San Francisco Estuary Project

2007
Comprehensive Conservation And Management Plan

Comprehensive Conservation and Management Plan

Update 2007

San Francisco Estuary Project

San Francisco Estuary Project
Implementation Committee

Resolution: Adoption of Revised Comprehensive Conservation and Management Plan

Whereas:

1) The San Francisco Estuary Project (SFEP) was established in 1987 under the Clean Water Act's Section 320: The National Estuary Program (NEP) to develop and implement a Comprehensive Conservation and Management Plan (CCMP) to "restore and maintain the chemical, physical and biological integrity of the Estuary." The Act further states that the "plan shall be implemented."

2) Representatives from government agencies, private and community groups in the 12 county Bay-Delta region, came together in a consensus-based process over a five-year period to develop the 1993 CCMP. The Governor and U.S. EPA Administrator approved the Plan in 1993.

3) The CCMP is a blueprint for restoring and maintaining the estuary through recommended corrective actions in nine program areas. It seeks to achieve high standards of water quality, including restoration and maintenance of a balanced indigenous population of fish, shellfish and wildlife, and recreational activities in the estuary, and assure that the designated uses of the estuary are protected.

4) CCMP actions influence enforceable policies; some actions have been implemented by agencies under current authorities, other actions can be implemented under existing authority, but require additional resources; and some actions call for changes in federal or state legislation.

5) The Implementation Committee, as SFEP's primary decision-making body, represents a unique partnership of organizations and agencies that have worked together and overseen the implementation of the 1993 CCMP for the past 14 years.

6) The U.S. EPA recommends that all NEPs periodically review their CCMPs to incorporate emerging issues and reconfirm the commitments of those who play a role in CCMP implementation. With continuing and new challenges for the estuary, the Implementation Committee recognized the need to review and update 1993 CCMP actions that need significant revision due to error, obsolescence, or new information.

7) The Implementation Committee used an inclusive and open process for updating the 1993 CCMP and invited all Implementation Committee members and other interested parties to participate in work groups that undertook the detailed CCMP review. The Implementation Committee carried out a Public Outreach Strategy that included invitations to over 500 individuals to participate in the process; regular updates in the ESTUARY newsletter (over 3000 circulation); and information posted on the website. SFEP Executive Council and

Implementation Committee members and interested parties (180 on mail list) received copies of all draft and final 2007 CCMP recommendations.

8) In 2006, the Implementation Committee convened six program area work groups to review goals, objectives and actions that needed updating in the 1993 CCMP. Over 80 volunteers participated in 30 work group meetings over an 18-month period to research, write and edit the 1993 CCMP.

9) The Implementation Committee approved and carried out a process for chapter-by-chapter revision of the 1993 CCMP. This included two presentations by each work group of all new or revised language to the Implementation Committee; the first to describe the revisions, provide clarification, take oral comments and request written public comment; the second to review the revised draft language reflecting requested changes and vote acceptance of the revised chapter. The 2007 CCMP includes 63 new actions and 72 revised actions.

Therefore, be it resolved that:

We, as members of the San Francisco Estuary Project Implementation Committee, agree to:

1) Adopt the 2007 CCMP;

2) Forward the 2007 CCMP to the Executive Council for review and approval;

3) Work with staff and potential implementors in both government and the private sector on an action-by-action basis to determine potential revenue sources, establish clear priorities, develop effective and efficient mechanisms to implement the 2007 CCMP and refine implementation schedules. Participants at the biennial CCMP Public Workshop shall continue to assist SFEP, the Implementation Committee and Executive Council in determining priority actions for implementation;

4) Recognize that CCMP implementation requires continued encouragement and collaborative effort to secure understandings and agreements among the various capable parties for implementing the actions; and

5) Incorporate this resolution to the beginning of the 2007 CCMP.

This resolution was approved by the Implementation Committee on August 3, 2007.

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Thomas E. Mumley, Ph.D.
Chair, SFEP Implementation Committee

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2007 CCMP INTRODUCTION

The San Francisco Estuary Project is a federal-state-local partnership established in 1987 under the Clean Water Act's Section 320: National Estuary Program. It is a cooperative effort working to promote effective management of the Bay-Delta Estuary, and to restore and maintain its water quality and natural resources while maintaining the region's economic vitality. The Estuary Project oversees and tracks implementation of the Comprehensive Conservation and Management Plan (CCMP); manages complicated, technical research and restoration projects; and disseminates newsletters, fact sheets, videos, and other materials to educate the public about Bay-Delta Estuary wetlands, wildlife, aquatic resources, and land use issues. It administers small grants, organizes erosion control and science workshops and conferences, and conducts many other programs.

INTRODUCTION

The San Francisco Estuary Project's Comprehensive Conservation and Management Plan (CCMP) is a collaboratively produced, consensus-based agreement about what should be done to protect and restore the Estuary. It serves as a roadmap for restoring the Estuary's chemical, physical, and biological health. The CCMP was mandated under a reauthorization of the Clean Water Act in 1987, and Congress has directed that it be implemented. However, many of the actions suggested in the CCMP will require regulatory or policy initiatives to ensure implementation. Meanwhile, securing the necessary funding for acquisition, restoration, and other projects is an ongoing challenge.

This 2007 CCMP updates the 1993 CCMP, which was based on input from the broad stakeholder community—including more than 100 representatives from federal and state agencies, local governments, environmental groups, business and industry, academia, and the public, all with an interest in the Estuary. The 2007 CCMP includes new and revised actions, while retaining many of the original plan's actions. Based on successes since 1993 and new and continuing challenges, participants updating the plan focused on those actions they considered most relevant at this time. Some actions from the 1993 edition were not revised due to time and resource constraints.

Successes Since 1993

CCMP actions are being carried out by many entities—federal and state agencies, nonprofits, cities, counties, private businesses, and coalitions of such groups. The bottom line is that, as was intended, Estuary advocates have taken action since the original CCMP was approved in 1993 by the Governor and the Administrator of the U.S. Environmental Protection Agency. Much progress has been made. There has been a change in scientists' and resource managers' thinking about managing and restoring the Estuary. There is more integration of disciplines, including hydrology, geology, biology (both plant and animal), and chemistry. Specialization in species or habitats has given way to a more interdisciplinary focus on watersheds and watershed management. A groundswell of citizen activism has also taken place. For almost every river and stream

that flows to the Estuary today, there is a "Friends" group or a watershed council working, often in partnership with wetland groups, to remove invasive vegetation, grow and plant native plants, clean up trash, and advocate for healthier watersheds.

There have been many additional CCMP-related successes, including:

- The "Baylands Ecosystem Habitat Goals Report" was completed.
- Nearly 67,000 acres of wetlands, including 16,000 acres of South Bay salt ponds, have been acquired and are in the process of being restored.
- Gains have been made in controlling some non-native invasive species—*Spartina alterniflora*, for example.
- The scope and scale of habitat restoration, both tidal wetland and riparian, have increased.
- Private landowners in the Central Valley are restoring and returning vineyards planted in floodplains years ago back to riparian forests.
- Government agencies have partnered with nonprofit organizations on large-scale riparian restoration projects along several of the Estuary's rivers; some of those projects have resulted in the return of bird species not seen in decades.
- Regional agencies and local governments are beginning to explore ways to establish watershed goals and protection policies.
- The Regional Monitoring Program for Water Quality in the San Francisco Estuary has evolved from a program that tracked status and trends of pollutants in the Estuary to one that also advances scientific understanding of the Estuary and its watershed to aid decision-makers in resource management.
- Many total maximum daily load (TMDL) projects—for pathogens, nutrients, salt, selenium, sediment, pesticides, polychlorinated biphenyls (PCBs), oxygen, and mercury—are being developed and implemented, both in the Bay Area and in the Central Valley. The phase-out of most urban uses of diazinon can be partly attributed to the attention this pesticide received as a source of water quality impairment.
- The Long Term Management Strategy for the Placement of Dredged Material (LTMS) in the San Francisco Bay Region was launched in 1990 as a multi-agency approach to managing dredged materials. The LTMS has implemented the majority of the actions called for in the 1993 CCMP Dredging and Waterway Modification program, including the beneficial re-use of over 9 million cubic yards of dredged material.
- The San Francisco Bay National Estuarine Research Reserve has been established.
- The San Francisco Bay Joint Venture, the Riparian Habitat Joint Venture, and the Central Valley Joint Venture were created as large-scale collaborative efforts to restore and protect habitat and natural resources. They involve coalitions of nonprofits, business, government, and agency stakeholders throughout the Estuary watershed.

New and Continuing Challenges

The 2007 CCMP identifies new concerns that affect CCMP implementation. Global climate change is now widely recognized by the scientific community, government agencies, and the public as a significant threat to ecosystem health and public safety.

Anticipated sea level rise from global warming may result in saltwater intrusion into the Delta, changes in timing and flows of rivers and streams flowing into the Estuary, and damage to restored wetlands and marshes. These impacts may degrade drinking water quality and undermine the viability of fisheries, and present even greater challenges for the preservation of already endangered species.

One of these species is the Delta smelt, which is quickly approaching extinction. The rapid decline of open water, or pelagic organisms, like the Delta smelt, is creating ever more urgency around the question: How can we best manage the Delta, and for what purposes and values? Answers to this question affect a variety of management decisions, including whether or not a new "peripheral canal," smaller than the one voters rejected twenty-five years ago, should be built; whether levees should be fortified or abandoned; and whether the amount and timing of flows from the state and federal pumps must be changed. Governor Arnold Schwarzenegger established the Delta Vision to examine these questions. It is anticipated that a draft Delta Vision will be developed by December 2007, and a Strategic Plan recommended by December 2008.

Despite significant pollution control efforts, many pollutants and legacy contaminants persist throughout the Estuary, which means that warnings about eating fish from the Estuary are still in effect. Plastics and other trash from creeks and rivers continue to flow into the Estuary, impacting water quality, wildlife, and the aesthetics of the Bay and Delta. Other, less visible pollutants must also be addressed. Agricultural pollution and urban runoff continue to be a problem. And new and emerging pollutants include the myriad products humans use every day in the form of pharmaceuticals and personal care products. Wastewater treatment plants do not completely remove these compounds.

Many challenges relate to wetlands. There is a new focus on methylmercury production in wetlands. Advocates and scientists alike are researching options that would facilitate continued stream and tidal wetland restoration projects without increasing methylmercury, the most biologically available form of mercury.

Although great strides have been made in restoring tidal marshes and other aquatic habitats in the Estuary, seasonal wetlands and riparian areas throughout the watershed continue to be lost, mostly to urban expansion. Future impacts to these valuable resources could be minimized through the preparation of regional watershed plans. In addition to identifying the most valuable wetland and riparian areas, these plans should seek to provide and protect transition habitats between wetlands and uplands, buffer areas adjacent to wetlands and stream corridors, and functional connections between wetlands, riparian areas, and other ecologically important parts of the watershed. Watershed plans should be based on scientifically developed habitat goals.

Even with watershed plans in place, development will continue to adversely affect wetlands and riparian areas within the Estuary watershed. To offset these impacts more effectively, the design and management of compensatory mitigation—both individual mitigation projects and mitigation banks—should be improved.

As restoration activities have burgeoned, the need for sustainable sources of funding continues to grow as well. Many restoration projects, currently in the acquisition or planning stages, will need substantial funding to be implemented.

Although much progress has been made reusing dredge materials, federal policies—and budgets—continue to favor open-water disposal. Improved state and federal policies and funding for beneficial reuse are needed. If the cost of reusing dredged material could be made comparable to that of open-water disposal, more dredgers (especially small ones) could participate in beneficial reuse projects.

Two of the biggest challenges to ecosystem protection are continued population growth and urban sprawl. Regional and local land use decisions that direct development toward existing infrastructure, including mass transportation, flood protection, water systems, and jobs, would help protect the Estuary and its watershed. Better land use policies, better project designs, including green stormwater systems, and better building practices are needed to preserve open space and habitat, improve resource efficiency, and reduce water quality and other environmental impacts. Challenges in achieving more sustainable land use throughout the Estuary watershed include the complexity of integrated planning; the lack of understanding of the full costs of sprawl and of the potential benefits of infill, higher density, and mixed-use development; and tax policies that make development and associated fees more attractive than investment in open space uses. Additionally, it is difficult to secure voter approval for funds to purchase and protect open space.

As the state's population increases, the need for broad public support and understanding of the Estuary's natural resources and functions also continues to grow. Such support is possible only if the public shares the goals of the CCMP and values attempts to protect and restore the Estuary. For that to happen, people need to see and experience the Estuary and its waters and wildlife, and they also need to understand the threats to its health. Developing this kind of broad community support and understanding requires hands-on programs and printed media efforts that reach all the diverse communities of the Bay-Delta region, overcoming language, economic, and cultural barriers. Even though such programs may be difficult to fund and sustain, they are absolutely essential for the success of efforts presented in the CCMP.

Readers Guide to the 2007 CCMP

The 1993 CCMP Action Plan has been fully integrated into this edition of the CCMP, including all nine program areas with their mission statements, goals, and actions. Participants in the update process left some program areas intact and revised others. The Public Involvement Program has been updated to reflect the many organizations now working to implement the CCMP. The Research and Monitoring Program was not revised. The 2007 CCMP also recognizes that a number of its actions are interconnected and therefore provides appropriate cross-references among actions.

The 2007 CCMP has some new features. A list of actions is provided at the beginning of each program. Each action is designated as "1993 CCMP," "Revised 2007," or "New 2007." All new actions will evaluate progress using performance measures. Cost estimates for new actions are given using a $-sign scale that reflects the magnitude of the cost. The type of cost—policy action, program development/implementation, project, staff, resource purchases, etc.—and level of uncertainty are also evaluated in each action. The new cost estimates also acknowledge the fact that some costs are not easily quantifiable.

Cost Key

Symbol	**Amount**
$	Up to $100,000
$$	Up to $1 million
$$$	Up to $10 million
$$$$	Up to $100 million
$$$$$	> $100 million

Aquatic Resources

Goals:

- Stem and reverse the decline in the health and abundance of estuarine biota (indigenous and desirable non-indigenous), restoring healthy natural reproduction.

- Restore healthy estuarine habitat to the Bay-Delta, taking into consideration all beneficial uses of Bay-Delta resources.

- Ensure the survival and recovery of listed (and candidate) threatened and endangered species, as well as other species in decline.

- Manage the fish and wildlife resources of the Estuary to achieve the goals stated above.

Problem Statement

For more than a century, humans have modified the habitats of the Bay-Delta Estuary and its watershed, and extracted its resources. Federal and state water projects were constructed in and upstream of the Delta for the primary purposes of water conveyance and distribution, but their effects on ecological systems were not adequately understood, addressed, or mitigated for. The result has been diminished ecosystem functions and the imperilment of estuarine habitats and biodiversity.

The pumping plants for the Central Valley Project (CVP) and the State Water Project (SWP) are located in the southern part of the Delta near Byron. These pumps divert water from the Sacramento-San Joaquin river system for conveyance south to farms and urban centers. During periods of high pumping relative to low outflow, water in the Delta channels and the San Joaquin River can flow upstream, resulting in the disorientation and mortality of anadromous and estuarine-dependent fish. Society, in spite of much investment and effort to date, has been unable to protect aquatic life from the direct and indirect effects of these operations.

Additionally, in the Delta alone, there are approximately 1,800 agricultural diversions that divert flows, ranging from several cubic feet per second (cfs) to several hundred cfs; only a few of these are screened. Industrial facilities in the Delta use estuarine waters in their cooling systems, where aquatic organisms are entrained in intake valves or impinged on fish screens.

Other possible causes for the decline of aquatic resources include habitat alteration by flood control and navigation projects, the loss of shaded riverine aquatic and riparian habitat (California has lost close to 95 percent of its riparian habitat since European settlement), the spread of non-native invasive species that out-compete native species of plants and animals, water pollution, and poaching. Recent stings by fish and wildlife agencies have uncovered and halted several ambitious poaching operations of striped bass and sturgeon.

Populations of four important species of estuarine fish—the endemic and threatened Delta smelt; the introduced striped bass, a popular sport fish; the native longfin smelt;

and the introduced threadfin shad—have declined since 1967, and all four species of fish showed a precipitous drop in abundance beginning in 2002. Resource managers have termed the phenomenon "pelagic organism decline," or POD. An interagency workgroup has formed to study the problem. The workgroup is examining data on food availability, disease, contaminants, toxic algae, predation, salinity, freshwater flows[1], and entrainment. At this time, a great deal of uncertainty remains as to the causes and remedies for the decline.

Pollutants are another suspect in the decline of aquatic resources. Even at very low concentrations, they can cause sub-lethal effects on fish behavior, increase their susceptibility to disease and predators, and affect reproduction. Pyrethroids—synthetic insecticides modeled on pyrethrins that occur naturally in plants—were thought to be safer alternatives to organophosphate pesticides like diazinon, which is known to harm fish and is no longer on the market. But pyrethroids, too, have emerged as contaminants of concern. In the Central Valley alone, pyrethroid use tripled in the last decade, with 178,000 pounds used in 2003. Beginning in 2001, urban use exceeded agricultural use. Greater efforts need to be made to keep pollutants out of surface waters.

Existing Management Structure

The management structure for the Estuary as it relates to aquatic resources remains largely the same since the CCMP was first approved in 1993. However, there is one new and important player: A cooperative state/federal effort known as the CALFED Bay-Delta Program began in 1995, charged with balancing water supply reliability, water quality, ecosystem restoration, and sustainable levees. CALFED is currently focusing many of its efforts on problems related to the Delta (see "Challenges" section below). Also new since 1993, the state recently began the Delta Vision to plan for a future for the Delta that reflects current understanding of problems and opportunities. Nationally, and in this Estuary, the issue of levee stability is acknowledged as critical for both short-term and long-term ramifications. This will be a key focus for the management decisions that emerge from the Delta Vision.

Recommended Approach

The Recommended Approach to restore the Estuary suggested in 1993 remains valid, although it will be more complex, difficult, and costly to implement than envisioned 14 years ago. While many new state bonds that include funding for environmental restoration have been passed since 1993, no new, more sustainable, large-scale funding sources have been identified and implemented. This is a serious issue and needs to be addressed as one of the highest priorities.

[1] The total annual volume of freshwater reaching the Estuary is highly variable, primarily as a result of California's variable precipitation patterns. Between 1921 and 1990, the annual flow of freshwater into the Delta ranged from about 6 million acre-feet (MAF) to more than 50 MAF, with an average of about 24 MAF. However, normal or above normal rainfall in recent years has meant improved inflows. In water-year 2004, inflows to the Delta and Estuary were 21.6 MAF, and 21.8 MAF in water-year 2005. Delta outflows were 15 MAF in 2004 and 15 MAF in 2005.

Today, government agencies, including CALFED; academic institutions; environmental nonprofits; and coalitions of many of these entities are working to improve the scientific basis for managing the Estuary and to restore the Estuary. One such coalition is the San Francisco Bay Joint Venture, a group of non-governmental organizations, utilities, landowners, and resource agencies collaborating to acquire, restore, and enhance wetlands on San Francisco Bay. Working together and with other agencies, members of this group have acquired, restored, and enhanced more than 60,000 acres around the Bay, including tidal marsh and flats, seasonal wetlands, creeks, lakes, lagoons, salt ponds, and open and subtidal water habitat.

The ongoing Regional Monitoring Program for Water Quality led by the San Francisco Estuary Institute has given us a better understanding of the impacts of a variety of contaminants on the Estuary's aquatic resources (see Pollution Prevention and Reduction Program).

Achievements, 1993-2007

Despite ongoing challenges and problems, there have been notable successes and progress in restoring some areas and functions of the Estuary and its watersheds since 1993. Anadromous fish habitat upstream of the Delta has improved in the 14 years since the CCMP was approved. Restoration activities on Butte Creek, Battle Creek, and Clear Creek demonstrate that given access to viable habitat, salmon can increase in numbers. Significant improvement in controlling water temperatures has been achieved at a few large reservoirs, and this will benefit downstream salmonid populations. Some unscreened water diversions have been effectively screened for juvenile salmonids. Naturally spawning stocks of salmonids are being emphasized over hatchery stocks. Striped bass are no longer being stocked as juveniles, which were preying on the juveniles of listed species of salmon. The population of catchable-sized striped bass, a non-native species of high beneficial use, has returned to fair numbers, although continued low abundance of early life stages is still of concern.

Other activities that have taken place since 1993 that will benefit the Estuary's aquatic resources include the acquisition of thousands of acres of Bay habitats, including tidal marshes and flats, lagoons, beaches, salt ponds, and open water/subtidal habitat, seasonal wetlands, and creeks and lakes. Current projects include the restoration of 49,000 acres and enhancement of 80,000 acres of those habitats. With the acquisition of the Cargill Salt ponds in the South Bay, 17,700 acres of diked former baylands are in the planning process for and early stages of restoration.

In the North Bay, resource managers broke ground in 2005 to restore 3,000 acres of salt ponds to tidal marsh, and to enhance three additional ponds. At the former Hamilton Airfield in the city of Novato, 620 acres of filled baylands are being restored to tidal and seasonal wetlands. In the East Bay, many urban streams have been restored, improving water quality and supporting viable fish runs.

A Flow Management Standard for the lower American River was developed under the auspices of the Sacramento Region Water Forum in 2006 to correct water temperature

and minimum flow standard deficiencies. The Bureau of Reclamation, state and federal fishery agencies, and other stakeholders agreed to improved flow objectives, which will be recommended to the State Water Resources Control Board in 2007 for consideration and inclusion in the Bureau of Reclamation's water right permits for the American River.

Another significant achievement was the signing in 2006 of a groundbreaking agreement among agricultural interests, environmentalists, and others to restore flows to the lower San Joaquin River in an attempt to reintroduce and restore spring-run Chinook**.**

Challenges, 2007-2017

The breakdown of the Delta's aquatic resources base is a major challenge. Despite much research, scientists have not yet been successful in addressing the causes of the decline of the Estuary's open water (pelagic) resources. The Pelagic Organism Decline workgroup plans to take a closer look at top-down stressors like salvage and predation, and to release a report synthesizing its findings by late 2007. Many scientists believe that the decline probably has more than one cause, and/or that it is the result of the cumulative impacts of many problems—including non-native invasive species, water projects, pollution, and poaching. In addition to the focus on the Delta, a better understanding of Bay inflow needs and of whether tributaries (along with the Sacramento and San Joaquin rivers) have flows that will keep them in good condition for aquatic resources is required.

Yet the fate of the Estuary's aquatic resources may hinge, to a large extent, on the solutions derived for the Delta, the hub of the state's water supply system. Human water needs have been elevated in importance as the issues of population growth, climate change, levee strength, and risk to homes, property, and water supply have become more prominent, particularly after Hurricane Katrina struck New Orleans (also protected by levees), and after a levee broke in the Delta's Jones Tract in 2004, causing millions of dollars' worth of damage. State resource agencies are attempting to juggle and balance these needs in the Delta Vision directed by an executive order of Governor Arnold Schwarzenegger. Delta Vision is intended to be a "sustainable" solution that will balance the environment with water supply needs. The California Resources Agency, CALFED, and the Governor's office have established a Stakeholder Coordinating Committee and Blue Ribbon Task Force for the Delta Vision and Implementation Plan process. It is anticipated that a draft Delta Vision will be developed by December 2007 and a Strategic Plan recommended by December 2008.

Also needing focus and attention are the issues of both legacy and emerging contaminants, including an ever-growing trash and plastic debris problem (see Pollution Prevention and Reduction Program). Global warming, too, could pose unprecedented challenges for aquatic resources, as water temperatures rise, the timing and volume of flows change, and habitats are altered by floods, droughts, or new dams built to capture water earlier in the year as the snowpack continues to shrink. Tidal marsh restoration efforts could be slowed if there is a sediment deficit. Other potential worries are impacts to aquatic life from new desalination and power plants proposed for the Estuary. Perhaps the biggest unknown is how and in what form (via what new infrastructure) the state will supply water—while still restoring flows and habitat for fish and wildlife—to its human population, predicted to increase by 11 million new residents by 2030.

Aquatic Resources Actions

Objective AR-1 (Revised 2007)

Improve the effectiveness of the techniques and programs used to monitor and evaluate ecosystem condition/"health" and the responses of the ecosystem to restoration projects, resource management and regulatory actions, and large-scale environmental change (e.g., climate change and sea level rise).

ACTION AR-1.1 (Revised 2007)

Coordinate, and refine where appropriate, existing and future monitoring programs to improve our understanding of the current status and long-term trends of ecosystem condition in the Estuary. Make the information derived from monitoring programs available in published formats to serve a variety of audiences. The goal is to more fully characterize natural ecosystem processes and properties sufficient to allow us to enhance our understanding of how anthropogenic stressors influence ecosystem condition and to make informed management and regulatory decisions.

Who: Member agencies of the Interagency Ecological Program (IEP) for the San Francisco Bay-Delta Estuary, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, San Francisco Estuary Institute, PRBO Conservation Science, CALFED Bay-Delta Program, South Bay Salt Pond Restoration Project, and others conducting or sponsoring monitoring programs in the Bay-Delta system.

What: Better coordinate, and refine where appropriate, Bay-Delta monitoring programs focused on physical, chemical, and biological conditions and changes along the axis of the Estuary between the Delta and extreme South Bay while at the same time maintaining those ongoing, long-term monitoring programs that continue to provide key understanding of the Estuary and its physical, chemical, and biological attributes and changes over decadal periods. Place increased monitoring emphasis on those specific locations where restoration or other management actions have the potential to change local/regional physical, chemical, and biological conditions. Emphasis in biological monitoring should be placed on detecting changes in populations of listed species, as well as in resident and migratory species populations considered critical to the well-being of the ecosystem in representative habitats in response to (a) physical, chemical, and biological changes brought about by both natural and anthropogenic stressors (e.g., processes related to climate change and sea level rise); (b) introduction of exotic species; and (c) restoration or resource management actions, including Delta outflow management. Identify data gaps and discontinuities, and enhance predictive capabilities of ecosystem models. Finally, incorporate into all data collection programs a greatly increased emphasis on, and requirement for the synthesis, interpretation, and dissemination of, the monitoring results in published formats that serve a variety of audiences, including resource managers, decision makers, scientists, and the public.

When: Immediately incorporate new information and ideas into monitoring programs and management actions. On an ongoing basis, through the process of adaptive management, update new information and ideas into programs and actions.

Cost: $$. Type: Program Development and Implementation.
Uncertainty: Costs to coordinate monitoring programs are part of the existing budgets for agencies that participate in the Interagency Ecological Program and the Regional Monitoring Program. To ask those that monitor, evaluate, and report to "work harder" requires more resources. The cost estimate of between $100,000 and $1,000,000 reflects a cost of approximately 1 percent to 5 percent over the existing program budgets.

Performance Measures:
1) Establish guidelines for "effective" Estuary-wide monitoring programs.

2) Number of conferences/meetings held to coordinate monitoring efforts, increase overall effectiveness, and share data

3) Number (or percentage) of monitoring programs that include tasks to coordinate activities and share data with other programs

4) Number of organizations/agencies (or percentage of decision makers) that are able to access monitoring data and associated reports (and have clear instructions on where to obtain information)

5) Number of updates of key indicators of ecosystem condition and change to ensure they are providing the information necessary to manage the Estuary's resources

6) Number of organizations/agencies (and percentage of Estuary resource managers) that receive information on key indicators (including how to access, comment, and add their own data)

Objective AR-2 (Revised 2007)

Develop and implement species-specific management actions for the Estuary to assist in the recovery and maintenance of sustainable fish populations and to control or eliminate undesirable non-native invasive species.

ACTION AR-2.1 (Revised 2007)
Continue to develop, implement, and enforce stringent regulations to control discharges of ship ballast water within the Estuary or adjacent waters sufficient to protect beneficial aquatic resources.

Who: California Department of Fish and Game, California Department of Health Services, California State Lands Commission, State Water Resources Control Board, U.S. Coast Guard, Bay-Delta Port Authorities, San Francisco Bay Conservation and Development Commission, San Francisco Estuary Institute, San Francisco Estuary Project

What: Reduce or eliminate the introduction of non-native invasive species that might harm existing beneficial aquatic resources of the San Francisco Estuary. As provided for in the 1999 Ballast Water Management for Control of Nonindigenous Species Act (California Assembly Bill 703) and later revised and reauthorized in 2003 by the Marine Invasive Species Act (AB 433), the California State Lands Commission, in conjunction with other state agencies, is charged with managing ballast water so as to prevent the introduction of non-native invasive species into state waters.

Prior to March 2006, California State Lands Commission regulations mandated the management of ballast water in vessels entering California waters after having departed ports outside of the Exclusive Economic Zone of the United States (extends to a distance 200 nautical miles from the baseline from which the breadth of the territorial sea is measured). After March 2006, the California State Lands Commission implemented additional regulations, in accordance with the Marine Invasive Species Act, to include the management of ballast water in coastwise vessel traffic. Coastwise traffic includes vessels operating in and/or entering California waters after departing from ports or "places" within the "Pacific Coast Region" (an area extending roughly from the Baja Peninsula in Mexico to Cook's Inlet, Alaska). This regulation modified the management requirements of vessels arriving to California from Mexico, Alaska, and Canada, and placed new requirements on vessels arriving from Washington, Oregon, and other California ports. All ports within the San Francisco Estuary, including the ports of Stockton and Sacramento, are considered to be a single "place" under the March 2006 regulation.

Activities pertaining to ballast water management in the San Francisco Bay-Delta Estuary should be monitored in conjunction with the California State Lands Commission and appropriate state agencies. Current approved management practices include open-ocean ballast water exchange and retention of ballast water; however, California Senate Bill 497 will begin to require vessels to meet strict interim ballast water discharge standards over a phased time period starting in 2009. All vessels will have to meet a zero discharge standard by 2020. The development of ballast water treatment technologies will be required to meet these stringent discharge standards.

A successful ballast water program sufficient to protect beneficial aquatic resources requires: 1) continued species monitoring in the San Francisco Bay-Delta Estuary, 2) enhanced enforcement of regulations, both in terms of personnel available for vessel inspections and tools required to verify ballast water management, 3) development and/or funding of treatment technologies that will meet performance standards, and 4) establishment of a ballast water treatment testing and evaluation center. If these actions are considered insufficient to address the issue of species invasions due to ballast water release, agencies should work to strengthen legislation both at the state and federal levels.

When*:* Immediately

Cost: The California Marine Invasive Species Program is funded by vessel fees. The development of treatment technologies and a testing and evaluation center will require additional sources of funding.

Performance Measures:
1) Develop system to analyze percentage of full ballast exchange by all arriving vessels (and discontinue current self-reporting).

2) Report percentage of vessels analyzed entering San Francisco Bay-Delta ports.
3) Change method of compliance calculation to track compliance separately for international and domestic vessels as well as multiply percentage of vessels in compliance by percentage of full ballast exchange.

4) Percentage increase in compliance rate

5) Publish a report detailing gaps in the ballast water exchange and enforcement laws and distribute widely to the public.

6) Revise or delete California Public Resources Code section 71207.

ACTION AR-2.2 (Revised 2007)
Prohibit and prevent the intentional, illegal, and unintentional introduction of non-native invasive species into the Estuary and its watershed.

Who: California Department of Fish and Game, California Fish and Game Commission, California State Lands Commission, California Department of Food and Agriculture, California Department of Boating and Waterways, California Department of Water Resources, State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board

What*:* To be prudent, the California Fish and Game Commission should deny all requests for the introduction of new species into the Estuary's watershed unless strong evidence is produced to demonstrate that an introduction will not have deleterious effects on indigenous species. Many of the non-native invasive species introduced into the Estuary have damaged ecosystem functions. Nevertheless, there are still proposals to introduce even more non-native invasive species into the system (e.g., grass carp). With regard to mosquito abatement, explore the feasibility of using indigenous minnows in appropriate aquatic sites to control mosquito populations.

The California Department of Fish and Game and associated agencies should perform an inventory and associated risk assessment to identify vectors (e.g., vessel fouling, the live seafood industry, the live bait industry, pet stores and aquariums, etc.) associated with the unintentional introduction of non-native invasive species into Estuary waters. Programs should be developed to minimize the risk of introduction by these vectors. These programs should include: 1) quantifying the extent of each vector's contribution to the problem, 2) educating stakeholders about the impacts of unintentional introductions and

what they can do to prevent them, 3) increasing inspection programs, and, if necessary, 4) developing regulations to curb unintentional introductions.

The California Aquatic Invasive Species Management Plan (California AIS Management Plan) is expected to be approved in 2007. The plan creates a coordinating framework and a list of management objectives, strategies, and actions for non-native invasive species within the state of California. All actions regarding non-native invasive species prevention should be conducted in consultation with the California AIS Management Plan and the California Noxious and Invasive Weed Action Plan.

***When**:* Immediately

Cost: $$. The cost would be included in the existing budgets for the agencies. Additional funding is needed to implement some of the items in this action and actions within the California AIS Management Plan.

Performance Measures:
1) Develop an index that includes the number of commercial and recreational vessels arriving in Bay-Delta ports from other countries, the amount (tons) of live seafood imported, the number of baitworms imported, and the amount of fish traded for aquariums.

2) Develop and implement programs (of management and/or outreach) that address the main vectors of non-native invasive species: aquarium trade, bait worm trade, and aquaculture.

ACTION AR-2.3 (Revised 2007)
Control problem non-native invasive species already in the Estuary.

Who: California Department of Fish and Game, California Department of Food and Agriculture, and California Department of Boating and Waterways

What: Appropriate agencies should examine the lifecycles and environmental requirements of undesirable non-native invasive species and develop and implement feasible measures to control or eliminate these organisms.

When: Ongoing

Cost: $$. The cost for a single investigation program could be up to $750,000–$1,000,000 annually. Implementing the plan could cost much more.

ACTION AR-2.4 (Revised 2007)
Develop programs to educate the public about the problems with non-native invasive species and their incidental transport or introduction.

Who: Friends of the San Francisco Estuary, California Department of Fish and Game, California Department of Food and Agriculture, and California Department of Boating and Waterways

What: Consistent with Action PI-3.1 of the Public Involvement and Education Program, develop a long-term educational program for user groups (e.g., anglers, sports clubs, commercial interests, schools, and environmental organizations) to curb the introduction of –non-native invasive species into the Estuary.

When: Began in 1994

Cost: The cost is addressed in Action PI-3.1.

ACTION AR-2.5 (1993 CCMP)
Strengthen programs to reduce the poaching of species within the Estuary.

Who: California Department of Fish and Game and California Department of Water Resources

What: Increase funding for the existing CalTIP (Californians Turn In Poachers and Polluters) anti-poaching program. Also, provide long-term funding for the special enforcement unit that has been established by the California Department of Fish and Game and funded for three years by the California Department of Water Resources to deal with "illegal take" and poaching of estuarine aquatic species. This special enforcement unit is equipped with state-of-the-art equipment (e.g., night-vision scopes, shallow-water jet boats, and deep-water patrol boats) and would augment existing night and overtime patrols. Consider adding a component to Action PI-3.1 of the Public Involvement and Education Program to curb poaching of aquatic resources.

When: Immediately

Cost: Funding for CalTIP should be increased by $100,000 annually. The California Department of Water Resources is currently providing $600,000 annually for three years from its Delta pumps mitigation fund to get the special enforcement effort started.

ACTION AR-2.6 (1993 CCMP)
Review and modify, if necessary, harvest regulations for aquatic species of concern.

Who: California Department of Fish and Game, California Fish and Game Commission, and Pacific Fishery Management Council

What: Review harvest regulations and determine if they are adequately protecting aquatic species. If not, prepare alternative regulations and adopt modifications.

When: The Pacific Fishery Management Council should perform this task annually, and the California Fish and Game Commission should do so biannually.

Cost: No additional cost

ACTION AR-2.7 (1993 CCMP)
Identify and control sources and sinks of contaminants that may affect fish populations or ecosystem health.

Who: State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, California Department of Transportation, California Environmental Protection Agency, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, industrial dischargers, and agricultural dischargers

What: Consistent with Action PO-2.3 of the Pollution Prevention and Reduction Program, identify sources and sinks of contaminants (e.g., mercury, selenium, and acid mine drainage) suspected of affecting populations and implement control programs to eliminate potential hazards to the ecosystem and public health.

In addition, when managing pulses of Delta outflows, give consideration to the impacts of altered circulation and transport and bioavailability of pollutants on estuarine aquatic resources.

When: Reduce toxic effects as quickly as feasible and, by the year 2030, reduce all toxicants to levels that cause no adverse effects.

Cost: The majority of costs appear to be addressed in Action PO-2.3.

ACTION AR-2.8 (1993 CCMP)
Research and develop methods to reduce the incidental take of non-target species in commercial activities.

Who: California Department of Fish and Game, National Marine Fisheries Service, the commercial fishing industry, and Sea Grant

What: Currently, the trawling methods used by the commercial shrimp industry result in the incidental take of striped bass and other fish species. Resources agencies should work with the industry to develop methods that would reduce the incidental take of non-target species.

When: Implement when funding is obtained

Cost: $125,000 for a one-year program

Objective AR-3

Implement recovery actions for all listed and candidate threatened and endangered species.

ACTION AR-3.1 (1993 CCMP)
Prepare/update recovery plans for all listed species. This includes designation of critical habitat.

Who: California Department of Fish and Game, U.S. Fish and Wildlife Service, and National Marine Fisheries Service

What: Review all existing data on listed species and determine their adequacy for developing recovery plans. Conduct additional studies as necessary to address critical uncertainties. When sufficient data are obtained, develop recovery plans and monitoring objectives designed to improve reproduction and survival of the species. Critical habitat should be identified to the extent practicable and desirable. All plans, whether new or existing, should be periodically reviewed and updated.

When: Develop recovery plans within one year of listing.

Cost: Approximately $300,000–$500,000 per recovery plan

ACTION AR-3.2 (1993 CCMP)
Monitor status of all candidate species and list them if warranted.

Who: U.S. Fish and Wildlife Service, National Marine Fisheries Service, and California Department of Fish and Game

What: Develop and implement programs to monitor the status of all Class I and Class II candidate species, as well as state-identified species of special concern. Agencies should take steps to list any species that warrant it to afford them the full protection of the law. Any listing package should include designation of critical habitat to the extent practicable and desirable. Consider listing groups of species inhabiting common habitat areas in lieu of individual listings.

When: Implement when funding is obtained

Cost: $120,000 per year

ACTION AR-3.3 (1993 CCMP)
Initiate consultations with all federal agencies that propose or are continuing actions that may affect listed species.

Who: National Marine Fisheries Service, U.S. Fish and Wildlife Service, and federal action agencies

What: All federal action agencies whose programs may affect listed aquatic species should consult with the responsible fish and wildlife agency to ensure their actions do not jeopardize the continued existence of the species or adversely affect designated "critical" habitat. These consultations will also serve to identify actions that these same federal agencies might take to improve conditions for listed species.

When: Immediately

Cost: No additional costs

ACTION AR-3.4 (1993 CCMP)
Review all non-federal proposals and continuing actions that may result in take of listed species and take appropriate actions.

Who: U.S. Fish and Wildlife Service, National Marine Fisheries Service, and California Department of Fish and Game

What: This action directs resource agencies to provide upfront technical assistance to non-federal agencies to enable them to avoid violations of the "take" provisions of the federal Endangered Species Act. While non-federal agencies are not obligated to consult with the U.S. Fish and Wildlife Service or the National Marine Fisheries Service regarding potential impacts on listed threatened or endangered species, they are prohibited from "taking" a listed species. Compliance with the recommendations from the resource agencies is discretionary, but prohibitions against "taking" are not.

When: Implement when funding is obtained.

Cost: Estimated at $120,000 per year for each agency

ACTION AR-3.5 (1993 CCMP)
Investigate the feasibility of developing a Habitat Conservation Plan (or Plans) for the Bay and Delta that promotes the recovery of the species and addresses incidental take associated with non-federal actions.

Who: U.S. Fish and Wildlife Service, National Marine Fisheries Service, non-federal action agencies, California State Lands Commission, and local mosquito abatement districts

What: Individuals should be encouraged to enter into Habitat Conservation Plans (HCPs) or agreements per the state's Natural Communities Conservation Program (NCCP) when it would meet their needs and contribute to the protection of listed species. Permits can be granted for the "incidental" take of listed species in conjunction with an otherwise lawful activity on the part of a non-federal entity if that entity implements measures for habitat maintenance, enhancement, and protection coincident with its proposed action. These measures should be detailed in an HCP.

HCPs can be developed to address multiple development actions covering large areas and involving numerous listed species. The ideal HCP is one that improves and safeguards habitat for listed species, while allowing development to proceed concurrently.

When: Implement when funding is obtained

Cost: Estimated at $240,000 per year

ACTION AR-3.6 (1993 CCMP)
Adopt listed species recovery as a policy for all public agencies whose actions affect them.

Who: All federal and non-federal action agencies and local mosquito abatement districts

What: Under this action, all public agencies would be urged to promote recovery of listed species. If recovery were assured, perhaps barriers to development could be removed. The federal Endangered Species Act precludes federal agencies from taking actions that might jeopardize listed species or adversely affect designated critical habitat. It also states that federal agencies use their authorities to promote recovery of listed species. Non-federal agencies are only precluded from "taking" listed species.

When: Immediately

Cost: In some cases, this action could be accomplished by redirecting existing funds toward an "ecosystem approach" to resource management. In other cases, new facilities may be needed that require new appropriations, or a shift in the operations of the water projects could be costly (e.g., foregone revenues from the generation of electric power), or new management practices may be required of mosquito abatement districts. Many of these costs for new facilities and modified operations are addressed by the actions under Objectives AR-4 and AR-6.

Objective AR-4

While awaiting completion of the comprehensive plan called for in Objective AR-5, and in order to create habitat conditions that contribute to the attainment of that Objective, immediately implement a phased approach to provide needed: (i) water quality, flows, and other operational measures;(ii) water management facilities; and (iii) other habitat components; so long as the phased approach significantly reduces impacts on aquatic estuarine resources.

ACTION AR-4.1 (1993 CCMP)

Adopt water quality and flow standards and operational requirements designed to halt and reverse the decline of indigenous and desirable non-indigenous estuarine biota and to contribute to the attainment of Objective AR-5. Implement these standards and requirements in at least three phases: (a) immediate, interim standards and requirements consistent with current legal requirements that would be in place with the Delta in its existing configuration; (b) standards and requirements linked to South Delta Water Management facilities; and (c) standards and requirements, as may be necessary, linked to off-stream storage south of the Delta to facilitate water banking and water-transfer activities, so long as the last two phases significantly reduce impacts on aquatic estuarine resources and meet all environmental requirements.

Who: State Water Resources Control Board, California Department of Water Resources, U.S. Bureau of Reclamation, and the U.S. Environmental Protection Agency, with input from all affected parties

What: The following are elements of the phased approach:

A. Immediate, interim standards …

- State Water Resources Control Board adopts and implements interim standards to protect the public trust resources of the Estuary;
- U.S. Environmental Protection Agency reviews the standards adopted by the State Water Resources Control Board and takes appropriate actions; and
- Holders of water rights comply with the adopted standards.

B. South Delta Water Management facilities …

- U.S. Bureau of Reclamation and California Department of Water Resources complete environmental documentation for the construction and operation of the proposed interim South Delta water management facilities (including information necessary to develop alternative standards relating to the implementation of these facilities) and meet necessary legal and statutory requirements;
- Based on this environmental documentation, State Water Resources Control Board adopts standards, as necessary, pertaining to selected alternatives; and
- U.S. Bureau of Reclamation and California Department of Water Resources implement the selected alternative.

C. Off-stream storage south of the Delta …

- California Department of Water Resources completes environmental documentation for the construction and operation of the proposed off-stream storage facilities south of the Delta (including information necessary to develop alternative standards relating to the implementation of these facilities) and meets necessary legal and statutory requirements;
- Based on this environmental documentation, State Water Resources Control Board adopts standards, as necessary, pertaining to selected alternatives; and
- California Department of Water Resources implements the selected alternative.

When: Begin phased implementation immediately

Cost: PART A: Costs might be reflected by foregone revenues from electrical power generation and from commodities produced from agricultural and urban sectors

PART B: Approximately $60 million needed from new appropriations

PART C: Unknown but significant; a numerical estimate of cost would depend on the facilities selected.

ACTION AR-4.2 (Revised 2007)
Develop and implement permit conditions and/or best management practices for industrial facility intakes and discharges to prevent adverse impacts to aquatic organisms in the Estuary.

Who: Industrial facilities in conjunction with the State Water Resources Control Board, California Ocean Protection Council, California State Lands Commission, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, San Francisco Bay Conservation and Development Commission, California Department of Fish and Game, California Energy Commission, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and any other agencies that regulate diversions or discharges

What: Develop and require permit conditions or best management practices and best available technology to prevent entrainment, impingement, and adverse exposure to changes in water temperature and salinity by requiring industrial facilities to: first, determine whether an alternative water source is available to achieve the purpose of the Bay water intake; and, second, determine whether alternative facility engineering and/or operations could eliminate the need for an intake or discharge located in the Bay. If no alternative is available, industrial facilities should: (a) locate water intake and discharge structures away from areas of high aquatic organism productivity; (b) use best available technology to reduce the volume and velocity of water intake and discharge; (c)

adequately engineer intake structures using best available screen technology; (d) temporarily reduce or cease intake, and possibly discharge, at times when eggs, larvae, and juvenile fish are present; and (e) ensure appropriate discharge temperature and salinity ranges in order to protect aquatic organisms.

The San Francisco Bay Conservation and Development Commission prepared its Power Plant Siting Study in 2002, which addressed impingement, entrainment, and thermal impacts related to once-through cooling for power plants. The Commission also developed findings and policies on entrainment, impingement, and brine discharges related to desalination plants. The California Ocean Protection Council, California State Lands Commission, State Water Resources Control Board, and California Energy Commission are developing a statewide policy that will address these issues in relation to once-through cooling for power plants, and the California State Lands Commission is taking the lead on evaluating these impacts in relation to Liquefied Natural Gas terminals. Additionally, the Regional Water Quality Control Boards are reviewing actions triennially.

When: Permit conditions should be developed as soon as possible and should be included as new permits or amendments to existing permits are issued.

Cost: $$; variable; depends on selected regulatory actions

Performance Measure:
Percentage of industrial permits issued with the permit conditions or best management practices described above

ACTION AR-4.3 (1993 CCMP)
Design and install gates or other facilities at channel openings known to be associated with the loss of fishes.

Who: California Department of Water Resources, California Department of Fish and Game, U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and National Marine Fisheries Service

What:

- Evaluate the benefits to salmon of installing a "gated" barrier at the head of Old River. U.S. Bureau of Reclamation cost estimates: $5–$10 million

- Evaluate the feasibility and benefits of installing a "gated" barrier at Georgiana Slough. U.S. Bureau of Reclamation cost estimates: $7.6–$15.9 million

- Consider other areas where the control of channel openings may be desirable.

- Consider evaluating other devices, such as barriers or deflectors.

- Construct and operate feasible facilities that decrease the loss of fishes.

- In designing the facilities, consider the potential impacts on recreational boating.

When: Ongoing

Cost: If found feasible, the facilities could cost in excess of $100 million. The Central Valley Project Improvement Act (Title XXXIV of PL 102–575) provides a federal/state cost-sharing formula to help fund these mitigation projects.

ACTION AR-4.4 (1993 CCMP)
Design, install, and effectively operate fish screens or other protective devices at diversions associated with fish mortality.

Who: California Department of Water Resources, California Department of Fish and Game, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and diverters of water

What: State and federal agencies should assist diverters with developing and implementing measures to avoid the losses of juvenile anadromous fish that result from unscreened or inadequately screened diversions in the Sacramento-San Joaquin Delta and Suisun Marsh. Measures include the construction of screens on unscreened diversions, rehabilitation of existing screens, replacement of existing non-functioning screens, and relocation of diversions to sites less harmful to fishery resources.

When: Accelerate ongoing efforts

Cost: Approximately 1,800 unscreened diversions exist in the Delta and Suisun Marsh. The California Department of Fish and Game estimates that the capital costs for installing screens will average about $5,000/cfs diverted. U.S. Bureau of Reclamation estimates that the total cost could range between $9 million and $60 million.

ACTION AR-4.5 (1993 CCMP)
Improve screen efficiencies at state and federal water project pumping and fish salvage facilities.

Who: California Department of Water Resources, California Department of Fish and Game, U.S. Bureau of Reclamation, and U.S. Fish and Wildlife Service

What: Evaluate the effectiveness of State Water Project and Central Valley Project salvage and screening facilities and identify and correct deficiencies. Consider both reconstructing the primary and secondary channels at the Tracy Fish Collection Facility and covering the secondary channels to eliminate light to reduce predation.

When: Ongoing

Cost: Approximately $30 million needs to be appropriated

ACTION AR-4.6 (1993 CCMP)
Develop and implement a management plan to reduce predation in Clifton Court Forebay and near the John E. Skinner Delta Fish Protection Facility.

Who: California Department of Water Resources and California Department of Fish and Game

What: Develop feasible measures to reduce predator populations. Implement those measures and evaluate the results.

When: Ongoing

Cost: $300,000 per year

ACTION AR-4.7 (1993 CCMP)
Protect existing shaded riverine aquatic habitats to ensure no net loss of acreage, lineal coverage, and habitat value within the Estuary. Activities within the "legal Delta" should be conducted consistent with California's Delta Levees Flood Protection Act of 1988.

Who: Government agencies at all levels, private landowners, local mosquito abatement districts, and non-governmental organizations

What: Government agencies, non-governmental organizations, and landowners should forge public/private partnerships to preserve the remnants of shaded riverine aquatic habitat. In the "legal Delta," partnerships should be designed to complement ongoing levee maintenance and habitat protection activities undertaken pursuant to California's Delta Levees Flood Control Protection Act of 1988 to ensure no net long-term loss of habitat. Where possible, flood control agencies should emphasize set-back levees rather than stream alteration (refer to Action DW-5.2 regarding levee protection).

Shaded riverine aquatic habitat consists of the dense vegetation that occurs along undisturbed, partially disturbed, or restored rivers and creeks. This riparian forest stabilizes stream banks, supports diverse terrestrial habitats, provides a shady streamside canopy, and creates sub-surface habitats with branches and roots that protrude into the water. Because of these functions, it ranks among the most important habitat types along the Sacramento River and in the Delta, and therefore deserves special mention in this Aquatic Resources Program. More than 98 percent of this habitat has been lost to development, flood control activities, and the effects of wave action generated mostly by boating.

When: Implement when funding is obtained

Cost: Unknown, but potentially significant

ACTION AR-4.8 (1993 CCMP)
Increase the quantity of shaded riverine aquatic habitat by 1,000 percent.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, U.S. Army Corps of Engineers, California Department of Water Resources, California State Lands Commission, California Reclamation Board, reclamation districts, San Francisco Bay Conservation and Development Commission, county mosquito abatement districts, landowners, and non-governmental organizations

What: Only 100 acres of shaded riverine habitat remain scattered in fragments within the "legal Delta." Over the next twenty years, public and private entities should achieve a 1,000 percent increase in this acreage resulting in approximately 1,000 acres of additional habitat. Restoration of this habitat is difficult along riprapped shorelines, but should occur along natural banks and where set-back levees exist (refer to Action DW-5.2 regarding levee protection). Initial restoration efforts should focus on sites contiguous with remnant parcels. Restoration could be accomplished in conjunction with environmental mitigation. When designing restoration sites, federal and state agencies should consult with mosquito abatement districts to prevent the breeding of mosquito species that are prone to carry diseases.

When: Implement when funding is obtained

Cost: Unknown, but potentially significant

ACTION AR-4.9 (1993 CCMP)
Promote the maintenance and development of tule islands, tidal wetlands, and offshore berms to protect against erosion and to provide detrital input and juvenile fish nursery habitat.

Who: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, California Department of Fish and Game, California State Lands Commission, San Francisco Bay Conservation and Development Commission, and California Reclamation Board

What: Consistent with Action DW-5.2, agencies should encourage the protection and creation of these habitats to serve ecological and erosion control needs. These habitats perform important ecological functions and help control erosion in the Estuary. Unfortunately, these habitats are often destroyed through the construction of structural erosion control projects.

When: Immediately

Cost: Minimal; potentially more cost-effective than conventional erosion control techniques

ACTION AR-4.10 (1993 CCMP)
Work with the dredging and flood control interests to reduce or eliminate practices that adversely affect fish habitat.

