduced in the Bay region. Aside from the loss in acreage, if we assume that the average riparian corridor is 100 feet wide, over 400 miles of creeks and streams have been eliminated.

Riparian restoration work has been significant in the Bay region, but it is generally very costly. Most creeks now carry large flows from adjacent neighborhoods or other developed areas, and more pollutants. Newly planted woodlands must be able to withstand these impacts. Many urban creeks have been culverted underground and, although there has been some success in bringing several streams back to the surface, this is an expensive process.

Seasonal Wetlands

Seasonal wetlands are wetlands within a matrix of uplands. The acreage figures in the attached tables show the extent of the total landscape, including both wetlands and uplands. These habitats typically occur as basins in relatively flat areas or on gently rolling ground. The basins are typically wetlands, and may be termed vernal pools, seasonal wetlands or marshes, or wet meadows. They typically consist of seeps,

wet soils, and vernal pools. The values of these habitats are often significant. They may host large numbers of waterfowl and shorebirds during the winter and spring migratory periods, and may support several rare or endangered plants and invertebrates.

The loss of these areas has been great, almost 75 percent of their original level. Additionally, of the remaining areas, uplands have often been converted from native perennial grasses and wildflowers to non-native annual weeds. Restoration work has begun on these types of habitats but most projects are relatively new. However, large areas are potentially restorable.

Associated Uplands

Uplands associated with habitats outside the Baylands historically included native grasslands, shrublands, and woodlands. The value of these habitats was immense as filter zones for the wetlands, as refuge for wetland-related wildlife, nesting habitat, and other functions. Many of these lands have been converted to other uses; defining the exact extent of the acreage would be impossible. Restoration has begun on many types of associated uplands, often as buffers for wetland creation projects, and many of the issues involved have been explored and defined.

Appendix E—
Goals-Setting Worksheets

Summary of Sources and Process

Regional Goals Habitats	Past	Present	Future (Reg. Ec. Goals)	Protected
Tidal Flat	SFEI (1)	SFEI (1)	JV (5)	GI/SFEI (7)
Tidal Marsh	SFEI (1)	SFEI (1)	GP (4)	GI/SFEI (7)
Lagoon	SFEI (1)	SFEI (1)	GP (4)	GI/SFEI (7)
Beach	SFEI (1)	SFEI (1)	JV (5)	GI/SFEI (7)
Salt Pond	SFEI (1)	SFEI (1)	GP (4)	GI/SFEI (7)
Storage/Treatment Pond	SFEI (1)	SFEI (1)	GP (4)	GI/SFEI (7)
Diked Wetland	SFEI (1)	SFEI (1)	GP (4)	GI/SFEI (7)
Agricultural Bayland	SFEI (1)	SFEI (1)	GP (4)	GI/SFEI (7)
Moist Grassland	SFEI (1)	SFEI (1)	JV (6)	GI/SFEI (7)
Vernal Pool Complex	SFEI (1)	SFEI (1)	JV (6)	GI/SFEI (7)
Lake	na	NWI/SFEI (3)	JV (6)	GI/SFEI (7)
Creek and Riparian Zone	SFEI/NWI/USGS(2)	SFEI/NWI/USGS(2)	JV (5)	GI/SFEI (7)

All values acres except "Creek and Riparian Zone," which are miles. (Summed total "Creeks and Lakes" is in acres.)

Definitions
Past: Habitat acreage circa 1800.
Present: Habitat acreage circa 1998.
Future: Regional ecological goal for the habitat.
Protected: Public lands (or lands protected by easement) dedicated to the habitat type. Includes lands proposed for restoration of the habitat type.
Acquire: Land which needs to be placed in protective ownership to meet JV goals. (Difference between "Future" and "Protected".)
Restore: 20 year SFBJV restoration goal. Restoration refers to conversion from one habitat type to a different habitat type.
Enhancement: 20 Year goal for enhancement of currently existing habitat. Enhanced habitats do not change habitat type.
tr: less than 500 acres (trace).