Who: U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, California Department of Fish and Game, California State Lands Commission, San Francisco Bay Conservation and Development Commission, San Francisco Bay Regional Water Quality Control Board, and Central Valley Regional Water Quality Control Board

What: Consistent with both the Dredging and Waterway Modification Program of this CCMP and the Long-Term Management Strategy, agencies should work more closely with dredging and flood control interests to reduce or eliminate adverse practices. In addition, pilot projects of environmentally preferable techniques should be devised and implemented.

When: Immediately

Cost: Initially, this action may require greater effort than currently expended by resource agencies and construction and regulatory agencies (perhaps an additional staff-year per agency). However, as conflicts are reduced, it should cost no more (and perhaps less) than at present.

ACTION AR-4.11 (1993 CCMP)
Identify and protect remnant stream habitats containing indigenous and endemic fishes and other native aquatic species.

Who: University of California, California Resources Agency, California Department of Fish and Game, State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, California State Lands Commission, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, California Department of Water Resources, San Francisco Bay Conservation and Development Commission, Natural Resources Conservation Service, Urban Creeks Council, local Resource Conservation Districts, water districts, local governments, land trusts, landowners, and citizen monitors

What: The report entitled “Status and Trends Report on Aquatic Resources in the San Francisco Estuary” noted that small-stream tributaries to the Bay and Delta (i.e., the numerous creeks and small rivers besides the Sacramento and San Joaquin rivers) support remnant wild populations of steelhead, Chinook salmon, and coho salmon, in addition to a variety of endemic and rare species. Human activities have damaged the functional integrity of these streams through habitat fragmentation, the introduction of exotic plants and animals, and the discharge of pollutants. Furthermore, the importance of these streams to the Estuary’s biodiversity has been overlooked while scientists and regulators focus their efforts on managing the large rivers and bays.

In 1992, the San Francisco Estuary Project organized and funded a network of demonstration projects for watershed protection within the Bay-Delta region. Two projects involve the inventory of streams to determine: (a) the status of riparian and aquatic habitat conditions; and (b) the diversity and abundance of native aquatic organisms (e.g., fishes, amphibians, reptiles, and invertebrates).

These projects should be implemented to complement the statewide River Assessment being conducted by the California Resources Agency. Data from the inventories should be entered into computer systems to allow investigators to identify, evaluate, and rank priority sites for inclusion into a system of Aquatic Diversity Management Areas (ADMAs) to maintain local biodiversity. The concept of ADMA designation is detailed in the report entitled "Fishes, Aquatic Diversity Management Areas, and Endangered Species: A Plan to Protect California's Native Aquatic Biota." Top priority should be given to the most pristine systems to prevent their degradation. However, degraded streams (or segments) with restoration potential should also be considered.

For each designated ADMA, management plans should be developed and implemented to protect and restore habitat conditions. Management measures could include the provision of instream flows, erosion control, pollution prevention, and the elimination of exotic flora and fauna. Public/private partnerships should be pursued to obtain landowner participation and, where appropriate, acquisition. GIS should be employed as a monitoring tool to measure the response of stream systems to improved management practices. Inventories are underway or proposed for the following streams:

BAY AREA

- Mt. Diablo Creek (Contra Costa)
- Upper Wildcat Creek (Alameda)
- Upper San Leandro Creek (Alameda/Contra Costa)
    - Redwood, Moraga, and Indian Creeks
- Alameda Creek Drainage (Alameda/Santa Clara)
- Coyote Creek Drainage (Santa Clara)
- Upper Guadalupe River Drainage (Santa Clara)
    - Los Gatos Creek
- Saratoga Creek Drainage (Santa Clara)
    - McElroy and Bonjetti Creeks
- Upper Stevens Creek Drainage (Santa Clara)
- San Francisquito Creek Drainage (Santa Clara/San Mateo)
- Upper San Mateo Creek Drainage (San Mateo)
- Novato Creek Drainage (Marin)
- Miller Creek (Marin)
- Corte Madera Creek Drainage (Marin)
- Sonoma Creek Drainage (Sonoma)
- Huichica Creek (Napa)
- Petaluma River Drainage (Sonoma)
- Napa River Drainage (Napa)

- Suisun Creek Drainage (Solano)
- Pinole
- San Pablo
- Walnut Creek Drainage (including Grayson)

DELTA

- Cosumnes Drainage
- Mokelumne Drainage
- Putah Creek
- Marsh Creek

When: Begin field inventories immediately. Within two years, propose a list of streams for priority protection. At that time, begin negotiations with local governments and private landowners on proposed ADMA boundaries, land-use agreements, and management plans. Complete the designation of an Estuary-wide network of ADMAs within ten years.

Cost: The cost of inventorying the streams on the list above would be approximately $500,000, assuming substantial participation by the academic community. Costs for developing management plans, achieving land-use agreements through public/private partnerships, and for restoration of degraded parcels are unknown, but expected to be substantial. Cost estimates for developing a regional GIS based on the inventories may be calculated as the San Francisco Estuary Project-sponsored demonstration projects for watershed protection are implemented.

ACTION AR-4.12 (1993 CCMP)
Protect and maintain marshes, wetlands, shallow water areas, and tidal sloughs to protect fisheries values.

Who: U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, National Marine Fisheries Service, California Department of Fish and Game, California State Lands Commission, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, and San Francisco Bay Conservation and Development Commission

What: This action should be performed while awaiting completion and implementation of the comprehensive plan identified in Objective AR-5 and in conjunction with the Wetlands Management Program. When reviewing proposed projects and appropriate regulatory actions that might affect the aquatic sites mentioned above, agencies should recommend ways to protect and enhance the fisheries habitat values associated with wetlands, shallow water areas, and tidal sloughs and should use existing regulatory authorities to ensure “no net loss” of wetland habitats.

When: Immediately

Cost: Minimal regulatory costs; unknown project costs

Objective AR-5 (Revised 2007)

Use existing and new information to develop and implement a comprehensive plan that protects the Estuary's freshwater inflow-dependent aquatic resources.

ACTION AR-5.1 (Revised 2007)

Analyze existing estuarine ecological information; identify, collect, and analyze needed and essential new ecological information; prepare and implement a comprehensive plan that will protect and, where needed, restore ecologically important inflow-related characteristics of San Francisco Bay from Carquinez Strait to extreme South Bay, as well as the estuarine-influenced areas outside the Golden Gate.

Who: California Environmental Protection Agency; State Water Resources Control Board, with participation and assistance by water rights holders potentially affected by any State Water Resources Control Board action; federal and state water managers and wildlife resource agencies; and all third parties that might be affected and wish to participate technically

What: The purpose of this action is to develop the understanding necessary to prepare a plan that would prescribe freshwater inflow needs for San Pablo, Central, and South bays to protect their aquatic resources and other beneficial uses. Present methods of protection of the Estuary's flow-related aquatic resources target (via the CALFED process) the upper reaches of the Estuary and, most specifically, Suisun Bay and the Delta. The inflow needs of the Estuary's other bays are addressed only indirectly by several objectives of the water quality control plan, especially by the geographically based water quality X2 objective [X2 = the distance upstream in km from the Golden Gate to the near bottom 2 practical salinity units (psu) isohaline]. The X2 objective may address the upper Estuary (i.e., the Delta and Suisun Bay), but there are no flow standards specifically for the bays in the lower reaches of the Estuary. The assumption is that Delta flow protections, in combination with uncontrollable outflow events, are protective for the downstream bays as well. Moreover, the X2 objective is in and of itself only a portion of a larger set of potential flow management tools that could provide more complete protection of the Estuary's freshwater inflow-dependent aquatic resources.

In light of recent concurrent and severe declines in the populations of four pelagic fish species (identified collectively as the Pelagic Organism Decline or POD), more attention to inflow effects on organisms throughout the Estuary is warranted. Additionally, it is now assumed that large-scale discretionary changes (e.g., changes in the water supply infrastructure and operations, and perhaps structural reconfiguration of the Estuary), and non-discretionary actions (e.g., changing climate patterns resulting in decreasing snow pack accumulation and snowmelt runoff) will, over time, result in increased diversions of freshwater and reduced Delta outflow/Bay inflow.

It is therefore essential that additional studies be carried out to increase understanding of Delta and local watershed outflows as they influence fish and wildlife habitats throughout the Estuary, and to identify other flow-related indicators of estuarine health that could be incorporated into regulatory measures and associated management actions to protect the Estuary's beneficial uses.

A five-task study would:

Task 1: Establish a study plan and steering committee;

Task 2: Determine Delta outflow effects on benthic, subtidal, and tidal habitats downstream of Carquinez Strait;

Task 3: Define the individual characteristics of freshwater inflow (effects of mixing and gravitational circulation, contaminant transport, etc.) that may have detrimental impact on biota in individual bays (Suisun, San Pablo, Central, South, and extreme South bays) and associated tidal channels and marshes;

Task 4: Determine how various inflow-related impacts, either alone or synergistically, influence the viability of key species in those bays, channels, and marshes; and

Task 5: Publish a report of findings and recommendations for bay inflow management to protect and, if needed, restore estuarine beneficial uses.

Because of the unique physical configuration of this Estuary (constrictions at the Golden Gate, San Pablo Strait, Carquinez Strait, San Bruno Shoal, etc.), its latitude on the eastern Pacific Ocean, diverse marine ship traffic and ballast concerns, non-native invasive species issues, legacy contaminant issues, etc., the study steering committee will require participation by scientists with diverse estuarine ecosystem expertise and study capability.

When: The preparation of the comprehensive plan is to be completed in advance of significant new commitments or alteration of Central Valley Sacramento/San Joaquin rivers and Bay tributary water resources.

***Cost*:** $$$. Study costs that remain to be determined will be substantial. Implementation costs may be very high to extremely high depending on the findings and how and by whom the costs of implementation are shared.

Performance Measures:
1) Publish a report that details relevant water quality criteria and hydrologic standards (e.g., flows, salinity, and circulation) for Bay/Delta inflow/outflow to maintain healthy pelagic fish populations.

2) Percentage change in abundance indices of key freshwater inflow-dependent estuarine aquatic resources (e.g., organisms, fish)

ACTION AR-5.2 (1993 CCMP)
Develop an EIS/EIR to display the alternatives and tradeoffs identified in Action AR-5.1 and to initiate the selection of a preferred alternative.

Who: California Resources Agency, California Department of Water Resources, and California Department of Fish and Game, with input from the Governor's Bay-Delta Oversight Council and appropriate federal regulatory agencies

What: The EIS/EIR would comprehensively evaluate physical and biological processes of the Estuary and identify the changes in water management, operations, habitat improvements, and facilities required to meet the needs of the ecosystem, while recognizing the demands of urban and agricultural communities. The state would take the lead in preparing the EIS/EIR in conjunction with the lead federal agency. Concurrent with preparing the EIS/EIR, steps would be taken to comply with federal and state Endangered Species Acts, the federal Clean Water Act, and other applicable laws.

When: Within three years

Cost: Potentially covered by ongoing agency expenditures

ACTION AR-5.3 (1993 CCMP)
Implement the alternative from Action AR-5.2 (including the adoption of long-term water quality and flow standards and operational requirements) that best optimizes conditions for aquatic resources, efficiently conserves scarce water resources, and restores an equitable balance to the estuarine ecosystem.

Who: State Water Resources Control Board, California Department of Water Resources, U.S. Bureau of Reclamation, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, and other water project operators and diverters as appropriate

What: Improve habitat of the Estuary, modify operations involving diversion and storage of water, construct the necessary facilities, and take other appropriate measures to meet the objectives identified in Action AR-5.1 and to implement the selected alternative.

When: Start upon completion of Action AR-5.2, and adoption by state and federal entities of preferred alternatives

Cost: Approximately $500 million needed through appropriations and cost sharing

Objective AR-6

Develop and implement programs in the watershed above the Estuary necessary to complement Objective AR-5.

ACTION AR-6.1 (1993 CCMP)

Provide necessary instream flows and temperatures to benefit salmon and steelhead in the Central Valley to support the implementation of the state and federal mandates to double the natural production of anadromous fishes.

Who: State Water Resources Control Board, Central Valley Regional Water Quality Control Board, California Department of Water Resources, U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, Federal Energy Regulatory Commission, U.S. Environmental Protection Agency, and private water project operators

What: In order to provide adequate habitat for the various life stages of anadromous salmonids and to provide for the restoration of salmonid populations, projects (existing and proposed) must store adequate supplies of cool water, reduce flow fluctuations, and provide adequate minimum instream flows.

Salmon and steelhead production throughout the Central Valley has been severely limited by the construction and operation of water resource projects. Dams have blocked access to upstream spawning areas, and hydrologic changes below impoundments have altered remaining habitats.

Spawning still occurs in the mainstream Sacramento River and in most major tributaries in the Sacramento Basin, but the lack of adequate instream flows and suitable water temperature is limiting production. In the San Joaquin River Basin, all salmon production has been limited to the major tributaries since the construction of Friant Dam on the mainstream San Joaquin River. It appears that adequate spawning gravels exist on the Stanislaus, Tuolumne, and Merced rivers to support the restoration and maintenance of fall-run Chinook salmon below existing impoundments. However, existing minimum instream flow release requirements are inadequate, especially with regard to springtime releases, when flows are needed to move juvenile salmon out from the tributaries, down the mainstream of the San Joaquin, and safely past the Delta export pumps.

Instream flow studies are needed to identify the releases needed from project reservoirs to support restoration of salmon populations. Flow studies have already been completed on several basin streams and rivers and are underway on others. These flow studies are conducted using the Instream Flow Incremental Methodology (IFIM) developed by the U.S. Fish and Wildlife Service. The results of the studies, along with recommendations from the resource agencies regarding minimum instream release schedules and appropriate changes in operation, should be transmitted to project operators and/or regulators for action. Authority to make decisions on changes in operation and/or releases may rest with the State Water Resources Control Board, the Federal Energy Regulatory Commission, or the project operators.

The following information has been submitted by fisheries agencies to the appropriate decision-making authorities for consideration in water rights adjudication. In certain cases, flow studies have not yet been completed. Final decisions will take into account other factors, including water supply availability.

Mainstream Sacramento River (below Keswick Dam)

- Flow study underway. Existing minimum instream flow requirements and temperature conditions are inadequate. The California Department of Fish and Game has initiated a flow study. Until the study has been completed and evaluated, the U.S. Bureau of Reclamation should continue to coordinate releases with resource agencies. U.S. Fish and Wildlife Service and the California Department of Fish and Game believe that minimum beneficial flows of 3,500–6,000 cfs may be warranted during the spawning season, with attraction and out-migration flows of up to 14,000 cfs. Also, project operations need to be modified to reduce fluctuations and to provide adequate carryover storage to meet flow and temperature needs.

Clear Creek (below Whiskeytown Dam)

- Existing minimum release requirements for a normal water year total 48,000 acre-feet per year. The California Department of Fish and Game and the California Department of Water Resources completed a flow study that identified a need of 175,000 acre-feet/year for fishery purposes, with releases ranging from 150 to 250 cfs. The Central Valley Project Improvement Act (Title XXXIV of PL 102-575) requires the increased releases to aid in restoration of the fishery.

Feather River (below Thennalito Dam)

- A flow study needs to be conducted. Current releases are per agreement between the California Department of Fish and Game and the California Department of Water Resources. Fishery needs are being re-evaluated, with investigations scheduled for completion in 1994.

Yuba River (below Englebright Dam)

- Existing releases range from 70 to 400 cfs (172,800 acre-feet per year). Based on results of a completed flow study, the U.S. Fish and Wildlife Service and the California Department of Fish and Game have recommended releases ranging from 450–2,000 cfs (603,000 acre-feet per year). This matter is under consideration by the State Water Resources Control Board.

Bear River (below Camp Far West)

- A flow study may be conducted as part of an application to the Federal Energy Regulatory Commission for a license. Existing release requirements total 9,000 acre-feet per year. Pending completion of a flow study, the U.S. Fish and Wildlife Service believes that releases on the order of 50,000 acre-feet per year are needed.

American River (below Nimbus Dam)

- Existing minimum release requirements are 250 cfs, increased to 500 cfs during the spawning season. Temperature is a major problem due to reservoir draw-down. Several studies have been conducted. Based on a 1986 flow study, the California Department of Fish and Game believes that flows ranging from 1,500 to 6,000 cfs and totaling about two million acre-feet per year are needed. These

preliminary estimates are expected to be refined as studies currently underway are completed. Congress or the courts may ultimately decide flow requirements.

Mokelumne River (below Camanche Dam)

- A flow study has been completed. Existing requirements are 20 cfs year-round (13,000 acre-feet per year) for a hatchery supply. Based on the completed flow study results, U.S. Fish and Wildlife Service and the California Department of Fish and Game have recommended releases ranging from 100–450 cfs and totaling 207,000 acre-feet per year. The matter is under consideration by the State Water Resources Control Board.

Stanislaus River (below New Melones Reservoir)

- A flow evaluation is underway, but the current drought has hampered the efforts to study higher flows. Existing minimum release requirements for fish are 98,000 acre-feet per year, but pending completion of the ongoing flow study, the U.S. Bureau of Reclamation and the California Department of Fish and Game have signed an agreement for release of 302,000 acre-feet per year, with cutbacks in dry years. This allocation will be continued until all flow evaluations are completed and until the State Water Resources Control Board has made a final release determination.

Tuolumne River (below New Don Pedro Reservoir)

- Existing normal year release requirements are 123,210 acre-feet per year (range: 3–385 cfs with a one-day flush of 2,500 cfs). Flow studies are underway and scheduled for completion by 1996. There is an agreement with the California Department of Fish and Game for higher interim releases, which are to prevail until the completion of the current study.

Merced River (below New Exchequer Dam)

- U.S. Fish and Wildlife Service and the California Department of Fish and Game believe existing flow requirements are inadequate. A flow study has been proposed. Flow releases should be revised upon completion of the study by the Federal Energy Regulatory Commission.

Mainstem San Joaquin River (below Friant Dam)

- Minimum release requirements are inadequate to support aquatic life. A flow study is needed to quantify fishery needs and to determine the feasibility of restoring runs to the mainstream San Joaquin River. The Central Valley Project Improvement Act (Title XXXIV of PL 102–575) requires completion of an evaluation and plan by September 1996 for consideration by Congress.

Mainstem San Joaquin River (at Vemalis)

- No flow study has been conducted, but data have been collected showing a high positive correlation between springtime outflow and increased abundance of adult salmon returning 2.5 years later. Increasing releases from basin impoundments, especially during the months of April, May, and June, would promote the survival of juveniles and the recovery of the basin's population of wild, fall-run Chinook salmon. U.S. Fish and Wildlife Service and the California Department of Fish and Game recommended to the State Water Resources Control Board an interim level of protection consisting of minimum flows during these months ranging from 2,000 to 10,000 cfs for water-year types ranging from critical to wet, in

conjunction with export limits. Further evaluation and development of a basin-wide flow release plan are needed. That will be accomplished as part of Action AR-6.3.

When: Ongoing

Cost: Costs depend on the flow requirements that are established.

ACTION AR-6.2 (1993 CCMP)
Implement the Upper Sacramento River Management Plan.

Who: State Water Resources Control Board, California Department of Water Resources, California Department of Fish and Game, California State Lands Commission, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and non-governmental organizations

What: The Upper Sacramento River Management Plan was developed through consensus of a diverse group of people interested in improved management of the river's biological resources. Improved habitat conditions on the Sacramento River will directly benefit the Bay-Delta ecosystem. At minimum, the following high-priority measures should be implemented:

- Installation of structural temperature control devices on Shasta and Trinity dams (U.S. Bureau of Reclamation estimate of funds potentially available from other sources: $55,000,000);

- Rehabilitation and expansion of the Coleman National Fish Hatchery (SB 1086 estimate of cost: $24,450,000);

- Implementation of a spawning gravel replenishment program (SB 1086 estimate of cost: $12,000,000);

- Delivery of dependable water supplies to the Central Valley wildlife refuges;

- Re-operation of Central Valley reservoirs to minimize fisheries impacts from flow fluctuations (SB 1086 estimate of cost: $1,100,000);

- Modification of Red Bluff Diversion Dam to minimize fish passage problems (U.S. Bureau of Reclamation estimate of funds potentially available from other sources: $60,000,000 minus SB 1086 estimate of cost: $23,000,000 = $37 million net); and

- Continued acquisition of remnant habitats along the river, as well as degraded areas with restoration potential (SB 1086 funds appropriated: $33,000,000).

When: The aforementioned activities are either planned or underway; necessary facilities are scheduled for completion within ten years.

Cost:

Total SB 1086 outlays	$243,530,000
Other funds needed	$93,000,000
TOTAL COST:	$336,530,000

ACTION AR-6.3 (Revised 2007)
Develop and implement the San Joaquin River Management Plan to identify reservoir operational changes, habitat improvement measures, and other action items to improve habitat and health of the aquatic ecosystem in the San Joaquin River watershed.

Who: State Water Resources Control Board, California Department of Water Resources, California Department of Fish and Game, California State Lands Commission, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and non-governmental organizations

What: Implement pursuant to Congressional authorization and appropriation the court settlement of Natural Resources Defense Council, et al. vs. Kirk Rodgers. The settlement specifies the restoration of fall-run and spring-run Chinook salmon on the San Joaquin River below Friant Dam, specifically through accomplishment of the following four actions:

1) Establishment of experimental flows;
2) Construction of channel improvements;
3) Restoration of flows; and
4) Reintroduction of fish.

When: Establishment of experimental flows in the channel will begin in 2009. Channel improvements will begin to be made in 2013 and will be completed by 2016. Restoration-objective flows will begin in 2014. Finally, fish will be reintroduced beginning in 2012.

Cost: $$$$$

ACTION AR-6.4 (1993 CCMP)
Screen upstream diversions that individually or cumulatively result in significant mortality to fishes that utilize the Estuary.

Who: California Department of Water Resources, California Department of Fish and Game, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and diverters of water

What: State and federal agencies should assist diverters with developing and implementing measures to avoid losses of juvenile anadromous fish resulting from unscreened or inadequately screened diversions in the Sacramento and San Joaquin rivers and their tributaries. Measures include the construction of screens on unscreened diversions, rehabilitation of existing screens, replacement of existing non-functioning screens, and relocation of diversions to less fishery-sensitive areas.

When: Accelerate ongoing efforts

Cost: Approximately three hundred unscreened diversions exist in the Sacramento River and tributaries and in the San Joaquin River and tributaries. The California Department of Fish and Game estimates that the capital costs for installing screens will average about $5,000 per cfs diverted. The U.S. Bureau of Reclamation estimates that the total cost of the action will reach $20 million. The Central Valley Project Improvement Act (Title XXXIV of PL 102–575) provides a federal/state cost-sharing formula to help fund these mitigation projects; please refer to Section 3406(b)(17, 20, and 21) of the Act.

ACTION AR-6.5 (1993 CCMP)
Seek damages for all impacts to trust resources from spills and discharges affecting them and use the funds to improve the resource base.

Who: State Water Resources Control Board, California Department of Fish and Game, California State Lands Commission, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, San Francisco Bay Conservation and Development Commission, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, and National Marine Fisheries Service

What: Whenever aquatic resources and beneficial uses are adversely impacted by spills and discharges of pollutants, monetary damages should be sought. Those funds, once obtained, should be dedicated to improving the natural resource base consistent with legal authorities.

When: Immediately

Cost: Variable, but borne by the responsible parties

ACTION AR-6.6 (New 2007)
In support of setting goals for bay-tributary instream flow restoration and/or protection, 1) identify, compile, and summarize both historic and present-day stream flow averages; and 2) estimate the future flow average that will be necessary to support freshwater flow-dependent aquatic resources within the streams themselves and in the stream-influenced portions of the Estuary, especially in light of anticipated changes in runoff patterns and upstream migration of head of tide caused by global warming and sea level rise.

Who: State Water Resources Control Board, California Department of Fish and Game, National Marine Fisheries Service, U.S. Fish and Wildlife Service, and water resource management agencies and organizations (California Department of Water Resources, U.S. Geological Survey, U.S. Bureau of Reclamation, water management districts, etc.)

What: This action addresses the need to analyze existing freshwater inflow data in order to develop strategies to maintain and/or restore hydrologic functions of streams in local watersheds other than the Central Valley (stream flows in Bay tributaries from local watersheds other than the Central Valley) sufficient to support aquatic resources in the streams and in the stream-influenced portions of the Estuary in good condition. This project would be focused on identifying streams that drain into San Francisco Bay downstream of the confluence of the Sacramento and San Joaquin rivers and gathering all available records of historical (unimpaired if available) and existing (recent years) flows (on daily and annual bases). In addition, all available instream flow studies/needs assessments (flow/fishery habitat relationships) would be summarized and tabulated. Average annual and seasonally important existing flows would be expressed as a percentage of historical/unimpaired flows. If possible, existing stream flow would be expressed as a percentage of that flow understood to be needed to keep aquatic resources in good condition as defined by state laws. These data could also be used for scenario-planning purposes to anticipate hydrologic changes due to changing rainfall patterns and to provide management options to limit or mitigate adverse effects of climate change.

When: This action should be accomplished within one to three years, depending on funding availability and personnel committed.

Cost: $$. Cost will depend on the number of streams addressed. No new empirical data will be collected from the field for this action; this is simply a compilation of existing data and records.

Performance Measures:
1) Publish a report that compiles existing information on streamflow as described above.

2) Percentage of total stream miles in region of interest where data exists and was compiled in report

Objective AR-7 (New 2007)

Protect, enhance, and restore subtidal habitats.

ACTION AR-7.1 (New 2007)

Complete the San Francisco Bay Subtidal Habitat Goals Project and implement its recommendations to benefit fish, wildlife, aquatic organisms, and their associated habitats.

Who: California Coastal Conservancy, National Oceanic and Atmospheric Administration, San Francisco Estuary Project, San Francisco Bay Conservation and Development Commission, U.S. Environmental Protection Agency, San Francisco Bay Regional Water Quality Control Board, California Department of Fish and Game, California State Lands Commission, California Department of Water Resources, California Department of Parks and Recreation, California Department of Boating and Waterways, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, Association of Bay Area Governments, local and regional park districts, and local water agencies

What: The San Francisco Bay Subtidal Habitat Goals Project is a collaborative effort to establish a comprehensive and long-term management vision for protection, restoration, and appropriate use of the subtidal habitats of the San Francisco Bay.

Human uses, such as fishing, shipping, and ports, dredging, transportation projects, sand mining, recreational use, marinas, and industrial uses, have direct impacts on the subtidal habitats of the Bay. These habitats are also threatened by non-native invasive species and other systemic alterations, such as bathymetric changes, water control in the Delta, and both point and nonpoint source pollution. Because of these stresses, there is an increased need to develop a plan to protect and enhance subtidal resources within the Bay.

The project will communicate with a broad range of stakeholders and seek input and review from all agencies, groups, organizations, and user groups with an interest in the subtidal habitats of the San Francisco Bay. The primary product of the Subtidal Habitat Goals Project will be a document (Subtidal Goals Report) that provides recommendations and goals for use, protection, restoration, and research to improve subtidal habitat management in San Francisco Bay. Resource managers will be able to use this document to make informed decisions, and researchers will be able to prioritize activities and pursue funding for subtidal projects.

When: 2008 for completion of the Subtidal Goals Report and ongoing support for implementation

Cost: $350,000

Performance Measures:

1) Complete Subtidal Goals Report and distribute widely.

2) Percentage of Estuary subtidal habitat restored per recommendations of Subtidal Habitat Goals Report

Objective AR-8 (New 2007)

Define, study, and protect habitat values of aquatic mineral resources, including sand and oyster shell benthic environments.

ACTION AR-8.1 (New 2007)

Identify the extent of the sand resources in the Estuary and the use of this habitat by native flora and fauna, and develop a plan to protect the natural resources and their beneficial uses.

Who: National Marine Fisheries Service, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, U.S. Geological Survey, California Department of Fish and Game, California State Lands Commission, California State Mining and Geology Board, San Francisco Bay Conservation and Development Commission, San Francisco Bay Regional Water Quality Control Board, San Francisco Estuary Project, and mineral extraction companies

What: The purpose of this action is to map the quantity of sand substrate that is appropriate for extraction, conduct research on the ecological and physical impacts of sand mining, and devise a strategy for minimizing the impacts of sand mining to sand habitat and associated biological communities.

Approximately 2.4 million cubic yards of sand of varying qualities are extracted annually from the Central Bay, Suisun Bay, and Carquinez Strait areas for use as fill and for other construction projects. Sand substrate provides unique habitat features essential to flora and fauna that are adapted to live in and on particles of larger grain size and other large-sized debris.

In order to determine the impact of sand mining on sediment movement and on the subtidal habitat and associated species in the Estuary, it is necessary to understand the geographic extent and depth of sand substrate appropriate for extraction, the process by and rate at which sand is replenished at any location, and the ecological importance of sand habitat for fish and other benthic organisms. Existing data on these topics should be utilized, and data gaps and additional information needs should be identified.

When: Authorization for the ongoing sand mining projects expires in 2008. The California State Lands Commission is currently undertaking an environmental review process under the California Environmental Quality Act (CEQA). Thus, the regulatory and resource agencies require map and research information soon to assist in managing these resources.

Cost: $$

Performance Measures:
1) Amount of money spent on studies of physical and biological attributes of Bay and Delta sandy substrate habitat

2) Percentage of sand habitat mapped

ACTION AR-8.2 (New 2007)
Identify the extent of oyster shell resources in the Estuary and the use of this habitat by the native flora and fauna, and develop a plan to protect the natural resources and their beneficial uses.

Who: National Marine Fisheries Service, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, U.S. Geological Survey, California Department of Fish and Game, California State Mining and Geology Board, San Francisco Bay Conservation and Development Commission, San Francisco Bay Regional Water Quality Control Board, San Francisco Estuary Project, and mineral extraction companies

What: The purpose of this action is to identify the existing quantity of oyster shell resources in the Estuary, conduct research on the ecological and physical impacts of shell extraction, and develop a plan to minimize the impact of shell mining on this habitat and its associated biological communities.

Historic oyster shell beds in the Estuary are largely restricted to South Bay. The broken shell debris in these beds provides a unique and valuable habitat that is utilized by both sessile and non-sessile plants and animal species. Currently, oyster shell extraction is limited to one location in the South Bay with an annual extraction limit of 80,000 cubic yards. Oyster shells mined from the Estuary are used for calcium carbonate in poultry production and for human nutrient supplements. Because of the reduced population of oysters in the Estuary and the inability to utilize alternative mollusk shells due to their small size, shell mining is not considered a renewable resource.

In order to determine the impact of oyster shell mining on the subtidal habitat and associated species in the Estuary, it is necessary to understand the total aerial extent and depth of these shell reserves and the ecological importance of broken shell habitat for fish and other benthic organisms. Existing data on these topics should be utilized, and data gaps and additional information needs should be identified.

The California State Lands Commission has completed its CEQA review. However, because information about this habitat and the shell resource that it contains is limited, funding for mapping the extent of the oyster shell substrate and for research on the impacts of extraction is needed before further permits are issued.

When: December 31, 2008

Cost: $$

Performance Measures:
1) Percentage area of the Estuary mapped detailing geographic extent, bioavailability, and habitat value of mixed shell substrate

2) Complete a study of the impact of oyster shell mining on bottom-dwelling organisms and the estuarine ecosystem and distribute widely.

Objective AR-9 (New 2007)
Reduce and prevent marine debris and its impacts to the Estuary.

ACTION AR-9.1 (New 2007)
Improve understanding of sources, types, and impacts of marine debris in the Estuary.

Who: California Coastal Commission, California Coastal Conservancy, California Department of Boating and Waterways, California Department of Conservation, California Department of Fish and Game, California Integrated Waste Management Board, San Francisco Bay Conservation and Development Commission, San Francisco Bay Regional Water Quality Control Board, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and National Marine Fisheries Service, in coordination with non-governmental organizations, such as Save the Bay, watershed stewards, and academic institutions

***What*:** Compile and analyze data on marine debris in the Estuary and identify research needs. Data sources may include cleanup events and surveys undertaken by government and non-governmental organizations. Agencies and organizations should look to research undertaken in other estuaries (e.g., Southern California) for guidance on survey and analysis methods. Research questions should focus on developing management strategies. To fund these efforts, agencies and organizations should seek funding from the Marine Debris Prevention and Removal Grant Program of the National Fish and Wildlife Foundation and the Marine Debris Program within the NOAA Restoration Center.

When: Immediately (2007-2008). Pending state legislation may soon require the California Coastal Commission to convene a multi-agency task force consisting of the California Department of Conservation, the State Water Resources Control Board, the California Integrated Waste Management Board, the California Department of Boating and Waterways, the California Coastal Conservancy, and the San Francisco Bay Conservation and Development Commission for the purpose of implementing a statewide marine debris reduction effort. Study of sources and impacts that are completed will support this and other initiatives.

Cost: $$. Magnitude: For a three-year (minimum) study staffed by 1.5 full-time employees (e.g., a senior-level scientist and a research assistant) who coordinate the project with interested and affected agencies and organizations to design the study and gather and compile data. Assumes that the project will be housed in one of these agencies or organizations.

***Performance Measures*:**
1) Publish report documenting marine debris sources, accumulations, and impacts in the Estuary using maps and other spatial analysis (including relative severity of different sources and impacts and identification of priority areas).

2) Publish fact sheet on effects of marine debris and distribute/post around marinas and associated businesses directing readers to Web site with more information, including how they can help.

3) Number of Web site hits

4) Number of sites (or miles of shoreline) with reduced marine debris

ACTION AR-9.2 (New 2007)
Expand existing marine debris prevention and cleanup programs and develop new initiatives to reduce discharge of debris to waterways.

Who: California Coastal Commission, California Coastal Conservancy, California Department of Boating and Waterways, California Integrated Waste Management Board, San Francisco Bay Conservation and Development Commission, San Francisco Bay Regional Water Quality Control Board**, U.S.** Army Corps of Engineers, National Marine Fisheries Service, landfills and recycling operators, and non-governmental organizations, such as the American Plastics Council, the boating and fishing community, and local watershed stewardship groups, cities, counties, stormwater programs, water districts, and flood control districts

What: Increase public awareness through outreach and education campaigns. Improve collaboration among public agencies to promote and expand programs such as Adopt-a-Beach, Coastal Cleanup Day, and Dockwalkers in the Estuary. Encourage and support public-private partnerships to target and eliminate significant sources of marine debris, with a special emphasis on reducing inputs of plastic wastes. Example actions include partnering with businesses to reduce the use of disposable packaging and plastic bags, and implementing education campaigns on large passenger vessels, such as ferries and cruise ships.

When: In conjunction with efforts to carry out recommendations in the California Ocean Protection Council's 2006 California Marine Debris Action Plan

Cost: $$ over five years

***Performance Measures*:**
1) Number of events, organizations, and individuals removing marine debris

2) Amount of debris removed per year or per event (cubic yards or tons)

3) Number of municipalities and businesses participating in trash reduction programs (via annual survey)

4) Percentage decrease in trash around marinas/beaches (especially Styrofoam containers and plastic bags)

5) Develop recommendations for current trash reduction and cleanup programs that could be expanded.

ACTION AR-9.3 (New 2007)
Improve understanding of sources, locations, and impacts of abandoned or sunken ships and dilapidated pile-supported structures in the Estuary.

Who: California Coastal Commission, California Coastal Conservancy, California Department of Boating and Waterways, San Francisco Bay Conservation and Development Commission, U.S. Coast Guard, U.S. Army Corps of Engineers, National Marine Fisheries Service, cities, counties, water districts, flood control districts, the boating and fishing community, and local watershed stewardship groups

***What*:** Abandoned and sunken ships and dilapidated pile-supported structures are found throughout the Estuary. These features may contribute to poor water quality, thus adversely impacting both plant and wildlife species utilizing the Estuary. These features may also cause adverse impacts on subtidal habitats in the Estuary. In order to address this issue, the locations of all abandoned or sunken ships and dilapidated pile-supported structures in the Estuary should be mapped. If possible, the party responsible for each ship or structure should be determined.

In some cases, abandoned or sunken ships and pile-supported structures may provide an increase in habitat value. Available data should be used to determine if specific abandoned features in the Estuary are providing any habitat value. If these features do not provide significant habitat value, agencies and organizations should collaborate to remove them from the Estuary.

When: Within five years

Cost: $$$

***Performance Measures*:**
1) Develop an Estuary-wide map and database that catalogs all the abandoned or sunken ships and dilapidated pile-supported structures (including responsible party/owner of structure and whether the structure provides good marine habitat).

2) Develop criteria for removing ships/structures.

3) Number of abandoned or sunken ships and dilapidated pile-supported structures removed from the Estuary

Wildlife

Goals:

- Stem and reverse the decline of estuarine plants and animals and the habitats on which they depend.

- Ensure the survival and recovery of listed and candidate threatened and endangered species, as well as special status species.

- Optimally manage and monitor the wildlife resources of the Estuary.

Problem Statement

Probably the greatest harm to the wildlife of the Estuary and its watershed has been habitat loss and degradation. Because their populations have declined, a total of ninety taxa of insects, amphibians, reptiles, birds, and mammals within the Estuary alone have been designated by federal and state governments as deserving special protection or monitoring. Of these ninety taxa, sixty-one (or 68 percent) have been depleted through loss of wetland and riparian habitats. At least seven insect species, one reptile species, three bird species, and five mammal species have been extirpated from the Estuary, primarily due to habitat loss. For this same reason, the California tiger salamander, red-legged frog, giant garter snake, western pond turtle, and several butterfly species may also soon be extirpated.

In the early 1900s, destruction or conversion of terrestrial and aquatic habitats within the Estuary watershed began to accelerate. Conversion of land for agriculture and, ultimately, urban development destroyed wetlands of all kinds, riparian forests, native grasslands, coastal scrub, and oak woodlands throughout the watershed (and state). Habitat destruction continues today as the human population continues to sprawl into prime wildlife habitat. Other causes of past and present declines in wildlife populations include overharvesting by humans, competition with and predation by natural or introduced competitors, human use of organochlorine pesticides, and discharge of pollutants, including plastic debris, into the environment, as well as human disturbances of many kinds.

What habitat remains is often fragmented, yet it continues to support wildlife. The remnant tidal salt and brackish marsh and uplands of San Francisco, San Pablo, and Suisun bays harbor many threatened and endangered species, including the endangered California clapper rail and the endangered salt marsh harvest mouse. While rails have colonized several newly restored tidal marshes—and there is much tidal marsh restoration taking place—not all restoration projects have been successful, there is a shortage of available sites, and it can take years for a marsh to support rails. These same problems hold true for the endangered salt marsh harvest mouse. Although mouse surveys are supposed to be conducted when new developments and land use changes occur, they often are not done, and scientists thus do not have enough information about the Estuary's mouse population. However, some recent habitat surveys in the South Bay have shown that there is little cover left for the mouse to escape from both high tides and predators—what was once miles of high marsh has been reduced to a maximum width of

eight or nine feet, or eliminated completely. Black rails, too, have suffered from loss of both tidal marsh and upland areas in which they can take refuge.

In addition to habitat loss and human disturbances, rails and mice are also threatened by predators like the introduced red fox and feral cats. The red fox has nearly eliminated the clapper rail in some portions of its range and seriously impacted its reproductive success, and the rail could yet become extinct. Despite control programs, red foxes have also caused major nesting failures among endangered California least terns and snowy plovers, Caspian terns, and species of herons and egrets. Gulls and ravens also harass least terns and snowy plovers, causing their nests to fail.

Burrowing owls have almost disappeared from around the Bay, as their habitat has been disked and plowed for urban development. In addition, there have been widespread attempts to eradicate ground squirrels, whose burrows the owls use to nest in. Although attempts have been made to relocate these tiny owls, one study found only one relocation in eight to be successful.

Except for some recent signs of recovery, populations of many species of dabbling ducks and geese have generally declined to the lowest levels since monitoring began in the 1950s. This has been attributed primarily to the combined effects of drought, habitat loss, and predation within wintering and nesting grounds. The ability of these populations to recover is uncertain and hinges on the extent of habitat recovery in the Canadian prairies and California and on long-term weather trends—including those induced by global climate change. Contaminants, in the form of trace elements, also occur in Bay diving ducks at levels known to impair reproduction.

Numbers of wintering diving ducks (bay and sea ducks) in the Estuary have declined over the past few decades, with some species showing dramatic declines (e.g., canvasbacks). Continentally, many of these same species are declining. For instance, scaup (combined populations of greater and lesser scaup) have declined precipitously since the 1980s and are now at their lowest levels since population counts began. Similarly, many species of sea ducks are also in continental decline. In San Francisco Bay, the most numerous sea duck species present is the surf scoter. San Francisco Bay is one of the largest wintering areas for migratory birds on the West Coast of the Americas, and it hosts between 40 percent and 50 percent of many diving duck populations using the Pacific Flyway. Thus, changes in the quality (i.e., contaminants, habitat loss, disturbance, etc.) of this important wintering site could have broader implications for continental populations of diving ducks.

Intensified agricultural practices, conversion of natural areas to vineyards, and urban sprawl have also had negative effects on numerous species of native songbirds. However, recent riparian restoration efforts along the San Joaquin and Sacramento rivers seem to be boosting songbird numbers (see “Achievements” section below).

Other threats to wildlife require further monitoring, and some could result in dramatic losses or alteration of habitat. These include expansion of the introduced Asian clam and cordgrass species, and conversion of salt marshes to fresh due to the discharge of sewage

effluent. Ironically, the clapper rail seems to be using Atlantic cordgrass (*Spartina alterniflora*) successfully, but there are still concerns about the population's viability in the hybridized habitat. The long-term effects of global climate change and resulting sea-level rise could cause dramatic losses and alterations of tidal mudflats and marshes, salt ponds, and farmed wetlands. This could lead to a loss of critical habitat for many species, with some possible long-term benefits for wintering waterfowl.

Existing Management Structure

The existing management structure as it relates to wildlife is the same as it was in 1993, with a few important additions. The CALFED Bay-Delta Program, a cooperative state/federal effort that began in 2000, is charged with balancing water supply reliability, water quality, ecosystem restoration, and sustainable levees. CALFED is currently focusing on problems related to the Delta (see the Aquatic Resources Program); however, it has funded many restoration projects that are benefiting wildlife, including riparian restoration projects on the San Joaquin and Mokelumne rivers that have provided habitat for songbirds, ducks, and small mammals, including the endangered riparian brush rabbit.

The San Francisco Bay Joint Venture, established in 1995, is a coalition of non-governmental organizations, utilities, landowners, and resource agencies collaborating to acquire, restore, and enhance wetlands on San Francisco Bay. Working together with other organizations, this group has acquired, restored, and enhanced more than 60,000 acres around the Bay, or 25 percent of its goal of 236,000 acres restored, including tidal marsh and flats, seasonal wetlands, creeks, lakes, lagoons, salt ponds, and open and subtidal water habitat. The San Francisco Bay Conservation and Development Commission and the California Coastal Conservancy continue to provide leadership in wildlife restoration and protection through their mandates of permitting and acquisition, while nonprofits like the Marin Audubon Society, Citizens to Complete the Refuge, River Partners, Urban Creeks Council, The Nature Conservancy, and others have made great strides in wetland and other habitat acquisition and restoration.

The U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the U.S. Navy, the California Department of Fish and Game, the California Department of Parks and Recreation, and the East Bay Regional Park District have significant management and conservation responsibilities for wildlife populations within the Estuary. These agencies manage a significant amount of land within national wildlife refuges, wildlife areas, preserves, parks, and installations.

If adequately implemented, several recent planning and land acquisition efforts by state and federal agencies may help offset some of the habitat losses of the past, primarily wetlands. These include the purchase of the South Bay salt ponds, the Central Valley Habitat Joint Venture of the North American Waterfowl Management Plan, the San Francisco Bay Habitat Joint Venture of the North American Waterfowl Management Plan, the Central Valley and San Francisco Bay Concept Plans for Waterfowl Habitat Protection, and the habitat acquisition program for the San Francisco Bay National Wildlife Refuge.

The primary agencies responsible for wildlife management are authorized under numerous laws to carry out the protection, conservation, and improvement of these resources. Nevertheless, ongoing declines in the quantity and quality of habitats and the wildlife they support clearly demonstrate the critical shortage of funding—including serious underfunding of California Department of Fish and Game wardens—economic incentives, and public resolve necessary to adequately implement these needed protections and restorations.

Recommended Approach

The Wildlife Program will be most effective when combined with actions identified or categorized in the other programs of the CCMP. Many of the recommended actions described in the other sections in this document will also benefit wildlife. These actions should result in increases in critical habitat, decreases in the most harmful pollutants, and beneficial changes in freshwater flow through the Estuary. Therefore, the list of actions in this program area is not intended to be a comprehensive catalog of recommendations (or challenges and successes) for the Estuary's wildlife, but should be viewed in the context of the entire package of actions embodied in the CCMP. The combined goal of all the actions is to restore and protect a diverse, balanced, and healthy community of wildlife and plants, with a focus on indigenous species.

Achievements 1993–2007

Despite the habitat losses and issues described above, there have been many impressive large- and small-scale efforts to restore habitat that are beginning to show successful wildlife responses.

In 2005, for the first time since the early 1900s, a pair of least Bell's vireos nested at the San Joaquin River National Wildlife Refuge, rearing two broods, after a riparian restoration project was undertaken by the U.S. Fish and Wildlife Service in collaboration with PRBO Science and River Partners, with funding from CALFED. Similarly, the endangered riparian brush rabbit has begun to recolonize riparian habitat along the San Joaquin River after a captive breeding and release program was begun in 2002. More than 300 rabbits have been released so far, and efforts are underway to improve habitat for the rabbit, as well as for the riparian wood rat. On the Tuolumne River, private wine grape growers are partnering with water and wildlife agencies, with grants from CALFED, to restore riparian habitat and return floodplains (that had been planted in grapes for years) to their natural state. Riparian restoration in urban areas is also helping songbirds, providing winter stopover points and habitat for resident birds.

Funding for habitat restoration has been generous in the past decade, via the many state bonds passed by voters. Funding has enabled nonprofits and agencies like the California Coastal Conservancy and San Francisco Bay Joint Venture to support or conduct restoration and environmental education programs around the Bay, and to eradicate non-native invasive species. Watershed groups have burgeoned, doing important restoration and cleanup projects using volunteers. Coastal Cleanup Days, sponsored by the California Coastal Commission, have also been very successful, attracting thousands of volunteers to clean the Estuary's creeks, rivers, shoreline, and marshes. These efforts

have huge educational value, not to mention removal of a substantial volume of trash from the Estuary. Hundreds of volunteers are growing native plants for restoration projects through nonprofits like Save the Bay, as well as acting as stewards and guides in short-staffed national parks and wildlife refuges around the Estuary.

The Wetlands Goals project, which is being implemented by partners in the San Francisco Bay Joint Venture, aims to triple the amount of tidal marsh around the Bay, currently at about 25 percent of what it was in the 1800s. The acquisition of the South Bay salt ponds, which will be restored to tidal marsh and other habitats, is a huge step toward restoring tidal marsh and other wetlands for wildlife. In the North Bay, goaded by citizen activists, the East Bay Regional Park District acquired an important marsh on the north Richmond shoreline—Breuner Marsh—using eminent domain. The marsh and its uplands, which are home to several species of concern, including the white-tailed kite, were in danger of being developed with condominiums.

California sea lions, recovering from past exploitation, are increasing their use of San Francisco Bay. Bay-wide censuses of harbor seals indicate a population of approximately 600 that has remained stable for the past decade. There are approximately twelve known haul-out sites in the Bay, but harbor seals are found in the greatest numbers at Mowry Slough, Yerba Buena Island, and Castro Rocks.

San Francisco Bay remains a major coastal wintering and migrational stopover area for a variety of Pacific Flyway diving ducks and shorebirds. Suisun Marsh and the Delta provide valuable habitat for significant numbers of dabbling and diving ducks, geese, swans, and cranes. Some waterbird populations appear to have increased in response to the creation of artificial habitats, such as salt evaporation ponds. With the acquisition of the South Bay's salt ponds, many of which will be restored to tidal marsh, efforts are being made to balance the needs of a variety of bird species, and to provide a mosaic of habitat types, including retaining some of the ponds for those species that have come to rely on them.

Continuing Challenges, 2007–2017

Many of the current causes of wildlife problems will likely continue into the future. Despite the many bonds with funding for environmental restoration and protection passed in recent years, we still do not have any new large-scale, sustainable sources of funding for the environment. New solutions need to be found as the state's bond debt continues to grow. And while there is greater public awareness of many environmental issues, there is a never-ending need for strong environmental advocacy throughout the Estuary's watershed. The entire north Richmond shoreline remains in danger from proposed developments, despite the fact that it is home to many species of concern.

With support from regulatory and other agencies like the California Coastal Conservancy, activists and nonprofits have managed to prevent—or at least scale back—many developments that would have negatively impacted the Bay. Yet in spite of our progress since 1993, the need to "save the Bay" has not diminished. The need to preserve open space and other undeveloped lands throughout the Estuary's watershed is probably

greater now than ever, as the state's population continues to grow. We need to find viable places for people to live that do not sprawl into the wildlife habitat that is left. Urban habitat restoration can help make our cities more livable, as can access to regional parks and the Bay. The Bay Trail has generated much public interest in the Bay and its wildlife; however, we need to make sure public access is done in a careful way that does not disturb wildlife—often easier said than done. We also need to better plan development to preserve wildlife corridors between habitats—too often, this does not happen.

Another continuing challenge for birds and other wildlife that nest in and around and use the Estuary is that of legacy pollutants. Mercury, selenium, and PCBs, among others, have been shown to impair avian reproduction. Emerging contaminants like the fire retardant PBDEs have been found in the tissues of Bay harbor seals, and scientists do not yet completely understand the impacts of PPCPs—pharmaceuticals and personal care products that enter our wastewater treatment system but do not get completely treated—on wildlife. Selenium-laden agricultural discharges from the west side of the San Joaquin Valley continue to be a threat to the Estuary and its watershed and wildlife.

Nonpoint source pollution—the grease, oil, pet waste, and trash, including plastics that enter the Estuary and its tributaries via storm drains—is another ongoing problem for wildlife that needs a more collaborative and comprehensive effort. The San Francisco Bay Regional Water Quality Control Board proposes to address this in its Municipal Regional Stormwater Permit now being drafted. As California's population grows, these problems will continue to harm wildlife unless we come up with better solutions and the will to implement them.

Wildlife Actions

Objective WL-1

Create and restore habitats critical to the survival of plant and animal populations and enhance the biodiversity of the Estuary.

ACTION WL-1.1 (1993 CCMP)
Preserve, create, restore, and manage large, contiguous expanses of tidal salt marsh and necessary adjacent uplands for the California clapper rail and the salt marsh harvest mouse.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, public land management agencies, in coordination with special districts, such as mosquito abatement districts, California Coastal Conservancy, and California Conservation Corps (as appropriate)

What: Habitats for these rapidly dwindling species are extremely fragmented, particularly in the South Bay. Recovery will require the creation of large, contiguous tracts of salt marsh interlaced with tidal sloughs and suitable refuge from high tides. At least 15,000 acres are needed (in addition to the acreage listed in the Wetlands

Management Program and the planned acreage for the San Francisco National Wildlife Refuge listed under WL-1.2 below). Acquisition should be pursued with willing sellers.

When: Immediately

Cost: $170 million estimated total ($90 million federal and $80 million state)

ACTION WL-1.2 (1993 CCMP)
Complete the expansion of the San Francisco Bay National Wildlife Refuge and its satellite refuges and acquire the proposed Stone Lakes National Wildlife Refuge.

Who: U.S. Fish and Wildlife Service

What: Congressional budget augmentation should be provided to acquire the additional 22,000 acres authorized in the legislation for the expansion of the San Francisco Bay National Wildlife Refuge. In addition, the U.S. Fish and Wildlife Service should continue to pursue acquisition of appropriate North Bay parcels for addition to the refuge as part of the normal planning process. Particular emphasis should be placed on the Napa River marshes. The U.S. Fish and Wildlife Service should continue to pursue the acquisition of the proposed Stone Lakes National Wildlife Refuge at no less than 18,200 acres, on a willing seller basis, to be the keystone of a much larger (75,000–100,000 acres) North Delta wetland package that could include Yolo Basin wetlands, the Putah Creek and Cache Creek riparian areas, Natomas wetlands, and the Cosumnes River Preserve. All acquisition strategies, including eminent domain, easements, and other methods addressed in the preceding action, should be employed as needed. Sovereign and public trust land should be managed consistent with the refuge purposes.

When: To be determined

Cost: $237,520,000 estimated total ($230 million federal and $7,520,000 state)

ACTION WL-1.3 (1993 CCMP)
Implement concerted efforts to acquire wetlands already degraded or destroyed and restore them so that wetlands in the Estuary are increased by 50 percent by 2000.
(See the Wetlands Management Action WT-4.1 for details.)

ACTION WL-1.4 (1993 CCMP)
Restore tidal marshes in San Francisco Bay.
(See the Wetlands Management Action WT-3.1 for details.)

ACTION WL-1.5 (1993 CCMP)
Identify and convert or restore non-wetland areas to wetland or riparian-oriented wildlife habitat.
(See the Wetlands Management Action WT-4.1 for details.)

ACTION WL-1.6 (New 2007)
Establish a comprehensively managed baylands wildlife refuge in Marin and southern Sonoma counties.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, California Coastal Conservancy, or other government agencies with authority to hold title to and/or cooperatively manage and restore relatively large acreages of wildlife habitat, and non-governmental organizations, including the Marin Audubon Society

***What*:** The potential exists for a comprehensively managed wildlife refuge consisting of approximately 25,000 acres. The foundation for this refuge would be the former Hamilton Airfield, Bel Marin Keys, Bahia, Sears Point, North Parcel, Tolay Creek, and Sonoma Baylands, all of which have been acquired and have moved forward in restoration planning and/or implementation. Particularly at this time, the establishment and comprehensive management of a refuge system in east Marin County and southern Sonoma County (San Pablo Bay area) would be invaluable for endangered species recovery efforts and is consistent with recommendations in the "Baylands Ecosystem Habitat Goals" report.

The San Pablo Bay National Wildlife Refuge is presently conducting an update to its Comprehensive Conservation Plan (CCP) for its North Bay Refuge lands, and this is an opportunity to consider expansion of this refuge. Candidate properties for acquisition and restoration should be identified, aggregated into a list, and put forward for inclusion in this CCP process. The former Navy facility at Skaggs Island should be included as a candidate property. Expansion of the Marin Islands Refuge, establishment of a Marin Baylands Refuge or a Petaluma River Refuge under the U.S. Fish and Wildlife Service, or expansion of the California Department of Fish and Game's Ecological Reserve system are also possibilities.

***When*:** Immediately

Cost: $$$

Uncertainty: Dependent on land acquisition and restoration costs, and annual operation, maintenance, and repair costs, which can be substantial

Performance Measures:
1) Acres brought into acquisition and/or cooperative wildlife habitat management agreements

2) Acres within the refuge restored

Objective WL-2

Develop a comprehensive wildlife management plan for the Estuary.

ACTION WL-2.1 (1993 CCMP)
Prepare a comprehensive management plan for the San Francisco Bay National Wildlife Refuge.

Who: U.S. Fish and Wildlife Service, in coordination with special districts, such as mosquito abatement districts

What: In anticipation of the San Francisco Bay National Wildlife Refuge assuming full land management responsibility over significant salt pond acreage, the U.S. Fish and Wildlife Service should prepare a refuge habitat management plan. A goal of the plan is the maintenance of sufficient acreage of managed and tidal wetlands to support the unique assemblage of wildlife relying on those habitats. Appropriate emphasis should be placed on non-game species, such as shorebirds, colonial waterbirds, seabirds, and raptors. This plan will include the following:

1) Identification of an appropriate combination of tidal and managed wetlands to maintain greatest species diversity and population stability;

2) Identification of the most suitable tidal marsh restoration areas;

3) Identification of the optimal and most economically feasible wetland management techniques;

4) Environmental assessment of various management approaches; and

5) Coordination with ongoing monitoring and research efforts of PRBO Conservation Science, San Francisco Bay Bird Observatory, etc.

When: Within three years

Cost: $270,000 estimated total ($270,000 federal)

ACTION WL-2.2 (1993 CCMP)
Enhance the biodiversity within all publicly owned or managed wetlands and other wildlife habitats as appropriate.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, National Park Service, Department of Defense, California Department of Transportation, East Bay Regional Park District, San Francisco Bay Conservation and Development Commission, other public land management agencies (in consultation with the Executive Council on Biological Diversity, National Audubon Society, PRBO Conservation Science, Marine Mammal Center, California Academy of Sciences, and the general public), mosquito

abatement districts, California Coastal Conservancy, and California Conservation Corps (as appropriate)

What: Resource agencies will plan and implement enhancement measures that promote biodiversity for the wildlife habitats they own or manage. This could involve the establishment of a Habitat Task Force. The resource agencies will also provide technical assistance to other land management agencies in the planning and implementation of similar measures on those lands to the extent it is consistent with their missions. Cooperative agreements between the resource agencies and other public landowners to improve biodiversity and wildlife habitat values on those lands, consistent with the primary mission of the landowner, should be explored and implemented whenever practicable. Comparable agreements with private landowners should also be explored. All such agreements should be periodically reviewed and renegotiated to improve them whenever the opportunity exists. The technical results of these enhancement measures will be used by the agencies to implement the actions, and summary material will be incorporated into the Public Involvement and Education Program. The measures will address some of the following issues:

1) Identification of wildlife groups of concern, with particular emphasis on native species;

2) Mosquito abatement districts should provide private and public wetland managers with guidelines for enhancing seasonal wetlands, while addressing vector control;

3) To the extent that it is not inconsistent with their primary missions and budgets, flood control and mosquito abatement districts should be encouraged to manage their operations to maximize wildlife and wetland values. Bank erosion control projects should be designed to maximize riparian values; and

4) Using the efforts of the Executive Council on Biodiversity, establish bioregions within the Estuary and ensure that these regions are incorporated in the land use and wetlands plans. Educate the public, the agricultural community, landowners, developers, local government officials, and agencies on the value of this concept and how to incorporate it into agency missions, management goals, land use planning, etc.

When: To be determined

Cost: $4,260,000 estimated total ($1,260,000 federal and $3 million state)

ACTION WL-2.3 (1993 CCMP)
Complete and implement a wildlife habitat restoration and management plan for the Estuary.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, and landowners, in coordination with special districts, such as mosquito abatement districts, California Coastal Conservancy, and California Conservation Corps (as appropriate)

What: The resource agencies should lead a coordinated effort to develop and implement a wildlife habitat restoration and management plan for the entire Estuary. This plan would then be appended to the CCMP and should be reviewed and updated as necessary, or at least once every ten years. The plan should include extensive outreach by the resource agencies to ensure full participation by affected landowners and the public. The plan would include the following elements:

1) Identification of wildlife groups of concern, with particular emphasis on native species and overwintering and migrating shorebirds and waterfowl;

2) Analysis of management alternatives to maintain and restore wetland and riparian communities and biodiversity;

3) Assessment of impacts of various management alternatives;

4) Implementation and habitat acquisition strategies that incorporate biodiversity and wildlife corridors where possible;

5) Coordination of research activities with the Regional Monitoring Program for Water Quality, the Public Involvement and Education Program, and ongoing efforts by PRBO Conservation Science, San Francisco Bay Bird Observatory, etc.; and

6) Identification of possible funding sources and lead agencies.

The plan will also need to address private property rights.

When: Complete within three years

Cost: $2,060,000 estimated total ($1,560,000 federal and $500,000 state),

Objective WL-3

Develop predator control programs to decrease the impact of introduced species on listed and candidate species, as well as special status species.

ACTION WL-3.1 (1993 CCMP)
Implement predator control programs in areas where introduced predators are a constraint to maintenance and restoration of native populations.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, public land management agencies, Society for the Prevention of Cruelty to Animals, and local governments

What: Implement predator control whenever the effects of predation are determined to be a constraint to the maintenance and restoration of populations of native species. Control on public lands will be implemented by the landowner/manager under a plan approved by

the resource agencies. Control on private lands will be implemented by the resource agencies, with permission of the landowner, or by the landowner under a plan developed by the resource agencies. Red foxes, feral and domestic cats, and rats are some of the target species that are known to have significant impacts on native species.

When: Immediately

Cost: $6.1 million estimated total ($6 million federal and $100,000 state)

Objective WL-4

Implement management measures necessary to ensure survival and recovery of listed and candidate species, as well as special status species.

ACTION WL-4.1 (1993 CCMP)
Update, and, where necessary, prepare recovery plans for all listed wildlife species.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and San Francisco Bay Conservation and Development Commission

What: Detailed recovery plans for all listed species will be prepared or updated as necessary. Critical habitat will be identified, unless the identification of that habitat could hamper species recovery. Increased funding to prepare and implement recovery plans should be sought.

Implement recovery actions, including protection and enhancement of critical habitats targeted for acquisition or protection through regulatory processes. U.S. Fish and Wildlife Service and the California Department of Fish and Game will be the lead agencies for their respective listings. Created and restored marshes acquired for this purpose should be sufficiently large (more than 1,000 acres) to support extensive tidal channel systems. Priority sites are outlined in the Joint Clapper Rail and Salt Marsh Harvest Mouse Recovery Plan. Special attention shall be given to non-native invasive species in clapper rail and salt marsh harvest mouse habitat.

When: Within three years for listed species

Cost: $2,125,000 estimated total ($2,025,000 federal and $100,000 state)

ACTION WL-4.2 (Revised 2007)
Provide secure colony sites, allow for population recovery, control predators, and protect adjacent foraging areas for the California least tern.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, U.S. Navy, U.S. Army Corps of Engineers, San Francisco Bay Conservation and Development Commission, Port of Oakland, and Pacific Gas and Electric Company

What: Finalize the proposed Alameda National Wildlife Refuge and establish at least one other Bay Area colony site in order to provide several secure colony nesting sites for the California least tern. The Alameda National Wildlife Refuge is currently just a proposal. In the event the refuge does not materialize, the colony still needs protection.

The proposed Alameda National Wildlife Refuge provides one of the most productive California least tern nesting sites in California. The official establishment of the Alameda National Wildlife Refuge will protect the only consistent California least tern nesting colony in Northern California. Habitat management efforts for the Alameda National Wildlife Refuge colony and future colonies need to be adequately funded and staffed, as needed.

When: Immediately

Cost: $$$

ACTION WL-4.3 (1993 CCMP)
Monitor status of all candidate species and list them if warranted.

Who: U.S. Fish and Wildlife Service and California Department of Fish and Game

What: Develop and implement programs to monitor the status of all Class I and Class II candidate species. Agencies should take steps to list any species that warrant such listing to afford them the full protection of the law. Any listing package should include designation of critical habitat, unless the identification of that habitat could hamper species recovery.

When: Within five years

Cost: $25,200,000 estimated total ($7.2 million federal and $18 million state)

ACTION WL-4.4 (1993 CCMP)
Continue hunting closures to protect the Aleutian Canada goose. Investigate the need for hunting closures for other waterfowl species as necessary.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, and Pacific Flyway Council Technical Committees

What: Hunting closures to protect wintering populations of the Aleutian Canada goose in the Central Valley must be continued by the resource agencies until the subspecies is delisted.

Strengthen programs to educate hunters on proper identification of waterfowl species and male versus female (to minimize unlawful take).

Use educational programs to encourage anglers, hunters, and recreational boaters to avoid using critical areas where ducks, such as canvasbacks, white-winged scoters, and greater scaup, congregate. Use these same programs to encourage the public to purchase federal duck stamps at the post office.

When: Immediately

Cost: No direct costs

ACTION WL- 4.5 (New 2007)
Provide secure colony nest sites for Caspian and Forester's terns; double-crested, pelagic and Brandt's cormorants; great and snowy egrets; great blue heron; pigeon guillemot; common murre; and other colonial nesting water birds as might nest on the Bay or in the watersheds.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, U.S. Navy, U.S. Army Corps of Engineers, U.S. Air Force, San Francisco Bay Conservation and Development Commission, California Department of Transportation, Federal Highway Administration, ports, Pacific Gas and Electric Company, and others

What: Colonial nesting water birds use a variety of nest sites, from riparian habitats to bridges and bridge pilings, power line towers, navigational buoys, airstrips, salt pond levees, catwalks, etc.

Develop and implement a comprehensive plan that identifies the location of existing colonies and the location of likely future sites for nesting colonies and that identifies management programs necessary to sustain those colonies. Management programs may include the protection of sites from predators and human intrusion and also the protection of nearby foraging areas.

When: Immediately

Cost: $

Uncertainty: Applicable on a site-by-site basis

Performance Measures:
1) Completion of a nesting colony master plan

2) Percentage of nesting sites protected

3) Percentage increase in target colonial nesting water birds species

ACTION WL-4.6 (New 2007)
Implement a monitoring and research program to better understand the role of wintering habitat in population declines of those migratory diving waterbird species that overwinter on Bay waters and that rest and feed in large groups (rafts). Develop management strategies to address these population declines if the research shows that this is needed.

Who: U.S. Fish and Wildlife Service, U.S. Geological Survey, California Department of Fish and Game, San Francisco Bay Conservation and Development Commission, San Francisco Bay Joint Venture, San Francisco Bay Area Water Transit Authority, PRBO Conservation Science, and Audubon California and local chapters

***What*:** Resource agencies, the Water Transit Authority, and interested nonprofits will monitor populations of rafting ducks, such as scaup and scoter, western and Clark's grebes, and other waterbird species with declining populations, to determine causes for their sharp population declines.

Studies of the impacts of recreational and commercial water use (e.g., boating, ferries), contaminant uptake, and other potential impacts will be undertaken.

Upon determination of significant causative agents, management actions should be taken to attempt to reverse the declines.

***When*:** Immediately

***Cost*:** $

Performance Measures:
1) Establish a research and monitoring program.

2) Number and variety of species of migratory diving waterbird species that overwinter on Bay waters

3) Web site hits accessing report/other information on the monitoring program

Objective WL-5

Provide public access opportunities to, along, and on the Estuary that avoid or minimize adverse impacts to Bay resources and wildlife while facilitating Bay-related education and recreation.

ACTION WL-5.1 (New 2007)

Provide landside public access along the shoreline and nearshore areas of the Estuary that avoids to the extent feasible or minimizes adverse impacts to sensitive habitats and wildlife while accommodating education, biking, hiking, wildlife viewing, and other Bay-oriented recreational activities.

Who: Association of Bay Area Governments, San Francisco Bay Conservation and Development Commission, California Coastal Conservancy, California Department of Fish and Game, U.S. Fish and Wildlife Service, National Marine Fisheries Service, local governments of cities and counties, and park districts

What: The Estuary and its shoreline are important refuge, foraging, and nesting habitat for wildlife and also provide opportunities for unique recreational experiences. Participating in recreational activities along the shoreline allows the public to discover, experience, and appreciate the Bay's natural resources. These activities can also foster public support for Bay resource protection, including habitat acquisition and restoration. However, public access to the shoreline may have adverse effects on wildlife (including disturbance, increased stress, increased predation, interrupted foraging, or nest abandonment) and may result in adverse long-term population and species effects. The type and severity of effects, if any, on wildlife depend on many factors, including site planning, the type and number of species present, and the intensity and nature of human activity.

Recreational areas should be located, designed, and managed to prevent significant adverse impacts from human intrusion on sensitive habitats and on wildlife species. Avoiding adverse effects on wildlife may include siting and design strategies, such as locating parking and staging areas away from sensitive habitat areas, viewing platforms, fencing, open space, or vegetation to buffer wildlife from human use. Managing human use of an area may include periodic closure of access areas, pet restrictions, such as leash requirements, and prohibition of public access in areas where other strategies are insufficient to avoid adverse effects. Visitors should be provided with diverse and satisfying recreational opportunities to focus activities in designated areas, thus avoiding habitat fragmentation, vegetation trampling, and erosion. Interpretive centers, educational signage, docent-led tours, and community events educate visitors about local natural resources and wildlife, their ecological and historical importance, and appropriate visitor behavior, and can motivate people to participate in the responsible stewardship and protection of the Bay.

Consultation with wildlife agencies, such as the California Department of Fish and Game and the U.S. Fish and Wildlife Service, may be necessary to determine suitable locations

for public access. Effects of recreational activities on wildlife should be monitored over time to determine whether revisions of management strategies are needed.

When: Ongoing

Cost: $$

Uncertainty: Cost of siting and providing landside public access will be incurred by project applicants and will be dependent on project size.

Performance Measures:
1) Guidance document that identifies conditions under which public access does not adversely impact wildlife

2) Percentage of shoreline access protected and/or increased that is available for public recreation that does not adversely impact wildlife

ACTION WL-5.2 (New 2007)
Provide non-motorized small boat access, establish routes, and install associated infrastructure at carefully selected locations along the shoreline and nearshore areas of the Estuary that avoid to the extent feasible or minimize adverse impacts to resources and wildlife while providing opportunities for education and boating activities.

Who: California Coastal Conservancy, Association of Bay Area Governments, San Francisco Bay Conservation and Development Commission, U.S. Fish and Wildlife Service, California Department of Fish and Game, California Department of Boating and Waterways, National Marine Fisheries Service, U.S. Coast Guard, local governments of cities and counties, local and state park districts, marinas, harbor districts, and ports

What: The Estuary and its shoreline are important refuge, foraging, and nesting habitat for wildlife and also provide opportunities for unique recreational experiences. Water access within the Estuary (including landing and launching sites for human-powered boats and beachable sailcraft) provides the public a direct experience with the Estuary, fostering appreciation and promoting habitat preservation, restoration, and stewardship. However, development of water access and boat traffic within the Estuary may have adverse impacts on wildlife and their habitats.

Water access and associated facilities should be sited, designed, and managed to avoid or reduce adverse impacts from human intrusion on sensitive wildlife species. Sensitive shoreline and tideland habitat areas should be avoided. Water access should occur at existing and planned public access points. Signage and other educational methods, such as docent programs, should be employed to promote stewardship, inform the public of the importance and sensitivity of certain habitats and wildlife, and encourage safe, environmentally responsible recreation. Efforts toward increasing enforcement of sensitive habitat area restrictions should be pursued. Consultation with wildlife agencies,

such as the California Department of Fish and Game and the U.S. Fish and Wildlife Service, may be necessary to determine suitable locations for water access. Where appropriate, effects of water access on wildlife should be monitored over time to determine whether revisions of management strategies are needed.

When: Water Trail Plan to be completed by 2008. Implementation to begin thereafter**.**

Cost: $$$$$

Performance Measure:
Percentage of shoreline of public access (as identified in Water Trail Plan) that is accommodated while not adversely impacting wildlife

ACTION WL-5.3 (New 2007)
Develop a regional program, either through partnerships between existing agencies and organizations or the creation of a new agency or organization, to establish coordinated, consistent, and uniform signage, education, and outreach throughout the Bay.

Who: California Coastal Conservancy, San Francisco Bay Conservation and Development Commission, Association of Bay Area Governments, U.S. Fish and Wildlife Service, California Department of Fish and Game, National Marine Fisheries Service, local and state park districts, and Save the Bay

What: Interpretive centers, educational signage, docent-led tours, and community events educate visitors about local natural resources and wildlife and also inform them of appropriate visitor behavior. These tools not only educate the public about the value of Bay resources but can also inspire protection and stewardship of the Bay. Throughout the Bay, nonprofit, educational, local, state, and federal agencies and organizations have required or have provided directional and interpretive signage along public access areas on the shoreline of the Bay. Additionally, some of these organizations provide Bay-related educational tours and school curriculums. While tours, classes, and signage are effective methods for educating the public on the importance of the Bay and its resources, a consistent theme or "branding" that provides a uniform message throughout the Bay is lacking. Development of a regional program with coordinated signage, graphics, text, and educational materials and information would provide a uniform message that would be recognizable to the public and would establish connectivity between the many public access experiences throughout the Bay Area.

When: An analysis to examine the feasibility of developing this program should be initiated immediately.

Cost: $$$

Performance Measures:
1) Develop regional program to coordinate and build on current public access, signage, educational, and interpretive materials throughout the Bay.

2) Number of signs or materials developed

Objective WL-6 (New 2007)
Develop and implement a Wildlife Monitoring Master Plan.

ACTION WL-6.1 (New 2007)
Develop and implement a monitoring plan that will track the status of native wildlife species in the Estuary.

Who: U.S. Fish and Wildlife Service, National Marine Fisheries Service, California Department of Fish and Game, National Audubon Society, PRBO Conservation Science, San Francisco Bay National Estuarine Research Reserve, San Francisco Bay National Wildlife Refuge, and other nonprofits

What: A comprehensive regional monitoring plan tracking the numbers and status of native wildlife species needs to be developed. The plan should identify measures to ensure the recovery of any species identified by the monitoring plan as declining in population.

When: Immediately

Cost: $$

Performance Measures:
1) Develop a regional monitoring master plan documenting monitoring protocols and recommending recovery strategies for impacted species.

2) Percentage change in populations of key native wildlife species (especially those determined to be severely impacted)

Objective WL-7 (New 2007)
Protect native wildlife populations wherever possible.

ACTION WL-7.1 (New 2007)
Revise California Environmental Quality Act (CEQA) Checklist and Guidelines to ensure consideration of adverse impacts to native and migratory wildlife populations, including impacts of habitat loss or degradation and effects of global climate change and sea level rise.

Who: California Resources Agency and Governor's Office of Planning and Research

What: Current guidelines need to be modified to specifically consider adverse impacts to native wildlife populations.

When: Immediately

Cost: $

Type: Part of agency budget

Performance Measure:
Revised CEQA Checklist and Guidelines

ACTION WL-7.2 (New 2007)
Include policies and actions in General Plans to ensure that protection of native wildlife populations is considered.

Who: Local municipal and county governments

What: Current General Plans need to be modified to specifically consider adverse impacts to native wildlife populations.

When: Immediately

Cost: $

Performance Measure:
Number of revised general plans adopted including wildlife protection (via annual survey)

Wetlands Management

Action WT-5.2	Study effects of known stressors and emerging contaminants	New 2007	101
Action WT-5.3	Encourage academic institutions to study wetlands	New 2007	102

In the 14 years since the original CCMP was adopted in 1993, interest in wetlands protection and restoration has continued to be a high priority of the environmental community, the general public, resource agencies, and elected officials. Progress has been made toward attaining each of the wetlands management objectives. In particular, public and private funding and a strong spirit of partnership have led to the unprecedented undertaking of many wetland restoration projects—both large and small—throughout the Estuary. Accompanying these efforts has been a push to improve regulatory programs and to better understand the effects and benefits of wetlands restoration and enhancement on the estuarine ecosystem. It is important to acknowledge and embrace our accomplishments during the past decade while recognizing the problems still facing the protection and restoration of wetlands.

Goals:
The goals of the original CCMP remain our goals today:

- Protect and manage existing wetlands.
- Restore and enhance the ecological productivity and habitat values of wetlands.
- Expedite a significant increase in the quantity and quality of wetlands.
- Educate the public about the values of wetland resources.

Problem Statement
The original CCMP, drawing from several San Francisco Estuary Project technical documents, describes the myriad ways in which industrial, urban, and rural development have affected the Estuary's wetlands during the past one hundred-plus years. It notes that nearly 90 percent of the region's historical wetland acreage has been converted to non-wetland uses. Although the rate of wetland loss has declined markedly as a result of the federal Clean Water Act, Porter-Cologne Act, and McAteer-Petris Act, wetland losses continue. As was true when the CCMP was written, the most common types of projects that involve filling wetlands or shallow estuarine habitats include infrastructure improvements at ports and airports, roads and bridges, and residential and commercial developments.

The largest current threat to wetlands in the Estuary's immediate watershed is the expansion of urban and suburban development into agricultural areas and open space. This problem is most acute on lands adjacent to the North Bay and Suisun Marsh, and on the periphery of the Delta. The spread of development does not bode well for the ecosystems associated with the remaining non-tidal wetlands, especially seasonal wetlands and vernal pools.

Regardless of these ongoing habitat threats, efforts to restore and enhance the region's wetlands continue to garner widespread public support; this is reflected by the number and scale of wetland restoration projects throughout the Estuary. Today, scores of habitat

projects are in some stage of planning or implementation. These kinds of efforts will likely continue for years.

Existing Management Structure

The management entities described in the original CCMP—federal, state, and local agencies and non-governmental organizations—continue to implement the CCMP wetland actions. In 1995, the non-regulatory San Francisco Bay Joint Venture joined the management structure. Established to foster habitat restoration projects in partnerships with other nonprofit groups and government agencies, the Joint Venture released its implementation strategy in 1991. This strategy called for acquiring, restoring, and enhancing many thousands of acres of habitats in and adjacent to San Francisco Bay and in the Bay's immediate watershed. Many efforts are underway to meet the strategy's goals.

The State Legislature established the California Coastal Conservancy's San Francisco Bay Program in 1998; this program has taken a leadership role in working with state and federal resource agencies on large habitat restoration projects in the North and South bays. Nonprofit organizations, such as the Audubon Societies, Bay Institute, Citizens Committee to Complete the Refuge, Save the Bay, and Sierra Club continue to play a vital role in improving wetlands protection.

Achievements, 1993-2007

The CCMP has encouraged many major achievements in wetlands restoration and management in the Estuary. Progress has been made in each of the CCMP's four wetlands management objective areas: planning, regulatory, acquisition, and restoration/enhancement.

Although the objective to establish an Estuary-wide wetlands management plan has not been attained, many components of such a plan have been developed. For example, the "Baylands Ecosystem Habitat Goals Report" ("Goals Report") was published in 1999 and serves as a guide for planning wetlands restoration projects in and around the baylands. The scientific consensus achieved in preparing the "Goals Report" revealed that habitat restoration in the Estuary should seek to ensure a diversity of habitat types for plants, fish, and wildlife. Although the "Goals Report" did not prioritize specific areas for acquisition and restoration, it laid the groundwork for several large-scale efforts that followed.

Based on the success of the "Goals Report," a Subtidal Habitat Goals Project is now underway to establish a comprehensive and long-term management vision for protection, restoration, and appropriate use of the subtidal habitats of San Francisco Bay. An Uplands Habitat Goals Project is also being developed using existing and new data supplemented by expert opinion to recommend the types, amounts, and distribution of upland habitats, linkages, compatible uses, and the ecological processes needed to sustain diverse and healthy communities of plant, fish, and wildlife resources in the nine-county Bay Area. In addition, several pilot efforts to develop goals for the region's streams and

riparian corridors have begun. Each of these planning efforts will help guide decisions regarding habitat protection and improvement well into the future.

Soon after the CCMP was adopted, the State developed a wetlands conservation policy. This policy aimed to implement several of the CCMP Wetlands Program management objectives: It increased support for wetland planning, improved administration of existing regulatory programs, strengthened landowner incentives to protect wetlands, gave more support for mitigation banking, and encouraged integration of wetlands policy and planning with other environmental and land use processes. A key impact of the policy was the development of a statewide wetlands inventory. Policy actions have been carried out with varying degrees of success.

Protecting wetlands must include a regulatory component, and several agencies responsible for regulating projects in wetlands have improved their regulatory programs. The San Francisco Bay Conservation and Development Commission updated its policies regarding San Francisco Bay ecology and related habitats, public access and wildlife compatibility, and mitigation. Based on intensive technical studies, the Commission modified relevant parts of the Bay Plan to ensure better protection of important Bay resources, including wetlands. It also increased its enforcement penalties to discourage unauthorized activities in and around the Bay.

The San Francisco Bay Regional Water Quality Control Board (Water Board) recently initiated an effort to improve its protection of streams and riparian areas. This effort should result in improved regulation of activities that adversely affect these aquatic resources. The Water Board made several regulatory changes to protect wetlands in its Basin Plan; this included adopting a no-net-loss wetlands policy, incorporating the approach to protect wetlands embodied in the federal Clean Water Act Section 404(b)(1) Guidelines, and developing a more protective wetlands definition in its Basin Plan to specifically include isolated waters. In addition, the Water Board updated its Basin Plan to emphasize wetland preservation and restoration through regional planning efforts such as the “Goals Report.”

To facilitate the submission of applications for projects involving activities in wetlands, several state and federal agencies adopted a joint permit application form. Known as the Joint Aquatic Resources Permit Application (JARPA), this form may be used by applicants seeking authorizations from the San Francisco Bay Conservation and Development Commission, the California Department of Fish and Game, the San Francisco Bay Regional Water Quality Control Board, and U.S. Army Corps of Engineers. It is based on a very successful similar effort by the State of Washington.

Wetlands mitigation banking provides compensatory mitigation for projects that fill wetlands. Banking has grown dramatically throughout the state during the past decade. There are now at least two dozen mitigation banks, mostly in the Central Valley, on thousands of acres in the Estuary’s watershed. Although a recent statewide study by the State Water Resources Control Board found several mitigation banks to be performing well, studies elsewhere have identified a host of problems associated with banks. As a

result, the use of mitigation banking continues to be controversial. To improve the development and performance of mitigation banks, the U.S. Army Corps of Engineers offices in Sacramento and San Francisco established interagency mitigation banking review teams in 2006. At the federal level, the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers are developing guidance to tighten controls on mitigation banking and in-lieu fee mitigation.

Efforts to restore wetland habitats in and around the Estuary are at an all-time high. Since the CCMP was adopted, projects large and small have been initiated throughout the Delta, in Suisun Marsh, along the fringes of San Pablo Bay, and in South Bay. To date, some 67,000 acres of projects have been undertaken. These range in size from just a few acres to some 15,000 acres of salt ponds in the South Bay. Above and beyond the South Bay salt pond restoration effort, local governments and non-governmental organizations are working on some seventy-five habitat projects at this time. Some of these projects will be completed in the span of several years; others will continue for decades.

Spartina alterniflora is a non-native cordgrass that has hybridized in the Bay with the native cordgrass, *Spartina foliosa. S. alterniflora* and its hybrids out-compete *S. foliosa* and have displaced habitats used by two endangered species, the salt marsh harvest mouse and the California clapper rail. A long-term eradication program—the Invasive Spartina Project (ISP)—is underway, with some dramatic results already achieved through the use of herbicide and manual methods. The goal of the ISP is to eradicate this non-native invasive species in the Bay over the next four years.

Many large wetland projects, completed or in progress, are utilizing dredged material from ports or navigation channels to hasten the development of tidal marsh vegetation. Examples include Hamilton Airfield, Bel Marin Keys, Sonoma Baylands, and Montezuma Wetlands. Given the declining volume of sediment expected to enter the Estuary in the future, large-scale restoration projects likely will continue to incorporate the use of dredged sediments. The Long Term Management Strategy for dredged material will continue to recommend the efficient use of dredged material in habitat projects and foster coordination among dredging interests and restoration planners.

The CALFED Bay-Delta Ecosystem Restoration Program has dedicated millions of dollars to restoring habitat in the Sacramento and San Joaquin river watersheds and the San Francisco Estuary with a focus on the Delta. The CALFED Bay-Delta Science Program is also helping policymakers and resource managers understand the complex ecosystems within this key part of the state. As the public has become more informed about the Estuary and how its health affects their quality of life, it has approved bonds for the benefit of wetland habitat acquisition and restoration. CALFED oversees many of the projects made possible by these bonds.

In an effort to better understand, manage, and successfully restore an estuary that has lost 90 percent of its original extent of wetlands, the National Oceanic and Atmospheric Administration established the San Francisco Bay National Estuarine Research Reserve in 2003. The National Estuarine Research Reserve System is a network of twenty-seven

reserves established for long-term research, education, and stewardship of the nation's estuaries. The San Francisco Bay National Estuarine Research Reserve is a partnership among the National Oceanic and Atmospheric Administration, San Francisco State University, California State Parks, Solano Land Trust, and the San Francisco Bay Conservation and Development Commission. The San Francisco Bay National Estuarine Research Reserve provides a platform for estuarine research, hosts workshops on estuarine ecology and related scientific topics, provides educational programs to students and the public, and maintains a monitoring program for water quality and weather measurements.

Monitoring throughout the entire Estuary is an important component of managing restoration and enhancement projects, and while there is a real need for a more coordinated, multi-agency approach, monitoring wetlands has historically been handled on a project-by-project basis. In order to track compliance with the no-net-loss policy and to ensure that wetlands are restored to their fullest function and value, there is a need to dedicate resources for appropriate and accurate monitoring of both wetlands acreage and health. During the past decade, the San Francisco Bay Regional Water Quality Control Board has fostered a regional wetlands monitoring program to improve communication on regional wetlands monitoring progress and techniques.

Methodologies have been developed to assess the conditions of local wetlands, including the Wetlands Ecological Assessment (WEA) and the California Rapid Assessment Methodology (CRAM); the latter method is being tested statewide to provide a uniform, standardized database, and both methods are still under review for their effectiveness. Substantial progress has also been made on creating databases to track wetlands projects and indicators of wetland health. These include the San Francisco Bay Joint Venture habitat project tracking system and the San Francisco Estuary Institute's Wetland Tracker. The San Francisco Bay Regional Water Quality Control Board has begun a pilot program to test the advantages of using the Estuary Institute's Wetland Tracker to manage the data generated by wetland mitigation projects and to compare conditions in mitigation wetlands with ambient wetlands in the region.

Challenges, 2007-2017

Many of the 1993 CCMP's wetlands management actions have been implemented; however, a substantial number of actions either have not been undertaken or have been implemented with minimal success. Attaining all of the CCMP objectives clearly will require additional work.

Some actions that were not undertaken include the development of a regional wetlands management plan, State assumption of the Section 404 program, and completion of the San Francisco Bay National Wildlife Refuge. Actions that have been implemented with minimal success include standardized monitoring protocols, mitigation project monitoring, increased enforcement, and efforts to improve mitigation banking. However, funding from the U.S. Environmental Protection Agency and the California's Coastal Nonpoint Source Pollution Control Program should facilitate developing standardized monitoring protocols and mitigation project monitoring through tools such as the San

Francisco Estuary Institute's Wetland Tracker and the California Rapid Assessment Methodology, mentioned above.

While the rate of loss of tidal wetlands has declined sharply in recent decades, the loss of seasonal wetlands and streams continues. This loss is mostly a result of urban expansion and residential development on the agricultural lands and open spaces that surround the Estuary. The intense pressure to accommodate population growth, combined with the limitations of existing state and federal wetlands regulatory programs, make it difficult, in most instances, for the regulatory agencies to require complete avoidance of wetland fills. Many in the environmental community seeking better protections for wetlands and streams would like to see the agencies press harder for complete avoidance in instances where the avoided resources would continue to provide significant natural functions. Given projected population increases and associated land use changes, protecting the region's remaining wetlands and streams will be a challenge well into the future.

There is a continuing challenge to ensure that compensatory mitigation adequately offsets the impacts of authorized wetland fills. Many of the issues regarding mitigation apply both to individual mitigation projects and to mitigation banks; these include the ability to replace lost functions, use of out-of-kind mitigation, adequacy of performance measures, and lack of comprehensive monitoring. A chief concern with the use of mitigation banks is that it reduces efforts to avoid filling wetlands. Other frequently voiced concerns are the size and configuration of bank service areas and long-term bank site maintenance and protection. As regulatory agencies continue to use mitigation banks to offset wetlands losses, there will be a need for better dialogue among the agencies, bank developers, and environmental interests. More discussion on the improvements needed for properly functioning mitigation projects, including banks, is presented later in this chapter.

Recognizing the complexities of restoring and managing wetlands habitats and the need for coordination among large restoration projects, the CCMP recommended the preparation of a regional wetlands management plan. That management plan was never realized, and it is unlikely that it ever will be, given the existing practices of the resource and regulatory agencies, the way restoration projects are funded, and the entrepreneurial spirit that characterizes most restoration efforts. Fortunately, even without a formal plan in place, many of the recommended plan's most important components are being implemented in some fashion. As stated above, the "Goals Report" established a vision for wetland restoration in the San Francisco Bay region that is guiding local, state, and federal agencies responsible for habitat protection, as well as private and non-governmental organizations involved in habitat restoration.

A recent Supreme Court decision (*Rapanos et ux., et al. v. United States*) resulted in some ambiguity in the U.S. Environmental Protection Agency's and the U.S. Army Corps of Engineers' jurisdiction over certain waters of the United States, including isolated wetlands. At issue is whether ephemeral or intermittent streams provide a "significant nexus" to other waters of the United States to qualify as jurisdictional under the Clean Water Act. The U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers have been developing guidance to help clarify and interpret the Supreme

Court's decision. This issue points to the importance for the State to continue to improve its ability to regulate activities in these kinds of waters; accordingly, the State Water Resources Control Board and the Regional Water Boards have increased their efforts to protect isolated waters of the State.

Although there has been notable success in controlling *S. alterniflora*, this species and other non-native invasive species, such as the Quagga mussel, zebra mussel, water hyacinth, and pepper grass, to name a few, continue to have a very real potential to impact the Estuary's aquatic ecosystems. Our ability to control these and other non-native invasive species will largely depend on adequate funding for research, prevention, and control.

Mercury contamination in the Estuary's sediments presents a unique challenge to wetland restoration efforts. Sources of mercury include legacy mining, urban and non-urban runoff, wastewater treatment, and industry. Tidal wetlands provide an environment in which inorganic mercury in sediments may be transformed, in a process known as methylation, to a form that is toxic to animals and humans. While mercury in its inorganic form is not immediately harmful to living organisms, its presence in the environment poses a risk because it can be methylated at any time under certain conditions. The potential problem of mercury methylation in the Estuary may be most acute in the South Bay, where large quantities of mercury entered Bay sediments during the Gold Rush from the New Almaden mercury mine in the Guadalupe River watershed. As large areas of South Bay salt ponds are restored to tidal marsh, it will be important to monitor mercury concentrations carefully. As currently planned, restoration of the salt ponds is slated to proceed in tandem with a rigorous science program to assess mercury concentrations in sediments, water, fish, and wildlife. In addition to concerns in and around the Bay, methylation of mercury in managed wetlands is a concern throughout the Delta and upstream.

Another key issue that needs to be addressed is the development of a better understanding, through research and monitoring, of the effects of large-scale wetlands restoration on the estuarine ecosystem. There also are pressing needs to establish adequate protections for seasonal wetlands and riparian and uplands habitats, and to ensure that wetland mitigation banking is implemented on a watershed basis.

Finally, there is an issue of regional importance that received little attention in the original CCMP: global climate change. Scientists anticipate that rising concentrations of atmospheric greenhouse gases will lead to increased average global temperatures and rising sea levels. Coastal zones are particularly vulnerable to sea level rises, and the effects in the San Francisco Estuary may include inundation of existing tidal wetlands and other low-lying lands, intensification of flooding, and increased salinity. Combined with the projected alterations in the patterns of freshwater runoff, these changes likely will have an enormous effect on estuarine wetlands, other aquatic habitats, and the fish and wildlife resources they support. Human-induced climate change represents a new and very real challenge to wetlands and other resources, and the CCMP should establish the framework for addressing it.

Wetlands Actions

Objective WT-1

Create a comprehensive, Estuary-wide wetlands management program. [Each of the subsequent objectives would be components of the program.]

ACTION WT-1.1 (1993 CCMP)
Prepare Regional Wetlands Management Plan(s).

Who: California Resources Agency (lead agency), California Environmental Protection Agency, California Department of Fish and Game, California Department of Water Resources, State Water Resources Control Board, Central Valley and San Francisco Bay Regional Water Quality Control Boards, California Coastal Conservancy, California State Lands Commission, San Francisco Bay Conservation and Development Commission, U.S. Fish and Wildlife Service, Natural Resources Conservation Commission, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, National Marine Fisheries Service, and local governments and special districts in coordination with the interested public

What: Prepare a Regional Wetlands Management Plan (the Plan) for San Francisco Bay and the Delta to protect, enhance, restore, and create wetlands in the Estuary. For the purposes of developing the Plan, establish geographical subregional components (e.g., the Plan may consider San Pablo Bay, the Delta, Suisun Marsh, South Bay, and others as planning units). The Plan should utilize to the fullest extent possible existing documents, such as the Concept Plans for Waterfowl Habitat Protection (San Francisco Bay and Delta), Central Valley Habitat Joint Venture, Suisun Marsh Protection Plan, and the San Francisco Bay Refuge Expansion Plan. Whenever possible, the enhancement of wildlife habitat should be a priority. Restoration and other wetland values and functions should also be considered, consistent with wildlife protection goals. In order to allow sufficient public input and review, development of the Plan should employ a public process similar to that used by the State Water Resources Control Board in development of the Regional Water Quality Control Boards' Basin Plans or by the San Francisco Bay Conservation and Development Commission in development of its Bay Plan. The policies and programs of the Plan should be incorporated into appropriate documents, such as the Regional Water Quality Control Boards' Basin Plans, the San Francisco Bay Conservation and Development Commission's Bay Plan, local General Plans, etc.

NOTE: In recognition of the fact that the regulation of jurisdictional wetlands directly affects the implementation of the Regional Wetlands Management Plan, recommendations regarding improvements to and modifications of the existing wetland regulatory system are offered in Objective WT-2 of this document. Those recommendations are intended to complement and augment the effectiveness of the Regional Wetlands Management Plan and indeed be an integral component of it. Together, the Plan and the improved regulatory system will enhance the effectiveness and efficiency of federal, state, and local efforts to protect wetlands.

The Regional Wetlands Management Plan should:

1) Consider all wetlands identified by the California Department of Fish and Game and by the National Wetlands Inventory maps and should identify buffer areas and stream environments;

2) Establish wetland habitat goals by identifying wetland habitat needs (e.g., determine the amounts, locations, and types of wetlands necessary to support wetland plant and animal communities);

3) Prioritize areas for acquisition and restoration;

4) Recommend wetland acquisition, enhancement, and restoration programs by public, nonprofit, and private institutions and organizations;

5) Recommend programs to protect and restore non-tidal wetlands surrounding the Bay, including diked historic baylands, abandoned salt ponds, and tributary streams that are hydrologically part of the Bay; and

6) Recommend specific guidance to all appropriate agencies, including local and county governments, to help in the development of local wetland protection programs.

When: 1993

Cost: $5,746,000 estimated total ($1,091,000 federal and $4,655,000 state)

ACTION WT-1.2 (Revised 2007)
Encourage geographically focused cooperative efforts to protect wetlands.

Who: California Resources Agency (lead agency), California Coastal Conservancy, San Francisco Bay Conservation and Development Commission, California Department of Fish and Game, California State Lands Commission, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Natural Resources Conservation Commission, San Francisco Bay Joint Venture, San Francisco Bay National Estuarine Research Reserve, local governments, landowners, and nonprofit organizations

What: Opportunities should be sought immediately and during development of the Regional Wetlands Management Program to protect wetland areas particularly threatened by loss. Such areas include, among others, San Pablo Bay wetlands, Delta wetlands, wetlands identified in the proposed expansion of the San Francisco Bay National Wildlife Refuge complex, and Suisun Marsh wetlands. Cooperative efforts of government agencies, landowners, and conservationists should be undertaken to create immediate opportunities for protection, acquisition, and restoration. These efforts will facilitate the implementation of a coordinated strategy for wetlands protection, acquisition, and restoration that should be contained in the Regional Wetlands Management Program.

When: Ongoing

Cost: $$$$$ (High cost based on land acquisition, restoration, and enhancement)

ACTION WT-1.3 (New 2007)
Provide and protect wetland transition habitats, buffer areas adjacent to wetlands, and functional connections between wetlands and related habitats.

Who: Local governments, U.S. Fish and Wildlife Service, California Department of Fish and Game, Regional Water Quality Control Boards, U.S. Army Corps of Engineers, San Francisco Bay Conservation and Development Commission, San Francisco Bay Joint Venture, San Francisco Bay National Estuarine Research Reserve, California Coastal Conservancy, and other agencies, organizations, and individuals approving and implementing wetland restoration projects

What: Transition and buffer zones are essential to maintain ecological functions of habitats and have intrinsic value as habitats for endangered, threatened, and other species. The transition areas between wetlands and adjacent uplands are essential components of wetland ecosystems. They are critically important for three distinct, but related, reasons:

1) As refuge habitat during times of high water in the marshes when endangered and other species must leave the marshes and find cover to protect them from avian and other predators, and as nesting and foraging habitat;

2) As buffer zones between the transition habitats and adjacent uplands to ameliorate impacts of adjacent human development and uses on the species dependent on the wetlands and adjacent transition zones; and

3) Functional connectivity for the wetland landscape, allowing the flow of nutrients, resources, and organisms between the open water and terrestrial habitats. These areas also filter runoff, thereby helping to improve water quality. They are often used for public access features and need to be carefully managed to protect natural habitat functions (see AR-5.1). Protection and establishment of these areas is an essential implementation mechanism of stream and wetland protection policies (See LU-2.7).

The buffer width recommended by the "Baylands Ecosystem Habitat Goals Report" is 300 feet, but no narrower than 100 feet. Additionally, those involved in wetland protection, mitigation, and restoration should:

- Recognize the importance of wetlands that have intact landscapes across habitat types.

- Include efforts to establish or maintain natural levels of connectivity between habitat types.

- Recognize the importance of including mosaics of wetland habitat types.

- Encourage connectivity between wetlands and uplands or open water habitats.

- Encourage studies of the effects of habitat connectivity on wildlife diversity, population health, and the larger ecosystem.

When: As projects are proposed for planning and implementation

Cost: $$$$$ (High cost based on land acquisition, restoration, and enhancement)

Performance Measures:
1) Percentage of projects that include buffer/transition zones. (Outcome)

2) Acreage designated and maintained as buffer/transition zones. (Output)

3) Percentage of projects that include monitoring for buffer/transition zones. (Output)

ACTION WT-1.4 (New 2007)
Identify and protect existing seasonal wetlands, and restore and create seasonal wetlands at appropriate sites.

Who: San Francisco Bay Joint Venture, U.S. Fish and Wildlife Service, California Department of Fish and Game, U.S. Geological Survey, San Francisco Estuary Institute, California Coastal Conservancy, California Wildlife Conservation Board, Natural Resources Conservation Service, San Francisco Bay Conservation and Development Commission, San Francisco Bay Regional Water Quality Control Board, San Francisco Bay National Estuarine Research Reserve, vector control agencies, landowners, non-governmental organizations, land trusts, and local governments

What:
- Appropriate agencies should protect seasonal wetlands from destruction.

- Appropriate agencies, land trusts, and nonprofits should work together to acquire threatened seasonal wetlands.

- Mapping of existing seasonal wetlands should be performed to adequately identify baseline acreage of this resource.

- Important functions of seasonal wetlands should be identified. Sites where restoration/creation is feasible should be identified; these sites should be acquired and restoration/creation should be undertaken.

- Update local government General Plans and ordinances to include seasonal wetland protection, restoration, acquisition, and creation.

When: Ongoing

Cost: $$$$$ (High cost based on land acquisition, restoration, and enhancement)

Performance Measures:
1) Map existing seasonal wetlands and identify those that could be restored to original function or where new wetlands could be created. (Output)

2) Percentage of local government General Plans and/or ordinances that include seasonal wetland protection, restoration, acquisition, and creation. (Output)

3) Percentage of seasonal wetlands protected, restored, enhanced, and/or created. (Outcome)

4) Acreage of seasonal wetlands protected, restored, enhanced, and/or created. (Outcome)

ACTION WT-1.5 (New 2007)
Riparian areas should be protected and acquired in recognition of the value that they have in protecting hydrologic, water quality, fish and wildlife habitats, and ecosystem functions.

Who: Regional Water Quality Control Boards, State Water Resources Control Board, California Department of Fish and Game, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, San Francisco Bay National Estuarine Research Reserve, San Francisco Bay Conservation and Development Commission, California Coastal Conservancy, San Francisco Bay Joint Venture, local governments, and non-governmental organizations

What:
- Appropriate agencies should protect riparian areas from modification or destruction.

- Appropriate agencies, land trusts, and nonprofits should work together to acquire riparian areas.

- Mapping of existing riparian areas should be performed to adequately identify baseline acreage of this resource.

- Important functions of riparian areas should be identified. Sites where restoration/creation is feasible should be identified. Those sites should be acquired, and restoration/creation should be undertaken (see PO-4.1, 4.2, 4.3).

- Update local government General Plans and ordinances to include riparian area protection, restoration, acquisition, and creation.

- Protect riparian areas by supporting the stream and wetlands system protection policies and plans under development (see LU-2.7). Current items under consideration include:

1) Addition of water quality enhancement and flood peak attenuation as potential beneficial uses of wetlands and other surface water bodies, such as floodplains, stream channels, and riparian areas, and language stating that wetlands often have the same functions as adjacent water bodies.
2) Recognition of California's role in wetlands regulation irrespective of changes in federal wetlands jurisdiction.
3) A description of how many wetlands will not exhibit all federal delineation criteria (i.e., hydrophytic vegetation, hydric soils, and hydrology) because of the seasonality and interannual variability of rainfall in California or because specific physical, chemical, biotic, or anthropogenic factors have hindered their development.
4) An assertion that the Regional Water Board may exercise its independent judgment in determining both the size and functions of individual wetlands not identified with the federal delineation manual. The Regional Water Board will consider characteristics such as hydrophytic vegetation, hydric soils, and hydrology and may use more expansive identification/delineation methodologies as necessary to protect water quality and beneficial uses.
5) Support incentives for updating local General Plans and ordinances to protect riparian and wetland systems.

When: Ongoing

Cost: $$$$$ (High cost based on land acquisition, restoration and enhancement)

Performance Measures:
1) Map existing stream/riparian areas and identify those that could be restored to original function or protected. (Output)

2) Percentage of local government General Plans and/or ordinances that include stream/riparian area protection, acquisition, restoration, or enhancement. (Output)

3) Percentage of stream/riparian areas protected, restored, or enhanced. (Outcome)

4) Acreage of stream/riparian areas protected, restored, or enhanced. (Outcome)

Objective WT-2
Improve the wetland regulatory system.

ACTION WT-2.1 (Revised 2007)
Establish a comprehensive state wetlands program for the Estuary that, in addition, includes a coordinated regulatory and policy framework.

Who: San Francisco Bay Conservation and Development Commission, Central Valley Regional Water Quality Control Board, San Francisco Bay Regional Water Quality Control Board, Delta Protection Commission, California Resources Agency, California Department of Fish and Game, California Coastal Commission, California State Lands

Commission, California Environmental Protection Agency, State Water Resources Control Board, local governments, special districts, and California Legislature

What: **WT-2.1.1:** ***Establish state wetlands protection policies for the Estuary.***
A. Adopt a "no net loss" policy. Establish a consistent no net loss policy by all state agencies to prevent any activity that will result in the loss of either wetland acreage or values on a project-by-project basis in the San Francisco Estuary or the land surrounding the Estuary. No net loss should first be accomplished by avoiding destruction or degradation of wetlands, if possible, by minimizing impacts, and by mitigation. This program should be no less protective of wetlands than any existing State wetlands policies in the Estuary.

B. Adopt consistent wetland definition and jurisdictional delineation methods. Adopt a standard definition for wetlands based on the broad scientific consensus that all wetlands possess certain general characteristics. Adopt a single corresponding jurisdictional delineation methodology to identify those wetlands in the field. Jurisdictional wetlands should be delineated in a manner that includes all ecological wetlands. This definition and delineation methodology should identify at a minimum all lands that fall under federal Clean Water Act Section 404 jurisdiction and should be used by all appropriate state and local regulatory agencies. Where the CWA Section 404/401 jurisdiction does not apply to waters of the State, such as isolated wetlands, groundwater wetlands, and other types of non-navigable waters, the Regional Water Quality Control Boards should use their authorities to protect all waters of the State under the Porter-Cologne Act.

The State Water Resources Control Board should exercise its independent authority under the Water Code in situations where there is a difference between the State and the U.S. Army Corps of Engineers, such as over a jurisdictional determination, or in instances where the U.S. Army Corps of Engineers may not have jurisdiction. The Water Code provides the State and Regional Water Quality Control Boards clear authority to regulate such isolated, non-navigable waters of the State, including wetlands.

One of the two following wetlands definitions is generally used:

Option 1: A general definition that reflects the three characteristics accepted by the scientific community as indicators of wetland ecology.

Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For the purposes of this classification, wetlands must have one or more of the following attributes: 1) at least periodically, the land supports predominantly hydrophytes; 2) the substrate is predominately undrained hydric soils; and 3) the substrate is non-soil that is saturated with water or covered by shallow water at some time during the growing season of each year.