Sources
JV: San Francisco Bay Joint Venture.
SFEI: San Francisco Estuary Institute, from the EcoAtlas and analyses for JV.
NWI: National Wetlands Inventory, as reported in SFEP 1992.
GP: San Francisco Bay Area Wetlands Ecosystem Goals Project, as reported in *Baylands Ecosystem Habitat Goals, 1999*.
GI: Bay Area Open Space Coverage developed by John Woodbury and GreenInfo Network
na: not available

Process
(1) Calculated from EcoAtlas V1.50. Expected error <10%.
(2) Estimated from NWI, EcoAtlas Riparian Forest coverage, USGS 1:100,000 Hydrology coverage. Expected error up to 50%.
(3) Estimated from NWI. Expected error up to 25%.
(4) Calculated from *Habitat Goals*.
(5) Based upon *Habitat Goals* research and/or narrative recommendations.
(6) Goal is preservation of present acreage.
(7) Estimated from Open Space coverage and known parcel ownership. Expected error up to 25% (potentially larger for TM, Lakes, and C/RZ)

Rounding:
If less than 100 acres, value is rounded to nearest 10.
If 100 <x< 1,000 acres, value is rounded to nearest 100.
If 1,000 <x< 3,000 acres, value is rounded to nearest 500.
If greater than 3,000 acres, value is rounded to nearest 1000.
(Because of rounding, subregional values do not always sum to regional total.)

SFBAY Region

EcoAtlas Habitats	Past	Present	Future (Reg. Ec. Goals)	Protected
Tidal Flat	49,000	28,000	28,000	8,000
Tidal Marsh	133,000	32,000	74,000	16,500
Lagoon	80	4,000	3,000	1,000
Beach	200	70	150	tr
Salt Pond	1,500	34,000	15,000	19,000
Storage/Treatment Pond	—	4,000	4,000	2,000
Diked Wetland	—	17,000	25,000	5,000
Agricultural Bayland	—	30,000	0	tr
Moist Grassland	60,000	8,000	8,000	tr
Vernal Pool Complex	24,000	15,000	15,000	tr
Lake	NA	12,000	NA	8,000
Creek and Riparian Zone	NA	NA	NA	tr

EcoAtlas Habitats	SFBJV Tracked Habitats	Past	Present	Future	Protected	Acquire	Restore	Enhance
Tidal Flat	Tidal Flat	49,000	28,000	28,000	8,000	12,000	4,000	6,000
Tidal Marsh	Tidal Marsh	133,000	32,000	74,000	16,500	43,000	32,000	20,000
Lagoon	Lagoon	80	4,000	3,000	1,000	1,500	50	2,000
Beach	Beach	200	70	150	tr	113	6035	
Salt Pond	Salt Pond	1,500	34,000	15,000	19,000	6,000	1,000	8,000
Storage/ Treatment Pond Diked Wetland	Diked Wetland	—	21,000	29,000	7,000	16,000	6,000	12,000
Agricultural Bayland Moist Grassland Vernal Pool Complex	Grassland and Assoc. Wetlands	84,000	53,000	NA	tr	21,000	1000	10,500
Lake	Lake	NA	12,000	NA	8,000	3,000	1000	6,000
Creek and Riparian Zone	Creek and Riparian Zone	NA	NA	NA	tr	250	250	1,000

EcoAtlas Habitats	SFBJV Tracked Habitats	SFBJV Goals Habitats	Acquire	Restore	Enhance
Tidal Flat Tidal Marsh Lagoon Beach	Tidal Flat Tidal Marsh Lagoon Beach	Bay Habitats	63,000	37,000	36,000
Salt Pond Storage/Treatment Pond Diked Wetland	Salt Pond Diked Wetland	Seasonal Wetlands	37,000	7,000	23,000
Agricultural Bayland Moist Grassland Vernal Pool Complex	Grassland and Assoc. Wetlands				
Lake Creek and Riparian Zone	Lake Creek and Riparian Zone	Creeks and Lakes	7,000	5,000	22,000
Total			**107,000**	**49,000**	**81,000**