Option 2: Current federal definition, modified to include sites that reflect California's unique wetland ecology.

Wetlands are those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. In addition, wetlands include: mudflats, sandflats, unvegetated seasonally ponded areas, vegetated shallows, sloughs, wet meadows, playa lakes, salt ponds, natural ponds, vernal pools, and riparian woodland and scrub.

Jurisdictional delineation methodology. Based on the adopted definition, a delineation method should be developed and adopted to allow consistent and accurate field identification of jurisdictional wetlands.

To more fully protect wetlands, state agencies with authority to do so should adopt a wetland definition that uses one parameter to determine jurisdictional wetlands. They should also develop a wetlands delineation approach to identify wetlands under this definition.

State agencies with authority to do so should provide consistent definitions for wetland habitat types throughout the state and Estuary. These definitions should consider the needs of specific biological species for habitats such as tidal marshes and seasonal wetlands. If possible, existing definitions should be used, such as those developed by the San Francisco Estuary Institute for the Wetland Tracker, which has been developed for statewide use with the collaboration of regulatory agencies, academic institutions, and the public. Whichever definition is used, cross-reference to standard terms used in other habitat classification systems should be provided.

C. Adopt wetland alteration policies. Adopt policies that require avoidance of fill and other alterations (e.g., removal of vegetation and draining) in wetlands. It is presumed that an alternative location exists for non-water-dependent projects unless otherwise demonstrated. Exceptions may be considered where the project proponent clearly demonstrates that no feasible alternative non-wetland location exists, or when the project is necessary for the health, safety, or welfare of the residents of the Bay-Delta Estuary region and no feasible non-wetland location exists. Fill should further be limited to projects where:

1) It is demonstrated that the public benefits outweigh the public detriment (e.g., minor filling for wildlife refuges or other wildlife purposes, or minor filling for public access where existing access is inadequate and such access can be designed consistent with protection of sensitive wildlife and wetland habitat);

2) The fill is the minimum necessary to achieve the purpose of the project;

3) The fill minimizes harm to water circulation and quality, fertility of the marsh, and fish and wildlife resources;

4) The fill is engineered to reasonably withstand earthquakes and flooding;

5) In order to prevent a piecemeal approach, the fill project prevents future fill in wetlands at the site; and

6) The fill is limited to areas where ownership has been clearly established so that wetlands are not altered on property without legal authorization.

D. Establish sufficient buffer areas to protect wetlands from adjacent uses. Buffer zones adjacent to wetlands are necessary to provide for adequate transitional and refuge habitat between wetland and developed uses. Buffer zones should be of adequate size and quality to insulate the wetland, transition, and refuge habitat from adverse impacts of nearby developed areas. Buffer areas should be protected consistent with the legal rights of the property owners. (See WT-1.3 for details.)

WT-2.1.2: ***Investigate state assumption of Section 404 of the Clean Water Act.***

A. Study implications for state assumption of the Section 404 program. A study of state assumption of the Section 404 program should consider effectiveness, efficiency, and cost. Any assumption should maintain the appropriate federal role necessitated by interstate and international responsibilities and consider the establishment of an appeals program for review of state decisions.

B. If the study indicates that state assumption would improve resource protection, move toward state assumption of the Section 404 program.

C. Study methods to improve coordination of wetland regulation, including single agency authority for wetland alteration activities. The purpose of this would be to consolidate the permit process consistent with improved wetland protection.

D. If the study indicates that improved resource protection would result, move toward allowing consolidated or coordinated permit authority for wetland alteration activities. The purpose would be to consolidate the permit process consistent with improving wetland protection. For instance, agencies with other wetland-related permit activities (e.g., San Francisco Bay Conservation and Development Commission, Regional Water Quality Control Boards, the California Department of Fish and Game, and Delta agency could issue permits concurrently under the same application process or issue consistency determinations.

WT-2.1.3: ***Establish an implementation program to achieve wetlands protection policies.*** In order to improve wetland protection and reduce regulatory duplication, a uniform and coordinated program should be established that provides state oversight of locally implemented wetlands protection policies. Such a program may be modeled after the Suisun Marsh Protection Plan. The policies themselves (described in Actions WT-2.1, 2.2, and 2.3) should be adopted by the San Francisco Bay and Central Valley Regional Water Quality Control Boards, the San Francisco Bay Conservation and Development

Commission, and the Delta Protection Commission. Authority and resources to implement these policies should be provided to local governments. In that manner, project sponsors will be informed of wetland protection requirements early in the application process, thereby minimizing uncertainty and delay. State oversight agencies will coordinate their actions with relevant federal agencies in a manner consistent with the policies and objectives described herein (Actions WT-2.1 through WT-2.4).

Fill gaps in existing wetland regulatory programs consistent with policies recommended above. Based on wetland resource needs, state policies and programs should be implemented to fill in gaps in existing wetland regulatory programs. In particular, this should include the following:

A. The State Water Resources Control Board and the San Francisco and Central Valley Regional Water Quality Control Boards should adopt policies and programs consistent with the Clean Water Act. The State Water Resources Control Board and/or San Francisco Bay and Central Valley Regional Water Quality Control Boards should be directed and allocated adequate resources to:

   - Clarify that wetlands are waters of the State and develop a program to protect wetland resources;

   - Adopt a definition of wetlands as specified in Action WT-2.1;

   - Apply the beneficial uses process developed by San Francisco Bay Regional Water Quality Control Board;

   - Develop scientifically based narrative water quality standards for wetlands;

   - Utilize CWA Section 401 authority to certify Section 404 permits;

   - Implement a wetlands anti-degradation policy;

   - Regulate removal of vegetation, draining, and hydrologic modifications to prevent loss of wetlands; and

   - Protect and restore the managed and unmanaged fresh/brackish wetlands of Suisun Marsh and Suisun Bay by providing sufficient Delta outflow and utilizing appropriate management techniques.

B. The McAteer-Petris Act should be amended to:

   - Improve and strengthen the San Francisco Bay Conservation and Development Commission's mandate to protect wetland wildlife habitat values by: (a) making its wetland fill provisions consistent with those policies contained in WT-2.1.1; (b) clarifying that wetland wildlife habitat values are to be protected to the

maximum extent feasible; and (c) providing the authority to protect buffer areas along the shoreline.

- Establish a coordinated regulatory system that relies on the preparation of local government wetland protection programs as part of the local land use planning process, with San Francisco Bay Conservation and Development Commission oversight, to protect non-tidal wetlands surrounding the Bay, including diked historic baylands and tributary streams that are hydrologically part of the Bay. The Suisun Marsh Preservation Act may be used as a model.

- Make the San Francisco Bay Conservation and Development Commission's jurisdiction and policies regarding salt ponds and managed wetlands consistent with other state and federal laws and policies on wetlands and other waters, as recommended herein.

- Provide the San Francisco Bay Conservation and Development Commission with authority over shoreline areas in order to protect fully priority use areas, protect wetland buffer areas, and provide for seismic safety and flood protection (e.g., to minimize the effects from spills from shoreline activities).

C. Establish a program to protect Delta wetlands. The State Legislature should establish authority to implement a Delta component of the Plan that would protect the tidal and non-tidal wetlands of the Sacramento-San Joaquin Delta.

Establishment of a Delta regional authority or augmentation of an existing agency's authority should be employed to accomplish this component. (This component should be modeled after the Suisun Marsh Protection Plan and similar to the San Francisco Bay Conservation and Development Commission component of the Wetlands Management Program.) The Delta Protection Commission should be given permitting authority for any development proposed in the Delta's primary or secondary zones.

D. Develop and implement local government wetland protection programs to implement the policies of the Bay, Basin, and Delta plans. Financial and other resources should be provided to local governments that, as part of the local land use planning process and with the assistance of state and federal agencies, develop local wetlands protection plans and ordinances that implement and are consistent with the programs described above. Adequate resources should be allocated to allow thorough and timely processing of applications at the local and oversight level. Real estate point-of-sale disclosure should be required to ensure that wetland protection laws are disclosed to buyers at time of sale of property. Watershed management plans and actions to reduce pollutants in runoff should be main components of these programs. The establishment of local government wetland protection programs is consistent with related goals, objectives, and actions contained in the CCMP Land Use Management Program and the Pollution Prevention and Reduction Program.

When: Ongoing

Cost: $$$ (Agency staff costs)

ACTION WT-2.2 (Revised 2007)
Increase enforcement efforts to curtail illegal wetland alteration and to ensure compliance with permit conditions.

Who: U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, California Environmental Protection Agency, U.S. Congress and California Legislature, San Francisco Bay and Central Valley Regional Water Quality Control Boards, San Francisco Bay Conservation and Development Commission, U.S. Fish and Wildlife Service, National Marine Fisheries Service, federal and state justice departments, and local governments

What: Provide increased resources, including funding, staff, and statutory authority, to improve curtailment of illegal wetland alteration and to ensure compliance with permit conditions. These resources should also be devoted to:

- Increasing state and federal staff to reduce permit processing time, consistent with wetland protection objectives contained herein.

- Improving enforcement techniques of state and federal agencies (e.g., streamline enforcement processes for administrative cease-and-desist orders or enforcement penalties); enforcing cease-and-desist orders in a timely fashion; increasing prosecutions by federal and state justice departments; monitoring permitted projects to ensure compliance; and issuing fines sufficient to compensate for lost resources and to deter future violations within the Estuary.

- Requiring and enforcing appropriate wetlands restoration and corrective measures in those cases where unauthorized wetlands alteration has taken place. Mitigation and permit monitoring should be improved to ensure that such measures are successful. When permit violations that damage wetlands occur or mitigation goals are not met, agencies should exercise their authority to suspend, revoke, or otherwise revise permits and require corrective measures.

- Authority should be provided to allow all fines and penalties collected by public agencies in connection with illegal wetland activities in the Estuary to be used for acquisition and restoration of wetlands within the San Francisco Estuary area.

- The U.S. Army Corps of Engineers should make available to the public on a regular basis a listing of outstanding cease-and-desist orders, a listing of enforcement cases, and a report on the status of approved mitigation projects.

- Enforcement outreach programs should be conducted by agencies with enforcement authorities in order to educate the public and other resource agencies about wetland

enforcement programs. Information should be provided about how to report potential illegal activities to the appropriate authority.

- Providing adequate staff and funding for all of the above.

When: Ongoing

Cost: $$$ (Agency staff costs on an annual basis)

ACTION WT-2.3 (Revised 2007)
Develop and adopt uniform compensatory mitigation policies.

Who: California Resources Agency (lead agency), U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, California Environmental Protection Agency, California Department of Fish and Game, California Department of Water Resources, State Water Resources Control Board, Central Valley and San Francisco Bay Regional Water Quality Control Boards, San Francisco Bay Conservation and Development Commission, U.S. Fish and Wildlife Service, National Marine Fisheries Service, San Francisco Bay National Estuarine Research Reserve, and local governments

What: Projects should be designed to avoid adverse environmental impacts to the Estuary's plants, fish, other aquatic organisms, wildlife, subtidal areas, tidal marshes, and tidal flats. Whenever adverse impacts cannot be avoided, they should be minimized to the greatest extent practicable. Finally, measures to compensate for unavoidable adverse impacts to the Estuary's natural resources should be required. Mitigation is not a substitute for meeting all regulatory requirements.

When avoidance is not possible, planning and implementation of wetlands compensatory mitigation projects should be based on local watershed plans (see LU-2.6) to assure that wetland functions such as flood control, water quality improvement, and wildlife habitat are maintained or increased. If local watershed plans do not exist, mitigation should be in-kind and take place on site or as close as possible to the impact site. There may be some instances, such as with the San Francisco Bay Conservation and Development Commission, whose jurisdiction does not follow watershed boundaries, in which it may be infeasible to base mitigation decisions on a watershed plan.

Appropriate agencies should incorporate the following criteria concerning A) compensatory mitigation, and B) mitigation banking into their regulatory procedures.

A. Compensatory Mitigation

1. Mitigation should create or restore wetlands at the site of the wetland alteration; if onsite mitigation is not feasible, then mitigation should create or restore new wetlands as close as possible. If watershed plans that incorporate wetlands considerations have been developed, mitigation may occur at locations within the watershed selected to optimize wetland functions (based on established watershed plans).

2. Develop watershed plans on a region-by-region basis that address wetlands regulatory parameters (see LU-2.6 for the elements that should be included in a watershed plan and which are used to identify appropriate off-site, out-of-kind mitigation features).

3. Mitigation should be commensurate with adverse impacts of the wetland alteration and consist of providing similar functions and greater wetland acreage than those of the wetland area adversely affected.

4. Mitigation should include an area of adjacent upland habitat for wetland species that require such habitat, and some credit or recognition should be given for including it, but only after at least a 1:1 ratio of wetland mitigation is required for all projects.

5. If wetland mitigation is provided off-site, ratios should be higher than for on-site unless the mitigation complies with a local watershed plan, as described in LU-2.6.

6. Hydrologic storage and water quality improvement functions should be provided at the impacted site using grassy swales or other mechanisms, not at an off-site mitigation area.

7. Mitigation should, to the extent possible, be provided prior to or concurrently with those parts of the project causing the adverse impacts; mitigation should be carefully planned so as to ensure success, permanence, and long-term maintenance.

8. Mitigation sites should be permanently guaranteed as wetlands for open space and wildlife habitat purposes. The applicant should provide habitat maintenance and control of non-native invasive species (see Action AR-2.2).

9. All permitting agencies should develop minimum standardized requirements for compensatory mitigation plans and monitoring to ensure the success of mitigation projects. Requirements should be developed to address minimum reporting criteria, environmental assessments, and clearly defined goals and success criteria for the mitigation area, including a contingency plan in the event of partial or complete failure of the plan. (For appropriate site evaluation, planning and monitoring, see WT-4.3.)

10. All mitigation projects should be monitored for at least five years. The monitoring period should be extended for projects that do not meet performance criteria. Mitigation projects should include a contingency plan to ensure their success, or provide means to ensure that alternative appropriate measures are implemented if the identified mitigation cannot be modified to achieve success. Financial assurances, such as performance bonds or letters of credit, to cover the cost of mitigation actions based on the nature, extent, and duration of the impact and/or the risk of the mitigation plan not achieving the mitigation goals, may be necessary.

11. Mitigation sites should be tracked in geographic information systems (GIS), along with all known wetland and riparian sites, including restoration, creation, enhancement,

preservation, and existing natural wetland sites. To allow efficient monitoring and enforcement, permittees should be required to provide GIS site data.

12. Wetland mitigation projects should be assessed with standardized rapid methods, such as the California Rapid Assessment Method (CRAM) or the Wetland Ecological Assessment (WEA) method, that can be conducted along with wetland jurisdictional delineations when mitigation projects are completed to determine overall compliance and ecological success.

B. Mitigation Banking

1. Projects qualifying for use of mitigation banks should be limited to small fills in order to ensure the availability of adequate mitigation sites for the small project sponsor;

2. Mitigation banks should be developed within the context of local watershed plans (See LU-2.6);

3. Use of a mitigation bank should be authorized only after it is successfully functioning and providing in-kind habitat values; and

4. The mitigation bank should be used only if the fill project would otherwise meet criteria specified in the CWA Section 404(b)(1) Guidelines.

When: Ongoing

Cost: $$$ (Agency staff to develop policy and conduct project monitoring)

ACTION WT-2.4 (1993 CCMP)
Improve wetlands protection provided under the Clean Water Act.

Who: U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Congress, and California Legislature

What: During reauthorization of the Clean Water Act, the law should be amended to:

1. Include explicit reference to wetlands in the Clean Water Act goals section (" … Restore and maintain the chemical, physical, and biological integrity of the nation's waters, including wetlands …"); all appropriate provisions of the act should contribute to these goals.

2. Regulate wetland alteration activities, such as dredging, artificial flooding, and the placement of pile-supported and floating structures; the draining of wetlands and the destruction or removal of wetland vegetation should be regulated if such activities are not part of an ongoing farming operation; the draining of wetlands and the destruction or removal of wetland vegetation should be prohibited if the purpose is to achieve immediate or gradual conversion to a non-wetland type; and

3. Require the U.S. Army Corps of Engineers, in its decisions on permit applications, to follow the biological recommendations from the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, and the California Department of Fish and Game unless: (a) it makes a finding that these recommendations are inconsistent with U.S. Army Corps of Engineers' legal requirements; or (b) alternatives to the agencies' recommendations chosen by the U.S. Army Corps of Engineers are consistent with the wetland alteration policies described in Action WT-2.1.

- Eliminate use in the Estuary of Nationwide Permits (NWPs) for filling of wetlands less than ten acres (NWP 26) and bank stabilization (NWP 13); if not feasible to eliminate their use, NWP 26 should have its upper acreage limit reduced from ten acres to one acre, and NWP 13 should have its upper lineal limit significantly reduced from 500 feet. Application of both these Nationwide Permits in California is known to have significant cumulative adverse impact.

The U.S. Army Corps of Engineers should undertake a study of all other Nationwide and Regional Permits and recommend elimination of any that are resulting in or are likely to result in individual and/or cumulative adverse impacts to wetland resources. For example, certain other Nationwide Permits (including the newly issued amendments to the Nationwide Permit program) may have cumulative adverse effects on wetland resources. In particular, these include NWP 12 (backfill and bedding for utility lines), NWP 14 (minor road crossings), and NWP 15 (U.S. Coast Guard-approved bridges), in addition to NWP 26 and NWP 13.

If Nationwide Permits are continued, the State Water Resources Control Board should decline to certify or should revoke NWP 13 and 26 and any others that have been demonstrated to have significant adverse impacts, thereby requiring individual permits for any activity in California that would otherwise be covered by such Nationwide Permits.

- The San Francisco and Sacramento Districts of the U.S. Army Corps of Engineers should regulate vernal pools by individual permits rather than Nationwide Permits or General Permits and continue master planning efforts with local governments to protect wetland resources.

- Where it is currently not doing so, the U.S. Army Corps of Engineers should recognize that Section 404 jurisdiction occurs where Section 10 jurisdiction does, in order to better protect and restore wetlands (and other waters) in diked historic bayland areas.

- Guidance should be developed for writers and reviewers of National Environmental Policy Act (NEPA)/California Environmental Quality Act (CEQA) documents specific to Estuary wetlands.

- NEPA and CEQA documents should better assess potential impacts to wetland areas and, in particular, should ensure that cumulative impacts are evaluated and that documents be prepared for any projects in a diked historic baylands that would preclude wetlands restoration.

When: 1993

Cost: $280,000 estimated total ($280,000 federal)

Objective WT-3

Protect existing wetlands using current, new, and expanded programs of wetland acquisition, easement agreements, and cooperative management systems.

ACTION WT-3.1 (Revised 2007)
Expand wetlands acquisition programs, or establish a new Estuary-specific wetlands acquisition program.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, Wildlife Conservation Board, California State Lands Commission, California Coastal Conservancy, San Francisco Bay Joint Venture, and non-governmental organizations, such as Trust for Public Land and Nature Conservancy

What: Funding and level of effort would be increased for acquisition of priority wetland areas and associated habitat that are immediately threatened, provided that these areas are appropriate for restoration or are not otherwise protected.

- Increase federal funding for wetland acquisition by expanding allocations from the federal Land and Water Conservation Fund and through other federal funding mechanisms.

- Establish a program to purchase wetlands through land exchanges, and swaps. Authority and funding would be expanded for existing state programs for the acquisition of wetland areas, including the acquisition of non-wetland areas, for the purpose of conducting land exchanges to obtain title to wetland areas. State and federal lands would be inventoried to identify suitable and appropriate lands that could be used in land exchanges to secure wetland areas.

- Complete the expansion of the San Francisco Bay and San Pablo Bay National Wildlife Refuges and the Stone Lakes National Wildlife Refuge by acquiring (or gaining by other appropriate mechanisms) existing wetlands within the designated areas.

- Support the wetland benefits provided by salt pond operations. Should salt-making activities cease, salt ponds should be acquired and restored as wetland habitats.

- Assist landowners with establishing inheritance trusts for the protection of wetlands. Provide direct one-on-one assistance to individual landowners with the legal, financial, and tax aspects of establishing inheritance trusts for their wetland properties. Work through the Public Involvement and Education Program to disseminate information about this aspect of the program.

- Expand existing land acquisition programs to provide "Life Estate" acquisition services to wetland and associated lands, whereby landowners may continue to occupy or utilize the lands during their lifetime (within established agreements to maintain the wetland values).

- Encourage landowners to sell conservation easements.

When: 1993

Cost: $$$$$ (High cost based on land acquisition, restoration, and/or enhancement)

ACTION WT-3.2 (1993 CCMP)
Expand existing private, state, and federal financial and technical assistance programs to individual landowners.

Who: U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, California Secretary of Resources, California Department of Fish and Game, University of California Agriculture and Natural Resources Cooperative Extension; California State Lands Commission, California Wildlife Conservation Board, San Francisco Bay Conservation and Development Commission, and private landowners

What: Various incentives, including economic supports, subsidies, tax breaks, conservation easements, grants, project funding, regulatory permit conditions, and others, should be provided to landowners to implement measures or initiate practices to protect and enhance wetlands acreage and values. Emphasis needs to be placed on incentives to the agricultural community, particularly in the North Bay and Delta, where opportunities for large-scale benefits appear greatest.

- The U.S. Department of Agriculture should immediately provide funds for the Wetlands Reserve Program (WRP) authorized by the Food, Agriculture, Conservation, and Trade Act of 1990. The Wetlands Reserve Program retains private ownership but requires a recorded thirty-year or perpetual easement for restoration of wetlands on prior converted cropland and farmed wetlands and includes protection of adjoining wetlands.

- Establish a state task force of experts, landowners, and interested members of the public to develop an improved program to provide property tax, income tax, or other tax incentives that would encourage landowners to preserve wetlands in perpetuity.

- Information should be distributed to landowners concerning wetlands identification, values, and regulation. In addition, information should be provided by state and federal fish and wildlife agencies regarding management methods landowners could use to maintain or enhance the wetland resources they own.

- Special efforts would be made to encourage agricultural practices, particularly on farmed wetlands in the Delta, that enhance habitat and associated values.

- Improve management of wetlands owned and managed by government agencies through technical assistance. Provide direct technical assistance to each of the local, regional, state, and federal agencies that own wetland areas in order to protect the wetland values.

- Provide increased direct one-on-one assistance to individual landowners with the necessary legal, financial, and tax programs to establish voluntary landowner-initiated conservation easements for the perpetual protection of wetlands and associated lands. Such easements could include continued private ownership of the wetlands, whereby such lands would also remain on the local property tax base. Information about the increased level of service will be distributed to the greater public.

- The U.S. Congress should amend the Wetland Conservation (Swamp buster) provision of the Food Security Act of 1985 and the Food, Agriculture, Conservation, and Trade Act of 1990 to provide disincentives (loss of U.S. Department of Agriculture benefits) for wetland conversions for any agricultural crop instead of just commodity crops (any annually tilled planted crops; excluding perennial crops, orchards, and vineyards).

- Use the Public Involvement and Education Program as an organizing vehicle to bring citizens together in volunteer and other projects to provide services to local, regional, state, and federal agencies in the management of wetland areas. Projects could include restoration efforts, inventories, and construction of facilities, such as fencing or public access points. The Public Involvement Program will also be the vehicle through which information is disseminated about the services available to private landowners and investors to assist with the preservation and restoration of wetlands.

When: 1993

Cost: $62,720,000 estimated total ($61.2 million federal and $1,520,000 state)

ACTION WT-3.3 (Revised 2007)
Encourage wetland protection bylaws.

Who: U.S. Fish and Wildlife Service, National Marine Fisheries Service, California Department of Fish and Game, San Francisco Bay Conservation and Development Commission, San Francisco Bay National Estuarine Research Reserve, San Francisco

Bay Joint Venture, and University of California Agriculture and Natural Resources Cooperative Extension

What: A sample or model text of language would be prepared and made available to organizations, such as homeowners associations, hunting clubs, special districts (e.g., mosquito abatement), etc., through which such organizations could voluntarily modify their bylaws to incorporate improved management and protection of the wetlands under their jurisdiction.

When: Ongoing

Cost: $ (Agency staff costs on a one-time basis)

Objective WT-4

Expand the wetland resource base by restoring, enhancing, and creating wetland resources using a variety of approaches.

ACTION WT-4.1 (Revised 2007)

Identify potential and existing wetlands/riparian areas for habitat expansion and creation. Protect through acquisition, easement, or private land stewardship those non-wetland areas suitable for wetland creation.

Who: U.S. Fish and Wildlife Service, California Department of Fish and Game, California Legislature, California Coastal Conservancy, San Francisco Bay Joint Venture, San Francisco Bay National Estuarine Research Reserve, California Wildlife Conservation Board, landowners, land trusts and nonprofit organizations, open space districts, resource conservation districts, and other special districts

What:

- The California Legislature should appropriate funds to the California Wildlife Conservation Board and the California Coastal Conservancy to acquire and restore wetlands and riparian habitats that no longer function.

- Voter-approved funding through bonds and special assessments should be allocated by the California Coastal Conservancy and special districts to create wetlands at identified sites and to acquire and restore wetlands and riparian habitats that no longer function.

- Resource conservation districts and private landowners should take advantage of incentives to create new wetlands and restore wetland and riparian areas that no longer function.

- Historic wetland sites no longer functioning as wetlands should be purchased or in other ways protected and restored to maximize habitat and other associated values.

- Large-scale restoration of wetland habitats in the South Bay should proceed as rapidly as possible.

- Complete expansion and habitat restoration of Don Edwards, San Pablo Bay, and Stone Lakes National Wildlife Refuges.

When: Ongoing

Cost: $$$$$ (High cost based on land acquisition, restoration, and/or enhancement)

Performance Measures:
1) Amount of funding identified or appropriated by bonds or through legislation to increase acreage of restored or created wetlands. (Output)

2) Acres of wetlands and riparian habitats acquired, improved, enhanced, or restored on private land. (Outcome)

3) Acres of wetlands and riparian habitats acquired, improved, enhanced, or restored on public land. (Outcome)

ACTION WT-4.2 (New 2007)
Prevent the introduction and establishment of non-native invasive plant species in wetland restoration and mitigation projects.

Who: California Department of Fish and Game, San Francisco Bay Conservation and Development Commission, U.S. Fish and Wildlife Service, National Marine Fisheries Service, California Department of Food and Agriculture, State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, California Coastal Conservancy, San Francisco Bay National Estuarine Research Reserve, private nonprofit organizations, and public trusts

What: Non-native invasive plant species should not be used in habitat or wetland restoration and mitigation projects. All approved mitigation and restoration projects should include a program for periodic site monitoring for non-native invasive plant species and a program for control and, if appropriate and feasible, eradication should an introduction occur. The use of non-native invasive plant species in shoreline landscape improvements should be avoided where a potential exists for non-native plants to spread into the Bay, other waterways, or transition zones between tidal and upland habitats. Programs and outreach materials should be developed to educate stakeholders (individuals and groups involved in wetland monitoring, restoration, and mitigation) about the impacts of species introductions and what they can do to prevent them.

All actions regarding non-native invasive species monitoring, research, control, eradication, and education should be conducted in consultation with the California Aquatic Invasive Species Management Plan, the California Noxious and Invasive Weed

Action Plan, the California Invasive Plant Inventory, and the San Francisco Bay Regional Water Quality Control Board's list of Invasive Non-native Plants to Avoid in Mitigation and Restoration Sites. Upon completion of wetland mitigation projects, wetland assessments should determine permit compliance and overall wetland function, including the impact of non-native invasive species. (See also AR-2.1, 2.2, 2.3, and 2.4.)

When: Immediately

Cost: $$$ (Cost based on the number of species being addressed, extent of spread, and eradication methods. Cost for control at mitigation sites to be borne by permittees.)

Performance Measures:
1) Finalize list of non-native invasive species that should not be used in wetland/habitat restoration projects or shoreline landscape improvements. (Output)

2) Percentage of permits issued with conditions to control non-native invasive species. (Output)

3) Percentage of wetland mitigation and restoration project sites with a decrease in non-native invasive species as determined by wetland assessments for permit compliance and wetland function. (Outcome)

4) Acres of wetland projects where non-native invasive species are eradicated or controlled. (Outcome)

5) Number of non-native invasive species eradicated or controlled at project sites where biologically and financially feasible. (Outcome)

ACTION WT-4.3 (New 2007)
Identify, develop, and implement success criteria for wetland restoration and mitigation projects.

Who: State Water Resources Control Board, San Francisco Bay Conservation and Development Commission, San Francisco Bay Regional Water Quality Control Board, U.S. Army Corps of Engineers, California Department of Fish and Game, California Coastal Conservancy, U.S. Fish and Wildlife Service, National Marine Fisheries Service, San Francisco Estuary Institute, San Francisco Bay Joint Venture, San Francisco Bay National Estuarine Research Reserve, CALFED Science Program, universities, water districts, flood control districts, non-governmental organizations, and public trusts

What: Wetland restoration or mitigation projects should include clear and specific long-term and short-term biological and physical goals, success criteria, and a monitoring program to assess the progress of the project. Design and evaluation of the project should include, where appropriate, an analysis of: (a) the effects of sea level rise; (b) the impact of the project on the Bay's sediment budget; (c) localized sediment erosion and accretion; (d) the role of tidal flows; (e) potential non-native invasive species introduction, spread,

and their control; (f) rates of colonization by vegetation; (g) use of the site by fish, other aquatic organisms, and wildlife; (h) site characterization; and (i) mercury methylation in wetland sediments. If success criteria are not met for restoration and mitigation projects, appropriate corrective measures should be taken.

When: Immediately

Cost: $$ (Agency staff time)

Performance Measures:
Percentage of wetland restoration and or mitigation projects that meet one or more of the following:

1) Include short-term and long-term biological and physical goals as part of their permits. (Output)

2) Include success criteria as part of their permits. (Output)

3) Include a monitoring program as part of their permits. (Output)

4) Include design and evaluation elements as described in (a) thru (i) above as part of their permits. (Output)

5) Are assessed for permit compliance and ecological function with an approved wetland assessment method in addition to a jurisdictional delineation. (Output)

6) Have been corrected when appropriate. (Output)

7) Address and minimize the likelihood of creating a methylating environment. (Output)

Objective WT-5

Improve regional monitoring and tracking of wetland restoration and mitigation projects and encourage research on wetland issues.

ACTION WT-5.1 (New 2007)
Develop a comprehensive Wetlands Regional Monitoring Program for the Bay and the Delta.

Who: U.S. Environmental Protection Agency, National Marine Fisheries Service, U.S. Fish and Wildlife Service, California Coastal Conservancy, California Department of Fish and Game, San Francisco Bay Conservation and Development Commission, Regional Water Quality Control Boards, San Francisco Estuary Institute, Joint Ventures, and San Francisco Bay National Estuarine Research Reserve

What: To accurately and efficiently measure ecosystem health, develop a Wetlands Regional Monitoring Program (WRMP) that will establish wetland indicators and standardized methods for the collection of baseline data at both natural wetland reference sites and restored/created/enhanced sites, including mitigation sites. The Wetlands Regional Monitoring Program should be based on the San Francisco Estuary Institute's Regional Monitoring Program for Water Quality model. It should provide an inventory of all wetland and riparian habitats in San Francisco Bay and the Delta, a GIS database for locating and tracking all relevant information about wetland projects, and standardized methods for assessing wetland condition, such as the California Rapid Assessment Methodology (CRAM) or the Wetlands Ecological Assessment (WEA).

The Wetlands Regional Monitoring Program should build on existing efforts, such as the Environmental Monitoring and Assessment Program, Bay Area Integrated Regional Water Management Plan, the Joint Ventures' and San Francisco Estuary Institute's wetland trackers, San Francisco Estuary Institute's existing estuarine wetlands monitoring protocols, and other appropriate programs. The regional program should be consistent with the State Water Resources Control Board's Surface Water Ambient Monitoring Program and the U.S. Environmental Protection Agency's Application of Elements of a State Water Monitoring and Assessment Program for Wetlands.

When: Immediately

Cost: $$$ (Cost at lower end of $10 million range because some work is already completed)

Performance Measures:
1) Draft an interagency MOU that would implement a Regional Wetlands Monitoring Program. (Output)

2) Amount of funding available for Regional Wetlands Monitoring Program. (Output)

3) Develop final Regional Wetlands Monitoring Program. (Output)

ACTION WT-5.1.1: ***Implement wetland project tracking, data management, and coordination.***

Who: State Water Resources Control Board, San Francisco Bay Conservation and Development Commission, Regional Water Quality Control Boards, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, California Department of Fish and Game, U.S. Fish and Wildlife Service, National Marine Fisheries Service, San Francisco Estuary Institute, San Francisco Bay Joint Venture, CALFED Science Program, California Coastal Conservancy, and San Francisco Bay National Estuarine Research Reserve

What: As part of implementing the Regional Wetlands Monitoring Program, agencies responsible for regulating wetlands should collect and share data and establish a tracking

system for the Bay and Delta (or statewide), coordinating existing systems, with the following features:

1) The ability to incorporate all the individual agency permits in addition to the large regulatory documents (e.g., mitigation plans, monitoring reports).

2) A GIS capability.

3) The ability for permit information to be submitted electronically by the permit applicant.

4) Use of consistent habitat definitions for wetland and riparian losses and gains.

5) Use of consistent formats for tracking locations, performance criteria, monitoring elements, and final assessments of permit compliance and wetland condition.

6) Management by a state or non-governmental agency or organization with the capability to do so.

7) Accessibility to the public.

When: Immediately

Cost: $$ (Per agency with permit database)

Performance Measures:
1) Percentage of wetland management and related agencies/organizations sharing compatible data. (Output)

2) Establish monitoring network with features identified in WT-5.1.1. (Output)

3) Percentage of sites monitored and analyzed. (Output)

ACTION WT-5.2 (New 2007)
Study the effects of known stressors and emerging contaminants on the Estuary's wetlands, including non-native invasive species, sea level rise, global climate change, and chemical contamination from mercury and other pollutants (e.g., PCBs, DDT, chlordane, dieldrin, and dioxin).

Who: U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, National Marine Fisheries Service, U.S. Geological Survey, CALFED Science Program, California Department of Fish and Game, State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, San Francisco Bay Conservation and Development Commission, Bay Area Air Quality Management District, San Francisco Estuary Institute, California Coastal Conservancy, Bay Institute, San Francisco Bay National Estuarine Research Reserve, and universities

What: Identify, study, and recommend actions to address known and emerging stressors on tidal or seasonal wetland restoration and mitigation projects. There are a variety of impacts from global climate change that are anticipated to affect the coastal zones; for example, research will be needed to understand the effects of sea level rise, wetlands inundation, intensification of flooding and increased salinity, to name a few. Focused studies can help identify whether trends in other coastal areas will also affect the Bay-Delta wetlands system. (See also WL-4.7 and PO-2.3.)

When: Ongoing

Cost: $$$$ (Depends on scope and duration of studies)

Performance Measure:
Number of studies with recommendations for actions to minimize effects of stressors. (Output)

ACTION WT-5.3 (New 2007)
Encourage local academic institutions to study wetlands and to communicate their findings.

Who: University of California (Berkeley, Davis, Santa Cruz), California State University (East Bay, Sonoma State, San Francisco State, San Jose State, Sacramento State), private colleges (Stanford University, St. Mary's University, University of San Francisco), community colleges, and San Francisco Bay National Estuarine Research Reserve

What: There is a substantial need for additional research on San Francisco Bay-Delta wetland issues. Local academic institutions need to pursue research on wetland issues, which can aid in management decisions for Bay-Delta natural resources.

When: Immediately

Cost: $$ (Costs on a per-study basis; funded with grants)

Performance Measures:
1) Number of scientific studies undertaken by local academic institutions on Bay-Delta wetland issues. (Output)

2) Number of scientific conferences, seminars, or workshops organized on Bay-Delta wetland issues by local academic institutions. (Output)

3) Number of peer-reviewed journal articles or other publications. (Output)

Water Use

Goal:

- Develop and implement aggressive water management measures to increase freshwater availability to the Estuary.

Problem Statement

The rivers and streams of the Sacramento and San Joaquin watersheds carry approximately 40 percent of the state's available freshwater. The Sacramento-San Joaquin Delta serves as the vital link between most of the state's available water supply and most of its demand. More than 7,000 diversions for purposes such as irrigation and drinking water storage reduce the annual volume of freshwater entering San Francisco Bay by more than one-half in dry and critically dry years. The federal Central Valley Project and the State Water Project are the two largest diverters, together removing several million acre-feet per year. Approximately 80 percent of this diverted water is used by agriculture, and 20 percent goes to urban, industrial, and other uses. Construction of currently planned local water development projects and the completion of the State Water Project will likely increase annual diversions from the Estuary water supply by at least 1.1 million acre-feet.

Freshwater inflow is a major determinant of environmental conditions in the Estuary. The volume and timing of freshwater inflow affect the Estuary's circulation and water quality; conditions for wildlife; production and survival of phytoplankton, zooplankton, and all life stages; and survival of aquatic species, including salmon, striped bass, longfin smelt, California bay shrimp, and starry flounder.

As the new century starts, additional water development is pending within the Estuary and in other parts of California. With the state's human population expected to increase from 36.5 million to 48 million by 2030, it is safe to assume that future demands on the Estuary's freshwater will be considerable. As reflected in the 2005 California Water Plan Update, growing urban areas will demand further freshwater supplies, and agricultural uses are likely to hold steady or decline. The amount of additional demand will depend on a number of important factors, including the success of urban water use efficiency programs. California is continuing to struggle to balance competing demands from the urban and agricultural communities with the need to protect the health of the Estuary ecosystem.

While the challenges are great, there have been some successes in the Estuary since the Comprehensive Conservation and Management Plan (CCMP) was adopted in 1993:

- Water use efficiency, especially for urban users, has become much more robust, and a wider variety of urban water conservation programs are being actively implemented. As indicated in the 2005 Water Plan Update and the 2006 CALFED Water Use Efficiency Comprehensive Evaluation, there continues to be strong potential to use water even more efficiently.

- Several water-recycling projects have been constructed and are operating.

- Per capita urban water use around the Bay Area has decreased.

- Groundwater banking, brackish water desalination, and a variety of other innovative approaches are occurring.

- Regional water interests are cooperating throughout the Estuary to plan for the future.

There have also been statewide efforts that complement the regional approach. In 2000, state and federal agencies adopted the CALFED Record of Decision that launched the CALFED program to improve water management and restore the environment. Accomplishments to restore the environment can be found in many of the projects listed under other sections of the CCMP that have been funded through the CALFED Ecosystem Restoration Program. In addition, CALFED has implemented the Environmental Water Account (EWA), which is a program to purchase water for additional fishery needs in the Delta and its tributaries. The EWA has gone through annual reviews, and its effectiveness is now being comprehensively reviewed.

To improve water management, a wide variety of water use efficiency, water recycling, watershed management, groundwater management, and desalination projects have been funded throughout the Estuary that have helped reduce demand and improve water quality.

Existing Management Structure

California's Constitution governs all water use in the state. It provides that all water within the state is the property of the people of California. However, while water remains a public asset, individuals may acquire an exclusive right to its use. The State Water Resources Control Board oversees the allocation of these rights and the protection of water for the people of California. Private rights are conferred to those who exercise physical control over surface water or groundwater, with the condition that the water be put to a reasonable and beneficial use. The State Water Resources Control Board administers water rights by issuing water permits. It retains authority to modify these permits to prevent unreasonable use of water. However, unlike diversions of surface water, there is no state-administered permit system for groundwater extraction except in adjudicated basins (groundwater basins) in which diversions are governed by the courts and carried out by an implementing entity approved by the courts.

The California Department of Water Resources and the U.S. Bureau of Reclamation provide water through contracts to local water entities, including water agencies, water districts, irrigation districts, mutual water companies, and joint powers authorities. The Department operates the State Water Project to supply water users in urban and agricultural communities. The Department provides dam safety and flood control services, assists local water districts in water management activities, including water conservation, and plans for future statewide water needs.

The U.S. Bureau of Reclamation develops water supplies for many uses, but primarily for agriculture, and ensures delivery of water through operation of the federal Central Valley

Project. Furthermore, the Bureau holds water permits from the State Water Resources Control Board entitling it to store, divert, and deliver water to the Central Valley through the Central Valley Project. The State Water Project and the Central Valley Project, as appropriative rights holders, supply much of the state's agricultural irrigation water. However, appreciable amounts of irrigation water are supplied from groundwater pumping and local surface water.

The California Department of Water Resources' Office of Water Use Efficiency and Transfers has taken the lead to coordinate state, local, urban, and agricultural water conservation efforts. The State Legislature (AB 3616 Advisory Committee) and the Department of Water Resources are currently taking further steps to develop and implement agricultural water conservation practices. Water suppliers that contract with the U.S. Bureau of Reclamation (Central Valley Project) are required by the federal Reclamation Reform Act to prepare Water Conservation Plans and update those plans every five years.

Longstanding assistance in the wise use of soil, water, and related resources has been provided by the Natural Resources Conservation Service of the U.S. Department of Agriculture and the University of California Agriculture and Natural Resources Cooperative Extension. On a local and urban level, major credit for developing and implementing urban water conservation practices in California must be given to municipalities, water suppliers, and environmental organizations. They successfully created and implemented the document, "Memorandum of Understanding Regarding Urban Water Conservation in California." (MOU)

The urban water conservation MOU, conservation activities of the California Department of Water Resources and the U.S. Bureau of Reclamation, and other activities were incorporated into an overall water use efficiency framework as part of the CALFED Bay-Delta Program. While each program and entity retains its separate authorities and responsibilities, CALFED provides a focal point for additional funding for policy development and implementation. Water conservation has not remained stagnant. The California Urban Water Conservation Council has been an active and vibrant organization as it has worked to implement the MOU since it was signed in 1991. In 2005, a State Landscape Task Force was formed by legislation to develop additional proposals to gain additional water savings from urban landscapes. The Task Force's recommendations were sent to the Governor and Legislature at the end of 2005.

Regional Water Quality Control Boards address region-wide water quality concerns through the creation and triennial update of a Water Quality Control Plan (Basin Plan), which specifies beneficial uses of water, water quality objectives to protect uses, and schedules for achieving objectives.

The California Department of Health Services and local health and regulatory agencies are integrally involved in both development and operation of water reclamation projects. Implementation of reclamation projects requires the involvement, approval, and support of a number of agencies, including state and local health departments, Regional Water

Quality Control Boards, publicly owned treatment works (POTWs), water districts, and land use planning agencies.

The prospects for future reclamation projects are also dependent on effective coordination between reclamation agencies and land use planning agencies. For example, land use planning agencies can mandate the use of reclaimed water as a condition of development approval, and many reclamation ordinances in California require separate piping systems for drinking water and reclaimed water in new high-rise buildings and other new developments. Furthermore, due to public health considerations regarding reclaimed water use, the efforts of the State Water Resources Control Board, the California Department of Health Services, and county health departments must be also coordinated.

In short, no single agency or organization shapes or implements every aspect of water use management throughout the Estuary watershed. Instead, water use management is determined by networks of public and private water organizations and public interaction.

Recommended Approach

Aggressive water conservation measures should be developed and implemented statewide by users in agricultural, urban, and industrial communities. Urban communities have made great progress toward designing and implementing water conservation projects. One of the greatest achievements was the establishment of a memorandum of understanding addressing urban water conservation. Also, agricultural communities have employed conservation practices, most notably the concerted efforts of the farmers of the Imperial Irrigation District, Kern County Water Agency, and Westlands Water District. Some rural areas have installed state-of-the-art irrigation equipment and implemented bold water management practices. The California Department of Water Resources' Office of Water Conservation worked with the AB 3616 Advisory Committee to develop a list of "Efficient Water Management Practices" (EWMPs) and a strategy for implementing them. By providing funding to universities for research and pilot projects, government can foster further conservation of water used by agriculture.

A plan to increase water supplies and the efficiency of water use should include the utilization of reclaimed water to reduce:

1) The existing diversions of freshwater;

2) The demand for increased diversions; and

3) The existing discharge of wastewater directly into the Estuary.

Use of recycled water can be promoted by government on either a local or regional level. Many agencies throughout California, such as the Monterey County Water Resources Agency and the Monterey Water Pollution Control Agency, have implemented ordinances. The Monterey County Water Resources Agency and the Monterey Water

Pollution Control Agency are currently developing a project that will use reclaimed municipal wastewater for irrigating crops.

In areas throughout California that are free from groundwater contamination and have rights to surface water, arrangements can be made for the use of groundwater during years of below-normal runoff and for the use of surface water during wet years (i.e., conjunctive use). Surface water not diverted during dry years can remain in streams to be used for instream needs or other critical needs. In addition, groundwater basins with capacity to store additional water could be employed as water banks. Although the proposed Kern Water Bank did not get implemented as a State Water Project facility, it has turned out to be an important and active local water banking program. Similar programs have been developed, also within Kern County, by the Semitropic Water Storage District and Cawelo Water District. These two additional programs have been set up as partnerships with urban water agencies in other parts of the state, demonstrating that groundwater banking can work if the infrastructure and institutional relationships can be developed. In general, all three programs are able to accept water in wet years and wet months of all years, and extract water for use in dry months and dry years. Groundwater banking has provided an important degree of water supply reliability, particularly for water users who rely on water diversion from the Bay-Delta Estuary.

The legal and regulatory methods that could lead to the development of new water supplies and more efficient use of existing water supplies include pricing incentives, water-marketing arrangements, legal mechanisms for water transfers, water banking, and groundwater management.

Water Use Actions

Objective WU-1
Develop recycled water and the needed facilities to reuse water.

ACTION WU-1.1 (Revised 2007)
Water recycling feasibility studies should be completed by each publicly owned treatment works (POTW), municipality, and/or water district.

Who: Publicly owned treatment works, local governments, water districts, irrigation districts, State Water Resources Control Board, Regional Water Quality Control Boards, California Department of Health Services, California Department of Water Resources, and the U.S. Bureau of Reclamation

What: The studies should include:

1) The specific local uses of recycled water;

2) Present and potential quantity needs;

3) Timing of needs;

4) Water quality needs, including emerging contaminants;

5) Engineering feasibility of recycling systems;

6) Economic feasibility of recycling systems; and

7) Potential environmental effects.

When: Ongoing

Cost: $$$

ACTION WU-1.1.1 (New-2007)
Construct water recycling facilities and related distribution systems identified as feasible and environmentally sound.

Who: Publicly owned treatment works, local governments, water districts, irrigation districts, State Water Resources Control Board, Regional Water Quality Control Boards, California Department of Health Services, California Department of Water Resources, U.S. Bureau of Reclamation, water purveyors, and water suppliers

What: Construction and operation of water recycling facilities and related distribution systems.

When: 2020

Cost: $$$$$

Performance Measure:
Acre-feet of recycled water produced and used for beneficial uses

ACTION WU-1.2 (Revised 2007)
Municipalities and counties should adopt water recycling ordinances and code changes encouraging the use of recycled water for all state-approved uses while providing for the protection of public health and the environment.

Who: Municipalities, counties, publicly owned treatment works, water districts, and irrigation districts

What: Continue to work cooperatively to develop ordinances that encourage the use of recycled water where it is acceptable from an environmental and public health perspective.

When: Immediately

Cost: No direct cost

ACTION WU-1.3 (Revised 2007)
Local entities should develop and conduct public education programs to increase public acceptance of use of recycled water for appropriate water quality applications.

Who: Publicly owned treatment works, water districts, irrigation districts, municipal and county governments, California Department of Health Services, county health departments, city health departments, and the environmental community

What: Publicly owned treatment works, county governments, municipal governments, and other entities involved in the promotion, development, and implementation of water recycling projects should develop and conduct public education programs. Methods of public education should include public involvement in project development through citizen advisory committees, public workshops, public education programs, and the environmental review process (California Environmental Quality Act). Topics covered through public education should include:

1) Water reliability and sustainability benefits;

2) Protection of public health and safety of operation;

3) Siting of treatment facility, delivery system, and application;

4) Environmental benefits and impacts;

5) Quality of recycled water and specific use; and

6) Economic benefits.

Assistance in developing and conducting the public health component of public education and outreach programs should be sought from the California Department of Health Services and local health departments. Programs should be consistent with the State Recycled Water Task Force Recommendations.

When: Immediately

Cost: No direct cost

ACTION WU-1.4 (Revised 2007)
Ensure that state water quality standards and Basin Plans encourage water recycling and reuse while protecting the Estuary.

Who: State Water Resources Control Board and Regional Water Quality Control Boards

What: The State Water Resources Control Board and the Regional Water Quality Control Boards should continue to update state water quality standards and Basin Plans, as water recycling technology and practices evolve, to require specific standards for water bodies or streams dominated by recycled water.

When: Ongoing

Cost: $$

ACTION WU-1.5 (Revised 2007)
If practical, use existing facilities and develop new facilities in order to deliver recycled water for beneficial reuse.

Who: Bay Area publicly owned treatment works, Bay Area water agencies, Bay Area communities, State Water Resources Control Board, Central Valley Regional Water Quality Control Board, San Francisco Bay Regional Water Quality Control Board, U.S. Bureau of Reclamation, U.S. Army Corps of Engineers, California Department of Water Resources, California Environmental Protection Agency, and Central Valley irrigation districts

What: All Bay Area water and wastewater agencies should continue to work together to develop local water recycling programs. The two primary benefits of full usage of recycled water for the Estuary are: 1) a portion of the water that is freed up by water recycling could remain in the Delta system for the benefit of the environment; and 2) the publicly owned treatment works of the Bay Area will reduce discharge of wastewater into San Francisco Bay.

Feasibility studies should examine all the financial implications and the question of who benefits and who pays. The goal would be to spread the cost among as many beneficiaries as possible in order to make the cost of the recycled water affordable to users.

When: Ongoing

Cost: $$$

Objective WU-2

Develop water conservation methods and facilities to increase the availability of freshwater for instream uses and water supply.

ACTION WU-2.1 (Revised 2007)
Governmental, agricultural, public, and environmental interests should work together to develop a mechanism to ensure implementation of Efficient Agricultural Water Management Practices. They should also place increasing emphasis on achieving quantifiable objectives that produce ecosystem benefits, such as instream flow and timing.

Who: California Department of Food and Agriculture, California Department of Water Resources, CALFED Water Use Efficiency Program, University of California Agriculture and Natural Resources Cooperative Extension, State Water Conservation Coalition, California farmers, California Farm Water Coalition, U.S. Department of Agriculture, agricultural water suppliers, California Farm Bureau Federation, State Water Resources Control Board, U.S. Bureau of Reclamation, Natural Resources Conservation Service, and the environmental community

What: The Department of Water Resources' Office of Water Conservation, working with the AB 3616 Advisory Committee, has developed a list of Efficient Water Management Practices and a strategy for implementing it. More recently, the CALFED Water Use Efficiency program also has identified quantifiable objectives for agricultural water conservation by recognizing the ecosystem and water supply benefits that can be achieved through agricultural water conservation. Through 2005, sixty-three CALFED grants have been made to pursue targeted benefits research and education projects. Approximately $18.5 million in grant funding was awarded by the state; local agencies contributed another $9.5 million. Additional state, federal, and local funding for agricultural water use efficiency should be provided to continue to achieve quantifiable objectives and the related ecosystem benefits.

Where feasible, the AB 3616 Advisory Committee's and the California Department of Water Resources' list of Efficient Water Management Practices should also include:

1) Lands that cause the most severe environmental threats when irrigated should revert to dryland farming when feasible or should be permanently retired. Revegetation with native plants should be considered when land taken out of production is subject to wind or water erosion and growth of unwanted weeds.

2) Delivery of water by districts at time of need rather than a predetermined schedule.

3) Research the use of plant breeding for shorter-season crops and adopt planned water shortage techniques during targeted periods of plant growth.

4) Develop crops that consume less water.

5) Use of sprinklers and drip irrigation systems where applicable and feasible.

6) Implement more efficient irrigation scheduling practices and use of other scheduling tools, such as tensiometer and neutron probes, for measuring soil moisture, California Irrigation Management Information System (CIMIS), gypsum blocks, soil probes, and the pressure chambers of cotton.

7) Implement agricultural water metering.

8) Efficient use of surface irrigation systems.

9) Efficient Water Management Practices should also include upgrading existing surface irrigation methods by reducing field lengths and set times, converting to surge irrigation, improving field slopes, compacting furrows, and installing and properly managing tailwater recovery systems.

In addition to stating and defining the Efficient Water Management Practices, the AB 3616 and California Department of Water Resources list should include performance standards with explicit goals. An oversight council should be formed to enforce the performance standards and the implementation schedules for the Efficient Water Management Practices.

When: Immediately

Cost: $$$$

ACTION WU-2.2 (1993 CCMP)
New methods of agricultural water conservation should be researched through pilot projects and implemented where feasible.

Who: California Department of Food and Agriculture, University of California Agriculture and Natural Resources Cooperative Extension, California farmers, California Farm Bureau Federation, Natural Resources Conservation Service, California Department of Water Resources, California Farm Water Coalition, U.S. Environmental Protection Agency, California Environmental Protection Agency, State Water Resources Control Board, and U.S. Department of Agriculture

What: Pilot project studies should provide agriculture with new water conservation practices. They should also provide data on the cost effectiveness of currently available conservation practices. Funding for research is sometimes available through federal and state agencies in the form of research grants. Participating agencies include California Department of Water Resources, State Water Resources Control Board, U.S. Environmental Protection Agency, and California Environmental Protection Agency.

Dissemination of pilot project information will be achieved through public outreach to the agricultural, environmental, and urban communities.

When: Immediately

Cost: $12,640,000 estimated total ($12,640,000 federal)

ACTION WU-2.3 (Revised 2007)
Existing best management practices (BMPs) and additional water conservation measures developed through feasibility studies should be implemented by municipalities and/or water districts.

Who: The California Urban Water Conservation Council, municipalities, and water districts

What: Water conservation methods considered in the feasibility studies should include the best management practices (BMPs) as defined and set forth in the Memorandum of Understanding Regarding Urban Water Conservation in California. Methods should also include new recommendations being developed.

Some have questioned the long-term effectiveness of the voluntary best management practices implementation process. CALFED program staff drafted a framework for certifying best management practices implementation in 2002, which was not approved by its advisory committee. Some stakeholders have suggested legislation is needed to accelerate best management practices implementation, but no entities are known to be pursuing legislative fixes.

When: Immediately

Cost: Unknown

ACTION WU-2.4 (Revised 2007)
Maximize conjunctive use of water through groundwater recharge.

Who: State Water Resources Control Board, California Department of Water Resources, California State Lands Commission, water agencies, U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, and private landowners

What: In areas in California that have usable groundwater and have water rights to surface water, arrangements should be made for the use of groundwater during years of below-normal runoff and for the use of surface water during wet years, i.e., conjunctive use. The surface water not diverted during dry years should remain in streams to be used for instream needs or other critical needs.

In addition, groundwater basins with capacity to store additional water should be employed as “water banks.” Any flows in excess of those needed to meet aquatic resource needs in the Delta and streams of origin could be diverted for storage in aquifers

for use during dry periods. Existing successful water banking programs should be evaluated to see if they can be duplicated elsewhere and/or expanded.

When: Immediately

Cost: Unknown

ACTION WU-2.5 (Revised 2007)
Study storage of surface water at locations identified in the Record of Decision (ROD) for the CALFED Bay-Delta Program.

Who: California Department of Fish and Game, U.S. Fish and Wildlife Service, California State Lands Commission, State Water Resources Control Board, U.S. Bureau of Reclamation, California Department of Water Resources, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, California Environmental Protection Agency, municipal water districts, farmers, landowners, and the environmental community

What: Agencies should continue to work to determine costs, benefits, and impacts of additional surface water storage identified in the CALFED Record of Decision. Studies should discuss the significant impacts on fish and wildlife resources and supplies available for instream flows and drinking water.

When: Immediately

Cost: $$$$$

ACTION WU-2.6 (Revised 2007)
Encourage continued development of local groundwater management plans to protect the long-term integrity of groundwater basins.

Who: Water agencies, Regional Water Quality Control Boards, California Department of Water Resources, State Water Resources Control Board, U.S. Bureau of Reclamation, U.S. Environmental Protection Agency, U.S. Geological Survey, landowners, and groundwater users

What: Use changes in law that allow for development of groundwater management plans to prepare local plans to protect basins.

When: Immediately

Cost: Unknown

Objective WU-3

Improve the legal and regulatory mechanisms to facilitate the voluntary transfer of water in order to increase the availability of freshwater for instream uses and water supply.

ACTION WU-3.1 (Revised 2007)

Continue to fully utilize water transfers among agricultural, urban, and environmental interests.

Who: State Legislature, the Governor, State Water Resources Control Board, California Department of Water Resources, U.S. Bureau of Reclamation, California Department of Fish and Game, U.S. Fish and Wildlife Service, farmers, water utilities, and the environmental community

What: Voluntary water transfers, such as the State drought water bank in the early 1990s and more recent transfers, have shown success at meeting water supply needs without development of new infrastructure. Transfers should continue to be developed as part of integrated regional water management in a way that is environmentally acceptable.

When: Immediately

Cost: $$$

Objective WU-4 (New-2007)

Promote integrated regional water management and development of diversified portfolios of water management strategies to ensure better water quality, foster environmental restoration and stewardship, efficient urban development, protection of agriculture, sustainable water uses, reliable water supplies, and a strong economy.

ACTION WU-4.1 (New 2007)

Prepare and implement a Bay Area integrated regional water management plan that links flood control, wastewater, water supply, environmental stewardship, habitat restoration, and watershed management needs of the Bay Area and promotes solutions that integrate these various needs. Where appropriate, there should also be smaller, more focused integrated regional water management plans prepared and implemented.

Who: Water, wastewater, and flood control agencies; Association of Bay Area Governments, cities and counties, state and federal agencies, and partners in watershed management. This should reflect IRWMPs within and adjacent to the region.

What: Work collaboratively to develop an integrated regional water management plan for the nine Bay Area counties that addresses water management problems and solutions.

When: The Bay Area Integrated Regional Water Management Plan has been prepared and will need to be updated as needed.

Cost: $$ (For planning, with funding coming from the partners and from the California Department of Water Resources. Implementation costs will vary depending on the selected solutions.)

Performance Measure:
Prepare an annual status report tracking the number and types of priority projects that are underway.

ACTION WU-4.2 (New 2007)
Explore desalination of various water sources, including effluent, brackish groundwater, and Bay and ocean water, to improve water supplies in a manner that is environmentally sustainable.

Who: Water supply agencies, Regional Water Quality Control Boards, California Department of Water Resources, San Francisco Bay Conservation and Development Commission, National Oceanic and Atmospheric Administration, U.S. Army Corps of Engineers, California Department of Fish and Game, U.S. Fish and Wildlife Service, and the environmental community

What: Study the feasibility of desalination of brackish Bay and ocean water to determine if it has become cost-effective relative to other water supply sources, such as recycling, and if it can be developed in an environmentally acceptable manner, including addressing entrainment impacts and impacts of brine disposal. As part of the feasibility work, develop pilot projects.

When: Regional desalination studies and pilot projects are underway. A brackish groundwater project is already operational.

Cost: $$$$

Performance Measure:
Number of acre-feet of desalinated water that increases the overall water supply

Pollution Prevention and Reduction

Goals:
The four goals identified in the CCMP adopted in 1993 remain applicable and important. A fifth goal has been added, which is explained briefly below.

- Promote mechanisms to prevent pollution at its source.
- Where pollution prevention is not possible, control and reduce pollutants entering the Estuary.
- Clean up toxic pollution throughout the Estuary.
- Protect against toxic effects, including bioaccumulation and toxic sediment accumulation.
- Promote restoration and enhancement of stream and wetland functions to enhance resiliency and reduce pollution in the Estuary and its watersheds.

Resource managers have come to appreciate that healthy streams and wetlands perform functions related to pollutant removal. This is not to suggest that natural systems should be viewed exclusively or even primarily as waste treatment systems. Rather, they can perform this function as part of their very existence. Therefore, restoration of stream and wetland functions can serve not only to enhance the beauty of the natural landscape and provide valuable habitat, but can also help cleanse estuarine waters and prevent pollution while protecting the beneficial uses of streams and wetlands. For example, long, straight, open channels often exhibit nuisance algae growth that pollutes the water. By restoring hydrologic and riparian functions to such areas, we not only reduce the pollution itself, but also increase the resiliency of the system's ability to reduce the adverse effects on biota and aesthetics.

Problem Statement
The discussion of pollutant sources in the 1993 CCMP is still largely applicable in 2007. The list of pollutants is relatively complete. Mercury has continued to be a focus of effort and attention, and there is evidence that it impairs the reproductive success of various species of birds and other wildlife that consume fish from the Estuary. Planned and much-needed, large-scale restoration of wetlands raises the concern that these restored wetlands may promote mercury methylation and subsequent incorporation into Estuary food webs. This is also an issue in riparian wetland restorations in some regions. Both mercury and polychlorinated biphenyls (PCBs) continue to be measured in high enough concentrations to limit consumption of fish by humans. Trash is gaining attention as a continuing problem both as an aesthetic nuisance and as a serious threat to aquatic life in tributaries and marine life in estuaries and oceans. For example, plastic from trash persists for hundreds of years or longer in the environment; is a threat to wildlife through ingestion, entrapment and entanglement; and can leach potentially harmful constituents, such as phthalates, bisphenol A, styrene, vinyl chloride, and flame retardants, to the environment. Pesticides continue to be measured at concentrations high enough to impair beneficial uses in the Estuary. One recent success, the phase out of diazinon for urban

uses, has led to the increased use of replacement pesticides, which can also threaten aquatic life.

Adding to the list of pollutants are the so-called “emerging pollutants.” These are pollutants of concern about which we do not have enough historical monitoring information to assess trends and which are not captured within existing water quality regulatory frameworks, but that are found at relatively high concentrations in sediment and biota. Emerging pollutants include polybrominated diphenyl ethers (PBDEs) used as flame retardants in many consumer products and perfluorinated chemicals used as nonstick or stain-resistant coatings (trade names like Teflon, Scotchgard, Zonyl, etc.). The broad class of pollutants known as endocrine disrupting compounds is included as an emerging pollutant and will be a focus of concern in the coming decade. An additional regulatory challenge associated with these emerging pollutants is that, as of 2007, there are almost no water quality criteria to assess impairment. One exception to this is the case of nonylphenol, for which the U.S. Environmental Protection Agency has developed an aquatic life criterion.

The discussion of trends in the 1993 CCMP remains relevant. Since 1982, there has been a continuing decline in Bay bivalve PCB concentrations, but there are no recent declines in PCB concentrations in sportfish. Regional Monitoring Program for Water Quality data show an apparent decrease in total mercury concentrations in sediment, but there have not been measurable declines in mercury concentrations in birds or sportfish since the Regional Monitoring Program started measuring these concentrations.

Existing Management Structure

The description of the existing management structure in the 1993 edition of the CCMP remains valid and is relatively complete. The California Department of Pesticide Regulation has been partnering with the State Water Resources Control Board and the Regional Water Quality Control Boards to address water quality concerns associated with a wide variety of pesticides—especially through the registration and reevaluation processes. The California Air Resources Board and local air quality management districts have a future role to play as the connections between atmospheric deposition and water quality impairments are further demonstrated.

Recommended Approach

In 1993, the recommended approach was a three-tiered action program for addressing pollution that emphasized pollution prevention, control of pollutants that could not be avoided, and recommended remediation of existing pollution. To this program we add a fourth tier of actions to support the objective of improving water quality through restoration and enhancement of tidal and floodplain wetland functions.

More attention needs to be paid to consumer products as a water quality threat. There are some potentially harmful new pollutants whose presence in consumer products is so ubiquitous that their control by traditional pollution prevention efforts is problematic. Furthermore, once these pollutants enter the environment, it is extremely difficult, if not impossible, to remove them through conventional treatment, so they may remain in

reclaimed water. Even if treatment is successful and the pollutants are removed from wastewater and transferred to biosolids, the pollutants can be reintroduced into the environment if these biosolids are not properly managed. Therefore, emphasis needs to be placed on developing new ways to control these pollutants.

Tables 1–3 below summarize the current state of knowledge about sources and control strategies for most pollutants of concern in the Estuary. These tables present, by pollutant, the issue of concern, characteristics relevant to treatment or transport to the Estuary, and the control strategies appropriate for the pollutant. The pollutants shown in Table 1 are well-characterized in terms of sources, and there are effective control strategies available that are often already in place. The pollutants in Table 2 are those for which sources are known, but for which effective control strategies are not yet available due to insufficient information on how best to accomplish the desired results. Note that some pollutants (e.g., FOG, or fats, oils, and grease) appear in both Table 1 and Table 2 if there is a different degree of certainty regarding control strategies for different pollutant sources. Finally Table 3 contains pollutants for which there is a lack of both sufficient information on sources and effective control strategies. As a measure of progress over the next decade, many or most of the pollutants in Table 2 should be moved into Table 1, and those in Table 3 should be moved to Table 2 or Table 1.

Pollutant of Concern Categorization Tables – State of Knowledge on Sources, Fate, and Control Strategies

Table 1: Pollutants for which effective controls are available

Pollutant	Issue of Concern/Impact	Origin/Sources	Fate	Control Strategies
Copper	Aquatic toxicity	-Brake pads -Pesticides • Copper sulfate root control, banned in Bay Area • Pool, spa, or fountain discharges -Industrial/commercial • Numerous industrial uses—electroplating, printing, various chemical solutions -Architectural materials -Residential (pesticides) -Water supply/piping -Marine antifouling paints	Adsorbs to solids but substantial fraction remains dissolved in water	-Product substitutions (brake pad materials; copper sulfate root control; less toxic pesticides) -BMPs for installation and maintenance of architectural copper -Effective pretreatment for industrial uses -BMPs for commercial uses (e.g., vehicle service, printers) -Product bans (copper sulfate root control) -BMPs for plumbers -Alternative hull coatings -Marina/boatyard BMPs
FOG (Fats, Oils, and Grease)	Raw sewage overflows to streets, creeks, and the Estuary, as well as direct stormwater discharge to the Estuary	-Commercial—food service establishments -Automobiles via streets and parking facilities	Collection system blockages	-Grease interceptors -Public outreach -Take-back programs -Structural controls
Mercury	Methylation, persistent bioaccumulative toxin	-Industrial/commercial • Dental amalgam • Laboratories:	-Adsorption to biosolids, small amount of pass-through to receiving	-Discharge permits -Dental amalgam separators -Detention and disposal of high-

Pollutant	Issue of Concern/Impact	Origin/Sources	Fate	Control Strategies
		thermometers, liquid Hg, chemical solutions • Hospitals -Residential • Thermometers • Fluorescent bulbs • Novelty items (now banned) • Thermostats and switches (in buildings and vehicles)	waters -Mercury not passing through treatment plant usually binds to solids and is transported with sediment.	mercury sediments -Waste fluorescent bulb management -BMPs -Product substitution -Product bans (novelty items)
Cyanide	Aquatic toxicity	Industrial—metal finishing, pharmaceutical manufacturing	Can be produced in a wastewater plant. Degrades rapidly in receiving water	Effective pretreatment for industrial uses
Selenium	Bioaccumulative toxin	Sedimentary deposits in Central Valley. Can be present in crude oil taken from high-selenium deposits and possibly refined products that are combusted.	Complex fate depending on redox form. Substantial fraction remains dissolved.	Reduce agricultural drainage from source areas in Central Valley
Trash	Trash is a public nuisance pollutant because it impacts habitat, is ingested by fish and birds, and conveys pollutants adsorbed to trash that can pose a threat to fish, birds, and wildlife in creeks,	-Urban runoff and illegal dumping -Direct deposition to shoreline and piers -Boats/ships	Depending on the physical and chemical nature of the item, the trash may become lodged in vegetation, settle into sediments, be deposited on banks. However, long-	-Public education -Product substitution -Street sweeping -End-of-pipe full capture devices -Physical removal from creeks,

Pollutant	Issue of Concern/Impact	Origin/Sources	Fate	Control Strategies
	wetlands, and the Estuary; and is a contaminant because of the presence of hazardous materials, including broken glass, hypodermic needles, diapers, etc.		term fate is transport downstream and reduction in size, but threats to wildlife may increase as this occurs (ingestion by fish, birds, and wildlife).	wetlands, and the Estuary

Table 2: Pollutants for which sources are identified, but not sufficient information to do effective pollution prevention

Pollutant	Issue of Concern/Impact	Origin/Sources	Fate	Control Strategies
Pesticides (Current) **(e.g., pyrethroids, organophosphate pesticides, agricultural use of diazinon, and chlorpyrifos)**	Aquatic toxicity	-Commercial—pest control operators -Residential—garden/landscape use -Agricultural uses	Urban creeks, the Estuary, biosolids, aerial drift, and subsequent runoff into surface waters	-Product substitutions -Outreach for proper use/disposal -Implement least-toxic pest control methods and use Integrated Pest Management -Change use directions to minimize amount reaching surface waters
PCBs (polychlorinated biphenyls)	Dioxin-like toxicity, bioaccumulation	Legacy—industrial	Resistant to degradation; adsorbs to organic solids	Contaminated site cleanup
Mercury	Methylation, persistent bioaccumulative toxin	-Air (combustion) -Mining legacy in watersheds and receiving waters	Adsorption to biosolids; small amount of pass-through to receiving waters	-Fireplace ordinances -Mine cleanup -Permit requirements at refineries
FOG (Fats, Oils, and Grease)	Raw sewage overflows to streets, creeks and the Estuary, as well as direct stormwater discharge to Estuary	-Residential—domestic grease use/discharge -Automobiles via streets and parking facilities	Collection system blockages	-Residential outreach -Public outreach -Take-back programs -Structural controls
Pesticides (Legacy) **(organochlorine [e.g., DDT] and organophosphate**	Aquatic toxicity	Legacy—agricultural and urban	Surface waters; possible groundwater contamination from landfill leaching	

Pollutant	Issue of Concern/Impact	Origin/Sources	Fate	Control Strategies
[e.g., diazinon])				
Phthalates	Possibly damaging to liver, lungs, kidneys, and reproductive systems from large doses; endocrine disruption	Soft flexible plastics, nail polish, solvents, perfumes, adhesives, caulks, pigments	Generally non-persistent to moderately persistent in the environment. Will generally adsorb to soil and sediments and should not leach appreciably to groundwater. Will undergo biodegradation, but not evaporation.	-Product substitutions
Alkylphenol Ethoxylates (APEs) and Nonylphenol Ethoxylates (NPEs)	Endocrine disruption, estrogenic	Residential and commercial detergents, plastics, paints, textiles, paper and pulp manufacturing, all-purpose cleaners, floor care products, sanitizers, contraceptives, hair products, and degreasers	Pass-through to receiving waters; adsorption to biosolids	-Reformulations -Product substitution
Antimicrobial Products/ Triclosan	Materials not primarily broken down in treatment processes, endocrine disruption, bioaccumulation	Commercial and residential cleaning products, soaps, toothpaste, cutting boards, pesticides, plastics, and hair products	Most antimicrobials go into biosolids. Some pass-through into receiving waters. Methyl triclosan may be produced in the treatment process and is known to be extremely persistent.	-Consumer education -Substitutions for entire group of products -Statewide interagency collaboration

Table 3: Pollutants for which insufficient information exists regarding sources (most are emerging pollutants)

Pollutant/Issue of Concern	Issue of Concern/Impact	Origin/Sources	Fate	Control Strategies
Perfluorinated Compounds (PFAs, PFOs)	Toxicity and developmental impacts	-Residential (Teflon) -Fabric protector (Scotchgard)	Extremely resistant to degradation	Product ban/reformulation
Pharmaceuticals and Personal Care Products (PPCPs)	Endocrine disruption, antibiotic resistance, toxicity, etc.	-Hospitals and other medical facilities—sewer disposal and excretion -Residential—sewer disposal and excretion	Pass through into receiving waters; adsorption to biosolids	-BMPs and permit requirements for hospitals and medical facilities -Medicine collection events for residents -Outreach and disposal alternatives
PBDEs (Polybrominated Diphenyl Ethers)	Persistent bioaccumulative toxins	Commercial and/or residential carpets, cushions, carpeting, bedding		Product bans/reformulation
PAHs (Polyaromatic Hydrocarbons)	Cancer, and damage to eyes, kidneys, liver	Combustion byproduct, paving sealants, fuel spills, boat motors, creosote pilings	Low molecular weight PAHS degrade, high weight build up in sediments	-Support BCDC restriction on creosote pilings in Estuary -Reduce use of high-PAH paving sealants
Dioxin/ Dibenzofurans	Persistent bioaccumulative toxins			

Achievements, 1993–2007

One of the ongoing achievements from the past decade has been the maturation and growth of the Regional Monitoring Program for Water Quality (RMP). It has evolved from a program to track status and trends of pollutants in the Estuary to one that is increasing scientific understanding of the Estuary and its watershed to aid decision-makers in resource management.

Another achievement is that the RMP and the State Mussel Watch have demonstrated that concentrations of PCBs in bivalves have been declining since 1982. There is a shorter period of record of PCBs in fish tissue concentrations, so trends there are not yet apparent.

Since 1993, the total maximum daily load (TMDL) program has begun. The phase-out of most urban uses of diazinon can be partly attributed to the attention this pesticide received as a source of water quality impairment and TMDL development. TMDLs have also been adopted for salt, selenium, pesticides, oxygen, and mercury.

Other notable regulatory achievements for the Estuary include the development of the Long Term Management Strategy (LTMS) that should result in less dredged material (and associated pollutants) disposed in the Estuary. The development and implementation of the Phase I and Phase II stormwater permits and management programs is another significant achievement. While formidable challenges remain in terms of proper stormwater management, every city, town, and county in the Bay Area has a stormwater quality management program, and thousands of businesses and construction sites have permits that require proper management of stormwater runoff.

Another development that will affect all of California is the Universal Hazardous Waste Rule that is now part of the California Code of Regulations. This rule prohibits common hazardous materials like batteries, fluorescent tubes, thermostats, mercury thermometers, rubber flooring, cathode ray tubes, and similar products from being discarded in the trash.

In the Central Valley, there has been progress in the area of regulation of agricultural sources of pollution. Discharges from agricultural lands include irrigation return flow, flows from tile drains, and stormwater runoff. These discharges can affect water quality by transporting pollutants, including pesticides, sediment, nutrients, salts (including selenium and boron), pathogens, and heavy metals, from cultivated fields into surface waters. Many surface water and groundwater bodies are impaired because of pollutants from agricultural sources.

Success has also come from individual strategic projects that targeted specific sources of certain pollutants. The Brake Pad Partnership is a joint effort of regulators, urban runoff management agencies, environmental groups, and brake pad manufacturers funded through Proposition 13 to develop scientific information assessing the role of brake pads as a source of copper to the Bay.

Local municipal wastewater treatment plants have encouraged dental offices to install amalgam separators to control the chief source of mercury in wastewater. One local environmental organization and a local utility district formed an effective partnership to work together on a take-back program for mercury-containing thermometers to replace them with ones that do not contain mercury. Another success is the Our Water, Our World program—a

partnership between local water quality agencies (wastewater and stormwater) and local hardware and nursery stores to educate consumers about pesticides and water quality and promote less toxic pest prevention. The program has grown from a pilot in a few stores to hundreds of stores across the state, garnered numerous awards, changed pesticide purchasing behaviors, and reduced the potential for water pollution. This is a model that can and should be extended to the entire watershed of the Estuary.

Challenges, 2007–2017

Many of our most difficult water quality problems in the Estuary come from the impacts of legacy pollutant sources (like mercury and PCBs). There are large amounts of these legacy pollutants already in the Bay with relatively small ongoing loads entering the Bay every year. However, because it is not practical to remove large quantities of sediment from the Bay and the processes for burial or export of those pollutants from the Bay are slow, the impacts of these legacy pollutants are going to be with us for decades.

Another challenge for the future will come from emerging pollutants. These are compounds like perfluorinated compounds (used in stain-resistant and nonstick coatings), PBDEs (flame retardants in consumer products), phthalates (used as plasticizers), triclosan (in antibacterial soaps), and a variety of other endocrine disrupting compounds, along with pharmaceuticals and personal care products. Many of these emerging pollutants are associated with common consumer products that are not viewed as toxic and are often associated with the convenience of modern life. However, these pollutants are becoming known for their ubiquity and resistance to degradation while tending to bioaccumulate. One possible strategy is to encourage manufacturers to take greater responsibility for assessing the total environmental fate and effects of all products and packaging they produce and take responsibility for the fate and effects throughout the life cycle of the product and packaging. In fact, there is movement in this direction in some European countries.

The current process in place for identifying and conducting cleanups of contaminated sites both in the Estuary and on surrounding lands is incomplete, insufficiently funded, and beset with difficulties, including the way in which the public participates in the process. There are many sites that have been identified as needing remediation, but agency resources to begin oversight of cleanup are lacking. There are likewise insufficient resources to do an exhaustive accounting of other sites on land or in the Estuary that may be contaminated but that have not been discovered. Disputes over jurisdiction and authority have made cleanup efforts for current or former military facilities unnecessarily slow and difficult.

A growing body of information suggests that a primary conveyance of pollution to the Estuary is urban runoff. Part of this pollution appears to be coming from atmospheric deposition, so it will be necessary to integrate the work of air and water regulatory agencies to address this component. However, there are other contributions to urban runoff that can be effectively addressed by urban runoff management agencies.

Currently, the financial resources available for effective urban runoff are inadequate. To make more comprehensive progress in addressing all pollutants for which urban runoff is a major conveyance, it will be necessary to increase the financial resources devoted to urban runoff management. To increase financial resources, the appropriate agencies should consider mandating responsible reduction and prevention requirements, and the public should

be convinced of the benefits and cost-effectiveness of the proposed investment. Achieving this support will involve clear communication of the problems, the legal and regulatory requirements for improvement, the possible solutions, the costs, what the benefits will be, and the cost for not solving the problem. A potential model exists in Southern California, where public acceptance of bond funding to improve infrastructure was obtained by educating the public about beach closures and their impact on the local economy and the general quality of life for residents.

The Delta and upstream areas are experiencing many of the same challenges as the Bay, along with some unique challenges. For example, controlling agricultural discharges is a major challenge in the Delta and upstream areas.

Looking to the future, decision-makers must adaptively manage solutions to water quality problems in the Estuary. All strategies to address water quality problems have uncertainties in terms of technical approach, effectiveness, cost, and practicability that must be resolved.

As scientists and managers continue to learn more about the Estuary and develop more sophisticated tools to model and understand how the various parts of the system work, it is crucial that this enhanced understanding be integrated into decision-making. This is a formidable challenge because of the rapid pace of scientific discovery compared with the relatively slower pace and complicated process of policy-making or regulatory action. There has been greater cooperation and communication between scientists and policy makers during the past decade.

Finally, global climate change may present profound challenges that are difficult to predict. Global climate change may impact strategies to control pollutants to the Estuary, and it could have a dramatic impact on local and statewide rainfall patterns and the timing and magnitude of water delivery to the system. These factors, in turn, need to be taken into account in the design of treatment systems, the management of stormwater runoff, and other measures to control pollution.

Pollution Prevention and Reduction Actions

A. Pollution Prevention

Objective PO-1

Reduce pollutants entering into the Estuary by establishing a pollution prevention program.

ACTION PO-1.1 (1993 CCMP)

Establish specific goals for reducing the discharge of toxic pollution over time and discourage reliance on toxic materials. All dischargers should implement measures to reduce pollutants at their source.

Who: California Legislature, U.S. Congress, California Environmental Protection Agency, California Department of Food and Agriculture, California Department of Fish and Game, State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, California Department of Pesticide Regulation, Natural Resources Conservation Service, and the private sector

What: Building upon the pollution prevention audits required under the 1991 Senate Bill 14, which focuses on hazardous waste and right-to-know reports, pollution prevention should be a primary element in all watershed management plans and regulatory actions. All dischargers should participate in a pollution prevention program, and publicly owned treatment works should require industrial, commercial, and residential sources connected to their systems to implement pollution prevention measures. Pollution prevention measures should be incorporated into all levels of government planning and enforcement programs. An active public outreach program is also fundamental to a successful pollution prevention program.

A comprehensive pollution prevention program should include the following strategies, where practicable:

1) Redesign or reformulation of products;

2) Substitution of raw materials or alternative chemicals that introduce smaller quantities of hazardous substances into agricultural and industrial production processes;

3) Improved process technology and equipment to alter the primary source of waste generation;

4) Improved plant operations (housekeeping); and

5) Recycling of polluted substances at the site of their generation (closed loop recycling).

Pollution prevention programs should include a comprehensive toxic reduction program, with defined goals for reducing the loading of toxic pollutants over time, identification of areas where pollution prevention techniques should be implemented, and monitoring and reporting of success in meeting these goals.

When: Ongoing

Cost: $2,700,000 estimated total ($300,000 federal and $2.4 million state)

ACTION PO-1.2 (Revised 2007)
Recommend institutional and financial changes needed to place more focus on pollution prevention.

Who: California Legislature, regulatory agencies, and local agencies

What: Economic incentives should be created to discourage reliance on toxic materials and reduce the discharge of toxic pollutants over time. Resources are needed to fund urban runoff control, pretreatment, and waste minimization programs that are currently being started by federal regulations, state requirements, and local government initiatives. Revenue enhancement measures, in the form of additional fees and direct cost measures, could provide local agencies with needed resources to adequately implement these programs.

Economic measures for agricultural discharges should incorporate incentives in water pricing to reduce sediment loading and improve water quality. Provisions of the Food Security Act

and the Agricultural Credit Act should be used more aggressively to conserve soils on erosion-prone lands. Voluntary retirement of marginal agricultural lands that currently yield a high discharge of toxic elements, such as selenium, should be encouraged through public/private joint ventures.

The following economic incentives to encourage pollution prevention should be evaluated:

1) Deposit/rebate systems (to encourage recycling of hazardous consumer products that might otherwise be released to the environment);

2) Effluent taxes based on mass loading to stimulate waste minimization by dischargers; and

3) Effluent credits based on mass loading to encourage municipal wastewater treatment plants to accept strategically routed urban runoff into the sanitary sewer to enable net reduction in pollutants to the Estuary.

When: Immediately

Cost: $$$ (Policy action, program development and implementation, staff. Uncertain how difficult it will be to develop policy/programs.)

ACTION PO-1.3 (1993 CCMP)
Develop environmental audit procedures for all significant users and/or producers of toxic substances.

Who: California Environmental Protection Agency, State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, and Central Valley Regional Water Quality Control Board

What*:* The California Environmental Protection Agency should develop uniform requirements for environmental audits for industrial use of toxics and discharge. The need for legislation to legally mandate pollution prevention audits should be evaluated. Audits could be conducted by the user or discharger. Information collected under this program should be used to encourage corporate management accountability, as well as to provide regulatory agencies with data needed to conduct mass balance analyses of toxics use and wasteload allocations within the Estuary. The program should include a mandatory annual reporting of pollution prevention activities.

The Central Valley and San Francisco Bay Regional Water Quality Control Boards should make pollution prevention audits mandatory for all industrial facilities that discharge significant toxic pollutants into the Estuary. The audits should be mandated in National Pollutant Discharge Elimination System (NPDES) permits and publicly owned treatment works pretreatment programs.

When*:* 1993

Cost*:* $4 million estimated total ($4 million state)

ACTION PO-1.4.1 (1993 CCMP): ***Improve agricultural practices that reduce introduction of pollutants into the Estuary.***

Who*:* California Department of Water Resources and water districts, landowners, Natural Resources Conservation Service, and the State Legislature as needed

What: The California Department of Water Resources and the water districts should coordinate efforts to improve agricultural practices that contribute to the introduction of pollutants into the Estuary. Using best available information, best management practices (BMPs) and water management plans should be developed and implemented.

Agricultural practices should be developed and implemented to encourage efficient water use to reduce pollutants entering the estuarine system.

When*:* As soon as possible

Cost: $19,060,000 estimated total ($9,060,000 federal and $10 million state)

ACTION PO-1.4.2 (New 2007): ***Implement control measures to reduce pollutant loadings from certain agricultural practices.***

Who: San Francisco Bay and Central Valley Regional Water Quality Control Boards, Central Valley Coalition Groups, individual agricultural operations, Resource Conservation Districts, California Department of Health Services, Natural Resources Conservation Service

***What*:** Confined animal feeding operations, irrigated agricultural, and open pasture livestock grazing have the potential to discharge pollutants to water courses tributary to the Bay-Delta system and are subject to regulation under the federal National Pollutant Discharge Elimination System (NPDES) permit program and/or the California Water Code.

1) Discharges from confined animal feeding operations are subject to NPDES permits issued and administered by the Regional Water Quality Control Boards that have four main sets of requirements: effluent limitations, special conditions, standard conditions, and monitoring and recordkeeping requirements.

2) The Central Valley Regional Water Quality Control Board established a program to regulate discharges from irrigated lands that relied on Coalition Groups and individual dischargers to conduct monitoring programs to determine the water quality impacts of discharges from agricultural drains and irrigation runoff, determine compliance with water quality standards, assess the effectiveness of best management practices, and identify the need for additional control measures.

3) While water quality impacts associated with open pasture grazing have not been subject to regulation under federal and state water quality programs, guidance for those types of operations has been issued by the U.S. Environmental Protection Agency under the Coastal Zone Act Reauthorization Amendments to Section 6217. Total maximum daily load (TMDL)

programs are also starting to address common impacts of increased sediment loadings and temperature impacts due to riparian area alterations from grazing.

The Regional Water Quality Control Boards should continue the implementation of the existing programs to minimize the water quality impacts from agricultural practices. The recent nationwide public health concern from contamination of produce grown in California provides an even greater incentive for the agriculture community to control pollutants in the state's waterways.

When: As soon as possible

Cost: $$$ (Program development and implementation, monitoring, and staff costs. Uncertainty regarding intensity and duration of program and ongoing staff costs.)

Performance Measures:
1) Achieve water quality standards in affected receiving waters.

2) Percentage of dischargers that have properly filed complete waste discharge requirement applications or request for waivers

3) Number of best management practices implemented by landowners or revisions to regulatory process to better protect source waters

4) Percentage compliance with permit requirements determined by facility inspection

ACTION PO-1.5 (1993 CCMP)
Reinforce existing programs and develop new incentives where necessary to reduce selenium levels in agricultural drainage.

Who*:* California Department of Water Resources, water districts, U.S. Bureau of Reclamation (210 Authority), Natural Resources Conservation Service, U.S. Environmental Protection Agency (319 program), and the Regional Water Quality Control Boards

What*:* A strategy based upon existing programs and new incentives should be implemented to reduce selenium levels in agricultural drainage. Components include evaluation of attainment of selenium standards through non-structural methods and on-farm practices before use of drain extensions, use of waste discharge permits by the Regional Water Quality Control Boards where cooperative methods are ineffective, and low-cost loans. The San Joaquin Valley Drainage program should be implemented and supported. Use of incentive programs should include awards, developing model programs, educational tools, such as the Agricultural Water Program developed by California Polytechnic University, and recognizing innovative water district programs.

When*:* As soon as possible

Cost*:* $10,560,000 estimated total ($6,060,000 federal and $4.5 million state)

ACTION PO-1.6 (Revised 2007)
Implement a comprehensive strategy to reduce pesticides coming into the Estuary.

Who: State Water Resources Control Board, Regional Water Quality Control Boards, California Environmental Protection Agency, California Department of Pesticide Regulation, California Department of Fish and Game, U.S. Environmental Protection Agency, county commissioners, county agricultural commissioners, California Department of Consumer Affairs, University of California Statewide Integrated Pest Management Program, pesticide manufacturers, formulators, distributors, retailers, and users, urban runoff/management agencies, and the State Legislature

What: The pesticide-related total maximum daily load (TMDL) developed by the San Francisco Bay Regional Water Quality Board proposed a comprehensive strategy that can serve as a blueprint for preventing impairments due to pesticides in the future. The strategy includes:

1) Proactive regulation to prevent pollution using existing regulatory tools;

2) Education and outreach to decrease demand for pesticides that threaten water quality and increase awareness of less toxic alternatives; and

3) Fill data gaps and measure progress and success through research and monitoring.

The Central Valley Regional Water Quality Control Board has adopted total maximum daily loads (TMDLs) to regulate agricultural and urban discharges of diazinon and chlorpyrifos and replacement products. These TMDLs should be fully implemented. In addition, the Central Valley Regional Water Quality Control Board is implementing a control program for discharges from irrigated lands that includes pesticides.

Ideally, Water Quality Control Plans should contain numerical objectives for all pesticides detected in the Estuary. However, with more than 900 pesticide active ingredients registered for use in California, this is probably already impractical. Recent regulatory efforts have focused on pesticide-related toxicity as the preferred success metric rather than environmental concentrations of individual pesticides. Therefore, it is essential that biotoxicity monitoring continue to be used or supervised by the Regional Water Quality Control Boards, the California Department of Pesticide Regulation, or other state agencies to ensure the data are reliable.

Biotoxicity monitoring should continue to be used to identify waters where pesticides and other toxic materials are impacting aquatic life. Toxicity identification evaluations can then be used to find the chemicals that are causing adverse impacts, and control strategies should be developed to address those impacts. However, a lesson that emerged recently is that it is vitally important, when developing control strategies, not simply to eliminate the use of one compound such that another can take its place and cause problems. Strategies targeting pesticides should always take a comprehensive view to ensure that implementing the solution reduces overall environmental risk.

The U.S. Environmental Protection Agency should ensure that there is an approved laboratory analysis method for every pesticide and significant breakdown products. The detection level should be below concentrations that may impact beneficial uses.

When a pesticide is detected in waters of the Estuary, the California Department of Pesticide Regulation should work with the Regional Water Quality Control Boards and other appropriate parties to determine whether water quality objectives are violated and to develop control measures, if necessary, that will result in compliance with these objectives.

The U.S. Environmental Protection Agency should be notified of detection of pesticides in waters of the San Francisco Estuary. The U.S. Environmental Protection Agency should then provide technical and monetary support for the development of any necessary control measures and determine whether the local problem should result in a change in pesticide regulation and label directions. Contamination of surface water as a result of drift from aerial applications should be quantified. Drift in aerial applications that results in violations of water quality standards should be mitigated.

Pesticide users should work with the county agricultural commissioners to keep informed of new control measures, including measures to protect endangered species, which are disseminated primarily through "county bulletins." Agricultural extension and other education and outreach programs can be used to show pesticide users best application methods. The California Department of Pesticide Regulation and county agricultural commissioners should take strong enforcement action against pesticide users who do not comply with label instructions and other use restrictions.

Where control effort is based on voluntary use of specified management practices versus mandatory restrictions, goals and a timetable must be set to gauge progress toward compliance. Failure to make meaningful progress in a reasonable timeframe should result in a regulatory-based program that mandates such progress.

When: As soon as possible

Cost*:* $$$ (Water Boards' costs for implementation, and for agricultural pest management in the Bay and Delta. Cost uncertainties involve number of staff, amount of outreach material, and cost for studies to fill data gaps.)

Performance Measure:
Percentage decrease in monitoring sites exhibiting toxicity due to pesticides

ACTION PO 1.7.1 (New 2007): ***Develop product stewardship program for new commercial products to minimize future pollutant releases.***

Who: Local governments, non-governmental agencies, agencies of the California Environmental Protection Agency and the California Resources Agency

What: Develop a new program to ensure that a pollutant release minimization strategy (strategy) is developed along with each new commercial product. These strategies should consider the complete product lifecycle. They would be required before a new consumer

product designed to be used in a manner that could release environmentally relevant quantities of potentially harmful pollutants to the Estuary or its watershed is brought to market. The strategy, which should be the responsibility of the product manufacturer, should ensure that the product's use will not result in discharges to surface waters that result in violation of water quality standards in place to protect beneficial uses in the Estuary. Because there are not numeric water quality objectives for most emerging contaminants, when strategies are developed for new chemicals or new uses of existing chemicals, they will generally look to narrative water quality standards, such as those that speak to the idea of preventing toxic substances from being present in receiving waters in toxic amounts.

The new program should be developed incrementally by building consensus among environmental non-governmental organizations, government, manufacturers, and retailers. The San Francisco Estuary Project Implementation Committee would provide input to the national Product Stewardship Institute, the California Product Stewardship Council, the San Francisco Bay Area Pollution Prevention Group, and others working on program development.

The key concept is that manufacturers would either design products to minimize release, or provide for "take-back" at the end of the product life, or a combination of the two. Legislation will be required to implement the program, so the next step would be to build consensus in the Legislature. It will also be necessary to conduct public education and outreach to make the program effective.

When: As soon as possible

Cost*:* $$$ (Program development and implementation, and staff costs. Uncertainty regarding level of effort, staff costs, and types of analysis needed as part of program development.)

Performance Measure:
Development of a workable program with legislative support

ACTION PO 1.7.2 (New 2007): *Seek redesign, reformulation, or replacement of existing commercial products that are sources of pollution to the Estuary.*

Who: U.S. Congress, U.S. Environmental Protection Agency, California Legislature, California Environmental Protection Agency, State Water Resources Control Board, Regional Water Quality Control Boards, and the private sector

What: Commercial products have been associated with numerous water pollution problems. For example, past use of PCBs in electrical products (from which releases are inevitable) and in uncontained applications like sealants and coatings continues to impair Estuary water quality today. Other consumer products that have been linked to pollution of the Estuary include copper-based root control products, tributyltin-containing cooling water additives, and copper-containing vehicle brake pads. Many emerging pollutant concerns are also linked to consumer products:

- Polybrominated diphenyl ethers (PBDEs) are used as flame retardants in a wide range of products like computers, couches, carpets, and mattresses.

- Perfluorinated chemicals like perfluorooctane sulfonate (PFOS) and perflurorooctanoic acid (PFOA) are components of waterproof and nonstick coatings used in products like cookware, coats, microwave popcorn bags, and stain-resistant fabric treatments.

- Pharmaceuticals are used to improve human health.

- Phthalates are added to polymers to make flexible plastics like shower curtains, flexible tubing, and intravenous (IV) bags.

- Triclosan is an antimicrobial that is added to soaps, such as dish and clothing detergents, to kill bacteria?

- Tiny particles (nanometers in diameter)—much smaller than particles normally occurring in the environment—that are being developed through nanotechnology are bringing new properties to a vast array of consumer products like sunscreen, paint, and fabrics.

While understanding fate and transport is important and can improve the design of control strategies, it should not become a barrier to the implementation of control strategies. Components of consumer products can degrade into other chemicals that may also be environmentally significant. For example, degradation breakdown products of certain pharmaceuticals have been linked to endocrine disruption in aquatic life and amphibians.

The U.S. Environmental Protection Agency should ensure that there is an approved laboratory analysis method for every potentially harmful chemical that is used in a manner that could release meaningful quantities to the Estuary or its watershed (methods for significant breakdown products should also be required). The detection level should be below concentrations that may impact beneficial uses.

When a potentially harmful chemical associated with consumer products is detected in the Estuary, the California Environmental Protection Agency should work with the Regional Water Quality Control Boards, product manufacturers, product users, and other appropriate parties to determine whether water quality standards are violated and, if necessary, to develop control strategies, including possible phase out, that will result in compliance with these standards.

When control programs are required to prevent consumer product-related discharges from exceeding water quality standards, the costs for the development of the control program and the monitoring needed to verify that the control program is effective should generally be borne directly or indirectly by the user and manufacturer of the product. Costs of water quality monitoring should be borne by product manufacturers and users. If necessary, legislation should be enacted to provide adequate funds to address consumer product-related water pollution, especially in the case of bioaccumulative pollutants.

Where control effort is based on voluntary use of specified management practices versus mandatory restrictions, goals and a timetable must be set to gauge progress toward compliance with water quality standards. Failure to make meaningful progress in a

reasonable time frame should result in a regulatory-based program that mandates such progress.

***When**:* As soon as possible

Cost: $$$ (Program development and implementation, and agency staff costs. Uncertainty regarding level of effort, cooperation by manufacturers, staff costs, and types of analysis needed as part of program development.)

***Performance Measures**:*
1) Percentage of manufacturers participating in expired product take-back programs

2) Percentage (or quantity) of expired product or packaging taken back

3) Percentage of products reformulated

4) Percentage of manufacturers implementing procedures to assess and prevent environmental risks from products

5) Percentage of pollutants of concern for which appropriate laboratory testing methods are available

ACTION PO-1.8 (New 2007)
Develop and implement programs to prevent pollution of the Estuary by other harmful pollutants like trash, bacteria, sediments, and nutrients.

Who: California Legislature, California Environmental Protection Agency, State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, Natural Resources Conservation Service, local agencies, California Department of Health Services, local health departments, U.S. Army Corps of Engineers, local water districts, local flood control districts, California Ocean Protection Council, California Resources Agency, and the private sector

What: In many shoreline areas, full use of the Estuary is being impeded by the presence of pollutants like trash, bacteria, excess sediments, and excess nutrients (pollutants other than metals and synthetic organic chemicals). Sediment and natural nutrients can be either beneficial or damaging, depending on the amounts and circumstances. They only become pollutants when they occur in quantities out of balance with other beneficial uses or needs of the receiving water. Trash from watersheds also contributes to the problem of marine debris (See AR-9.1, AR-9.2). The presence of fats, oils, and grease contributes to sewer line blockages and overflows that can release untreated wastewater to the Estuary. Region-specific pollution prevention strategies based upon existing programs, watershed-specific voluntary and regulatory programs, and new incentives should be implemented to correct these problems.

Region-specific evaluations of the sources of the pollution are appropriate to form the basis for developing the region-specific strategies. Examples of practical strategies include: restrictions on use of plastic retail bags and cups; modifications of contracts with refreshment

vendors to eliminate trash sources, particularly plastics; beach smoking bans; increased availability of well-maintained trash receptacles, recycling containers and ashtrays; increased public education and enforcement of littering laws; installation of treatment control facilities; diversion of dry weather flows to sanitary sewer systems; ordinances that require sewer lateral or septic system testing and repair upon property transfer; programs and ordinances for fats, oil, and grease control; erosion control projects for unpaved roads; providing pet waste pickup bags at parks and beaches; and modification of fertilizer application and leaf litter collection practices to reduce nutrient flow to slough and shoreline areas experiencing nuisance algae problems.

When: As soon as possible

Cost: $$$ (Program development and implementation, assessment/evaluation of the problems, and staff costs for ongoing implementation. Uncertainty regarding level of effort, staff costs, and types of assessments needed as part of program development.)

Performance Measures:
1) Publish report that examines case studies of past and ongoing efforts that are successful.

2) Percentage reduction in trash and other pollutants of concern

3) Percentage reduction in incidents of algae fouling in areas experiencing nuisance algae

4) Percentage of municipalities with sewer lateral ordinances (via survey)

B. Pollution Control and Reduction

Objective PO-2

Improve regulatory systems for point and nonpoint source pollution control.

ACTION PO.2.1 (Revised 2007)
Pursue a mass emissions strategy to reduce pollutant discharges into the Estuary from point and nonpoint sources and to address the accumulation of pollutants in estuarine organisms and sediments.

Who: San Francisco Bay Regional Water Quality Control Board and Central Valley Regional Water Quality Control Board, U.S. Environmental Protection Agency, State Water Resources Control Board, and local pollution control authorities

What: A mass emissions strategy should be developed that includes the following elements, where appropriate:

1) The Regional Water Quality Control Boards should implement waste load allocation projects for all water bodies in the Estuary that do not meet water quality standards for pollutants.

2) Pretreatment programs should be expanded to control persistent, accumulative pollutants and to include mass limits.

3) The Regional Water Quality Control Boards should impose numerical effluent limitations, toxicity control requirements for point sources, best management practices for nonpoint sources, and other regulatory and enforcement mechanisms to assure compliance with adopted standards.

4) Evaluate marketable discharge permits to ensure that the capacity of the ecosystem to accept pollutants is not exceeded.

5) Provide incentives for collaboration between municipal wastewater treatment plants and urban runoff management agencies to promote the strategic routing of runoff into the sanitary sewer to enable net reduction in pollutant loading to the Estuary.

***When**:* As soon as possible

Cost: $8,260,000 estimated total ($60,000 federal and $8.2 million state)

ACTION PO-2.2 (1993 CCMP)
Adopt water quality objectives that effectively protect estuarine species and human health.

Who: State Water Resources Control Board, San Francisco Bay and Central Valley Regional Water Quality Control Boards, California Department of Health Services, and California Environmental Protection Agency

What: The State Board and the Regional Water Quality Control Boards should, to the extent provided by law, revise their Water Quality Control Plans so that water quality objectives protect the most sensitive species in the Estuary. Objectives should be developed for all pollutants of concern that are discharged into the Estuary, taking into account data regarding species sensitivity and, where this sensitivity is unknown, use an appropriate safety factor in the standards to account for this uncertainty. In the long term, toxicity test information and additional research should be performed in order to determine overall species sensitivity.

The Regional Water Quality Control Boards should take into account the proportion of receiving water species and conditions that have been tested, known or suspected interactions between pollutants, other sources of stress to receiving water populations, natural variability, and other relevant factors. The Regional Water Quality Control Boards should also perform a hazard assessment of affected receiving waters and species.

Water quality objectives for appropriate water body segments for copper, selenium, mercury, and others should be developed and adopted to address bioaccumulation effects and protect aquatic life. Objectives should be developed to protect against potential adverse effects due to accumulation through the food chain.

Chemical-specific or toxicity-based sediment quality objectives that are protective of aquatic life for the Bay and Delta should be developed and adopted. Tissue levels that protect human health and predator species against adverse effects from contaminated fish or shellfish should be adopted.

When: Immediately through 1994

Cost: $2,412,000 estimated total ($2,412,000 state)

ACTION PO-2.3 (1993 CCMP)
Identify and control sources and sinks of selenium and mercury where they are accumulating in aquatic populations in the Estuary.

Who: State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, and the Natural Resources Conservation Service (with assistance from California Department of Fish and Game)

What: Sources of mercury into the Estuary need to be identified and controlled. Loading of selenium from petroleum refineries, agriculture, sewage treatment, and other identified sources discharging to the Estuary must also be reduced. The State Water Resources Control Board and/or the Regional Water Quality Control Boards should fund and/or carry out necessary investigations to identify the source(s) of selenium (e.g., oil refineries, agricultural return flows, etc.) and implement necessary regulations to control its discharge. Source loads and areas of accumulation should also be identified.

Based upon results obtained in monitoring bioaccumulation of selenium, discharge permits for petroleum refineries and other significant dischargers need to include mass emission limitations for selenium. The control strategy should include management practices and waste discharge requirements as necessary to limit selenium in agricultural subsurface drainage to reduce selenium loadings to the Delta and attain water quality objectives for selenium in the San Joaquin River.

When: 1992–1997; control measures: 1997–2002

Cost: $21,400,000 estimated total ($8.4 million federal and $13 million state)

ACTION PO-2.4 (Revised 2007)
Improve the management and control of urban runoff from public and private sources.

Who: San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, and local agencies

What: Continue to implement comprehensive urban runoff management programs having the following elements:

1) Baseline control programs with a focus on prevention in all watersheds;

2) Comprehensive control programs with a focus on prevention and remediation in urban watersheds;

3) Industrial activity control programs;

4) Construction and post-construction (new and redevelopment) control programs;

5) Education and outreach; and

6) Forum to address barriers.

Baseline Control Programs
These programs should continue to implement:

1) Operation and maintenance of new and existing public and private storm drain systems;

2) Ordinance and general procedures updated as needed to require the control of runoff from new and existing development and significant redevelopment both during and after construction; and

3) Measures toward educating the public.

The Regional Water Quality Control Boards require municipalities to submit annual reports documenting program activities. The municipal programs should continue to be integrated into the implementation of watershed management plans, and the Regional Boards should consider issuing waste discharge requirements to municipalities that do not demonstrate adequate progress or fail to participate in watershed management. The Regional Boards should consider enforcement actions.

Comprehensive Control Programs
In addition to baseline control program elements, comprehensive control programs include:

1) Measures to reduce pollutants in runoff to the maximum extent practicable (MEP) from commercial, residential, and industrial areas;

2) Measures to eliminate illicit connections and illegal dumping into storm drain systems;

3) Measures for operating and maintaining public highways to reduce pollutants in runoff;

4) Measures to reduce pollutants in discharges associated with the application of pesticides, herbicides, and fertilizer; and

5) Compliance monitoring.