Full Bay Area (m2) 11,681,459,630.6013 Full Bay Area (acres) 2,886,552

Suisun ****(note area includes Contra Costa Shoreline plus upland habitats)*

EcoAtlas Habitats	Past	Present	Future (Reg. Ec. Goals)	Protected
Tidal Flat	1,201	209	209	tr
Tidal Marsh	9,204	5,556	5,804	2,500
Lagoon	0	6	6	0
Beach	0	0	0	0
Salt Pond	0	0	0	0
Storage/Treatment Pond	—	632	632	632
Diked Wetland	—	2,145	2,145	tr
Agricultural Bayland	—	160	0	0
Moist Grassland	7,000	1,000	1,000	tr
Vernal Pool Complex	14,000	9,000	9,000	tr
Lake	NA	2,500	2,500	tr
Creek and Riparian Zone	NA	NA	NA	tr

EcoAtlas Habitats	SFBJV Tracked Habitats	Past	Present	Future	Protected	Acquire	Restore	Enhance
Tidal Flat	Tidal Flat	1,201	209	209	tr	294	98	147
Tidal Marsh	Tidal Marsh	9,204	5,556	5,804	2,500	2,976	2,214	1,384
Lagoon	Lagoon	0	6	6	0	0	0	4
Beach	Beach	0	0	0	0	0	0	0
Salt Pond	Salt Pond	0	0	0	0	0	0	0
Storage/ Treatment Pond Diked Wetland	Diked Wetland	—	2,777	2,786	tr	1,537	576	1,153
Agricultural Bayland Moist Grassland Vernal Pool Complex	Grassland and Assoc. Wetlands	21,000	10,160	NA	tr	9,130	435	4,565
Lake	Lake	NA	2,500	2,500	tr	625	208	1,250
Creek and Riparian Zone	Creek and Riparian Zone	NA	NA	NA	tr	36	36	146

EcoAtlas Habitats	SFBJV Tracked Habitats	SFBJV Goals Habitats	Acquire	Restore	Enhance
Tidal Flat Tidal Marsh Lagoon Beach	Tidal Flat Tidal Marsh Lagoon Beach	Bay Habitats	3,000	2,000	2,000
Salt Pond Storage/Treatment Pond Diked Wetland	Salt Pond Diked Wetland	Seasonal Wetlands	11,000	1,000	6,000
Agricultural Bayland Moist Grassland Vernal Pool Complex	Grassland and Assoc. Wetlands				
Lake Creek and Riparian Zone	Lake Creek and Riparian Zone	Creeks and Lakes	1,000	1,000	4,000

North Bay

EcoAtlas Habitats	Past	Present	Future (Reg. Ec. Goals)	Protected
Tidal Flat	13,000	9,000	9,000	3,000
Tidal Marsh	55,000	16,000	38,000	9,000
Lagoon	40	2,500	2,000	1,000
Beach	30	0	20	tr
Salt Pond	300	7,000	4,000	
Storage/Treatment Pond	—	1,500	1,000	1,000
Diked Wetland	—	8,000	17,000	4,000
Agricultural Bayland	—	28,000	0	3,000
Moist Grassland	15,000	6,000	6,000	tr
Vernal Pool Complex	4,000	3,000	3,000	0
Lake	NA	2,000	2,000	1,000
Creek and Riparian Zone	NA	NA	NA	tr

EcoAtlas Habitats	SFBJV Tracked Habitats	Past	Present	Future	Protected	Acquire	Restore	Enhance
Tidal Flat	Tidal Flat	13,000	9,000	9,000	3,000	3,184	1,061	1,592
Tidal Marsh	Tidal Marsh	55,000	16,000	38,000	9,000	17,782	13,233	8,271
Lagoon	Lagoon	40	2,500	2,000	1,000	750	31	1,333
Beach	Beach	30	0	20	0	17	0	5
Salt Pond	Salt Pond	3,000	7,000	4,000	6,000	1,235	206	3,133
Storage/ Treatment Pond Diked Wetland	Diked Wetland	—	9,500	18,000	tr	9,931	3,724	7,448
Agricultural Bayland Moist Grassland Vernal Pool Complex	Grassland and Assoc. Wetlands	19,000	37,000	NA	tr	8,217	391	4,109
Lake	Lake	NA	2,000	2,000	1,000	500	167	1,000
Creek and Riparian Zone	Creek and Riparian Zone	NA	NA	NA	tr	52	52	208