The requirements of the comprehensive control program are intended to be consistent with National Pollutant Discharge Elimination System (NPDES) regulations for municipal stormwater discharges. Discharges from storm sewer systems that cause or contribute to violations of water quality standards are prohibited. Therefore, urban runoff management agencies will implement measures that not only reduce pollutants in runoff to the maximum extent practicable, but the State Water Resources Control Board and the Regional Water Quality Control Boards may require implementation of additional measures to ensure achievement of water quality standards. The State and Regional Water Boards recommend an iterative approach to achieving compliance with water quality standards. The Regional Water

Quality Control Boards issue NPDES permits to municipalities in urban watersheds for the implementation of comprehensive control programs and include transportation entities as responsible parties.

Industrial Activity Control Programs
The State and Regional Water Boards have issued general or individual NPDES permits for stormwater discharges from categories of industry or individual facilities that pose a significant threat to water quality. The Regional Water Quality Control Boards also issue NPDES permits for stormwater discharges from facilities that were not originally required in the federal regulations to obtain permits (such as automotive operations), but pose a significant threat to water quality. These permits should include specific requirements beyond those in the existing industrial stormwater general permits as necessary to meet water quality objectives. Regional Water Quality Control Boards' actions should be coordinated with municipalities required to implement comprehensive control programs.

Construction Control Programs
Construction is regulated by the State Water Resources Control Board's general permit to address the discharge of construction waste material and pollutants during construction. Storm Water Pollution Prevention Plans (SWPPPs) include specific measures for erosion and sediment control, post-construction stormwater management, waste management and disposal, and ongoing maintenance and inspection of pollutant control measures.

Municipalities should continue to include pollution measures in their plan development and approval process to assure implementation of the Storm Water Pollution Prevention Plan.

Education and Outreach
The Regional Water Quality Control Boards and local agencies should develop collaborative programs to inform the public, commercial entities, and industries about the proper use and disposal of materials and waste, and correct practices of urban runoff control.

Forum to Address Barriers
Establish a forum to address and remedy, where appropriate, administrative and regulatory barriers that inhibit implementation of urban runoff control measures, including construction, operation, and maintenance of detention/retention devices, wetlands, and paved surfaces.

When: As soon as possible

Cost: $$$$

ACTION PO-2.5 (Revised 2007)
Develop and implement control measures to reduce pollutant loadings from energy and transportation systems.

Who*:* California Air Resources Board, Metropolitan Transportation Commission, Bay Area Air Quality Management District, Association of Bay Area Governments, California Department of Transportation, local congestion management agencies, and existing hazardous waste control agencies

What: The Clean Air Plan and regional and local transportation plans should include measures to control and/or prevent the impact of atmospheric deposition and runoff from paved surfaces. Potential contributions to water pollution need to be considered in the development of air pollution standards, such as those involving automotive emissions. Regional programs need to be created to ensure proper recycling of waste oil (e.g., a deposit system for motor oil). Mass transportation systems need to be supported to reduce personal automobile use. Control measures for transportation facilities should be implemented. In the near-term, these measures should focus on trash from roadways, as well as a host of automobile-associated pollutants like metals and polycyclic aromatic hydrocarbons (PAHs) that are often associated with fine particulate matter. Much information has been gained through studies to characterize pollutants in runoff, and some of this knowledge has already been put into practice to design effective pollution prevention and treatment strategies. More can and should be done to extend these strategies to optimize transportation facilities for pollutant removal, especially as new facilities are built.

Transportation and energy system changes in response to current and future state and federal regulations and programs addressing global climate change are expected to have the additional benefit of reducing pollutants released into the air. Control measures for fine particulate matter are being put in place, and these measures will reduce transportation-related pollutant loads in urban runoff.

When: Immediately

Cost: $$$$$

ACTION PO-2.6 (1993 CCMP)
Improve the management and control of agricultural sources of toxic substances.

Who: California Environmental Protection Agency, California Department of Food and Agriculture, California Department of Fish and Game, State Water Resources Control Board, Central Valley Regional Water Quality Control Board, Natural Resources Conservation Service, California Department of Pesticide Regulation

What: The State Water Resources Control Board and the Regional Water Quality Control Boards should utilize existing nonpoint programs in developing and implementing best management practices (BMPs). Specifically, better management of agricultural uses of pesticides (herbicides, fungicides, etc.) is needed to reduce concentrations of these pollutants to below toxic levels in receiving waters. Periodic reviews for the effectiveness of this program should be conducted. Where water quality objectives are not met through best management practices, the Regional Water Quality Control Board should consider waste discharge requirements when there is evidence that agricultural drainage is limiting the defined beneficial uses of any body of water.

The California Inland Surface Water Plan and other appropriate policies and laws should be implemented and strengthened where needed to reduce pesticides in the environment.

The Regional Water Quality Control Board and water districts should encourage the establishment of legally responsible drainage entities. Farmers could be organized into

groups to facilitate water quality monitoring and develop best management practices plans to be submitted to the Regional Board for review and approval. These plans could be used to prioritize efforts based upon known or suspected water quality problems and their solutions.

The State Water Resources Control Board and the Regional Water Quality Control Boards should develop an enforceable instream toxicity program. Elements of this program would include:

1) Continued and expanded ambient biotoxicity monitoring efforts;

2) Relating biotoxicity monitoring to biomonitoring and chemical data; and

3) Development of compliance points for measuring chronic toxicity.

When: Immediately

Cost: $44,120,000 estimated total ($28,120,000 federal and $16 million state)

ACTION PO-2.7 (1993 CCMP)
Reduce toxic loadings from mines.

Who*:* U.S. Environmental Protection Agency, California Environmental Protection Agency, California Department of Health Services, State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, California Legislature

What*:* Require the development and implementation of control measures to reduce the discharge of metals associated with sediments, acid mine drainage, or process wastes and require effective closure of inactive mines. The implementation of a program should include measures prioritized by loadings to particular watersheds. Responsible parties and potential sources of funding should be identified. State and federal Superfund programs should give high priorities to these remediation projects to rapidly correct water quality problems as well as human health problems from abandoned mines.

Regional Water Quality Control Boards should use state Clean-Up and Abatement Act funds to correct abandoned mine pollutant discharge. Legislation is needed to limit or exempt the Regional Boards and their members from liability for mine cleanup efforts, including implementation through the NPDES stormwater permits.

When*:* 1994

Cost*:* $8,600,000 estimated total ($2.6 million federal and $6 million state)

ACTION PO-2.8 (1993 CCMP)
Establish a model environmental compliance program at federal facilities within the jurisdiction of the Estuary Project.

Who: U.S. Department of Defense, U.S. Department of Energy, U.S. Environmental Protection Agency, State of California, U.S. Department of the Interior, U.S. Department of Agriculture, and other active facilities

What: The U.S. Department of Defense, the U.S. Department of Energy, the U.S. Environmental Protection Agency, and the Estuary Project should establish a memorandum of understanding (MOU) to create a model federal facilities program within the boundaries of the Estuary Project. The MOU would comprehensively address issues affecting environmental quality of the Bay-Delta. Elements to be included in the MOU are:

1) Pollution prevention, including review and revision of contract specifications to allow use of nontoxic or less toxic substitutes by contractors;

2) Improved compliance with environmental regulations;

3) Stormwater and collection systems;

4) Expedited remediation of sites affecting the Bay-Delta; and

5) Restoration/creation of wildlife habitat on unoccupied federal land and adequate funds to implement action.

When: As soon as possible

Cost: $13,440,000 estimated total ($13,440,000 federal)

Objective PO-3

Remediate pollution threats to public health and wildlife in the Estuary.

ACTION PO-3.1 (Revised 2007)
Clean up contaminants currently affecting fish, wildlife, their habitats, and food supplies in the Bay and Delta.

Who: U.S. Environmental Protection Agency, State Water Resources Control Board, San Francisco Bay Regional Water Quality Control Board, Central Valley Regional Water Quality Control Board, California Department of Fish and Game, and U.S. Fish and Wildlife Service

What: A comprehensive watershed analysis should be undertaken to evaluate, identify, and reduce toxicity in problem areas. Where toxic agents and sources are known, the resources agencies should immediately seek damages to effect the cleanup or remediation of contaminants affecting public trust resources. Special attention should be placed on implementing cleanup of upland and Bay-Delta margin sites contaminated with mercury and polychlorinated biphenyls (PCBs). In addition, efforts should be undertaken to determine if

there are sites contaminated with emerging contaminants where cleanup (e.g., cap in place, removal, pump and treat, etc.) can substantially reduce risk to humans and wildlife. The priority list of emerging contaminants currently includes polybrominated diphenyl ethers, perfluorinated chemicals, and pharmaceuticals and personal care products. However, other compounds may be identified and should be included in cleanup decisions as appropriate.

When: Immediately

Cost*:* $$$

ACTION PO-3.2 (Revised 2007)
Expedite the cleanup of toxic hot spots in estuarine sediments.

Who*:* State Water Resources Control Board, Regional Water Quality Control Boards, California Department of Toxic Substances Control (DTSC), and California Legislature

What: Pursuant to the Bay Protection and Toxic Cleanup Program established by the California Legislature, the State Water Resources Control Board has adopted a workplan to identify and develop cleanup plans for toxic hot spots in bays and estuaries. This cleanup or remediation will reduce the potential exposure of aquatic organisms and humans to contaminated sediments. Completion of this work should be a high priority for the Regional Water Quality Control Boards. Particular attention should be given to those contaminated areas where the Estuary receives runoff from industrial areas. In such cases, the ongoing cause of the contamination should be addressed at the same time as cleanup efforts. Legislation is needed to require the implementation of the cleanup plans and to identify a funding mechanism. Where responsible parties are known, the resource agencies should seek damages.

In cases where expedited cleanup is needed, the state should establish a funding mechanism or specific contracting authority to allow cleanups to proceed under the direction of the State Water Resources Control Board or the Department of Toxic Substances Control. Cost recovery to reimburse the state can then be accomplished as cleanup proceeds.

Additionally, the state should seek legal authority to compel cleanup at sites with no readily identifiable responsible party and also seek enhanced authority in those cases when dealing with recalcitrant responsible parties. As part of the cleanup efforts, state agencies should emphasize outreach efforts to inform local citizens of the technical issues involved.

When*:* Ongoing

Cost: $$$

ACTION PO-3.3 (New 2007)
Accomplish large-scale improvements to Bay-Delta area infrastructure and implement pollution prevention strategies to prevent pollution threats to public health and wildlife.

Who*:* Regional Water Quality Control Boards, local governments, State Legislature, San Francisco Estuary Project

What: Large-scale improvements in infrastructure (flood control, stormwater conveyance systems, wastewater treatment and conveyance, etc.) and pollution prevention efforts are needed, particularly for addressing the impacts of urban runoff to the Estuary. Jurisdictions have ongoing needs to upgrade and maintain sanitary sewer collection and treatment systems. The resources needed for such improvements will require the approval of Bay-Delta area residents and decision-makers. To achieve this consent, the public must be engaged through effective communication regarding the types of pollutant-related threats to the Estuary. The case must also be made that the solutions to these problems will require significant public expenditures, possibly hundreds of millions of dollars. A successful example of such a strategy can be found in the way Southern California addressed chronic beach closures. The problem was communicated to the public and galvanized public support for a $500 million bond measure to be spent on public infrastructure improvements to remedy the causes of the beach closures. Similar measures may be necessary to address emerging pollutants and controlling pollution to the Estuary. The following are the first steps toward accomplishing this action in the Bay-Delta Area:

1) Clearly communicate to the public and decision-makers the nature of the problem to be addressed, its causes, and that clear legal mandates and regulatory requirements already exist and must be implemented.

2) Clearly communicate the possible solutions to address these sources of pollutants and the cost of such solutions.

3) Assess the public's willingness to pay for such solutions.

4) Propose funding mechanisms to decision-makers and the public (e.g., bond measures, property tax assessments, rate increases, etc.)

5) With funding secured, initiate infrastructure improvements and pollution prevention strategies to address the most urgent needs as identified by the public, local experts, the State and Regional Water Boards, and municipalities.

When: Immediately

Cost: $$$$$ (Program development and implementation, outreach to public, effort to secure funding, assessment/evaluation of the problems, and staff costs for ongoing implementation. Uncertainty regarding level of effort, especially in securing funding, staff costs, and types of assessments needed as part of program development.)

Performance Measures:
1) Develop opinion surveys to assess whether infrastructure needs and financing are supported by the public and decision-makers.

2) Percentage increase in spending on infrastructure improvements directly related to reducing pollutants entering the Estuary

Objective PO-4

Improve water quality through restoration and enhancement of tidal wetland functions in the Estuary and riparian and floodplain wetland functions in the watersheds.

ACTION PO-4.1 (New 2007)

Increase regulatory incentives for municipalities, through urban runoff and other programs, to invest in projects that restore or enhance stream and wetland functions.

Who: State Water Resources Control Board, Regional Water Quality Control Boards, California Department of Fish and Game, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, National Marine Fisheries Service, local agencies, and the environmental community

What: Stream and wetland functions to be restored or enhanced can be divided into hydrologic functions, biogeochemical functions, and habitat functions. All of these processes in watersheds and the Estuary contribute to improved water quality and support beneficial uses. Restoration of stream and wetland functions is not a formally recognized element of urban runoff pollution prevention programs. These programs have always struggled to have enough funding for the minimum control programs, so the pollution reduction benefits of urban stream and wetland restoration have not been pursued or realized by municipalities, with few exceptions.

Through traditional urban development, the functions of streams and wetlands have been lost, reducing the capacity of natural systems to maintain water quality and habitat. Channelization of urban streams and diking and filling of tidal wetlands have made it more difficult to meet water quality standards for dissolved oxygen, temperature, sediment and other parameters. While urban stormwater pollutants certainly play a role in depleting water quality, the removal of native vegetation and meanders from the streams and wetlands, most often as part of flood control projects, has also negatively affected water quality. Additionally, the design of stormwater drainage in watersheds, to rapidly move stormwater to streams and the Estuary, has caused destruction of habitat and property near creeks, transported pollutants such as trash and contaminated sediments to wetlands, and not provided enough travel time for pollutants to be naturally reduced prior to entering aquatic habitat.

As land is developed or redeveloped, opportunities arise to restore or enhance stream and wetland functions. For example, projects that reduce direct connections of impervious surfaces to streams and tidal wetlands should be encouraged because they can improve functions of stream systems by reducing the rapid and destructive peak flows of the urban runoff. Additionally, projects to use existing public rights-of-way near streams for re-establishing riparian corridors and floodplains should be encouraged because they improve biogeochemical and habitat functions that reduce urban runoff pollution and improve dissolved oxygen, temperature, and sediment levels for aquatic life.

Incentives should be offered by the regulatory agencies through stream and wetlands system protection policies (see LU-2.7), total maximum daily loads (TMDLs), National Pollutant Discharge Elimination System (NPDES) permits, Section 404/401 Wetland Permits, California Department of Fish and Game Streambed Alteration Agreements (SAA), and other

programs that recognize and reinforce the importance of restoring and enhancing natural functions to attain water quality standards, improve aquatic habitat, and provide greater recreational opportunities for local citizens.

One example of an incentive could be pollutant mass reduction credits to be applied to total maximum daily load (TMDL) requirements for urban runoff. This would require some technical development of a defensible credit system for different types of function-enhancement projects. For instance, mass reduction credits for TMDL pollutants should be based on recent local research conducted on various pollutant reductions associated with urban runoff best management practices.

To create more incentives for function enhancement, other regulatory programs, such as the Section 404/401 Wetland Permit and Streambed Alteration Agreement programs could emphasize that certain function enhancements, such as disconnecting impervious surface runoff from streams or restoring a stable active stream channel, make projects "self-mitigating," reducing the regulatory burden of restoration projects that have short-term impacts during and after construction.

The urban runoff programs of the San Francisco Bay-Delta region should consider the voluntary implementation of an additional control measure: "Restoration and enhancement of stream and wetland functions." For this measure to be successful, the Regional Water Quality Control Boards, the State Water Resources Control Board and the U.S. Environmental Protection Agency would need to recognize that the control measure goes beyond the six minimum control measures the regulatory program requires, and consider the granting of regulatory tradeoffs or credits, with input from local agencies and environmental community.

Flood control districts are part of urban runoff programs. The above voluntary control measure could be met through preparation of flood control watershed plans that integrate restoration and enhancement activities coordinated with municipalities as part of a watershed-wide project description. The authorization of such watershed plans by regulatory agencies through a public process would authorize all flood control, restoration, and enhancement projects within a watershed. Such wide-scale approaches are likely to be more effective in recovering stream and wetland functions in urbanized areas.

When: 2007

Cost: $$$ (Program development and implementation, and staff costs for ongoing implementation.)

Performance Measures:
1) Number of total maximum daily load (TMDL)-related mass reduction credits issued for stream and function enhancement

2) Percentage of jurisdictions with authorized flood control watershed plans or other programs/policies that restore stream and wetland function (via survey)

ACTION PO-4.2 (New 2007)
Apply reasonable regulatory requirements and improve collaboration to facilitate tidal and riparian restoration projects and pollution reduction projects, emphasizing fish and wildlife habitat improvement, human community benefits, and pollution reduction benefits of restoring stream and wetland functions (see also LU-1.2).

Who: U.S. Fish and Wildlife Service, National Marine Fisheries Service, California Department of Fish and Game, State Water Resources Control Board and Regional Water Quality Control Boards, U.S. Environmental Protection Agency, San Francisco Bay Conservation and Development Commission, local agencies, U.S. Army Corps of Engineers, and the environmental community

What: Municipalities should invest in projects that benefit the Estuary and its watersheds by enhancing stream and wetland functions that reduce pollution. They are reluctant to propose work in aquatic habitats because these habitats support sensitive species and trigger complex and sometimes lengthy regulatory and environmental review processes that undermine momentum in achieving improvements in stream and wetland functions. This can be minimized to a certain extent by involving the appropriate agencies earlier in the planning process than is customary.

The Endangered Species Act consultation requirements and other permitting programs in state waters have undoubtedly assisted in preserving wetland functions through habitat protection. Sometimes these requirements can have unintended consequences of slowing down or even discouraging needed restoration and enhancement of stream and wetland functions. Understaffed agencies justifiably target staff resources to regulation of projects that can harm endangered species or water quality, and are consequently unable to prioritize projects with potential transient or relatively minor impacts on sensitive species during the restoration process.

The permitting process is sometimes complex and challenging for tidal and riparian wetland restoration because these areas are adjacent to critical remnant habitats that support the last of sensitive species of concern. To achieve Objective PO-4 on the large scale needed, the process needs to be streamlined for local agencies and private concerns that are restoring functions near sensitive areas, recognizing that their projects will likely expand and strengthen the remnant habitats that the consultation process aims to protect, and ultimately may contribute to removal of species from threatened or endangered species lists.

In some cases, the environmental review process under the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA) can slow down or discourage restoration efforts and add unnecessary costs. While potential adverse environmental side effects must be contemplated in any restoration effort, a full environmental impact report or statement, or even an environmental assessment or negative declaration entail public processes that are sometimes unnecessarily lengthy and costly for environmentally beneficial projects that have limited funding.

For projects that have been determined not to have a significant effect on the environment, CEQA includes categorical and statutory exemptions, and NEPA has categorical exclusions for environmental impact reports/statements and other documents. These exemptions and

exclusions do not remove the opportunity for the public to comment, in case some extraordinary circumstances exist that warrant more analysis of potential impact and mitigation. The categorical exemptions and exclusions save time and money by reducing the public review period and the paperwork requirements of environmental assessments and reports.

Over the past decade, regulatory agencies of the San Francisco Bay-Delta region have been successful in partnering to make the permitting and environmental review processes more efficient for state and federal restoration projects. These partnerships can be built upon to create streamlined permitting and environmental review processes for beneficial restoration and infrastructure projects conducted by local agencies.

A workgroup of the regulatory agencies should be formed to agree upon a Joint Aquatic Resources Permit Application (JARPA) process for infrastructure improvements related to 1) stream and wetland restoration projects, 2) drainage improvements that enhance functions, and 3) sanitary sewer infrastructure projects, that would recognize the benefits to water quality and habitat functions and speed up the recovery of these vital elements in the Estuary and its watersheds. Such a streamlined process would encourage municipalities, special districts, and other entities to take more risk in investing in these projects in and near aquatic habitats, which have the additional incentives of local community benefits, improving the local quality of life, and increasing property values.

CEQA and NEPA already contain categorical and statutory exemptions/exclusions, some pertaining to maintenance of aquatic and riparian habitat, and these should be used by the workgroup of regulatory agencies to clarify what kinds of the three types of projects above are categorically exempted under CEQA and categorically excluded under NEPA. The workgroup could consider certain thresholds in applying categorical exemptions/exclusions in the San Francisco Estuary watershed, such as lengths of stream enhanced or acreages of wetlands restored.

When: 2008

Cost: $$ (Program development and implementation, and staff costs for ongoing implementation)

Performance Measures:
1) Develop a coordinated permitting process for water quality-related infrastructure improvements.

2) Number of aquatic habitat restoration projects

ACTION PO-4.3 (New 2007)
Encourage opportunistic and cost-effective stream and wetland function restoration and enhancement in existing drainage infrastructure of urban areas around the Estuary.

Who: State Water Resources Control Board, Regional Water Quality Control Boards, California Department of Fish and Game, U.S. Environmental Protection Agency, U.S. Fish

and Wildlife Service, National Marine Fisheries Service, U.S. Army Corps of Engineers, local agencies, and the environmental community

What: The drainage infrastructure of the urban areas of the San Francisco Estuary is an amalgamation of gutters, pipes, ditches, impervious areas (roofs, roads, and parking lots), permeable areas, detention basins, pump stations, water supply reservoirs, streams, and tidal sloughs. As this infrastructure is replaced or upgraded, there are cost-effective opportunities for adding enhancements that would provide numerous water quality and restoration benefits. This complex infrastructure conveys stormwater runoff, as well as dry weather urban runoff, to the aquatic ecosystem. In most cases, the design of this infrastructure is solely based on reducing the risk of flooding, minimizing the retention time, and maximizing peak flows. This design results in lower travel time and less reduction of pollutants prior to discharge to aquatic habitats. It also results in destructive peak flows that increase erosion and siltation and can damage property near stream and wetland systems.

Some parts of the urban drainage system, particularly reservoirs and detention basins, are conversely designed to retain water for various purposes, but sometimes this water can stagnate and cause increased water temperatures, reduced oxygen, and perhaps mercury methylation problems in the downstream aquatic habitats. Often the stagnation is a byproduct of lack of attention, infrastructure maintenance, monitoring, and simple management.

As infrastructure, the drainage system in urban areas tributary to the San Francisco Estuary requires maintenance and periodic capital improvements. While the upper reaches of the infrastructure are on private property and more difficult to control, a substantial portion of it is within the jurisdiction and ownership of public agencies that spend millions of dollars annually to maintain and upgrade it. Pipes, gutters, and roadside ditches need periodic repair and/or replacement. Detention basin capacities need to be maintained. Pump stations need to be maintained and periodically upgraded or replaced. These are all controllable water quality factors that are on various schedules to be upgraded or replaced. Some private developments and redevelopments do lend themselves to better design for hydrologic functions, for instance through the existing urban runoff programs' new and redevelopment post-construction stormwater treatment requirements.

As municipalities and special districts implement capital improvement plans to improve elements of the public drainage system, they should be encouraged to enhance stream and wetland functions as part of the capital expenditures. Projects should be reviewed by local agencies from a hydrologic standpoint to take advantage of opportunities to reduce stagnant waters that deplete oxygen, methylate mercury, and create mosquito problems. Detention basins and reservoirs should be designed and operated to minimize these adverse effects by installing aeration devices or better managing the flow rates and patterns for water quality. For this effort, the local agencies should be afforded regulatory credit for the proposed voluntary urban runoff control measure described in Action PO-4.1, above.

There is an opportunity to improve stream and wetland functions as public drainage projects are implemented, which are usually built to reduce local flooding. These projects should have measures incorporated to slow the storm flows that incise stream channels and destroy habitat, and to enhance natural functions in the open channel portions of the drainage system, creating enough capacity for both natural functions and peak flows. Underground pipes

should be replaced with open channels with natural functions wherever feasible. Pump stations should be designed and operated to mimic natural flow regimes and not as episodic washout events of waters containing low levels of dissolved oxygen. Pollutant removal systems should be considered in every pump station upgrade in order to enhance the water quality of the urban runoff pump station discharges.

When: Ongoing

Cost: $$$$ (a 3 percent to 5 percent add-on to existing capital improvement budgets to enhance pollutant removal functions)

Performance Measures:
1) Develop a set of affordable, easily maintainable best management practices for urban runoff pump stations and detention basins.

2) Percentage of municipalities with best management practices installed that improve drainage and increase infiltration and other natural hydrologic functions (via survey).

Dredging and Waterway Modification

Goals:

- Eliminate unnecessary dredging activities.
- Maximize the beneficial reuse of dredged material.
- Conduct dredging activities in an environmentally sound fashion.
- Continue to develop and implement a comprehensive Sediment Management Strategy for "dredging and waterway modification."
- Manage modification of waterways to avoid or offset the adverse impacts of dredging, flood control, channelization, and shoreline development and protection projects.

Problem Statement

Sediment management in the San Francisco Bay has improved from the Gold Rush days of hydraulic mining and the more recent "Mudlock" period (a time when fishing boats and citizens concerned about degradation of Bay fisheries blocked the Alcatraz disposal site in the 1980's), to the creation and implementation of the multi-agency Long Term Management Strategy (LTMS) program. Increasingly, the process of governing how dredging and other waterway modification activities occur in the Estuary is more closely scrutinized and also more collaborative. However, given the major human-induced alterations that have already occurred to the physical character and biological resources of the San Francisco Bay Estuary (the Estuary) and the myriad of existing and future pressures on the system, a comprehensive approach to sediment management in the Estuary is increasingly important.

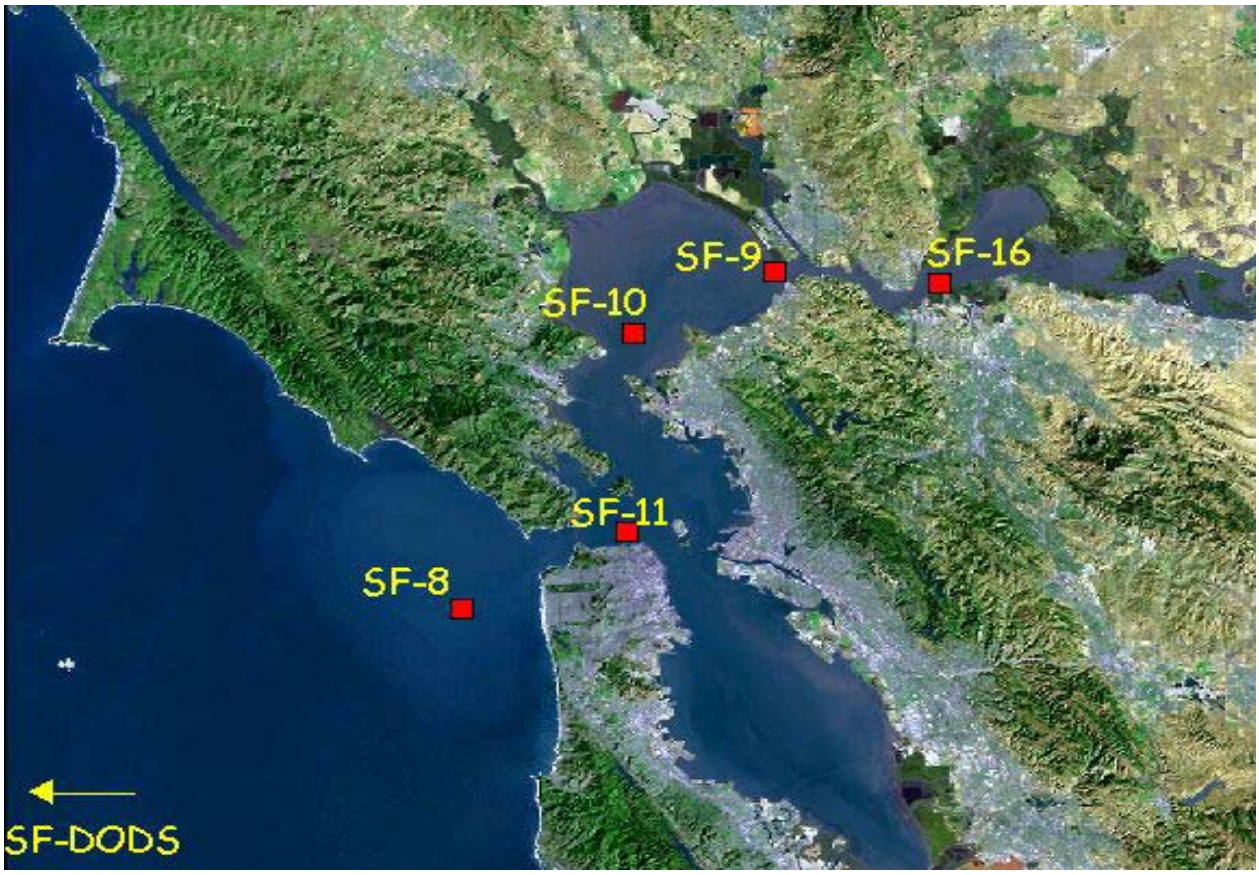
Sediment dynamics and processes in the Estuary have been drastically altered by human activities. Modification first began with hydraulic gold mining in the 1800's, which brought huge quantities of sediment into the Estuary, resulting in blocked waterways and increased storm flooding. From the late 1800's to the mid 1900's, most of the Estuary's historical tidal marshes were diked or filled to be used for agriculture, duck clubs, salt ponds, and urban development. These activities have reduced the tidally influenced area by 60 percent and caused most of the remaining slough channels to silt up. In recent decades, further changes to both the natural sediment regime and to the hydrologic patterns that transport sediment have occurred as a result of channelization, shoreline rip-rapping, and the construction of large-scale dams and flood control projects throughout the Estuary and its tributaries. Dredging and sand mining projects have also potentially contributed to changes in sediment movement and deposition.

Each year, an estimated 4,000 commercial ocean-going vessels[2] move through the San Francisco Estuary carrying over 75 million tons of cargo[3] worth approximately $20 to $25 billion.[4] These vessels depend on deepwater ports and shipping channels in the Bay and Delta, which must be dredged annually to maintain their navigability. The total volume of material dredged annually from channels, ports, and marinas in the Estuary has decreased from approximately 8 million cubic yards (cy) in 1993 to just over 4 million cy as of 2006 (including the San Francisco Main Ship Channel outside the Golden Gate). Of the 19 mcy of one-time new work dredging that was anticipated in the 1993 CCMP, most projects have either been completed or put on hold. The Oakland Harbor Navigation Improvement Project (a.k.a. the 50 Foot Deepening Project) is- currently in progress and the Baldwin Ship Channel

[2] The Marine Exchange of the San Francisco Bay Region (http://www.sfmx.org).
[3] U.S. Army Corps of Engineers' Navigation Data Center -Waterborne Commerce Statistics Center website (http://www.iwr.usace.army.mil/ndc/wcsc/wcsc.htm). Volumes are based upon data from 2005.
[4] The Metropolitan Transportation Commission's *Regional Goods Movement Study for the San Francisco Bay Area: Final Summary Report*, December 2004 (http://www.mtc.ca.gov/planning/rgm/).

is still under consideration. Few anticipated projects remain that involve large volumes of new dredging work. However, there is an increasing demand for new work dredging and deepening in smaller marinas around the Bay Area as these facilities strive to accommodate deeper draft boats.

Historically, dredged material from navigation channels have been disposed of at the various in-Bay disposal sites and expected to disperse with currents and tidal action. In the 1980's, mounding at the region's primary disposal site, SF-11, near Alcatraz Island (See Figure 1), and increasing concerns regarding the impacts of dredging and dredged material disposal on the Bay's aquatic organisms, water quality and other ecological resources, highlighted the need for improved management of and alternative disposal options for dredged material.



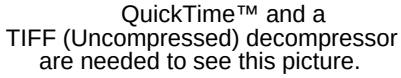
(Figure 1. Designated dredged material disposal sites for the San Francisco Bay region.)

Consequently, In the 1990's, the *Long-Term Management Strategy (LTMS) for the Placement of Dredged Material in the San Francisco Bay Region* was developed by the Bay regulatory agencies, resource agencies and numerous stakeholders involved in Bay dredging and disposal to better manage dredging and dredged material disposal in the Bay. It involved over thirty different participants, including government agencies, environmental organizations, development interests, ports, and fishing organizations. The LTMS was led by an Executive Committee of the Corps of Engineers' South Pacific Division Commander, the Environmental Protection Agency's Regional Administrator, the Chairs of the San Francisco Bay Regional Water Quality Control Board and the San Francisco Bay Conservation and Development Commission, and a State Coordinator. This group was regularly advised on pertinent issues by the Policy Review Committee.

The LTMS established a new management approach with the goal of reducing in-Bay disposal by encouraging beneficial reuse of dredged materials whenever and wherever possible. In addition, the LTMS has worked with the U.S. EPA to establish the federally authorized Deep Ocean Disposal Site (SF-DODS) as another alternative to in-Bay disposal. Since 1993, the LTMS has coordinated with agencies and private entities alike to use approximately 8 million cubic yards of dredged material in beneficial reuse projects such as the Hamilton Wetlands Restoration Project, the Oakland Middle Harbor Enhancement Project, the Sonoma Baylands Restoration Project, the Montezuma Wetlands Restoration Project, and the Ocean Beach Demonstration Beach Nourishment Project as well as a variety of other levee rehabilitation projects.

The LTMS has also worked to increase its understanding of the impacts of dredging and disposal on Bay biota and habitat by implementing more effective testing protocols for dredged material, funding ongoing technical studies and collaborating with the resources agencies in order to better regulate the timing and methods of dredging activities to protect Bay biota.

In 1998, the LTMS agencies jointly prepared an EIR/EIS to evaluate potential management strategies. In 1999, the LTMS was adopted in the federal Record of Decision (ROD) signed by the USACE and USEPA and was subsequently included in the San Francisco Bay RWQCB's Water Quality Control Plan (Basin Plan) amendments and BCDC's San Francisco Bay Plan (Bay Plan). In 2001, agencies released the LTMS Management Plan that describes the steady reduction of in-Bay disposal of dredged material from 2.8 million cubic yards (mcy) to approximately 1.25 mcy by 2012 (See Figure 2). A programmatic review of the LTMS occurs every three years, with each six-year review involving the consideration of policy amendments, if necessary, in order to ensure that the program is working effectively and that the LTMS goals are being implemented. In addition the LTMS Management Plan serves as a "living document" which is periodically updated to reflect emerging concerns and to guide the collective decision-making of the LTMS agencies.



(Figure 2: LTMS in-Bay disposal volume targets during the 12-year Transition Period. Every three years, the annual disposal volume limit automatically decreases by 387,500 cy.)

As of 2007, the LTMS continues to focus on increasing beneficial reuse of dredged materials. Despite the success of recent beneficial reuse projects in the Bay Area, there is a growing need to find ways to substantially increase the number of beneficial reuse opportunities especially in the next five years as the LTMS endeavors to complete its goal of reducing in-Bay disposal to one million cubic yards per year. One of the biggest constraints to maximizing beneficial reuse is the need for adequate and reliable funding at the state and federal level.

Another emerging issue is the potential of a sediment debt in the Estuary. Due to a variety of factors, such as increasing water diversions upstream of the Delta and morphologic and hydrologic alterations to the major tributaries and rivers that transport sediment into San Francisco Bay, the Estuary may be receiving decreasing volumes of sediment. Decreasing sediment inputs could impede wetland formation and increase erosion of existing habitats. Erosion of California's beaches (for example at Ocean Beach in San Francisco) is an ongoing issue and the sources and sinks of Bay sands are poorly understood. Adequate sediment input into the Estuary will be increasingly important as the rate of sea level rise continues to accelerate and storms become more intense. An adaptive, collaborative sediment management approach such as the LTMS, that addresses all aspects of Bay sediment dynamics is critical to address the impacts of global climate change and other human-induced changes in Bay sediment dynamics. The use of suitable dredged sediments in wetlands restoration projects and other appropriate strategies should be used to respond to a potential sediment deficit. The LTMS agencies will continue to study sediment dynamics in the Estuary to better address these types of emerging issues.

Existing Regulatory Structure

The U.S. Army Corps of Engineers (the Corps) has primary responsibility for maintaining navigable waters in the United States. The Corps' review of proposed dredging activities considers impacts of proposed activities on navigation, fish and wildlife, conservation, pollution, aesthetics, and the general public interest. The National Environmental Policy Act (NEPA) of 1969 and the California Environmental Quality Act (CEQA) of 1970 requires environmental assessment of each permit application and the preparation of an environmental impact statement where the assessment indicates significant environmental impacts. In 1972, Section 404 of the Clean Water Act and Section 103 of the Marine Protection, Research, and Sanctuaries Act (MPRSA) gave the Corps the primary authority to regulate dredging and disposal activities, authority to issue permits for discharge of dredged material into inland and near-coastal waters of the United States, and permitting authority over the transportation of dredged material for dumping into coastal waters and open ocean.

The Clean Water Act and the MPRSA also assign the U.S. Environmental Protection Agency (U.S. EPA) a major role in the management of dredged material. Section 102 of the MPRSA grants U.S. EPA authority to designate ocean disposal sites and cooperate with the Corps in the development of criteria for evaluation of environmental impacts of proposed disposal activities. Section 404 of the Clean Water Act requires U.S. EPA to perform similar functions in the regulation of dredging activities in estuaries and other inland waters. U.S. EPA, in cooperation with the Corps, has developed guidelines for evaluation of environmental impacts of dredged material discharges and responsibility of reviewing permit applications and providing comments to the Corps.

The State Water Resources Control Board (SWRCB) and its nine Regional Water Quality Control Boards (RWQCBs) regulate water quality in California. Activities affecting water quality are evaluated by the State and Regional Boards. As part of the environmental review specified by the Clean Water Act, Section 401 requires state water quality agencies to verify that a dredged material discharge will not violate water quality standards.

The state McAteer-Petris Act (1965) created the San Francisco Bay Conservation and Development Commission (BCDC) and gave it permitting authority for dredging and filling activities in San Francisco Bay. BCDC reviews proposed activities to ensure compliance with the Bay Plan.

The State Lands Commission (SLC) administers public trust lands in coastal waters (within a three-mile state territorial limit) and other tidal and submerged areas. Written authorization from SLC must be obtained prior to dredging or depositing dredged material on lands under SLC jurisdiction.

Various government agencies are involved in the review of dredging applications and provide comments to the permitting agencies including the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the U.S. Coast Guard, the California Department of Fish and Game, and the California Coastal Commission. Under Section 7 of the federal Endangered Species Act, federal agencies such the Corps are required to consult with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service on activities that may adversely affect federally listed species and their habitat before issuing dredging

permits. Similarly, Sections 2091 and 2081 of the California Endangered Species Act require state agencies to consult with the California Department of Fish and Game before permitting activities that may have adverse impacts on state listed species and their habitats. Local government agencies have jurisdiction over some types of dredged material disposal and beneficial reuse activities.

A 1996 amendment to the Magnuson-Stevens Act now requires the National Marine Fisheries Service and regional fishery management councils to minimize, to the extent practicable, adverse effects to Essential Fish Habitat (EFH) caused by fishing or dredging activities. The Act requires federal agencies such as the Corps to consult with the National Marine Fisheries Service about actions that could affect EFH.

The LTMS Management Committee continues to manage implementation of the LTMS and ~~it~~ maintains strong public involvement through the participation of interested parties and stakeholders at regularly held meetings and through several workgroups composed of LTMS stakeholders.

As part of the LTMS effort, the Dredged Material Management Office (DMMO) was created in 1995. It is a joint program of the BCDC, the San Francisco Bay RWQCB, the State Lands Commission, the Corps, and the U.S. EPA. Also participating are the California Department of Fish and Game, the National Marine Fisheries Service, and the U.S. Fish and Wildlife Service. The purpose of the DMMO is to make the dredging permitting process more efficient and less cumbersome for applicants and agencies alike. This is accomplished by (1) joint review of project-specific sampling and analysis plans and review of the results of the sediment quality sampling, (2) joint review of suitability determinations for material proposed for disposal in San Francisco Bay (See Figure 2) and (3) allowing applicants to fill out one application form, which the agencies then jointly review at bi-weekly meetings before issuing their respective authorizations. The DMMO is also intended to increase efficiency and coordination between the member agencies and to foster a comprehensive and consolidated approach to handling dredged material management issues.

The LTMS is designed to develop technically feasible, economically prudent, and environmentally acceptable long-term solutions over the next fifty years. Ocean, in-bay, and upland disposal sites will be evaluated, as well as the potential for using clean dredged materials to create wetlands or restore levees.

Capitalizing on the valuable work of the LTMS many of the dredging activities recommended in the 1993 Dredging and Waterway Modification program were drawn from its workplan. In addition, activities to specifically address waterway modification were developed such as shoreline protection and the acquisition of buffer areas. This program is intended to comprehensively address both dredging and waterway modification actions.

Achievements, 1993-2007

LTMS Goals

- Maintain in an economically sound manner those channels necessary for navigation in San Francisco Bay and Estuary and eliminate unnecessary dredging.
- Conduct dredged material disposal in the most environmentally sound manner.
- Maximize the use of dredged material as a beneficial resource.
- Establish a cooperative permitting framework for dredging disposal and applications.

Since the initiation of the LTMS program, substantial progress has been made in implementing the LTMS and toward meeting the program's overall goals. Allowable in-Bay disposal volumes have been reduced by more than 50 percent compared to pre-LTMS volumes, and actual in-Bay disposal in recent years has been about one-third of historical levels. In 1994, the San Francisco Deep Ocean Disposal Site (SF-DODS) was designated as an alternative to in-Bay disposal. The site is in waters nearly 10,000 feet deep and 55 miles off the coast of San Francisco, deeper and further offshore than any other designated ocean disposal site in the country. To date, over 10 mcy of material has been successfully diverted to SF-DODS and extensive annual monitoring indicates that there have been no significant adverse impacts at the site. Dredged sand has also been successfully diverted to the SF-8 disposal site for beach replenishment, immediately outside the Golden Gate in the city and county of San Francisco. In addition, since the inception of the LTMS program, new upland and wetland re-use projects have been approved, implemented and/or expanded. As of March 2007, over 9 mcy of material has been delivered to these beneficial re-use sites, which include:

- Hamilton Wetlands Restoration Project, Marin County – a 2400 acre seasonal tidal wetland restoration project
- Sonoma Baylands Salt Marsh Restoration Project, Sonoma County – a 322 acre tidal wetland restoration project
- Montezuma Wetlands Project, Solano County – a 2398 acre wetland and mixed habitat restoration project
- Winter Island Levee Rehabilitation Project, Contra Costa County – a levee rehabilitation project to protect approximately 450 acres of managed wetlands
- Sherman Island, Sacramento County – a levee rehabilitation project
- Oakland Middle Harbor Enhancement Project, Alameda County – an eelgrass sub-tidal habitat restoration project
- Ocean Beach Demonstration Beach Nourishment Project, San Francisco County – a beach restoration project designed to prevent coastal erosion

LTMS-Funded Scientific Studies

The LTMS continues to fund and implement scientific studies on dredging and disposal issues including data gaps related to environmental work windows, mercury methylation potential and management, disposal plume tracking and modeling, effects of dredging plumes on herring eggs, and juvenile salmon distribution in the Estuary.

Regulatory Improvements

The interagency Dredged Material Management Office (DMMO) has successfully created more efficient regulatory procedures, that have facilitated the processing of hundreds of dredging and disposal projects while still ensuring that LTMS targets are met and that federal and state permit requirements are implemented. The DMMO also posts electronic permit applications and guidance documents online, is developing a database for tracking project specific data, and produces annual reports each year to evaluate program performance.

The LTMS has developed tools to help dredgers and contractors fulfill their permit requirements while also meeting LTMS disposal targets. The Integrated Alternatives Analysis (IAA) reduces paperwork and encourages planning for beneficial reuse of dredged material by evaluating a permittee's overall dredging program. The Small Dredger Programmatic Alternatives Analysis (SDPAA) reduces paperwork and costs for small dredging operations, and expedites the processing of permits without reducing environmental protection.

The LTMS program includes Environmental Work Windows, which are those areas and times when dredging and disposal will have less potential impact on sensitive Bay fish and wildlife. Dredgers able to work within the Work Windows need not consult separately with the resource agencies. Prior to 2001, only about 50% of dredging work was being performed during work windows. But by 2003, 80% of dredging work was performed within the work windows and the percentage has increased in the last few years demonstrating the success of the program. In 2005, the LTMS completed additional programmatic consultation with the U.S. Fish and Wildlife Service in order to clarify work windows. From 2006 to the present, additional programmatic consultation with the National Marine Fisheries Service has been in progress to clarify work windows further and to include the green sturgeon as a new federally listed species.

The Inland Testing Manual for Dredged Material (ITM) was issued by the EPA and the Corps in 1998 to provide comprehensive guidance to evaluate the potential for contaminant-related impacts associated with dredged material disposal into open water. Since 1998, the DMMO agencies have issued a number of public notices (PN99-3, PN01-01, etc.) to provide additional regional guidance.

Challenges

Despite the significant progress that the LTMS has made in its coordinated and collaborative approach to sediment management since 1993, the next decade will bring emerging and ongoing challenges that will need to be addressed on a regional scale in order to continue to reduce in-Bay disposal, maximize beneficial reuse and meet the LTMS targets.

One of the biggest constraints to maximizing beneficial reuse is the need for adequate and reliable funding at the state and federal level. Decreasing dredging budgets and federal policies that favor open-water disposal are continuing problems. Improved state and federal policies and funding for beneficial reuse are needed. Achieving cost parity between the expense of beneficially reusing material versus disposing of it in-Bay would allow more dredgers (especially small dredgers) to participate in beneficial reuse projects.

Another challenge is the lack of disposal options for contaminated dredged materials. Rehandling sites are needed for the small but persistent volumes of dredged material that have elevated contaminated levels and cannot be used in the available reuse projects nor disposed of at the open water disposal sites.

Lastly, understanding and managing human impacts to sediment sources, movement and sinks in the Estuary is increasingly important in the face of global climate change and resultant sea level rise. As sea level continues to rise more rapidly as a result of global climate change, increased flooding and erosion and additional alterations to waterways and sediment processes are likely to occur. This is a particular concern to remaining wetlands and wetland restoration projects in the Estuary that need adequate sediment supplies to adapt to sea level rise. Delta islands are especially vulnerable to catastrophic flooding because of land subsidence and the increased risk of levee failure.

Dredging and Waterway Modification Actions

Objective DW-1

Determine the behavior and fate of sediments in the Estuary and adopt policies to manage their modifications.

ACTION DW-1.1 (Revised 2007)
Conduct studies, research-modeling and analysis of sediment processes and trends to more thoroughly understand sediment transport in San Francisco Bay particularly in light of sea level rise and changing sediment inputs from the Delta and major tributaries.

Who*:* LTMS agencies, U.S. Geological Survey, California Coastal Conservancy, National Oceanic and Atmospheric Agency, California Ocean Protection Council, San Francisco Estuary Institute, academic researchers, project proponents

What: To better understand the behavior and fate of sediments in the Estuary, the following activities were conducted as part of the LTMS workplan or are proposed or ongoing by others:

- Identify and summarize quantitative models available for application in the Estuary and the current status and variety of existing numerical modeling. As necessary, conduct tracer studies to define the short- and long-term transport of suspended particles from estuarine disposal sites. (LTMS Phase II, Task 3, Work Element F) (Completed)
- Calculate an annual sediment budget for the period 1956 to 1990 and project next fifty years. Calculate the distribution of in-bay deposits and loss to the ocean by difference between input and net accumulation. Obtain annual maintenance dredging volumes to relate annual sediment supply to maintenance requirements. (LTMS Phase II, Task 3, Work Element F) (Ongoing)
- Conduct field and laboratory studies to characterize suspended and dt1>°sited sediment. Complete detailed hydrographic surveys of navigation and disposal areas for verification of sediment transport models. (LTMS Phase II, Task 3, Work Element F) (Completed)

- Measure sediment afflux and influx through the Golden Gate over time, including major import or export events, to determine suspended sediment losses. (LTMS Phase II, Task 3, Work Element F) (To be performed)
- Develop three-dimensional sediment transport models that could be incorporated into existing two-dimensional models. (LTMS Phase II, Task 3, Work Element F) (Ongoing)
- Map Estuary bathymetry and sediment types, such as the Ocean Protection Council's California State Waters Mapping Project and the USGS' San Francisco Bay Project.
- Measure inputs from tributaries and exchange with the coastal ocean over time.
- Study sediment processes, particularly between tidal flats and wetlands.
- Encourage higher resolution geographic information systems (GIS) and other geospatial data collection efforts throughout the Bay to establish accurate baseline data for bathymetry, sediment composition, etc.

Further field studies and modeling efforts should be conducted to develop a more comprehensive knowledge base of sediment transport and deposition across the whole Estuary.

When: Ongoing

Cost: $$ (Type of cost = Multiple projects and studies; Level of uncertainty = Highly uncertain – high resolution mapping costs are probably higher and more variable that other research costs)

ACTION DW-1.2 (1993 CCMP)
Conduct studies on sediment changes aimed to define accumulation and erosion processes on beaches and in marsh and mudflat areas.

Who: U.S. Geological Survey (lead), LTMS agencies, National Marine Fisheries Service, California Coastal Conservancy, academic researchers, and project proponents

What: **S**tudy estuarine sediment dynamics with particular focus on processes acting in near-shore areas. Identify trends in accumulation and erosion of sediment and what management practices may be responsible for those trends. Also, pursue further research to determine potential impacts of large-scale sediment removal activities, both sand and muds, on sediment processes in San Francisco Bay. Integrate these efforts with the LTMS and other sediment research efforts.

When: Ongoing

Cost: $$ (Type of cost = projects and studies; Level of uncertainty = Cost likely in the low millions range but is fairly uncertain and dependent on geographic range and data richness of all the studies.)

ACTION DW-1.3 (Revised 2007)
Continue to adopt and improve policies to manage modification of estuarine sediment production, movement, and deposition.

Who: Lead and responsible agencies under CEQA and NEPA (i.e., U.S. Army Corps of Engineers, San Francisco Bay Regional Water Quality Control Board, San Francisco Bay Conservation and Development Commission, and the State Lands Commission)

What: Require applicants for waterway modification and sediment removal projects to avoid or minimize, where appropriate, project impacts on sediment production, movement, and deposition through development of erosion and sediment control plans and state and federal permits.

- Condition project approvals to avoid adverse impacts to estuarine sediment dynamics.

When: Ongoing

Cost: No direct costs

Objective DW-2

Determine the bioavailability of contaminants released by disposal of dredged material through methods such as bulk chemistry assays, toxicity bioassays, and bioaccumulation tests.

ACTION DW-2.1 (Revised 2007)
Conduct laboratory and field bioaccumulation investigations and studies on suspended sediment effects on sensitive life stages throughout the food chain.

Who: LTMS agencies, resource agencies, academic researchers, and project proponents

What: To better understand the effects of suspended sediment and bioaccumulation on aquatic species, the following activities were developed as part of the LTMS workplan:

- Prepare a detailed bioaccumulation study plan and conduct field investigations to produce a baseline bioaccumulation survey with conclusions about the levels of aquatic species contamination related to deposited and suspended sediment conditions. (LTMS Phase II, Task 3, Work Element G) (Completed)
- Conduct tests with pelagic eggs of fish species representative of those that spawn in San Francisco Bay. Eggs/embryos/larvae of other species representative of species that spawn in the Estuary might also be considered. (Ongoing)
- Document the distribution of suspended sediment in time and space from individual and multiple disposal activities in relation to long-term background concentrations of suspended sediments in the Central Bay. Hydraulically dredged sediment from hopper dredges and mechanically dredged sediment from barges will be monitored. All the data will be evaluated from a mass balance approach to assess the distribution of disposal-related suspended sediments and the role of disposal operations in the suspended sediment in the Central Bay. (LTMS Phase II, Task 3, Work Element G) (Ongoing)

- Develop a risk assessment model to determine the impacts of dredging and disposal activities on EFH and ESA species

The LTMS is continuing to develop a list of studies to address similar topics for future research.