EcoAtlas Habitats	SFBJV Tracked Habitats	SFBJV Goals Habitats	Acquire	Restore	Enhance
Tidal Flat Tidal Marsh Lagoon Beach	Tidal Flat Tidal Marsh Lagoon Beach	Bay Habitats	23,000	15,000	13,000
Salt Pond Storage/Treatment Pond Diked Wetland	Salt Pond Diked Wetland	Seasonal Wetlands	18,000	4,000	12,000
Agricultural Bayland Moist Grassland Vernal Pool Complex	Grassland and Assoc. Wetlands				
Lake Creek and Riparian Zone	Lake Creek and Riparian Zone	Creeks and Lakes	1,000	1,000	4,000

Central Bay

EcoAtlas Habitats	Past	Present	Future (Reg. Ec. Goals)	Protected
Tidal Flat	14,000	4,000	4,000	1,000
Tidal Marsh	13,000	1,000	1,500	tr
Lagoon	50	700	500	tr
Beach	200	50	100	tr
Salt Pond	0	0	0	0
Storage/Treatment Pond	—	60	60	0
Diked Wetland	—	1,300	1,500	0
Agricultural Bayland	—	30	0	tr
Moist Grassland	5,000	tr	tr	0
Vernal Pool Complex	0	0	0	0
Lake	NA	1,000	1,000	1,000
Creek and Riparian Zone	NA	NA	NA	tr

EcoAtlas Habitats	SFBJV Tracked Habitats	Past	Present	Future	Protected	Acquire	Restore	Enhance
Tidal Flat	Tidal Flat	14,000	4,000	4,000	1,000	3,429	1,143	1,714
Tidal Marsh	Tidal Marsh	13,000	1,000	1,500	tr	4,203	3,128	1,955
Lagoon	Lagoon	50	700	500	tr	938	9	333
Beach	Beach	200	50	100	tr	113	43	23
Salt Pond	Salt Pond	0	0	0	0	0	0	0
Storage/ Treatment Pond Diked Wetland	Diked Wetland	—	1,360	1560	tr	861	323	646
Agricultural Bayland Moist Grassland Vernal Pool Complex	Grassland and Assoc. Wetlands	5,000	30	NA	tr	0	0	0
Lake	Lake	NA	1,000	1,000	1,000	250	83	500
Creek and Riparian Zone	Creek and Riparian Zone	NA	NA	NA	tr	42	42	167

EcoAtlas Habitats	SFBJV Tracked Habitats	SFBJV Goals Habitats	Acquire	Restore	Enhance
Tidal Flat Tidal Marsh Lagoon Beach	Tidal Flat Tidal Marsh Lagoon Beach	Bay Habitats	9,000	4,000	4,000
Salt Pond Storage/Treatment Pond Diked Wetland	Salt Pond Diked Wetland	Seasonal Wetlands	1,000	0	1,000
Agricultural Bayland Moist Grassland Vernal Pool Complex	Grassland and Assoc. Wetlands				
Lake Creek and Riparian Zone	Lake Creek and Riparian Zone	Creeks and Lakes	1,000	1,000	3,000

South Bay

EcoAtlas Habitats	Past	Present	Future (Reg. Ec. Goals)	Protected
Tidal Flat	21,000	15,000	15,000	4,000
Tidal Marsh	56,000	9,000	29,000	5,000
Lagoon	0	600	600	tr
Beach	10	20	10	0
Salt Pond	1,500	27,000	11,000	13,000
Storage/Treatment Pond	—	2,000	2,000	tr
Diked Wetland	—	6,000	4,000	1,000
Agricultural Bayland	—	1,500	0	tr
Moist Grassland	33,000	700	700	tr
Vernal Pool Complex	6,000	3,000	3,000	tr
Lake	NA	6,000	6,000	6,000
Creek and Riparian Zone	NA	NA	NA	tr

EcoAtlas Habitats	SFBJV Tracked Habitats	Past	Present	Future	Protected	Acquire	Restore	Enhance
Tidal Flat	Tidal Flat	21,000	15,000	15,000	4,000	5,143	1,714	2,571
Tidal Marsh	Tidal Marsh	56,000	9,000	29,000	5,000	18,105	13,474	8,421
Lagoon	Lagoon	0	600	600	tr	0	8	400
Beach	Beach	10	20	10	0	6	17	2
Salt Pond	Salt Pond	1,500	27,000	11,000	13,000	4,765	794	5,867
Storage/ Treatment Pond Diked Wetland	Diked Wetland	—	8,000	6,000	tr	3,310	1,241	2,483
Agricultural Bayland Moist Grassland Vernal Pool Complex	Grassland and Assoc. Wetlands	39,000	5,200	NA	tr	3,378	161	1,689
Lake	Lake	NA	6,000	6,000	6,000	1,500	500	3,000
Creek and Riparian Zone	Creek and Riparian Zone	NA	NA	NA	tr	120	120	479

EcoAtlas Habitats	SFBJV Tracked Habitats	SFBJV Goals Habitats	Acquire	Restore	Enhance
Tidal Flat Tidal Marsh Lagoon Beach	Tidal Flat Tidal Marsh Lagoon Beach	Bay Habitats	28,000	16,000	17,000
Salt Pond Storage/Treatment Pond Diked Wetland	Salt Pond Diked Wetland	Seasonal Wetlands	7,000	1,000	4,000
Agricultural Bayland Moist Grassland Vernal Pool Complex	Grassland and Assoc. Wetlands				
Lake Creek and Riparian Zone	Lake Creek and Riparian Zone	Creeks and Lakes	3,000	2,000	11,000

Appendix F—
Waterfowl Survey Data from San Francisco Bay

Survey Limitations

Waterfowl population goals for San Francisco Bay are based on the best available data. Currently, the best data are the midwinter aerial surveys performed by USFWS personnel from the San Francisco Bay National Wildlife Refuge. Two caveats must be considered in any discussion of San Francisco Bay waterfowl populations. First, counting waterfowl is an inexact science, and the midwinter counts are at best an index of local abundance. Even though the USFWS collects the data using a repeatable protocol of standard transects, these estimates can be affected by factors that have nothing to do with population changes. Examples include weather conditions, changes in migratory behavior, and observer error. Another concern is changes in the survey technique and area surveyed over the 45 years of its existence. Data from different decades reflect slightly different methodologies, and thus are not totally comparable. For example, the findings of Accurso (1992) led to a major revamping of survey techniques in about 1998 (John Takekawa, USGS-BRD, personal communication). These changes resulted in more thorough coverage of the Bay, and a higher percentage of birds counted. More recently, some transects have been removed from the survey due to increased air traffic at San Francisco International Airport. Second, the midwinter index is not the best estimate of peak waterfowl abundance. Accurso (1992) surveyed from October through April, and reported peaks for certain species as early as October 3–4, and as late as March 20–21. Thus the midwinter count consistently underestimates the peak abundance for all species. For this reason, Accurso's data is used to derive correction factors that translate midwinter indices to annual peaks **(Table F-3)**. Third, waterfowl populations in San Francisco Bay do not simply reflect local habitat conditions. Rather they are a product of numerous factors throughout the life history and geographic range of these birds. For example, conditions in the major breeding habitats of the Central Plains will in large part determine how many waterfowl are produced in a given year. One exception is the locally breeding mallard population, which will be a valuable indicator of local habitat conditions. Restoration of wintering habitat in San Francisco Bay is very important, but by itself will not ensure healthy waterfowl populations.