When: Ongoing

Cost: $ (Type of cost = projects, studies; Level of uncertainty = fairly certain based on small number of studies needed)

ACTION DW-2.2 (Revised 2007)
Develop and set sediment quality objectives.

Who: State Water Resources Control Board, LTMS agencies

What: Coordinate with the State Water Resources Control Board's required efforts to establish sediment quality objectives for enclosed bays and estuaries that define when test results are considered to be significant in predicting an adverse environmental effect.

When: In-progress

Cost: $ (Type of cost = staff time; Level of uncertainty = fairly uncertain due to unknown number of additional staff hours required)

ACTION DW-2.3 (New 2007)
Use information on ambient concentrations of contaminants in San Francisco Bay sediments to help assess the amount of material suitable for beneficial reuse.

Who*:* LTMS agencies

What: Use the Dredged Material Management Office (DMMO) data on sediment results and coordinate with the Regional Monitoring Program and the San Francisco Bay Regional Water Quality Control Board's Toxic Hot Spot Cleanup Plan (Cleanup Plan) to effectively assess regional sediment quality and sediment concentrations for contaminants of concern throughout San Francisco Bay.

When: Ongoing

Cost: $ (Type of cost = staff time; Level of uncertainty = fairly uncertain due to unknown number of additional staff hours needed)

Performance Measure(s)*:* 1) Percentage of the Bay that has been sampled and quantified for contaminant concentrations 2) Percent increase in material used for beneficial reuse.

ACTION DW-2.4 (New 2007)
Address sediment quality and contaminant issues on a regional scale.

Who: LTMS agencies, Central Valley Regional Water Quality Control Board

***What*:** Use existing sediment quality data to assess the location of toxic "hot spots" throughout the Estuary and develop a plan to address them. Coordinate with the San Francisco Bay RWQCB's and Central Valley RWQCB's Regional Toxic Hot Spot Cleanup Plans (Cleanup Plans) (created under the Bay Protection and Toxic Cleanup Program).

When: Ongoing

Cost: $ (Type of cost = staff time, plan development; Level of uncertainty = fairly uncertain due to unknown number of hours needed)

Performance Measure(s): 1) Number of hot spots that have been identified in the Estuary 2) Volume of contaminated sediments removed from these spots.

Objective DW-3

Develop a comprehensive regional strategy to better manage dredging and waterway modification and ancillary activities.

ACTION DW-3.1 (Revised 2007)
Develop a dredge project needs assessment and, as necessary, a prioritization plan, including structural and nonstructural methods to minimize volume requirements.

Who: LTMS agencies, project proponents

What:

- Compile long-term dredging volume estimates for all federal projects, public and private ports, marinas, and harbors. Prioritize the disposal needs of each individual dredging project. ($25,000) (Completed)
- Identify alternative dredging practices ~~and~~ general design considerations and potential new technologies (e.g. shallow draft transports) for new projects and recommend modifications for existing projects to reduce dredged material volumes. Require implementation of the dredging design modifications for all applicable projects through the Clean Water Act Section 404 permitting process. (LTMS Phase II, Task 3, Work Element C) ($22,000) (Completed for several Corps projects)
- Address issues relating to maintaining authorized project depths while minimizing need for dredging, resulting when isolated shoaling can cause ship draft restrictions soon after dredging is completed.

When: Ongoing

Cost: $ (Type of cost = Project, staff time; Level of uncertainty = Highly uncertain since each project will vary in scale and amount of staff time needed)

ACTION DW-3.2 (Revised 2007)
Identify dredged material reuse and non-aquatic disposal opportunities and constraints and develop funding mechanisms to enable reuse and non-aquatic disposal opportunities to occur.

Who: LTMS agencies, U.S. Congress

What: The following tasks were developed as part of the LTMS workplan:

- Complete a comprehensive inventory of geographic sites that are suitable for reuse and/or disposal alternatives. Include preliminary cost estimates for the range of sites, review existing state or federal bonds available for restoration projects, and identify monetary benefits and intrinsic value to the public of created habitats. Working with local agencies, constraints on potential reuse sites such as laws, regulations, agency policies, engineering impediments, and environmental considerations, including contaminants, wetland impacts, endangered species, etc., will be evaluated. (LTMS Phase II, Task 2, Work Element B) (5200,000) (Completed)
- Document procedures necessary to evaluate acceptable material type, consistency, and contaminant levels for reuse projects; coordinate with regulatory and resource agencies to share information and achieve agreement(s). Estimate amount of material not acceptable for aquatic and unmanaged or unconstrained non-aquatic disposal. Identify potential benefits and impacts resulting from disposal on terrestrial, wetland, and aquatic ecosystems. Plan and conduct field/ laboratory experiments/demonstrations as needed to determine effectiveness and feasibility of dredged material reuse techniques. (LTMS Phase II, Task 3, Work Element D) ($790,000) (Completed)
- Develop site-specific conceptual reuse/non-aquatic disposal plans. Provide preliminary engineering, with cost estimates, for site improvements, unloading facilities, transportation improvements, site preparation, and maintenance. Develop "value-added" guidelines to determine intrinsic value to the public for restored or created wetlands. Develop "capitalization" programs for dredge material reuse projects, such as federal or state bonds to pay for reuse projects. (LTMS Phase II, Task 3, Work Element E) ($500,000) (Completed)
- The United States Congress should continue to authorize and appropriate funding for the U.S. Army Corps of Engineers to implement upland disposal and reuse sites within the Estuary. In addition, incentives should be developed for private disposal and wetland restoration opportunities. (Ongoing)

The LTMS will continue to increase capacity for and practicability of beneficial re-use and will work to identify opportunities and overcome constraints in order to maximize the potential for beneficial reuse of dredged materials.

When: Ongoing

Cost: $ (Type of cost = Program and policy implementation; Level of uncertainty = highly uncertain since dependent on Congressional participation and the scale and number of potential beneficial reuse projects is variable)

ACTION DW-3.3 (Revised 2007)
Develop land use procedures to promote reuse of dredged material, wetlands restoration and/or creation, and other beneficial uses.

Who: LTMS agencies, local land use agencies, and regulatory agencies

What: Evaluate state, regional, and local land use agencies' long-term plans with respect to promoting the beneficial reuse of dredged material for projects such as wetlands restoration/creation. Make recommendations to local land use agencies for procedures to promote the beneficial reuse of dredged material while avoiding or mitigating for impacts to existing natural resources. Follow up with active effort to obtain adoption of recommended procedures by local agencies.

When: Ongoing

Cost: $$ (Type of cost = Policy action, staff time; Level of uncertainty = Highly uncertain due to unknown number of hours and unknown number of land use agencies to participate)

ACTION DW-3.4 (Revised 2007)
Identify the aquatic and terrestrial resources that are affected by dredging and disposal and are to be protected in the Bay and Delta. (cross-reference to the Aquatic Resources program)

Who: LTMS agencies

What: Establish and document existing resources and beneficial uses to be protected. Document health and distribution of resources to be protected. Conduct a two-day intensive workshop on the impacts to resources and beneficial uses caused by dredging. Document effects of dredged material disposal on resources of concern. (LTMS Phase II, Task 2, Work Element A) ($50,000) (Completed)

The LTMS will continue to support science studies on the potential impacts of dredging and disposal on aquatic and terrestrial resources. In addition, the LTMS agencies will coordinate with regional efforts like the Subtidal Habitat Goals Project.

When: Ongoing

Cost: $$ (type of cost = policy action, staff time; level of uncertainty = fairly uncertain due to unknown number of studies required)

ACTION DW-3.5 (Revised 2007)
Identify appropriate dredged material reference sites for use in development of sediment testing protocols.

Who: LTMS Agencies

What: The LTMS and the EPA have developed databases to store sediment quality data for the Alcatraz Disposal Site (SF-11) and the Deep Ocean Disposal Site (SF-DODS). The

LTMS will continue to increase its data gathering potential in order to further refine sediment testing protocols.

When: Ongoing

Cost: $ (Type of cost = staff time; Level of uncertainty = fairly uncertain since unknown whether extraordinary costs and staff time will be needed to increase data gathering efforts)

ACTION DW-3.6 (Revised 2007)
Evaluate retention and removal needs for derelict structures in the Bay and Delta especially abandoned and sunken vessels and dilapidated pile-supported structures.

Who: the U.S. Army Corps of Engineers, San Francisco Bay Conservation and Development Commission

What: Various derelict structures along the shoreline are affecting sediment transport and local navigation. A comprehensive inventory should be completed to assess the feasibility of removing these structures on a case-by-case basis.

When: Ongoing

Cost: $ (Type of cost = Policy action, project implementation/mitigation; Level of uncertainty = fairly certain)

ACTION DW-3.7 (1993 CCMP)
Continue to implement and, as needed, develop new regulatory and management policies for Estuary sediment removal and placement projects and only allow projects that are consistent with the state's existing policies in the San Francisco Bay Plan and in the San Francisco Bay and Central Valley Basin Plans.

Who: Estuary regulatory, planning, and resource agencies and dredging project sponsors

What: Local, state, and federal agencies should modify their policies regarding dredging activities as needed to ensure that they are consistent with the policies of the San Francisco Bay Conservation and Development Commission's San Francisco Bay Plan and the respective Basin Plans of the San Francisco Bay and Central Valley Regional Boards. Ports and other dredging sponsors should plan and conduct dredging activities consistent with the state's dredging policies.

When: Ongoing

Cost: No direct cost

ACTION DW-3.8 (New 2007)
Standardize and consolidate the procedural aspects of dredging permit conditions, where possible, among the relevant agencies.

Who: LTMS agencies

What: Permit conditions in each of the regulatory agencies' permits often overlap (e.g., sampling efforts, monitoring, times of the year that they can work, reporting requirements, etc.) and can differ in their procedural aspects (e.g., dates to submit monitoring reports, post dredge survey formats, etc.). Complete LTMS-funded study to assess and catalog required permit conditions for each of the regulatory agencies, identify overlapping and/or conflicting procedural aspects of these permit conditions, and develop coordinated permit conditions. Then, LTMS agencies should identify how they will use these consolidated permit conditions in the issuance or their respective permits.

When: In-progress

Cost: $ (Type of cost = project, staff time; Level of uncertainty = fairly certain since project is underway)

Performance Measure(s): 1) Percentage of permits and percentage of total volume of removed material that has been authorized under this system 2) Number of guidance documents developed to facilitate implementing standardized conditions

ACTION DW-3.9 (New 2007)
Continue to identify and evaluate when and how in-place knockdowns should be used as an alternative to dredging.

Who: LTMS agencies

What: A knockdown is an activity involving the leveling or spreading of shoaled or mounded material in order to maintain a waterway rather than directly removing material from that waterway. Differentiate between in-place knockdowns and dredging activities and develop better protocols for when knockdowns may be appropriate to use. Additionally, identify the potential impacts of in-place knockdowns on habitat and aquatic resources and compare to the potential impacts of regular dredging activities.

When: Ongoing

Cost: $ (Type of cost = studies, policy action; Level of uncertainty = fairly certain due to known range of studies to be conducted to evaluate this issue)

Performance Measure(s): 1) Number of studies conducted on the potential impacts of knockdowns (output) 2) Number of projects that evaluated knockdown and dredging alternatives to determine the option with the least environmental impact

Objective DW-4

Encourage, support and implement the beneficial reuse of dredged material for projects such as wetlands creation/restoration, levee rehabilitation, landfill cover, and upland building material where environmentally acceptable.

ACTION DW-4.1 (Revised 2007)
Continue to implement the LTMS goal to maximize the use of dredged material as a beneficial resource.

Who: LTMS agencies

What:

- List all available disposal options (See Appendix A for *Status and Trends Report on Dredging and Waterway Modification)* and document studies performed to date that are specific to each option and the Estuary disposal requirement. Identify disposal options feasible for the Estuary together with potential disposal capacity and document unfeasible options. (LTMS Phase II, Task 1, Work Element A) ($25,000) (Completed)
- Prepare cost estimates to a preliminary level (Plus or minus 25 percent) for the dredging/disposal combinations under consideration. Develop a cost-estimating model covering the mobilization, excavation, hauling, disposal, and monitoring costs for the main dredging/disposal techniques under consideration. Develop methods for capitalization of costs considering funding by ports versus other methods, such as federal or state bonds. (LTMS Phase II, Task 3, Work Element B) ($18,000) (Completed)
- Summarize disposal options identified from previous actions. Categorize specific disposal options into management options and develop evaluation criteria. Criteria should consider environmental, engineering/economic, and institutional/regulatory factors. (LTMS Phase II, Task 4, Work Elements A, B) ($20,000) (Completed)
- Select dredged material disposal options. Evaluate alternative dredged material disposal approaches based on engineering, economic, and environmental criteria. Select the most practicable dredged material disposal option or options and provide the necessary documentation needed to support this selection. Develop site-specific management plans for the selected options, including site environmental and capacity monitoring, permit requirements, mitigation plans, operation procedures, guidance for site use, and delineation of site management responsibilities. (LTMS Phase III, Tasks 1, 2, and 3) (Completed)
- Develop implementation component for dredged material disposal plan. The implementation plan should include administrative, procedural, management, and monitoring requirements; environmental documentation for the life of the plan; long-term water quality certification, site specific and regional permits and authorization; formalized regional mitigation strategies; and implementation of site management requirements. (LTMS Phase IV) (Completed)
- Periodically re-evaluate the selected dredged material disposal plan based on changing regulatory, economic, environ- mental, and technological conditions. This review is to assure that decision-makers will maintain a viable implementation

strategy that reflects changing conditions throughout the fifty-year implementation timeframe. (LTMS Phase V) (Completed)

- Continue to support new beneficial reuse options and identify potential beneficial reuse sites throughout the Bay Area (e.g. South Bay Salt Pond Project levees), including cost estimates and alternative disposal methods. Conduct periodic review as necessary.
- Continue to implement the LTMS transition to reduced in-bay disposal and increased beneficial reuse in the Bay Area, and develop a tracking system to determine whether or not these goals are being met.
- Identify funding opportunities and constraints for potential beneficial reuse projects.
- Provide adequate funding for beneficial reuse at a regional and national level and amend policies that constrain beneficial reuse.
- Monitor wetlands where dredged material has been beneficially reused to assess project impacts and habitat functionality (e.g. sedimentation rates, success of native plant colonization, Methyl mercury creation, etc.). (Cross-Reference to Wetlands Program – Action WT-5.2)

When: Ongoing

Cost: $$ (Type of cost = Program implementation, monitoring; Level of uncertainty = highly uncertain due to unknown cost of monitoring, unknown number of beneficial projects, and unknown funding sources and amounts)

Performance Measure(s): 1) Volume of sediment used in beneficial reuse projects on an annual basis (Output) 2) Number of new active beneficial reuse sites annually (Output)

ACTION DW-4.2 (Revised 2007)
Maintain and improve local guidance and implementation for testing that is consistent with the federal Inland Testing Manual and the "Ecological Evaluation for Dredged Material Proposed for Ocean Disposal in the Marine Environment (a.k.a. the "Ocean Testing Manual" or the "Green Book") and continue to refine testing procedures and protocols for beneficial reuse and upland environments.

Who: U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, San Francisco Bay Regional Water Quality Control Board, San Francisco Bay Conservation and Development Commission, and State Lands Commission

What: The LTMS and Dredged Material Management Office (DMMO) agencies should continue to issue public notices and other documents when necessary to provide guidance and updates on testing protocols and procedures for both open-water disposal and beneficial reuse of dredged material.

When: Ongoing

Cost: No direct cost

ACTION DW-4.3 (Revised 2007)
Continue to implement sand replenishment projects like the Corps' Ocean Beach Demonstration Beach Nourishment Project.

Who: U.S. Army Corps of Engineers, U.S. Environmental Protection Agency

What: The Corps' Ocean Beach Demonstration Beach Nourishment Project has been achieving successful implementation since 2005. There is an increasing threat of coastal and estuarine erosion due to increasing storm events and sea level rise and management actions should be taken to address this threat.

- Implement more beach and sediment nourishment projects around the Bay Area to prevent massive sediment loss from important habitat. Both short-term pilot projects and ongoing programmatic projects should be pursued depending on the severity of the erosion issue and the success of the initial management action.
- Investigate the relationship between sand extraction and the potential for impacts on beach erosion.

When: Ongoing

Cost: $ (Type of cost = project development and implementation; Uncertainty = uncertain due to unknown number of potential projects and unknown volume of material to be placed)

Performance Measure(s): 1) Number of site(s) that have been designated 2) Number of cy of material that are reused at the site(s) annually.

Objective DW-5

Identify threats to and benefits for Estuary resources from future modifications to waterways.

ACTION DW-5.1 (Revised 2007)
Determine areas subject to flooding and erosion and identify causes. In particular, identify those areas most vulnerable to the effects of global climate change and sea level rise, evaluate the potential impacts, and identify potential management measures for these areas.

Who: The U.S. Geological Survey and local governments for local subsidence, U.S. Environmental Protection Agency for global changes

What:

- Submit a report that identifies areas subject to extreme wave events.
- Determine relative sea level change by: 1) quantifying local elevation changes along the shoreline; and 2) determining the most supportable estimate for change in global sea level.
- Identify buffer areas to accommodate coastal flooding.
- Identify management measures to minimize coastal erosion.

When: Ongoing

Cost: Unknown

ACTION DW-5.2 (Revised 2007)
Implement waterway modification policies that protect shoreline areas from detrimental flooding and erosion while maintaining natural resource values and while anticipating the potential effects of global climate change and sea level rise.

Who: U.S. Army Corps of Engineers, Federal Emergency Management Agency, Department of Water Resources, San Francisco Bay Conservation and Development Commission, the Delta regulatory agencies, and local governments

What: Adopt enforceable policies that require preservation, where possible, of upland areas to 1) provide adequate flood plain buffers and/or transition habitat zones or 2) allow space to build or enlarge protective levees or other flood control structures or 3) allow adequate space for marsh transgression and migration as a result of seal level rise. These policies may be enacted through local zoning, the U.S. Army Corps of Engineers, the Federal Emergency Management Agency, and the Department of Water Resources.

When: Ongoing

Cost: $$ (Type of cost = staff times, policy action; Level of uncertainty = highly uncertain due to unknown extent of increased flooding and rate sea level rise)

ACTION DW-5.3 (1993 CCMP)
Establish a program to acquire diked historic bay lands listed as buffer areas for coastal flooding and to adapt to sea level rise. (Cross-referenced to Wetlands Program)

Who: State Legislature, California Coastal Conservancy, land trusts, and State Lands Commission, San Francisco Bay Joint Venture, and private foundations

What: Bond and mitigation funds should be provided to purchase diked baylands that can serve as buffer areas for rising sea level or that could be used to mitigate for erosion *of* tidal marsh.

When: Ongoing

Cost: $$$ (Type of cost = land acquisition, program development and implementation; Level of uncertainty = highly uncertain due to unknown amount of land acquisition)

ACTION DW-5.4 (New 2007)
Conduct studies and research as necessary to address the potential impacts of new waterway modifications (e.g., wave, tidal and subtidal power generation facilities, Aquatic Transfer Facility, wind power generation facilities, LNG extraction, etc.) on the estuary and evaluate and potential avoidance and mitigation measures.

Who: Project proponents, permitting agencies

What: Evaluate project proposals involving new waterway modifications as needed in order to address the potential impacts they may have on aquatic organisms, habitat, sediment dynamics, and water quality. Develop appropriate management measures to eliminate or mitigate for these impacts.

When: Ongoing

Cost: $$ (Type of cost = project; Level of uncertainty = highly uncertain

Performance Measure(s): 1) Number of studies conducted for each proposed activity 2) Number of impact avoidance and mitigation measures that have been proposed or implemented.

ACTION DW-5.5 (New 2007)
Evaluate potential cross-media impacts of dredging and waterway modification activities and evaluate mitigation options.

Who: LTMS agencies, other appropriate agencies, project proponents

What: Consider potential cross-media impacts when evaluating projects and work with project proponents to assess mitigation options to offset impacts as appropriate.

When: Ongoing

Cost: $ (Type of cost = policy action, staff time; Level of uncertainty = highly uncertain due to difficulty of quantifying and mitigating cross media impacts)

Performance Measure(s): 1) Percentage of projects that have identified and quantified cross-media impacts 2) Percentage of projects that have established and implemented mitigation measures to address cross-media impacts.

ACTION DW-5.6 (New 2007)
Identify and minimize potential vectors for the spread of non-native and invasive species due to dredging and waterway modification activities. (Cross reference to Wetlands Sections – Action WT-4.2)

Who: LTMS agencies, San Francisco Estuary Institute, academic researchers, project proponents

What: Disturbance of sediments and habitat due to dredging and waterway modification activities may create a potential for the proliferation of non-native species. The transportation, disposal or beneficial reuse of dredged material may also contribute to the colonization of non-native species. Applicants and project proponents should be required to evaluate these potential impacts and management measures should be developed to address them when appropriate.

When: Ongoing

Cost: $ (Type of cost = policy action, staff time; Level of uncertainty = fairly uncertain since number of staff hours required is unknown)

Performance Measure(s): 1) Percentage of projects that have assessed the potential vectors for exotic species spread or colonization 2) Percentage of projects incorporating documented management measures to prevent the establishment or spread of non-native species.

ACTION DW-5.7 (1993 CCMP)
Conduct modeling and field studies to determine the saltwater intrusion impacts caused by dredging projects.

Who: U.S. Army Corps of Engineers and project proponents

What: Conduct modeling and field studies to determine saltwater intrusion impacts caused by dredging projects. Based on the results of the studies, manage dredging projects to minimize the impacts caused by saltwater intrusion. Require project expansions and future projects to mitigate for significant saltwater intrusion impacts as identified during the CEQA/NEPA process.

When: Ongoing

Cost: $ (Type of cost = studies; Level of uncertainty = fairly certain due to small number of studies and minimal staff time needed)

ACTION DW-5.8 (New 2007)
Encourage greater collaboration on scientific research projects and sharing of data and results within the LTMS community and use these findings to inform decision-making process.

Who: LTMS agencies, academic researchers, San Francisco Estuary Institute, private researchers, and the California Coastal Conservancy

***What*:** Conduct an annual Scientific Research Symposium to present the results of LTMS-funded and LTMS-related scientific studies. The symposium should contribute to the LTMS' program review by:

- Evaluating progress towards identifying and implementing beneficial reuse sites.
- Using new data to improve management of dredged material.
- Identifying potential topics for further research and funding constraints and opportunities for more technical studies.

When*:* Ongoing

Cost*:* $ (Type of cost = staff time, project implementation; Level of uncertainty = fairly certain

Performance Measure(s): 1) Frequency of the symposium 2) Number of people representatives from agencies, environmental research institutes/universities, and stakeholder groups who regularly attend the symposium 3) Percentage of emerging policy/regulatory issues for which data collection and analysis was conducted and completed.

Objective DW-6 (New 2007)

Develop a strategy to better understand sediment management, dredging, and waterway modification in the Delta.

ACTION DW-6.1 (New 2007)
Continue to develop, fund and implement the Delta Long-Term Management Strategy (Delta LTMS) Program.

Who: U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, Delta regulatory agencies, and stakeholders

What: The LTMS is limited to the Bay Region and does not include the Sacramento/San Joaquin Delta. The Delta is an important source of sediment supply to the Bay and efforts are underway to formulate a strategy for managing and restoring the Delta. Changes in Delta management could have large impacts on Bay sediment supply. There has been great interest in implementing an LTMS for the Delta. Currently in its formative stages, a Delta LTMS will be critical to both working to understand potential changes in sediment supply to the Estuary and in developing sediment management policies and goals for the region.

When: In-progress

Cost*:* $$$ (Type of cost = program development and implementation; Level of uncertainty = highly uncertain due to unknown scale of program, number of agencies involved, etc.)

Performance Measure(s): 1) Number of agencies and stakeholders participating in the Delta LTMS (output) 2) Number of policy documents (EIS/EIR, management plan, etc.) developed to support and guide the Delta LTMS program (output).

Land Use and Watershed Management

Goals:

- Establish and implement land use and transportation patterns and practices that protect, restore, and enhance watershed processes and functions, the Estuary's open waters, wetlands, tributary waterways, and essential upland habitats.

- Coordinate and improve planning, regulatory, and development programs of local, regional, state, and federal agencies to protect natural resources and improve the health of the Estuary and its watersheds.

- Adopt and utilize land use policies, including transportation patterns, that provide incentives for more active participation by the public and the private sector in cooperative efforts that protect and improve the Estuary and its watersheds.

Problem Statement

A number of problems impact Bay Area watersheds today. They include pollution of surface and groundwater sources; decreased infiltration; flooding, hydrologic disruption and aquifer draw-downs; loss of upland open space, riparian areas, and wetlands; and potential for catastrophic wildfires. These watershed issues, in turn, impact the health of aquatic and terrestrial wildlife, the Estuary itself, and the security and future availability of water supplies.

The population of the twelve-county San Francisco Estuary Project planning area is projected to increase by more than two million people during the next three decades. This growth and the corresponding changes in land uses will have direct and indirect impacts on the health of the Estuary and its surrounding watersheds. These impacts will include increased pollutants from point and nonpoint sources; alteration of hydrologic processes, such as infiltration, runoff, and stream flows; and impacts to associated vital habitats, such as wetlands and stream environments.

Why are healthy watersheds important?

The watersheds of the San Francisco Bay Area provide an ecological framework for considering how land and water management interact to affect the health of the Estuary and its uplands. A watershed is an area in which all the waters within it drain into one body of water. Bay Area watersheds consist of a series of nested watersheds at varying scales. Watersheds include wetlands, riparian areas, and uplands. Watersheds are the fundamental building blocks of the landscape, serving as the natural "consolidator" of all activities affecting water quality, runoff, and infiltration; hydrology; stream and wetland habitats; aquatic species; and other resources and conditions.

Protection of watersheds must consider uplands, riparian areas, floodplains, wetlands, lakes, streams, and the Estuary. Upland protection is necessary to minimize excessive sediment transport downstream, minimize pollutant inputs into waterways, and protect springs and other hydrologic features. Riparian protection provides for filtration of water pollutants, temperature moderation, stream bank stabilization and erosion control, maintenance of channel integrity, and sediment storage. Floodplain protection is also critical to protecting the resilience of watersheds and water bodies from flood events and from the effects of global climate change, such as sea level rise and changes in the timing and magnitude of rainfall.

Healthy watersheds help protect natural resources and environmental quality, maintain ecological processes, and contribute to the social and economic well-being of our communities.

How has land use contributed to current watershed conditions?
Many of our wetlands, creeks, and lakes, as well as the Estuary itself, are still adjusting to historical changes in land use, such as hydraulic mining, grazing, farming, and urbanization. The introduction of livestock grazing resulted in the replacement of native perennial grasses with exotic annual species and potential changes to infiltration and hydrology, disturbance of streams and riparian vegetation, pathogens, and nutrient loadings to watersheds. Mining debris continues to work its way from the lower river reaches and the Delta through the Golden Gate. During the 1800s and into the 1900s, a period of intensified agriculture caused creeks to be moved, wetlands drained, water tables lowered by abundant wells, and dams built, all of which have modified the natural watershed hydrology.

Reservoir development has also affected fluvial and hydrologic processes. Construction of on-stream reservoirs results in sediment buildup, which reduces downstream sediment transport and creates an imbalance. In response, streams and reservoirs downstream of dams often erode their banks and incise into their channel bottoms in search of sediment to carry and to re-establish equilibrium.

Urban development and expansion of impervious surfaces and drainage density (miles of connected runoff pathways per unit area) have affected stream channels, the magnitude and frequency of floods, and groundwater recharge functions. All these modifications have decreased the extent of perennial creeks, increased the loss of riparian habitat, and caused extirpations of native fish and other wildlife. They have also increased the amount of water and sediment sent to the lower reaches of our watersheds. Although these problems evolved over decades of land use change, there has been significant progress at state and local levels to improve planning, management, and protection of watersheds.

What successes have we had?
1) The link between watershed processes/functions, water quality, and land use is becoming more widely known among regulatory agencies, planners, building department staff, and developers.

2) New tools for implementation of best management practices (BMPs) are in place. Geographic information systems (GIS) have become an effective tool for watershed assessments and land use planning.

3) People increasingly value aquatic resources and are rediscovering and reclaiming river and Bay shorelines and recognizing their public values (e.g., riverfront redevelopment, Bay Trail).

4) Bayland Ecosystem Habitat Goals are being implemented. More than 15,000 acres of baylands have been acquired for restoration (see Wetlands Program, WT-1.2).

5) The number of watershed stewardship groups has increased substantially, and watershed stewardship activities, such as creek cleanups, creek day-lighting, and restoration, have increased correspondingly. Public understanding of the term “watersheds” has increased dramatically over the past few years.

6) Watershed and Estuary health continue to be improved through stormwater runoff management techniques implemented by public works departments and stormwater agencies.

7) Many governments throughout the region have adopted “green building” and “low-impact design” standards for municipal buildings, and “green business” models are taking hold in the agricultural sector (e.g., fish-friendly farming).

8) The Long-Term Management Strategy for dredged material is being implemented, especially the beneficial reuse of dredged materials (see Dredging and Waterway Modification Program).

9) Local land use policies related to stream protection are being promulgated and implemented, and habitat goals reports are being developed at various levels of detail for upland areas and Bay Area streams.

10) Additional coordination and information transfer forums have emerged (e.g., Bay Area Water Forum; Integrated Regional Water[shed] Management guidance; North Bay Watershed Association).

11) State legislation and bonds have memorialized the importance of watershed management, of resource protection, the value of local watershed groups and watershed-based activities, and the need for watershed planning and management. Since 1996, voters have approved more than $20 billion for water and habitat conservation (Propositions 204, 12, 13, 40, 50, 1E, and 84). These included about $1 billion for watershed protection, which resulted in grants for Bay Area watershed activities from CALFED agencies, the State Water Resources Control Board, the California Coastal Conservancy, and others.

12) The California Resources Agency and the California Environmental Protection Agency sponsored numerous forums, symposia, and seminars with stakeholders and partners, including the California Watershed Management Council and the CALFED Watershed Subcommittee, to support local watershed planning and management. In response to these, the state developed a strategic plan to implement recommended improvements to state programs.

Additional opportunities exist to improve protection of Bay Area watersheds as jurisdictions plan for more growth. State, regional, and local policies could add or strengthen watershed protection objectives and provide greater direction for planning programs, tools, and fiscal incentives related to new development and redevelopment. Zoning can direct development away from sensitive habitats and restore landscape features needed for watersheds to function. Improved technologies and new construction practices can be implemented to minimize surface and stormwater runoff. Habitat and open space conservation can be

designed to maximize hydrologic and flood protection benefits. Transportation within existing corridors and public transit improvements can also benefit water quality and habitat protection. Finally, enforcement of existing regulations can be improved.

What challenges do we face?

Watershed protection requires integrated, multi-stakeholder, multidisciplinary approaches, because no single agency has all the authority or capacity needed for comprehensive watershed planning and management. Unfortunately, existing institutions have not typically operated this way in the past.

1) The lack of a common vision and approach for watershed protection may be the biggest challenge. Protection of the San Francisco watershed requires an understanding and integration of watershed management and protection activities throughout the region. This will require definitions of watershed health that reflect watersheds of different scales, clarifications of how actions in smaller watersheds contribute to the health of regional watershed functions, and how policies and actions at the regional level can support grassroots watershed protection activities. A shared understanding of watershed issues and goals should be developed through collaborative processes and must be informed by science.

2) Systematic monitoring approaches that measure progress toward quantifiable goals are lacking. Often, investments in resource protection and restoration of watershed processes and functions are applied without appropriate performance measures in place that could indicate whether or not desired conditions are being achieved. Monitoring is also one of the last things funded, and the first dropped when funding runs short. Monitoring is critical, however, to measuring and reporting success, making needed adjustments, and to securing continued support from the public.

3) Agency mandates and jurisdictions are often defined narrowly. Local agencies may be reluctant to undertake watershed-scale planning and projects because they require working with many other local jurisdictions. Agencies may have watershed objectives that appear to conflict with those of other agencies (e.g., flood control versus sediment recruitment for marshes and beaches).

4) Agency resources, including providing the staff and resources needed to sustain stakeholder processes, can be problematic.

5) Failure to consider watershed complexity and to integrate approaches may be resulting in activities or projects that do not work, produce unintended impacts, or prove counter-productive. For example, rules are made to stop erosion while streams that are hungry for sediment eat their banks and beds, and tidal marshes are starved of the sediment needed to keep up with sea level rise. The way water flows downhill naturally has been manipulated through creek and river alterations, often without anticipating how straightening channels, constricting flows through levees, narrowing floodplains, and diverting water may affect maintenance costs or risks to life and property.

Billions of dollars are spent on flood control while developers are allowed to continue to build on floodplains and in low coastal regions susceptible to inundation as sea level rises.

Ongoing watershed degradation threatens downstream watershed restorations. There is a focus on cleaning polluted habitats that are disappearing due to permitted land uses.

6) Watershed protection needs to be incorporated into many types of local and regional resource protection and development plans. Many plans and activities are in place or already underway that depend on maintaining healthy watersheds. These include wetland restorations; upland habitat preservation; water quality protection and total maximum daily loads (TMDLs) implementation; endangered species recovery actions, habitat conservation plans (HCPs), and natural community conservation plans (NCCPs); and levee protection and flood control. There are also multiple individual watershed management plans that may warrant coordination, integration, or at least regional information sharing.

7) State and federal funding specifically for "watershed" activities is diminishing, and watersheds are not a traditional responsibility for most local agencies. Recent bond funds have not explicitly designated as much funding for watershed activities as earlier propositions. Proposition 84, however, provides $138 million to the Bay Area for regional water planning that allows for watershed management activities and related natural resource protection. Therefore, it is critical that the integral role of watershed protection and management be linked to environmental protection, habitat and species conservation, water supply and management, flooding and public safety, and public health. Working with private interests to understand how healthy streams and watersheds can revitalize their communities and contribute to social and economic well-being will also be critical.

Recommended Approach

The following actions are designed to improve planning and management of the lands surrounding the San Francisco Bay and Sacramento-San Joaquin Delta to protect and enhance the health of the Estuary. The actions recognize the importance of integrating management of the Estuary with the existing functions of state, regional, and local governments. Furthermore, these actions reflect a need to protect and enhance the Estuary while striving to ensure a sustainable economy.

First, actions are identified that would use existing mechanisms to improve the way that state government plans for and manages the resources of the Estuary. These include amendments to state laws and policies and integration of estuarine planning with major initiatives, such as growth management and regional biodiversity. Second, actions are identified that would improve the efficiency and effectiveness of land use decision making through improved regional integration. These include using existing regional entities, such as the Delta Protection Commission, encouraging growth in appropriate areas, and researching future population change. Third, actions are identified to undertake watershed planning to implement land use practices that are geographically targeted, locally tailored, and cost effective. Fourth, actions are identified to improve land use practices through education. Finally, actions are recommended to provide local government with adequate financial support for implementation and to establish economic incentives for resource protection.

Land Use and Watershed Management Actions

Many of the actions identified below will require additional financial resources and technical assistance that must be provided to local governments to enable effective implementation. Actions identified under Objective LU-5 specifically address the provision of financial resources to local government. Refer also to "Chapter 4: Implementation" for further detail regarding financing actions.

Objective LU-1

Use existing institutional capacity to improve planning, regulatory, and development programs of local, regional, and state agencies to protect the resources of the Estuary, in concert with a sustainable economy.

ACTION LU-1.1 (Revised 2007)
Local land use jurisdiction's General Plans should incorporate watershed protection goals for wetlands and stream environments and to reduce pollutants in runoff.

Who: Local governments and Governor's Office of Planning and Research

What: Goals, policies, and programs should more fully integrate Watershed Protection Plans and Stormwater Management Plans into local General Plans to protect wetlands and stream environments and reduce pollutants in runoff. To facilitate this integration in a uniform and consistent manner, state guidelines[5] should be referenced for data and analysis, development policies, and technical assistance. These tools are useful when developing an optional water element with watershed-based policies, or to use a mandated element, such as the safety element.

Watershed-based policies are suggested for maintaining healthy and functional watersheds, ranging from land use designations (or minimum parcel sizes) that protect floodplains, recharge areas, riparian corridors, wetlands, and other ecologically significant lands to erosion control policies and standards to maintain water quality. Setbacks from riparian corridors, lakes, ponds, and wetlands are typical, as are low-intensity land uses that maintain rainwater and runoff infiltration functions in groundwater recharge zones or water supply watersheds. Watershed-based policies also provide an opportunity to integrate state and federal requirements for protection of wetlands and endangered species habitat. The Watershed Protection Plans would be developed as specified in Actions LU-2.6 and LU-2.6.1.

When*:* Ongoing–2016

Cost: $$; substantial cost savings could be achieved through a countywide approach.

[5] State of California, Governor's Office of Planning and Research, *State of California General Plan Guidelines* (2003), www.opr.ca.gov/planning/PDFs/General_Plan_Guidelines_2003.pdf.

Performance Measures:
1) Percentage of cities/other government entities with adopted General Plan revisions that include watershed goals, such as protection of flood zones, riparian areas, groundwater recharge areas, etc. (via annual survey)

2) Percentage of General Plans including Ahwahnee Principles (via annual survey)

ACTION LU-1.1.1 (New 2007): ***Provide assistance to local agencies to ensure that applicable nonpoint source control elements are incorporated into local government and business practices.***

Who: Regional Water Quality Control Boards, State Water Resources Control Board, California Coastal Commission, San Francisco Bay Conservation and Development Commission, counties and cities, and special districts

What: State and local agencies should provide funds and assistance to local government to implement California's Nonpoint Source Pollution Plan[6] that deals with diffuse (nonpoint) sources of pollution in conformance with federal requirements.[7] The Nonpoint Source Plan includes sixty-one nonpoint source management measures, such as low-impact development, restoration of hydrologic processes, and zoning for stream and wetlands protection. After the initial five-year implementation phase of the Nonpoint Source Plan, agencies should provide tools (including expanded financing options) and guidance for prioritizing applicable elements of the Nonpoint Source Plan and incorporating that guidance into specific local codes and operation/maintenance manuals. This will minimize the adverse influences of many land use practices on water quality and beneficial use attainment.

When: 2007–2010

Cost: $$; staff resources needed for tech transfer and guidance

Performance Measures:
1) Number of adopted codes, manuals, training and certification programs, and tracking systems that incorporate principles of the Nonpoint Source Implementation Plan by city and county jurisdiction (via annual survey)

2) Knowledge of Nonpoint Source Implementation Plan and where to get help in order to address NPS issues (via survey to local governments)

[6] California Environmental Protection Agency, State Water Resources Control Board, *Nonpoint Source Pollution Control Program*, www.swrcb.ca.gov/nps/protecting.html.
[7] [Federal requirements are found in the] *Clean Water Act* (CWA) and the *Coastal Zone Act Reauthorization Amendments of 1990* (CZARA), Section 6217.

ACTION LU-1.2 (Revised 2007)
Amend the California Environmental Quality Act (CEQA) Guidelines[8] to add simple and concise criteria for assessing flooding impacts and the effect of cumulative environmental impacts on the Estuary when adopting or reviewing General Plans or Local Coastal Plans.

What: The CEQA checklist should be improved to ensure that projects are evaluated for flood impact pursuant to current state policy.[9] Particular attention should be given to improving the checklist for addressing flooding impacts under the Hydrology and Water Quality section of Appendix G of the CEQA Guidelines.

The California Resources Agency should also amend the California Environmental Quality Act Guidelines to add simple and concise criteria for assessing the cumulative environmental impacts on the Estuary and its watersheds, including floodplains within the twelve Bay Area and Delta counties, when adopting or reviewing General Plans or Local Coastal Plans. CEQA should require project proponents to define major cumulative impacts and should set forth concise criteria for evaluating these classes of impacts, including data to be collected and analyzed. The criteria should address potential impacts to wetlands, streams, and water quality. These Guidelines should apply at the General Plan level in portions of the Estuary planning area where watershed protection plans have not been prepared and certified (as specified in LU-3.1 and 4.3, Watershed Management Plans will include cumulative impact assessment). This is intended to provide an incentive for preparation of Watershed Management Plans.

Who: California Resources Agency, Councils of Governments, and Regional Water Quality Control Boards

When: Immediately

Cost: $$ (uncertainty in staff costs, printing)

Performance Measures:
1) Update CEQA checklist to include flooding impact evaluation.
2) Number or percentage of environmental impact reports/environmental assessments that consider impacts to flood attenuation capabilities

ACTION LU-1.3 (Revised 2007)
Integrate protection of the Estuary and its watersheds with other state land use-related initiatives and policies.

Who: State agencies and local governments

[8] *California Environmental Quality Act* (CEQA), Appendix G, Environmental Checklist Form, ceres.ca.gov/topic/env_law/ceqa/guidelines/Appendix_G.html.
[9] State of California, Department of Water Resources, *California Floodplain Management Report* (2002), recommendation #37, page 46, fpmtaskforce.water.ca.gov/.

What: All state entities involved in economic and infrastructure development must ensure consistency with state planning priorities in accordance with state guidance[10] and its enabling legislation.[11] This includes demonstrating that consistency annually to the Governor's office or legislature and to the California Department of Finance when requesting infrastructure funding. Since watersheds, floodplains, and wetlands are recognized by the state as deserving special protection, infrastructure planning should avoid impacts to their values and functions. Additional legislation[12] requires sustainable planning principles that both the state agencies and local governments are to incorporate into their planning and also requires these planning principles to govern state funding for infrastructure projects.

When: Ongoing

Cost: $ (staff resources at Governor's Office of Planning and Research to work with each state agency to ensure consistency with state goals and priorities)

Performance Measure:
Percentage of state agencies with functional plans and their degree of consistency with state planning priorities

ACTION LU-1.4 (New 2007)
Promote coordinated permitting processes among federal, state, and local programs to encourage and expedite restoration and stewardship activities by local agencies, citizens, and nonprofit conservation groups and organizations.

Who: U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Marine Fisheries Service, the Natural Resource Conservation Service, California Department of Fish and Game, San Francisco Bay Conservation and Development Commission, Regional Water Quality Control Boards, Association of Bay Area Governments, Resource Conservation Districts, and local governments

What: Agencies should schedule joint reviews of prospective grant proposals and projects in the early planning stages to reduce conflicts and overall consultations. Agencies should ensure that single application processes, such as the Joint Aquatic Resources Permit Application (JARPA), are reviewed in a timely fashion. Individual agencies should work together more closely to provide programmatic environmental impact reports, certifications, and permits for restoration programs and practices. Multiple permitting agencies should establish processes for permit coordination for specified activities at watershed or regional scales.

The benefits of a coordinated approach have been demonstrated by a partnership's success in getting agricultural landowners to implement erosion control best management practices in Elkhorn Slough by coordinating all necessary state and federal permits, making site reviews available to all regulatory agencies, and providing for quality control assurance. Some counties and resource conservation districts have developed a coordinated permit process for

[10] State of California, Governor's Office of Planning and Research, *Governor's Environmental Goals and Policy Report* (2003), www.opr.ca.gov/EnvGoals/PDFs/EGPR--11-10-03.pdf.
[11] California Government Code Section 65041.
[12] AB 857 (Wiggins), Chapter 1016, Statutes of 2002.

projects on agricultural lands that includes coordinated site visits by permitting agencies, pre-project design review, and permits issued for an annual group of projects.

Landowners, local agencies, restoration professionals, watershed groups, and others have asked that Bay Area agencies better coordinate permitting processes to encourage and facilitate restoration projects, best management practices, and stewardship activities to protect and restore habitats, water quality, and watersheds. These activities may also be used to assist in total maximum daily load implementation and for stormwater management, and should include:

1) Steps should be taken to improve the use and efficiency of the Joint Aquatic Resources Permit Application (JARPA) by requesting the Association of Bay Area Governments to reconvene agencies to update JARPA and by asking agencies to recommit to using it.

2) The Regional Water Quality Control Boards and other agencies should work with interested stakeholders to implement permit coordination for biotechnical bank stabilization, restoration, and erosion control practices where possible.

3) State, regional, and local county agencies should develop ways to expedite permitting for abandoned mine cleanup in Bay Area and Delta counties.

4) State agencies should work together to develop exemption from CEQA requirements for small restoration projects.

When: Ongoing

Cost: $ (uncertainty: agency staff costs)

Performance Measures:
1) Develop a coordinated permitting process for best management practices (BMPs) construction and other similar projects, based on other successful efforts.

2) Percentage of projects successfully completed due to updated permitting process

3) Percentage decrease in average permit processing time

4) Amount of funding provided to "permit brokers," such as resource conservation districts (RCDs), to coordinate and follow through on permit coordination

ACTION LU-1.5 (LU-3.2 in 1993 CCMP; Revised 2007)
Provide incentives and promote the use of building, planning, and maintenance guidelines for site planning and implementation of best management practices (BMPs) as related to stormwater and encourage local jurisdictions to adopt these guidelines as local ordinances.

Who: Local governments, Regional Water Quality Control Boards, Councils of Government, special districts, San Francisco Bay Conservation and Development Commission, Bay Area Stormwater Management Agencies Association, California Stormwater Quality Association, landowners, and non-governmental organizations

What: Local governments and natural resource and regulatory agencies should cooperate to regularly update and implement consistent guidelines for site planning, landscape design, and water conservation to reduce adverse effects on estuarine resources. Such guidelines should provide consistent and uniform criteria and standards that will include erosion control and pollution prevention measures, designation of appropriate buffer areas, construction and design standards, and guidelines for public access, as well as wetland and riparian protection and enhancement. These guidelines could be patterned after *Start at the Source,*[13] the design guidance manual produced by the Bay Area Stormwater Management Agencies Association and take advantage of complementary existing guidelines already in use (e.g., San Francisco Bay Conservation and Development Commission public access guidelines[14]).

When: Ongoing

Cost: $

Performance Measures:
1) Percentage of local jurisdictions that adopt stormwater management guidelines (modeled after *Start at the Source* guidelines) in governance documents or ordinances that are designed to protect and improve the Estuary (via annual survey)

2) Number of training sessions for local government staff covering these practices

ACTION LU-1.6 (New 2007)
Continue and enhance training and certification for planners, public works departments, consultants, and builders on sustainable design and building practices with the goal of preventing or minimizing alteration of watershed functions (e.g., flood water conveyance, groundwater infiltration, stream channel and floodplain maintenance), and preventing construction-related erosion and post-construction pollution.

Who: Local governments, building associations, Regional Water Quality Control Boards, San Francisco Bay Conservation and Development Commission, Bay Area Stormwater Management Agencies Association, California Stormwater Quality Association, San Francisco Estuary Project, local government commissions, Councils of Government

What: Provide education, training, and certification for local agency staff, civil engineers, planners, architects, and the construction industry on sustainable design principles and building practices, such as those delineated in current guidelines[15] and the Ahwahnee

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[13] Bay Area Stormwater Management Agencies Association (BASMAA), *Start at the Source: Design Guidance Manual for Stormwater Quality Protection* (1999), http://www.basmaa.org/resources/files/Start%20at%20the%20Source%20-%20Design%20Guidance%20Manual%20for%20Stormwater%20Quality%20Protection.pdf

[14] San Francisco Bay Conservation and Development Commission (BCDC), *Shoreline Spaces: Public Access Design Guidelines for the San Francisco Bay* (2005), www.bcdc.ca.gov/pdf/planning/PADG.pdf.

[15] Current guidelines include BASMAA, *Start at the Source*, http://www.basmaa.org/resources/files/Start%20at%20the%20Source%20-%20Design%20Guidance%20Manual%20for%20Stormwater%20Quality%20Protection.pdf; United States Environmental Protection Agency (US EPA), *Low Impact Development Design Strategies: An Integrated*

Principles for Resource-Efficient Communities from the Local Government Commission.[16] Municipal governments should adopt the Ahwahnee Principles or equivalent smart growth building guidelines into local ordinances. Municipalities should also consider developing potential certification programs as part of building permit requirements, in conjunction with the regional municipal stormwater permit and Phase II stormwater permitting strategies.

When: 2006 and ongoing

Cost: Training workshops range from $60,000 to $80,000 annually for organizing and staffing

Performance Measures:
1) Number of training sessions and attendees receiving certification per year

2) Percentage of municipalities adopting and implementing Ahwahnee Principles or equivalent into building/development permits or ordinances (via annual survey)

3) Increase in knowledge of sustainable design and building practices (via survey)

Objective LU-2

Coordinate and improve integrated and regional management for land use, water supply and recycled water, stormwater management and flood protection, habitat and watershed protection, transportation, housing, and physical infrastructure, to both protect the Estuary and its watersheds and provide for a sustainable economy.

ACTION LU-2.1 (Revised 2007)
Regional agencies should develop consistent policies that include anticipated impacts of and responses to global climate change and sea level rise to protect the economic and natural resources of the Estuary and its watersheds.

Who: Councils of Governments, Regional Water Quality Control Boards, San Francisco Bay Conservation and Development Commission, Delta Protection Commission

What: In coordination with local governments, regional agencies, such as the Councils of Governments, the Regional Water Quality Control Boards, the Delta Protection Commission, and the San Francisco Bay Conservation and Development Commission, should establish policies that coordinate land use and transportation patterns and processes in the context of sea level rise and global climate change. Such coordination should promote restoration and preservation of the Estuary and its natural resources, in concert with a sustainable economy.

The regional agencies should establish a consistent framework for local governments to manage uncertainties and risks related to sea level rise, altered rainfall, and runoff patterns; plan for resiliency measures in light of global climate change; and protect: 1) watersheds, 2) stream environments, and 3) wetlands through coordination with local governments, which will be responsible for preparing plans and policies and implementing ordinances that carry

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Design Approach, www.epa.gov/owow/nps/lidnatl.pdf; and San Francisco Bay Regional Water Quality Control Board, *Erosion and Sediment Control Field Manual.*

[16] Local Government Commission, *Ahwahnee Principles,* www.lgc.org/ahwahnee/principles.html.

out the policies. The policies, plans, and ordinances prepared by local governments shall be reviewed by the appropriate state or regional agency. This review would also ensure consistency with federal mandates that address nonpoint source pollution. The resulting local policies and plans should be consistent with the regional plans through a coordinated acceptance process jointly administered by regional commissions and local governments.

When: Ongoing

Cost: $$$$$

Performance Measures:
1) Develop a framework for local governments to manage uncertainties and risks related to global climate change.

2) Number of regional agencies that have included risk management plans related to global climate change in their policy documents (via annual survey)

ACTION LU-2.2 (Revised 2007)
Adopt and implement policies and plans to promote compact, contiguous, and infill development in both the nine-county Bay Area and the three-county Delta region.

Who: Councils of Governments, local and county governments, California Department of Transportation, Metropolitan Transportation Commission, other transit authorities, San Francisco Bay Conservation and Development Commission, and Delta Protection Commission

What: Adopt sustainable development policies, such as "smart growth" and Ahwahnee Principles,[17] that encourage economic development within existing incorporated city limits or existing urban service areas in a manner consistent with protection of the Estuary and its watersheds. Investigate options for accomplishing compact, contiguous development, such as the establishment of clear urban growth boundaries in portions of the nine-county Bay Area and the three-county Delta region. Urban growth boundaries would be intended to create added certainty for communities, landowners, government agencies, and developers, and to provide clearer protection for natural resources than existing state guidelines for the identification of urban sphere-of-influence lines. These policies would also support transit-oriented development and contribute to global climate protection.

Additional options to be investigated for accomplishing compact, contiguous development may include, but are not limited to, tax and zoning incentives, resource protection zones, and infrastructure investment strategies.

As policies and plans are prepared that address land use, population growth, air quality, and transportation, they should be designed to achieve compact, contiguous development. Urban growth should be directed away from resource protection areas, such as wetlands, stream environment zones, and wildlife corridors. Urban growth areas should be identified, and new development encouraged in these areas.

[17] Local Government Commission, *Ahwahnee Principles*, www.lgc.org/ahwahnee/principles.html.

When: Ongoing

Cost: $$$$

Performance Measures:
1) Percentage of jurisdictions that adopt Ahwahnee Principles or similar smart growth goals (via annual survey)

2) Acres of "infill" developments

ACTION LU-2.3 (New 2007)
Adopt and implement regional policies to protect and restore natural floodplains.