Figure F-1:
Midwinter Indices for Scaup in the Pacific Flyway 1955–99

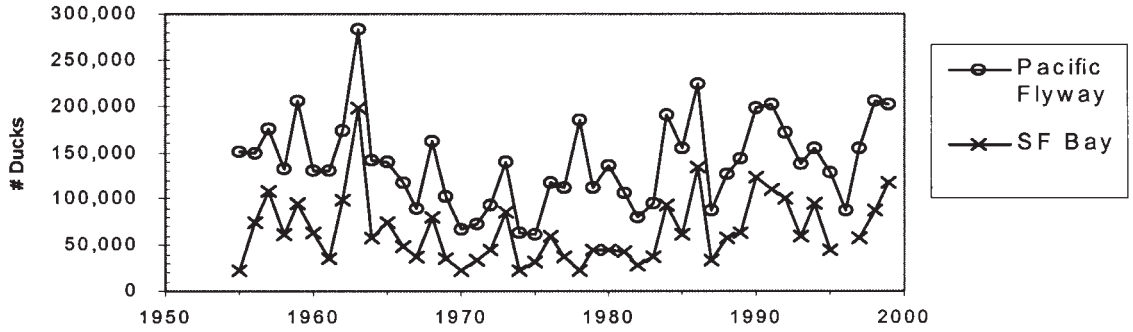


Figure F-2:
Midwinter Indices for Canvasbacks in the Pacific Flyway 1955–99

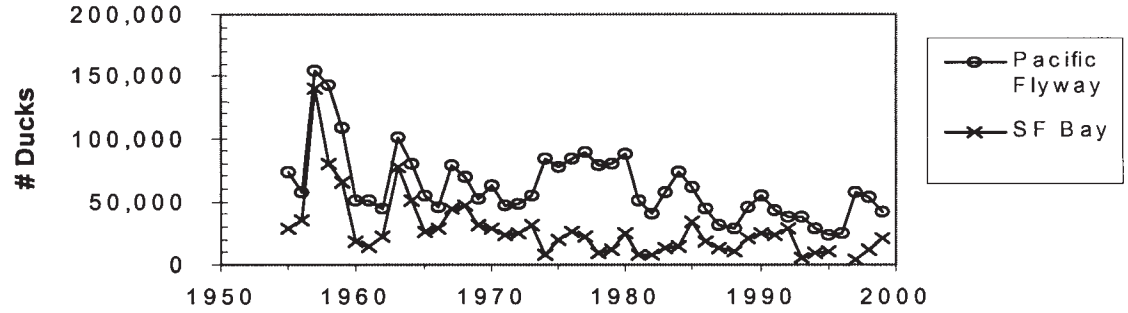


Figure F-3:
Midwinter Indices for Scoters in the Pacific Flyway 1955–99

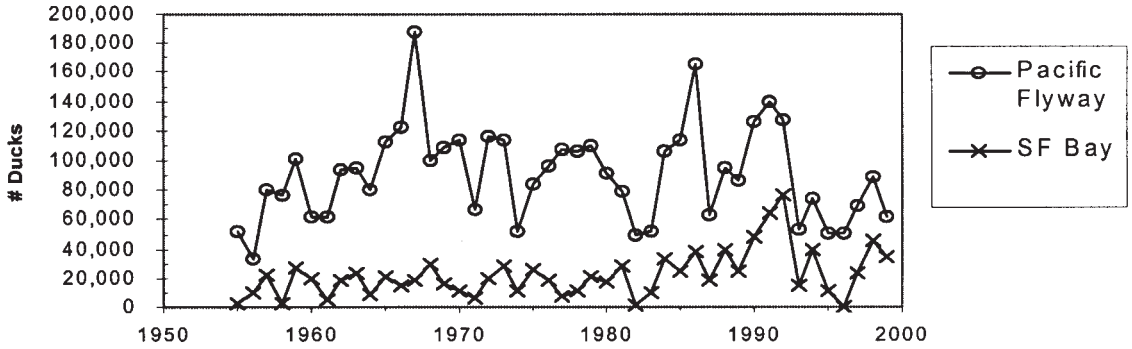


Table F-1:
Midwinter Indices for Canvasback, Scaup, Scoters, & Pintail 1955–99

	Canvasback		Scaup		Scoters		Pintails	
	Pacific Flyway	% in SF Bay	Pacific Flyway	% in SF Bay	Pacific Flyway	% in SF Bay	Pacific Flyway	% in SF Bay
1955	73,553	40%	150,953	15%	51,736	5%	2,221,786	1%
1956	57,977	62%	148,386	50%	32,989	31%	2,521,200	1%
1957	154,499	90%	175,122	61%	80,289	27%	2,155,306	2%
1958	142,257	56%	132,528	47%	76,846	4%	2,882,530	0%
1959	108,487	61%	205,016	47%	101,582	26%	2,321,848	1%
5 yr average	**107,355**	**65%**	**162,401**	**44%**	**68,688**	**19%**	**2,420,534**	**1%**
1960	50,713	36%	129,816	50%	61,855	32%	1,962,322	1%
1961	50,713	29%	129,816	28%	61,855	7%	1,962,322	2%
1962	44,761	50%	172,972	58%	93,413	20%	1,585,198	4%
1963	100,034	77%	283,418	70%	94,616	25%	1,641,994	0%
1964	80,383	63%	141,098	41%	79,972	11%	1,682,528	1%
1965	54,316	47%	140,588	53%	112,740	19%	2,288,802	0%
1966	45,599	63%	117,216	41%	121,874	12%	1,633,828	0%
1967	78,360	56%	88,904	42%	187,214	10%	2,342,643	0%
1968	69,186	68%	162,086	50%	99,852	30%	1,378,472	1%
1969	51,681	61%	101,952	34%	108,414	15%	1,685,502	0%
10 yr average	**62,575**	**58%**	**146,787**	**50%**	**102,181**	**17%**	**1,816,361**	1%
1970	63,157	45%	66,699	33%	113,000	10%	2,449,789	0%
1971	47,615	49%	72,039	47%	66,337	9%	3,857,712	1%
1972	48,204	53%	93,826	48%	116,425	17%	2,918,980	1%
1973	54,587	57%	139,120	62%	113,232	25%	2,868,092	0%
1974	83,260	10%	64,221	34%	52,121	22%	3,441,401	1%
1975	77,668	25%	61,785	50%	83,459	30%	3,278,495	1%
1976	83,261	31%	116,836	52%	96,801	20%	3,326,695	0%
1977	89,135	25%	112,083	34%	107,554	7%	3,620,038	1%
1978	78,308	11%	184,688	12%	105,877	10%	2,996,528	0%
1979	80,263	15%	111,658	41%	110,313	19%	3,265,814	1%
10 yr average	**70,546**	**29%**	**102,296**	**40%**	**96,512**	**16%**	**3,202,354**	**1%**

Table F-1: *(continued)*

Midwinter Indices for Canvasback, Scaup, Scoters, & Pintail 1955–99

	Canvasback		Scaup		Scoters		Pintails	
	Pacific Flyway	% in SF Bay	Pacific Flyway	% in SF Bay	Pacific Flyway	% in SF Bay	Pacific Flyway	% in SF Bay
1980	87,599	29%	135,270	32%	91,492	20%	4,015,739	
1981	50,432	15%	105,824	41%	79,554	35%	2,508,739	1%
1982	40,596	21%	79,498	36%	49,067	3%	1,831,832	0%
1983	57,933	22%	95,123	40%	51,299	19%	1,181,335	0%
1984	73,801	20%	190,833	49%	106,388	31%	2,411,716	1%
1985	60,996	55%	154,416	40%	113,554	22%	859,305	0%
1986	44,626	42%	223,838	60%	165,222	23%	1,254,794	1%
1987	31,570	42%	87,214	38%	62,455	29%	663,212	1%
1988	28,857	36%	125,835	45%	95,435	41%	1,262,689	1%
1989	45,888	44%	143,363	44%	86,617	28%	685,403	1%
10 yr average	**52,230**	**32%**	**134,121**	**44%**	**90,108**	**26%**	**1,667,476**	**1%**
1990	54,861	46%	196,652	62%	125,597	38%	888,876	1%
1991	42,690	55%	201,662	55%	139,892	46%	1,051,819	0%
1992	37,855	75%	170,566	59%	127,292	61%	773,548	2%
1993	37,509	16%	137,225	43%	52,578	28%	741,120	0%
1994	29,233	29%	154,321	61%	74,035	53%	1,055,970	0%
1995	23,994	43%	129,188	34%	50,134	23%	1,012,086	0%
1996	24,476	0%	87,099	0%	50,618	0%	1,435,296	0%
1997	57,447	7%	154,245	38%	69,563	34%	962,026	0%
1998	53,631	22%	205,084	43%	88,807	52%	1,278,494	0%
1999	41,847	51%	201,207	58%	61,358	56%	1,129,553	1%
10 yr average	**40,354**	**34%**	**163,725**	**49%**	**83,987**	**43%**	**1,032,879**	**0%**
45 yr average	**62,085**	**44%**	**139,584**	**46%**	**90,474**	**24%**	**1,984,297**	**1%**

Table F-2:

Midwinter Aerial Surveys for Waterfowl in San Francisco Bay (including salt ponds)

	Canvasback	Scaup	Scoters	Pintails
1955	29311	22896	2650	15612
1956	35810	73672	10300	22475
1957	139365	107480	21750	41980
1958	80180	61855	3055	13895
1959	65825	95350	26650	22095
5 year average	**70098.2**	**72250.6**	**12881**	**23211.4**
1960	18095	64270	19935	26445
1961	14650	36320	4570	39620
1962	22445	99650	18570	55935
1963	77325	197185	23464	2960
1964	50550	58085	8720	13145
1965	25523	74340	21313	10452
1966	28580	47640	15013	6200
1967	44120	37565	18930	6722
1968	47022	80440	29775	15770
1969	31595	34490	16360	1735
10 yr average	**35990.5**	**72998.5**	**17665**	**17898.4**

Table F-2: *(continued)*

Midwinter Aerial Surveys for Waterfowl in San Francisco Bay (including salt ponds)

	Canvasback	Scaup	Scoters	Pintails
1970	28370	22080	10745	4325
1971	23260	33610	6010	19840
1972	25378	45485	19272	31735
1973	31315	85676	27819	9587
1974	8035	21795	11390	17290
1975	19086	30760	25326	28430
1976	26025	60285	19100	7610
1977	22160	37865	7235	36590
1978	8752	22352	10804	13295
1979	11735	45410	21265	19940
10 yr average	**20411.6**	**40531.8**	**15896.6**	**18864.2**
1980	25260	43930	17885	28300
1981	7700	42990	27850	5070
1982	8470	28800	1250	1175
1983	12910	38110	9865	14480
1984	14860	93075	33300	11485
1985	33555	61970	24610	7535
1986	18599	134605	38502	14717
1987	13265	33282	18134	3319
1988	10245	56908	39352	12379
1989	20272	62728	24106	4006
10 yr average	**16513.6**	**59639.8**	**23485.4**	**10246.6**
1990	25087	122092	48278	5119
1991	23391	110331	63867	2964
1992	28297	100895	77040	13075
1993	5875	59503	14537	597
1994	8565	94379	39368	1902
1995	10428	44223	11459	4205
1996	No survey	No survey	No survey	No survey
1997	3746	58659	23352	1780
1998	11575	87301	46037	2621
1999	21316	117141	34143	14323
9 yr average	**13828.3**	**79452.4**	**35808.1**	**4658.9**
44 year average	**27,065**	**64,166**	**22,066**	**14,061**

Source: Dan Yparraguirre, Waterfowl Coordinator, California Department of Fish & Game

Table F-3:

Conversion Factors for Deriving Annual Peak Waterfowl Counts from Midwinter Aerial Survey Data

Conversions are species-specific, and are based on the three years of fall–winter surveys conducted by Accurso (1992). To obtain annual peak, multiply midwinter count by the conversion factor.

Species	Peak Conversion Factor
Northern pintail	1.341622
Canvasback	1.451713
Scaup	1.603405
Scoter	1.476519