Who: Regional Water Quality Control Boards, San Francisco Bay Conservation and Development Commission, California Reclamation Board, California Department of Fish and Game, Delta Protection Commission, U.S. Army Corps of Engineers, and Federal Emergency Management Agency

What: Provide policy guidance and incentives to local governments and local organizations that encourage flooding and land use planning that protects and restores natural floodplains, minimizes risks to lives and infrastructure, and avoids the use of impervious surfaces. These policies should assist with implementation and long-term monitoring of and compliance with regional restoration and protection goals and objectives. The guidance should take into account global climate change to recognize the effects of sea level rise, including Delta impacts.

When: 2007–2020

Cost*:* $$$ (program implementation)

Performance Measures:
1) Percentage of updated General Plans, regulatory policies, and other governing processes that demonstrate floodplain protection and restoration and minimization of impervious surfaces to mitigate the effects of rising sea level and global climate change (via annual survey)

2) Percentage of restored floodplain

3) Percentage of effective impervious area

ACTION LU-2.4 (Revised 2007)
Develop consistent data-gathering and reporting systems for the Land Use and Watershed Management Program performance measures contained in the CCMP. Develop similar data-gathering and reporting systems for the watershed health indicators referred to under Action LU-3.2 that could also be used for scenario-planning.

Who*:* Local government agencies, Regional Water Quality Control Boards, Councils of Governments, Metropolitan Transportation Commission, California Department of Water Resources, Governor's Office of Planning and Research, California Department of Transportation, universities, U.S. Environmental Protection Agency, San Francisco Estuary Institute

What: To better quantify progress on the Land Use and Watershed Management Program of the CCMP, data will have to be collected, assembled, and analyzed to allow tracking and evaluation of the performance measures. Many performance measures are newly included in the CCMP in 2007, and specific action item reporting mechanisms were not in place at the time of CCMP adoption in 1993. The Land Use and Watershed Management Program also calls for the development of watershed health indicators capable of tracking quantifiable goals (see LU-3.2). Once the indicators are developed, a companion system of data collection and analysis will be needed that is capable of linking implementation of policies, programs, and projects to desired environmental and socioeconomic outcomes.

Indicators will only be useful if they can be consistently monitored and reported upon. For forecasting and modeling purposes, the development of a standardized system and appropriate indicators to evaluate future population, land use, and water use changes for the nine Bay Area and three Delta counties is particularly important. The data generated by this monitoring system can be used as input into decision-making tools that can help achieve future desirable land use patterns in accordance with recommendations throughout this program.

When: 2007 and ongoing

Cost:
Performance measure system development: $
Ongoing support: $$

Performance Measures:
1) Develop indicators to track the progress of policy and project implementation.

2) Number of organizations/agencies that adopt indicators and are engaged in tracking progress

ACTION LU-2.5 (New 2007)
Review and update the San Francisco Bay Area Integrated Regional Water Management Plan as needed and ensure that it includes improved land use planning and watershed protection.

Who: Signatories to the San Francisco Bay Area Integrated Regional Water Management Plan, cities and counties, land use agencies, and other stakeholder groups

What: Water supply, flood management, stormwater, natural resource, and water recycling agencies (publicly owned treatment works) developed an Integrated Regional Water Management Plan in 2006 in an effort to realize efficiencies of scope, reduce conflicts among various water management and habitat protection and recovery goals, and identify projects with multiple benefits. Plan preparation was motivated by the funding incentives provided by bond legislation and represents a step toward coordinated project implementation that extends beyond traditional jurisdictional boundaries.

As the knowledge base increases about where opportunities for multipurpose projects are located and what kinds of synergies can be created among projects serving water supply, recycling, flood protection, and aquatic habitat protection needs, the initial plan should be updated as needed and used as guidance for restoration and development projects. The plan should move toward developing performance measures, performance targets, and milestones to ensure achieving them. It should also include revisiting the criteria for projects to provide for increased stakeholder involvement and input, and for the potential impacts of global climate change.

When: 2007 and periodically thereafter as needed

Cost: $ (program updates)

Performance Measures:
1) Number of Integrated Regional Water Management Plan updates that include new candidate watershed protection and restoration projects ready for implementation, with associated documentation

2) Percentage of Integrated Regional Water Management Plan projects with performance measures and other milestones to track progress in implementing the plan's goals

ACTION LU-2.6 (Revised 2007)
Prepare and implement multi-objective Watershed Management Plans that address watershed needs and priorities at varying scales and recognize their different functions and origins.

Who: Local governments and agencies, Resource Conservation Districts, Regional Water Quality Control Boards, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, San Francisco Bay Conservation and Development Commission, landowners, non-governmental organizations, various resource agencies, and other organizations leading watershed management planning efforts

What: Watershed management planning activities, to date, have had different origins and functions that can be grouped into four major, distinct categories:

- Local plans focused on recognized community needs and designed to solve specific issues;

- Plans developed for solving resource conflict issues and intended to meet multiple objectives (e.g., flood protection, water supply reliability, natural resource and water quality protection, recreation);

- Plans as a tool to achieve integration of compartmentalized agency business practices and to break through jurisdictional and programmatic barriers with the goal of achieving economies of scope and scale; and

- Plans to implement regulatory and mitigation requirements.

Regardless of scale and intended initial function, a comprehensive Watershed Management Plan ultimately should serve as an integration tool to address multiple objectives and include the following complementary elements where relevant:

1) Wetlands, riparian, and floodplain protection

2) Habitat and species protection

3) Reduction of pollutants in runoff

4) Flood attenuation

5) Environmental justice

6) Water supply

7) Recreation

Comprehensive Watershed Management Plans should include and integrate existing and emerging plans, programs, and activities that affect or are intended to protect watersheds. For example, a comprehensive Watershed Management Plan should incorporate regional and local nonpoint source action plans, total maximum daily load implementation plans, discharge waivers, stormwater management plans, stewardship and restoration plans, open space and habitat protection plans, implementation plans for stream and wetland system protection policies (see LU-2.7), and other relevant elements.

Watershed Management Plans should be prepared in a manner that is consistent with the relevant goals, objectives, and actions contained in other program area sections of the CCMP, such as Wetlands Management, Pollution Prevention and Reduction, Aquatic Resources and Wildlife. Guidance for developing Watershed Management Plans can be found in many

places. State legislation[18] has defined requirements for "local watershed plans" for the purpose of state grant programs, including a description of natural resource conditions, water quality improvement measures, monitoring and other aspects.

The Regional Water Quality Control Boards suggest best management practices (BMPs) for new development and other guidance that should be included in Watershed Management Plans. Financial and technical assistance should be provided to local governments for preparing and implementing policies, plans, programs, and ordinances relative to the Watershed Management Plans.

When: 2008–2018

Cost: $$$

Performance Measure:
Number of comprehensive and integrated Watershed Management Plans that incorporate goals and objectives of the CCMP

Action 2.6.1 (New 2007)
In order to use comprehensive Watershed Management Plans for site-specific project planning and implementation, these plans should address regulatory needs and identify appropriate mitigation proposals.

Who: Local governments and agencies in collaboration with Regional Water Quality Control Boards, San Francisco Bay Conservation and Development Commission, U.S. Environmental Protection Agency, and U.S. Army Corps of Engineers

What: Local, state, and federal government agencies often have insufficient capacity to guide effective implementation of regulatory requirements and would benefit from comprehensive Watershed Management Plan elements that could facilitate selection of mitigation projects. These plan elements should include:

A. Watershed-scale features, such as aquatic habitat diversity, habitat connectivity, and other landscape-scale functions;

B. Assessment of watershed conditions. The Clean Water Act §332.3. (a) includes the following:

1. Inventory of historic and existing aquatic resources,

2. Identification of degraded aquatic resources,

3. Chronic environmental problems, such as flooding or poor water quality,

4. Sources of watershed impairment,

5. The presence and habitat needs of sensitive and other wildlife and plant species,

6. Current trends in habitat loss or conversion,

[18] California Water Code section 79078.

7. Cumulative impacts of past development activities and current development trends,

8. Local watershed goals and priorities,

9. Identification and/or prioritization of aquatic resources that are important for maintaining and restoring ecological functions of the watershed,

10. Requirements of other regulatory and non-regulatory programs that affect the watershed, such as stormwater management or habitat conservation programs,

11. Identification of immediate and long-term aquatic resource functions within watersheds that can be met through permittee-responsible mitigation projects or mitigation banks, including the types and locations of compensatory mitigation activities that would best serve these watershed needs.

C. Assessment of mitigation-specific issues when identifying potential mitigation sites (many of which will also apply to non-regulatory wetlands restoration projects). This assessment of whether to mitigate, and if so, how, should include consideration of:

- Site conditions that favor or hinder the success of mitigation projects, including long-term functionality, hydrologic conditions, and connectivity with other habitat types,
- Compatibility with adjacent land uses and watershed management plans,
- Protection of adequate adjacent transition habitat and buffers,
- Consideration of functions, services, and values (e.g., water quality, flood control, shoreline protection, and non-wetland riparian areas) that will likely need to be addressed at or near the areas impacted by the permitted project.

When: Ongoing

Cost: $$$

Performance Measures:
1) Number of comprehensive Watershed Management Plans

2) Number of recommended elements per plan

ACTION LU-2.7 (New 2007)
Adopt and implement policies and plans that protect and restore water quality, flood water storage, and other natural functions of stream and wetland systems.

Who: Regional Water Quality Control Boards, State Water Resources Control Board, California Department of Fish and Game, San Francisco Bay Conservation and Development Commission, U.S. Army Corps of Engineers, U.S Fish and Wildlife Service, local governments, Natural Resources Conservation Service, Resource Conservation Districts

What: Policies and plans that provide guidance in protecting and restoring the physical forms of stream and wetland systems (i.e., riparian vegetation, floodplains, stable stream channels)

and their natural hydrologic regimes result in improved stream and wetland functions, such as pollutant removal, floodwater storage, and habitat connectivity.

Adopting and implementing the policies and plans will be a coordinated effort among federal, state, and local agencies with jurisdiction over water quality and stream and wetlands system protection. Improved coordination with regard to land use, transportation, and physical infrastructure planning efforts and projects will assist in the protection or restoration of the beneficial functions of stream and wetland systems. These policies will encourage low-impact development and "smart growth," which protects and restores natural stream and wetlands system functions and avoids the use of impervious surfaces.

Implementation mechanisms will include permit conditions, such as protecting and establishing stream and wetlands system transition and buffer zones (see WT-1.3); strategies to maintain and restore stream and wetlands system functions (see AR-6.6); financial and regulatory incentives, such as grants and a reduced regulatory burden for "self-mitigating" projects (see PO-4.1); and inclusion of appropriate elements in comprehensive Watershed Management Plans to coordinate the planning and protection of resources (see LU-2.6).

When: Development: 2005–2009; Implementation: Ongoing

Cost:
Development: $$$
Implementation: $$$$$

Performance Measures:
1) Number of updated General Plans, regulatory policies, and other governing requirements that demonstrate stream and wetlands system protection at the local, regional, and state level (via annual survey)

2) Percentage decrease in the permit processing time of compliant projects

3) Net increase in the number of acres of wetlands, floodplains, riparian areas, and streams protected and restored

4) Amount of funding available for implementation of projects/changes in permit procedures that promote protection of water resources

ACTION LU-2.8 (New 2007)
Increase participation, support, and incentives to economically disadvantaged and culturally diverse communities to protect and restore the Estuary and its watersheds.

Who: Regional and local governments, non-governmental organizations, and watershed stewardship organizations

What: Regional and local organizations should implement and incorporate into their business practices state guidance by the Governor's Office of Planning and Research and the California Environmental Protection Agency on environmental justice issues. This should include funding and other mechanisms to increase participation by community-based

organizations when targeting restoration, recreation, and pollution reduction and remediation efforts in economically disadvantaged neighborhoods where community members have historically not participated in the planning process. Disadvantaged community groups should be involved and supported in restoration efforts from the inception of a project. These efforts should focus on consensus and coalition-building within the community to foster long-term, sustainable projects that promote environmental health and stewardship (see LU-4.3).

When: Immediately

Cost: $$

Performance Measures:
1) Percentage increase in number of representatives from community-based organizations in project planning and implementation that come from underrepresented communities

2) Percentage increase in the number of community-supported projects in disadvantaged neighborhoods

3) Amount of funding available to assist participation by organizations from underrepresented communities that would otherwise not be able to participate

Objective LU-3 (Revised 2007)

Promote and support collaborative partnerships in developing and disseminating technical guidance on commonly encountered protection and restoration issues, and implementing local watershed approaches to stewardship and restoration that protect the Estuary and its watersheds.

ACTION LU-3.1 (New 2007)

Promote, encourage, and support collaborative partnerships with broad stakeholder representation, such as watershed councils, in order to develop diverse community-based approaches to long-term stewardship.

Who: Local governments, Regional Water Quality Control Boards, San Francisco Bay Conservation and Development Commission, U.S. Army Corps of Engineers, representatives from other levels of government, universities, and local non-governmental organizations

What: The support of local and regional watershed groups with diverse stakeholder participation and a common vision for the ecological and economic sustainability and livability of their respective watersheds is critical to watershed stewardship and management. State, local, and regional agencies; regional and local planning processes, such as the San Francisco Bay Area Integrated Regional Water Management Plan; and private sector groups, nonprofits, and local community groups should work with existing watershed groups and encourage the formation of additional groups where needed by providing sustainable funding, administrative assistance, and technical expertise and guidance. State grant programs should support these efforts of various partners to participate in local and regional plans and support projects to provide watershed-related input, expertise, and problem

solving, and ensure that staffing support for a regional watershed council is made available for communication, coordination, and implementation logistics support.

State, regional, and local agencies should work with local watershed groups to convene discussions and secure input on water and land use policy development and rule-making, general and specific plans, and project development and implementation efforts that affect watershed health. Outcomes of such collaboration should include development of a regionally accepted framework for demonstrating watershed health, adoption of watershed-based regulatory coordination for permitting, creation of a regional watershed forum to pursue regional funding, help with capacity building for local groups, and development of regional goals.

When: 2007 and ongoing

Cost: $

Performance Measures:
1) Establish a regional watershed planning forum to develop diverse community-based approaches to long-term stewardship (including a memorandum of understanding and regular meeting schedule).

2) Number and diversity (geography, type, focus/representation) of organizations/agencies participating in watershed planning forum

3) Percentage increase in new local watershed councils or existing councils that expand membership to be more diverse (including state, regional, and local agencies)

4) Amount of funding (preferably renewable) secured for watershed councils and capacity building for community groups

ACTION LU-3.2 (New 2007)
Apply the ecosystem goal-setting approach to watersheds of the Estuary.

Who: U.S. Army Corps of Engineers, California Coastal Conservancy, Regional Water Quality Control Boards, San Francisco Bay Conservation and Development Commission, Bay Area Open Space Council, San Francisco Estuary Institute, San Francisco Bay Joint Venture, water districts, public works departments, cities, counties, and a broad spectrum of public, private, and nonprofit entities

What: Support development and regular refinements of habitat goals reports and integrate with the completed "Baylands Ecosystem Habitat Goals Report" and other plans currently underway (Subtidal Habitat Goals, Upland Habitat Goals, and Stream and Wetland Protection Goals). These plans will result in geographic information systems database and reference documents that can be used as decision-support tools in developing strategies for voluntary, non-regulatory investment in habitat protection, restoration, and management. These strategies will assist public resource agencies, nonprofit conservation organizations, local governments, legislators, private foundations, and landowners seeking to preserve,

enhance, and restore the biological diversity of habitats before urban sprawl eliminates remaining opportunities.

In recognition of the fact that it is difficult to assess progress in ecosystem restoration and protection unless broadly agreed-upon targets exist, the three related efforts mentioned above have begun to develop quantifiable goals. Two of these goals processes are focusing on the watersheds surrounding the Estuary, while the third addresses subtidal habitat. The San Francisco Bay Area Upland Habitat Goals Project (Upland Habitat Goals), and a complementary effort to implement stream goals (Stream and Wetland Protection Goals), are coordinated, science-based processes that will use existing data (and develop new data where needed) and include community participation to identify the types, amounts, and distribution of upland habitats, riparian corridors, linkages, compatible land uses, and ecological and physical processes. The intent of goals development and implementation is to sustain diverse and healthy communities of habitat, plant, fish, and wildlife resources, and other ecosystem support functions (e.g., flood attenuation, sediment supply to Estuary margins to mitigate sea level rise) for the nine-county Bay Area and adjacent counties.

Based on broadly agreed-upon goals that are watershed-specific, appropriate indicators related to selected goals can track progress and form the foundation of a comprehensive watershed "health" monitoring system based on state and federal guidance documents (see Action LU-2.4).

When: January 2008–2010

Cost: $$$ (development)

Performance Measures:
1) Number of watersheds that start a goal-setting process with a plan to attract a diversity of stakeholders and to raise secure, renewable funds

2) Number of watersheds with clearly articulated and measurable habitat goals

Objective LU-4

Provide educational opportunities for the public and for government institutions as a foundation for protecting and enhancing the resources of the Estuary and its watersheds.

ACTION LU-4.1 (Revised 2007)
Educate the public about how human actions impact the Estuary and its watersheds.

Who: See Public Involvement and Education Program.

What: Develop and distribute educational materials that clearly communicate the interrelationship between human activities, including land use and transportation, and impacts on the ecosystem of the Estuary and its tributary waters.

When: Ongoing

Cost: $ (development)
$$ (effectiveness evaluation)

Performance Measures:
1) Web site created with downloadable education materials

2) Number of Web site hits

3) Knowledge of interrelationship of humans and the Estuary (via survey)

ACTION LU-4.2 (Revised 2007)
Provide training workshops for local government officials and staff and other key stakeholders to improve land use decision-making that affects the Estuary and its watersheds.

Who: See Public Involvement and Education Program.

What: Develop training materials and present programs for permit analysts, planning commissioners, and other local government decision-makers. Invite participation from other key stakeholders, including landowners, developers, and environmental representatives. Such training should increase participants' awareness of policies, programs, financing mechanisms, and tools that local governments can use to help protect and enhance the Estuary's resources. Local governments, including cities, counties, and special districts, should be provided model ordinances, handbooks, and manuals to integrate natural resources protection and enhancement into local decision-making, while providing for continued economic development.

When: Ongoing

Cost: $

Performance Measures:
1) Number and diversity of public officials, management staff, and other stakeholders attending training workshops

2) Number of materials that are actually used/implemented in local government policies/programs (e.g., using a model ordinance to develop a stream setback ordinance or decrease allowable impervious area at new development sites)

ACTION LU-4.3 (New 2007)
Engage with disadvantaged communities in educational programs about the linkages between human behaviors, the environment, public health and safety, and the health of the Estuary and its watersheds.

Who: Regional Water Quality Control Boards, San Francisco Bay Conservation and Development Commission, watershed councils, creek groups, Resource Conservation Districts, nonprofit organizations, community groups, and local governments

What: Encourage two-way communication about environmental issues and stewardship. Educational resources tend to be limited in underserved communities while environmental impacts are often most severe. Disadvantaged communities can become engaged in environmental stewardship by efforts that demonstrate the links between human actions, public health, and the health of the estuarine environment.

Educational programs should be developed for all members of the community, but focused primarily on K-12 students. The students should be provided with opportunities to actively participate in restoration efforts both within their community and throughout the Estuary.

When: Immediately

Cost: $$

Performance Measure:
Percentage of elementary school students demonstrating knowledge of link between humans and Estuary health (survey to sample of schools)

Objective LU-5

Develop new public and private economic incentives and funding mechanisms to promote protection and restoration of the Estuary and its watersheds and provide a forum for stakeholders that improves communication and leads to better natural resource management.

ACTION LU-5.1 (Revised 2007)

Create economic incentives that encourage local governments to take action to implement measures to protect and enhance the Estuary and its watersheds.

Who: U.S. Congress, California Legislature, and local governments

What: Make available federal and state funds for local governments to support planning activities and program administration to develop implementing ordinances, to fund capital improvements projects, and to maintain local facilities that protect the resources of the Estuary and its watersheds. Develop innovative incentives, in collaboration with the private sector, for watershed protection and restoration implementation projects, such as tax incentives to reduce impervious surfaces, enhance flood storage, and habitat restoration on public and private lands.

When: Ongoing

Cost: $$ (development)

Performance Measures:
1) Number of incentives developed and implemented

2) Number of disincentives removed

3) Amount of funding made available for local governments and other entities to protect the Estuary (e.g., maintaining facilities, engaging in planning efforts)

ACTION LU-5.2 (Revised 2007)
Develop new funding mechanisms to pay for plans, physical improvements, and program administration, management, and monitoring to protect the resources of the Estuary and its watersheds.

Who: California Legislature, League of California Cities, California State Association of Counties, Local Government Commission, Association of Bay Area Governments, local agencies, stakeholders, and non-governmental organizations

What: Utilize existing local funding mechanisms and create new funding mechanisms that support the protection of natural resources in the Estuary and its watersheds, such as benefit assessment districts and stormwater utility fees. For example, fees could be assessed on resources impacted from use of the Estuary, e.g., a storm drain district could assess dischargers into the Estuary an annual fee on a per-cubic-foot basis to fund Estuary improvement projects and plans.

Assist local governments with the development of draft language and legislative relationships that will lead to legislation supporting the implementation of watershed protection and restoration projects at the local level, such as reducing impediments to raising funds or creating new funding opportunities to plan and implement projects. Promote legislation that enhances the ability of local governments to fund watershed protection and restoration projects, as well as municipal stormwater and nonpoint source program implementation at the local level.

When: 2016

Cost: $$, depending on staff resources applied

Performance Measures:
1) Number of bills chartered that provide funding and enhance fundraising options for local governments

2) Number of special districts formed or other mechanisms established to create new funding

3) Dollars raised (per agency or region wide)

ACTION LU-5.3 (Revised 2007)
Investigate and create market-based incentives that promote active participation by the private sector in cooperative efforts to implement goals for protection and restoration of the Estuary and its watersheds.

Who: California Legislature, Councils of Governments, Regional Water Quality Control Boards, local governments, and stormwater programs

What: Develop market-based incentives, such as density bonuses, fast-track permit processing, or property tax and utility rate reductions, to encourage protection and restoration of the Estuary. For example, these incentives would be available to developers and project

sponsors for projects if specific protection measures are implemented that exceed minimum federal, state, regional, and local requirements to protect the Estuary. Incentives should encourage the use of alternative development techniques that contribute to the maintenance and restoration of the natural hydrologic system, including the floodplain.

Provide support for regulatory agencies, local planning and development entities, and the private sector to collaboratively develop desirable incentives that lead to the use of alternative development techniques. Make funds available to implement incentive pilot programs.

When: 2006–2016

Cost: $$

Performance Measures:
1) Number of new market-based incentives implemented

2) Dollars available for collaborative efforts to develop incentives

ACTION LU-5.4 (Revised 2007)
Identify financial barriers to implementing the actions recommended in this Watershed Management and Land Use Program and propose alternative taxation and funding arrangements.

Who: California Legislature, Councils of Governments, and research organizations, such as the Bay Area Economic Forum, the Public Policy Institute of California, and Environmental Defense

What: Create alternative funding arrangements, such as revenue sharing and changes to state law, that allow state, regional, or local agencies to raise the necessary capital for implementing specific land use and watershed management actions. Emphasize fiscal reforms that encourage environmentally sensitive land use.

When: 2006–2016

Cost: $$

Performance Measures:
1) Increase in new local and state initiatives launched that facilitate funding of watershed management activities

2) Dollars raised to fund protection efforts

ACTION LU-5.5 (Revised 2007)
Create a forum to improve communication and resolve disputes regarding land use management among different interest groups that have a stake in the protection and enhancement of the Estuary and its watersheds.

Who: Organizations such as university-based dispute resolution centers and private providers of dispute-resolution services

What: Enable continued dialogue among key interest groups to develop land use policies that will guide Estuary and watershed management. Include groups that have a stake in the protection and enhancement of the Estuary's natural resources, such as government agencies, business, industry, and environmental and other non-governmental organizations. Create a mechanism to arbitrate differences and achieve cross-acceptance between Watershed Management Plans, local General Plans, and regional plans and policies as one alternative to litigation and as means of augmenting the legislative hearing process.

When: 2006–2016

Cost: $

Performance Measures:
1) Effective forum is established and maintained

2) Increase in participation of entities that are bringing land use and watershed management issues to the table

Public Involvement and Education

Public Involvement and Education

Goals:

- Build public understanding of the value of the Estuary's natural resources and the need to restore, protect, and maintain a healthy Estuary for future generations.

- Increase public involvement in the ongoing stewardship of the Estuary.

Problem Statement

The San Francisco Bay-Delta Estuary is one of California's greatest biological and economic resources. The Estuary's watershed provides water to many of the state's farms, industries, and cities. The Bay-Delta region is home to more than seven million people who live, work, play, and invest in its unique environs. During the next twenty years, another one million people will move to the Estuary region to enjoy the benefits that it provides. The demands of the state's ever increasing population have stressed the carrying capacity of this great Estuary.

While most Californians value the Estuary, few really understand the extent to which it contributes to the state's treasured quality of life. Public attention and involvement are critical at this time to provide the momentum needed to restore and maintain this invaluable resource.

State, federal, and local leaders representing diverse interests have developed the Plan-the CCMP-as a way to restore and protect the Estuary. Public involvement, however, provides the vital link needed to achieve effective implementation of the Plan. It will make the difference between general caring and informed action and between indifference and directed public will. Public involvement is critical for the decision-making process and effective management of the Estuary's resources.

Public awareness of the Estuary's problems is growing, but there is a definite lack of understanding about the need for the public to be involved in solving the Estuary's problems. The people must awaken to their responsibility as stewards of the Estuary and must powerfully speak out for its protection. A united and organized public constituency able to monitor the ongoing management of the Estuary will ensure that the Plan's goals, objectives, and individual actions are achieved.

Existing Management Structure

Currently, the Estuary Project's Public Involvement Program (PIP) operates through a cooperative agreement with the Association of Bay Area Governments. The Program has developed many educational materials and activities, including a series of twelve information sheets about the Estuary's natural resources and its problems; a booklet, *An Introduction to the Ecology of the San Francisco Estuary; Estuarywise*, a guide to preventing pollution; outreach to local, state, and federal elected officials; a lecture series; many presentations to diverse community groups; Estuary education curriculum guides; teacher training workshops; academic outreach; a student intern program; multicultural involvement efforts; slide shows; radio and television public service announcements; co-sponsorship of community events and programs; public meetings and workshops on the Estuary's problems; and two State of the Estuary Conferences.

These activities were targeted at four audiences: key decision-makers; the Estuary Project's constituency (those involved in Estuary Project committees); youth; and the general adult public.

An evaluation of the PIP's past activities indicates that much more work needs to be done, specifically in the areas outlined in this action plan.

Recommended Approach

We have an opportunity to support and invest in the Estuary's productivity so that it can continue to provide benefits to us and to future generations. Recognizing that we can only sustain a healthy regional economy by maintaining a healthy Estuary, it is also true that we can only take this kind of action by mobilizing and inspiring our community. In conjunction with the interested public-statewide and nationwide-we can demonstrate our united commitment to building the region's strength.

In a time of severe budget constraints at every level of government and within nearly every private sector organization, the public's skills, energy, and enthusiasm can serve as low-cost resources to solve many Estuary problems that might not otherwise be addressed. Only when it comes to understand and embrace the Plan, however, will the public be able to actively promote it, support it, use it, enforce it, watchdog it, invest in it, and finance its continuance.

The community acting as a resource to solve the action items described in the Plan will maximize public involvement in the actual management, restoration, and protection of the Estuary. The community acting as a resource also will provide informed activism, trained and vigilant monitoring, financial contributions, and even some kind of Conservation Corps. An effective and strong public involvement program will provide an opportunity for educated and motivated volunteers to invest in sustaining and improving our biological resources. In doing so, they will also invest in the preservation of our economic resources.

Public Involvement and Education Actions

Objective PI-1

Develop CCMP public involvement, education, communication, and advocacy programs.

ACTION PI-1.1 (Revised 2007)
Build awareness, interest, and support in the general public and decision-makers for the CCMP's goals and action plans.

Who: Federal, State and Local agencies, Non-Governmental Organizations (NGOs), Environmental Advocacy Groups, Watershed Councils, Creek groups,high school and university students, interested public, and Friends of the San Francisco Estuary

What: Develop a high-visibility media campaign to make people aware of the CCMP's existence, how it came about and what it represents (consensus), and its specific action plans. The campaign will credit the groups, agencies, and citizens who worked hard to develop the CCMP. Efforts will include soliciting newspaper, radio, and TV coverage of CCMP issues and actions; scheduling coverage and public service announcement releases in conjunction with major outreach campaigns to decision-makers, business, etc.; and developing,

distributing, and using fact sheets, portable displays, public meetings, slide shows, brochures, a slogan, and other support materials.

Develop a strategy to assist government decision-makers in efforts to champion, legislate, and fund the CCMP. Provide information, materials, briefings, and public outreach assistance to cities and counties, local planning authorities, regional conservation districts, and other government agencies working to implement the CCMP.

Educate and mobilize constituencies and interested groups to keep pressure on government representatives and officials so that they continue to implement the CCMP. Research and provide needed information to promote and solicit public funding for CCMP enforcement.

Work with educated and informed private sector interest groups to promote and advocate the CCMP's implementation. Using the Estuary Project's constituency base, form a leadership committee of receptive people from industry, business, public utilities, and environmental and other special interest groups who are instrumental for implementation of the CCMP in the private sector.

Work with the committee to develop a region wide outreach program focused on concrete (interest-specific) goals based on the CCMP. Provide the program with presentation packages, printed information, easy access to government reports, scientific studies, and information on the successes of other businesses using pollutant source reduction and prevention activities, water conservation, and other environmentally sound management practices.

When: Ongoing

Cost: Media campaign: first year cost $100,000; $50,000 annually thereafter
Decision-makers' education: $50,000 annually
Advocacy program: $50,000 annually
Private sector: $100,000 annually

ACTION PI-1.2 (Revised 2007)
Provide and encourage opportunities for direct citizen involvement in implementing the CCMP.

Who: Non-Governmental Organizations (NGOs), Environmental Advocacy Groups, Watershed Councils, Creek Groups, Friends of the San Francisco Estuary

What: Provide broad-based public representation, including environmentalists, to encourage implementation of the CCMP. Develop and distribute information about the CCMP's progress. Provide an ongoing forum for citizens to debate and discuss controversial environmental issues related to the Estuary. Provide feedback mechanisms linking the debate forum to government decision-makers and CCMP lead agencies. Organize and provide training programs for citizens on local, state, and federal permit processes and public involvement policies. Publish public meeting schedules of lead agencies for CCMP implementation. Encourage citizen participation and attendance at these meetings.

When: Ongoing

Cost: $100,000 annually

ACTION PI-1.3 (Revised 2007)
Provide and encourage opportunities for direct citizen involvement in following the CCMP and making any necessary revisions to it.

Who: Implementation Committee, San Francisco Estuary Project, Non-Governmental Organizations (NGOs), Environmental Advocacy Groups, Friends of the San Francisco Estuary

What: Provide an open and public process for regular review of CCMP implementation. Through activities and programs developed to educate and involve the public in managing the Estuary, seek comment and feedback on CCMP policies and issues. Ensure there is public review and approval of any changes to the CCMP. Inform and advise the public, interest groups, elected officials, and decision-makers about CCMP implementation, results, and revisions.

When: Ongoing

Cost: Costs provided in Action 1.2

ACTION PI-1.4 (Revised 2007)
Serve as a public involvement and education resource for government agencies taking the lead in CCMP management actions.

Who: Non-Governmental Organizations (NGOs), Watershed Councils, Creek Groups, Environmental Advocacy Groups, and Friends of the San Francisco Estuary

What: Work with government agencies to implement the CCMP. Through agreements, grants, and contracts, provide assistance in public involvement and education programs to the government agencies responsible for CCMP implementation. Provide support to agencies in the form of staff time, easily understood informational materials for the public, handling of public inquiries, media contact, organizing public meetings and hearings, and consistent, timely communication.

Coordinate CCMP public involvement efforts among all agencies to produce a strong, unified message and image for the CCMP, to maximize impact, and to minimize costs and duplication of effort. Training programs on such topics as using volunteers, consensus building, and conflict resolution could be organized and provided for agency staff.

When: Ongoing

Cost: $150,000 annually

ACTION PI-1.5 (Revised 2007)
Ensure provisions for a central collection and distribution (clearinghouse) point for communication and coordination of all information concerning CCMP issues and the Estuary.

Who: San Francisco Estuary Project, Friends of the San Francisco Estuary

What: Provide and stock clearinghouse with comprehensive, up-to-date information resources, including a library, computer data bases, directories, mailing lists, public reports, pamphlets, and videotapes about the Estuary's natural resources, water quality, and economic and social values.

Advertise and maintain a public hotline to provide public information, handle CCMP inquiries, take citizen watchdog reports of illegal or irresponsible activities affecting the Estuary, refer callers to clearinghouse and other resources, and screen and direct inquiries to specific agencies.

Facilitate frequent information sharing among public agencies and interest groups by publishing a newsletter on CCMP and Estuary-related activities. Research, produce, and distribute five thousand copies of a monthly newsletter to interest groups, government agencies, the media, citizens, the Bay-Delta Congressional Delegation, and city, county, and regional decision-makers.

When: Ongoing

Cost: Equipment, hotline, literature, and library materials start-up costs: $200,000; $100,000 annually thereafter Newsletter: $85,000 annually (format will be six to ten pages, two-color, with graphics and photos)

ACTION PI-1.6 (Revised 2007)
Develop and/or promote community-designed model projects for public education and participation activities aimed at implementing the CCMP.

Who: Non-Governmental Organizations (NGOs), Watershed Councils, Creek Groups, Environmental Advocacy Groups, Local Elementary, High School and University students, Friends of the San Francisco Estuary

What: Interest groups (environmental, industry, education, science, etc.) and government agencies will be identified and asked to submit proposals. Projects might include a series of CCMP television public service announcements, a stenciling program for storm drains, a demonstration farm (water conservation, sustainable agricultural practices, etc.), informational brochures, educational materials, restoration projects, and/or boater education.

Following established procedures for the request for proposal process, research and identify criteria to select proposals for the model projects that will receive funds. Grants may cover all or partial costs of the proposals. Comprehensive evaluation mechanisms will be developed for completed model projects, including direct feedback from target audiences.

Follow-up support and funding will be provided for projects selected to serve as models for larger programs.

When: Ongoing

Cost: $100,000 the first year; $500,000 annually thereafter

ACTION PI-1.7 (Revised 2007)

Seek, encourage, and, where appropriate, actively support environmental projects and/or programs that are consistent with CCMP goals and objectives.

Who: Non-Governmental Organizations (NGOs), Watershed Councils, Creek Groups, Environmental Advocacy Groups, Local Elementary, High School and University students, Friends of the San Francisco Estuary

What: Work with fish and wildlife professionals and appropriate trade associations, government agencies, and public interest groups to seek and support new, creative programs that are consistent with the CCMP's goals and action plans. Encourage target programs to apply for model projects funding.

When: Ongoing

Cost: $50,000 annually, in addition to funds provided in Action PI-1.6 .

Objective PI-2

Promote direct citizen involvement in studying, restoring, and managing a healthy Estuary.

ACTION PI-2.1 (Revised 2007)

Develop, promote, and support multicultural understanding of and involvement in Estuary issues and the decision-making process for these issues.

Who: Non-Governmental Organizations (NGOs), Watershed Councils, Creek Groups, Environmental Advocacy Groups, Local Elementary, High School and University students, Friends of the San Francisco Estuary

What: Work with minority leaders and community groups to accomplish mutual goals and programs. Develop outreach programs to people of color, provide opportunities for understanding mutual goals, and encourage and support active participation in the decision-making process for protecting and restoring the Estuary's biological resources. Develop an active outreach program to multicultural neighborhood groups, businesses, farm workers, fishing associations, and urban coalitions.

When: Ongoing

Cost: $100,000 annually

ACTION PI-2.2 (Revised 2007)
Work with education groups, interpretive centers, decision-makers, and the general public to build awareness, appreciation, knowledge, and understanding of the Estuary's natural resources and the need to protect them. This would include how these natural resources contribute to and interact with social and economic values.

Who: Implementation Committee, San Francisco Estuary Project, Non-Governmental Organizations (NGOs), Environmental Advocacy Groups, Watershed Councils, Creek Groups, Local Elementary, High School and University students, Friends of the San Francisco Estuary

What: Work with local and state educators in organizing estuarine ecology materials and producing a coordinated education program for K-12 students. Distribute the Estuary Project's three curriculum guides on Estuary ecology and other appropriate materials to school districts, interpretive centers, and educational institutions. Hold teacher training workshops on the use of the curricula and general Estuary ecology.

Provide opportunities for teachers, students, and parents to participate in Estuary-related field trips and restoration projects. Provide a mechanism, such as the Estuary Project's Volunteer Education Advisory Committee, for coordinating education efforts in the Bay and Delta.

Promote increased funding for all estuarine, fish, and wildlife interpretive centers.

Develop additional materials as needed on fish, wildlife, and their habitats, such as a handbook on habitat protection and enhancement opportunities. These materials should be made available to private landowners, developers, contractors, realtors, and business and industrial organizations.

When: Ongoing

Cost: $200,000 annually

ACTION PI-2.3 (Revised 2007)
Promote, support, and cooperate with existing public education and involvement programs concerned with protecting and restoring the Estuary's biological resources.

Who: Implementation Committee, San Francisco Estuary Project, Non-Governmental Organizations (NGOs), Environmental Advocacy Groups, Watershed Councils, Creek Groups, Local Elementary, High School and University students, Friends of the San Francisco Estuary

What: Develop criteria for evaluating existing environmental education programs and set priorities for activities to be funded. Identify environmental education programs and organizations. After completing evaluation and priority tasks, work cooperatively and openly with other groups to avoid duplication of effort. Actively support successful environmental education programs and activities by providing funds, guidance, and in-kind support.

When: Ongoing

Cost: $35,000 annually for staff liaison (specific support funds for programs and activities will come from other programs, such as model projects)

ACTION PI-2.4 (Revised 2007)
Develop or promote necessary public education tools, such as a general education speakers bureau, Bay-Delta "Estuary Watch" bulletin boards, slide shows, brochures, and other support materials on a variety of topics.

Who: Implementation Committee, San Francisco Estuary Project, Non-Governmental Organizations (NGOs), Environmental Advocacy Groups, Watershed Councils, Creek Groups, Local Elementary, High School and University students, Friends of the San Francisco Estuary

What: Recruit and train volunteer speakers on a variety of subjects, including the Estuary, its natural resources, and efforts to implement the CCMP. Research current materials and, where gaps exist, write and produce materials to support the speakers, such as slide shows, information sheets, charts, and graphics.

Negotiate with appropriate businesses and public entities to update and post regularly: 1) educational posters about the Estuary; 2) bulletins indicating the progress of programs and legislation aimed at protecting the Estuary; and 3) information about what people can do to help out, for example, consumer tips, phone numbers for volunteer organizations, and contacts for more information.

When: Ongoing

Cost: $150,000 annually

ACTION PI-2.5 (Revised 2007)
Assist in the development of long-term educational programs designed to prevent pollution to the Estuary's ecosystem and provide assistance to other programs as needed.

Who: Implementation Committee, San Francisco Estuary Project, Non-Governmental Organizations (NGOs), Environmental Advocacy Groups, Watershed Councils, Creek Groups, Local Elementary, High School and University students, Friends of the San Francisco Estuary

What: Building on the efforts of existing programs and the Estuary Project's *Estuarywise*, a citizens' guide to pollution prevention, and storm drain stenciling activities, develop a coordinated, systematic, and long-term pollution prevention education program.

Work with cities, counties, water districts, environmental groups, business, and industry to assist in and coordinate the development of materials on how to prevent pollutants from entering the Estuary's waters. Produce a plan, timeline, and specific products and activities to educate the public on pollution prevention.

When: Ongoing

Cost: $250,000 annually (Costs include funds for staff to develop a plan, timeline/budget, coordination and implementation efforts, and to develop additionally needed educational materials, public meetings, and media coverage.)

ACTION PI-2.6 (Revised 2007)
Hold a State of the Estuary Conference at least every other year.

Who: Implementation Committee, San Francisco Estuary Project, Friends of the San Francisco Estuary, Federal, State, and Local Agencies and municipalities, NGO's, Sponsors and Supporters

What: The conference will bring together all CCMP players, Estuary interests, the general public, and the media on an ongoing basis to share progress reports, address challenges, provide public education, and solicit public feedback on CCMP implementation. Information presented should be appropriate to the San Francisco Bay-Delta Estuary. The National Estuary Program, under the Clean Water Act, requires participating programs to report to Congress biennially. The conference would assist in fulfilling this requirement.

When: Ongoing

Cost: $75,000 every other year (in addition to staff time)

Objective PI-3

Develop and implement specific and targeted public education and involvement action plans about fish and wildlife resources and how to restore and improve their populations and habitat.

ACTION PI-3.1 (Revised 2007)
Increase public opportunities to contribute directly to the protection and management of fish and wildlife populations and their habitats within the Estuary.

Who: Implementation Committee, Federal, State and Local Agencies, San Francisco Estuary Project, Non-Governmental Organizations (NGOs), Environmental Advocacy Groups, Watershed Councils, Creek Groups, Local Elementary, High School and University students, Friends of the San Francisco Estuary

What: Develop and implement an education program about the introduction of undesirable species to the Estuary and how they are transported. Presentations should be made to sports clubs, environmental groups, schools, etc., on a regular basis to educate people about the implications of illegal or unwanted introduction and transport of non-indigenous biota. Concepts such as the impact of new species on native species and possible impact on the ecosystem need to be stressed. Methods of educating individuals should include signs posted at fishing areas and boating facilities, inclusion of warnings with boat and fishing/hunting licenses, and public service announcements.

Develop support for citizens' fish, wildlife, and habitat monitoring programs coordinated by resource agencies, interest groups, and fish and wildlife associations. Provide for greater

public participation in permit review and other actions by regulatory agencies that affect fish and wildlife and their habitats. Organize conferences with the goal of developing a more coordinated approach to resource protection and management and increasing public involvement in this approach.

Develop and implement an education strategy to address wetlands functions, values, the Wetlands Management, Regulatory, and Watershed Plans, and the need to restore and protect wetlands. Targeted audiences should include local governments, schools, the general public, landowners, and professional, civic, and interest groups.

When: Ongoing

Cost: Introduction of non-indigenous species program: $200,000-$300,000 annually for each affected agency; fish and wildlife monitoring programs: $250,000 annually; wetlands: $200,000 annually

ACTION PI-3.2 (Revised 2007)
Using government agencies and citizens, promote the continued development of needed citizen monitoring programs to assist* in *the restoration and protection of the Estuary.

Who: Implementation Committee, Federal, State and Local Agencies, San Francisco Estuary Project, Non-Governmental Organizations (NGOs), Environmental Advocacy Groups, Watershed Councils, Creek Groups, Local Elementary, High School and University students, Friends of the San Francisco Estuary

What: Research and determine the need for monitoring programs that use volunteers to gather information about the Estuary's natural resources. Working with government agencies and knowledgeable interest groups, develop volunteer teams interested in helping to monitor the health of the Estuary on an ongoing basis. Develop a training program and manual for these volunteers that ensures the usefulness of their monitoring efforts as a supplement to enforcement agency activities. Review and evaluate agency and citizen monitoring efforts and provide feedback on effectiveness.

When: Ongoing

Cost: Start-up costs for research, volunteer manual, and equipment: $100,000
Annual costs for each program: $50,000

ACTION PI-3.3 (Revised 2007)
Provide opportunities for hands-on citizen action in Estuary restoration activities.

Who: Non-Governmental Organizations (NGOs), Environmental Advocacy Groups, Watershed Councils, Creek Groups, Friends of the San Francisco Estuary

What: Develop, promote, and maintain hands-on activities, such as wetland and creek restoration, recycling activities, and beach clean ups, to enable citizens, businesses, and constituent groups to participate directly in Estuary restoration.

Publish and distribute how-to information on water conservation, source reduction, waste disposal, and other specific restoration actions. Coordinate distribution with public-private sector outreach and media campaigns.

When: Ongoing

Cost: $50,000 annually

ACTION PI-3.4 (Revised 2007)
Assess the need and, if appropriate, develop and organize an Estuary Conservation Corps.

Who: Non-Governmental Organizations (NGOs), Environmental Advocacy Groups, Watershed Councils, Creek Groups, Friends of the San Francisco Estuary

What: Research and determine the need for an Estuary Conservation Corps to assist in Estuary restoration projects. Work and cooperate with existing Conservation Corps, interest groups, and government agencies in determining the need for an Estuary Corps. Contracts for the Corps' services may include fence building, wetland restoration, and screening projects. Because of the Corps' broader public service of job training, the target for self-financing would be 50 percent.

When: Begin in 1994

Cost: Estimated start-up costs for an Estuary Conservation Corps: *$600,000* (This would include organization, management, and worker-training programs.)

Objective PI-4

Develop a flexible, sustainable, community-based organization framework, supported by public and private funds, for public involvement and education in all aspects of Estuary management.

ACTION PI-4.1 (Revised 2007)
Develop, plan, and facilitate the transition from the Estuary Project to a community-based entity or entities that would help carry out public involvement and education goals and objectives of the Estuary Project and the* CCMP in *ways that* do not *duplicate the efforts of other organizations.

Who: Implementation Committee, Federal, State and Local Agencies, San Francisco Estuary Project, Non-Governmental Organizations (NGOs), Environmental Advocacy Groups, Watershed Councils, Creek Groups, Friends of the San Francisco Estuary

What: Plan and facilitate a smooth transition from the Estuary Project to a community-based entity or entities that would provide leadership for the continuation and expansion of public involvement in Estuary management. Research and develop needed legislation. Continue the Estuary Project's networking and facilitation functions among constituencies. Provide organizational and educational support to decision-makers and agencies involved in CCMP implementation.

When: Ongoing

Cost: Depending on where the organization is located (as an independent entity or within an existing agency or organization), start-up costs will range between $50,000 and $100,000.

ACTION PI-4.2 (Revised 2007)
Work to fund and support existing and new public involvement, education, research, and monitoring activities that* seek *to fulfill the goals of the CCMP.

Who: Implementation Committee, Federal, State and Local Agencies, San Francisco Estuary Project, Non-Governmental Organizations (NGOs), Environmental Advocacy Groups, Watershed Councils, Creek Groups, Friends of the San Francisco Estuary

What: Research and develop needed legislation. Seek agreements with interest groups and government agencies to perform or coordinate programs and activities. Programs may include purchase of special license plates for restoring the Estuary.

Explore diverse funding mechanisms, including government grants, special taxes, agency contracts, business sponsorships, merchandise development, and foundation support. Memoranda of Understanding, cooperative agreements, grants, or contracts may include performance of specific tasks, such as producing and distributing a newsletter, organizing training programs, producing educational materials and activities, and actual restoration projects (i.e., building fences and levees). Work cooperatively with other entities to avoid competition for limited funds.

When: Identify funding sources beginning in 1992

Cost: Special brochures or merchandise development costs (T-Shirts, posters, bumper stickers) could be 50,000 to $100,000, 50,000 annually.

ACTION PI-4.3 (Revised 2007)
Ensure that a technical/scientific/academic entity has responsibility to promote scientific research on and monitoring of the Estuary and provide advice and guidance related to those activities.

Who: Implementation Committee, Federal, State and Local Agencies, San Francisco Estuary Project, San Francisco Estuary Institute

What: With support from government, political, and community leaders, recruit a broad-based scientific and community interest board. Public representatives must be included. Coordinate and clarify research and monitoring priorities and channel funds in accordance with these priorities; review and support Estuary science. Provide opportunities for scientists and members of the interested public to learn from each other, discuss technical information, and how to get from science to policy. Provide advice on data management, modeling, sampling, and monitoring efforts and conduct peer review of studies.

When: Ongoing

Cost: $$$

Research and Monitoring

Goal:

- Improve the scientific basis for managing natural resources within the Estuary through an effective monitoring and research program.

Problem Statement

More than seventy monitoring and research programs can be identified as ongoing in the Estuary. These efforts are increasing as the need grows to acquire adequate information for effective management, preservation, and restoration of the area's resources and beneficial uses. Despite the large number of monitoring programs in the Estuary, no overall plan exists for coordinating agency or citizen monitoring. Also, there is no systematic distribution of the information derived from monitoring and research to Estuary managers or the public.

When discussing monitoring needs for the estuaries in the National Estuary Program, confusion often arises between monitoring of estuarine conditions (ambient monitoring) and monitoring the effectiveness of the CCMP. Section 320 of the Clean Water Act calls for each Management Conference "to monitor the effectiveness of actions taken pursuant to the Plan " Monitoring the CCMP's effectiveness will involve periodically evaluating the success of the Plan's implementation and determining whether the actions have resulted in the desired outcomes. This will require compiling data and information from a variety of sources, including ambient monitoring. This "CCMP effectiveness monitoring" should not be confused with the estuarine monitoring recommendations that are the focus of this chapter.

Managing a resource as complex as the San Francisco Estuary requires a comprehensive understanding of both its biological resources and of human impacts on its ecology. This section recommends actions to help foster this level of understanding and promote environmentally sound management.

Existing Management Structure

Most of the information in this section is taken directly from the Aquatic Habitat Institute's report on the "Status and Assessment of Selected Monitoring Programs in the San Francisco Estuary" dated March, 1992.

Monitoring of physical, chemical, and biological parameters in San Francisco Bay and the Sacramento-San Joaquin Delta has been proceeding at different levels of intensity for more than thirty years. Nearly two dozen agencies at the local, regional, state, and federal levels sponsor, participate in, and report on the results of monitoring and research projects. Monitoring and research are carried out in the Estuary as mandated by state and federal law and regulation, as part of elective state and federal programs to collect background data on riverine and estuarine structure and function, and as special projects aimed at the description and discovery of basic estuarine dynamics.

Monitoring programs in San Francisco Bay and the Sacramento-San Joaquin Delta are primarily focused on water quality and on determining the status of biological resources. The greatest emphasis among monitoring efforts, by far, is the measurement of physical and chemical water quality characteristics in the northern reach and in the South Bay.

Most monitoring in the Estuary is carried out as part of the Interagency Ecological Studies Program (IESP). The IESP was initiated in 1971 through a cooperative agreement with the California Department of Water Resources, the California Department of Fish and Game, U.S. Bureau of Reclamation, and U.S. Fish and Wildlife Service. More recently, the State Water Resources Control Board, U.S. Geological Survey, U.S. Army Corps of Engineers, and the U.S. Environmental Protection Agency have joined this coordinated effort. In 1992, the program carried out approximately $10 million of research and monitoring efforts. Cooperative studies among IESP members have included programs investigating: 1) effects of reduced flow on salinity distribution in the Bay-Delta; 2) primary production in the entrapment zone; 3) success of striped bass production in the Bay-Delta; 4) concentrations of chemical pollutants throughout the Estuary; 5) abundances of benthic and pelagic invertebrate populations that serve as food for important fishes; and 6) circulation and stratification patterns in the South Bay and their effects on sediment transport.

Biological sampling and analyses have concentrated on species of commercial and recreational value, particularly striped bass and Chinook salmon. Other species of importance have received less attention in terms of specific monitoring, and much information regarding these species and their functions in the Estuary has been collected in the course of striped bass studies. Relatively few monitoring programs have been carried out to ascertain the status of birds, mammals, and plants in the Estuary; nonetheless, these programs are active and have made significant contributions to our understanding concerning these resources and their responses to ongoing changes in the Estuary system.

Many monitoring programs are currently under review as to their objectives, design, and execution. IESP members have undertaken an intensive internal review of the efficacy of many of their Suisun Bay and Delta programs. The results of these reviews and revisions have suggested that an increased emphasis on regional monitoring would result in more efficient use of funds, better program design, and more meaningful data.
Other state and federal agencies and authorities conduct monitoring and research programs that are complementary to the programs carried out under the Interagency Ecological Studies Program (IESP). The San Francisco Bay Regional Water
Quality Control Board (SFBRWQCB) has recently initiated a pilot program for regional monitoring of pollutants in the Bay and Delta. The objectives of the pilot program are, in part, to gather data on baseline chemical parameters related to water and sediment quality.

Recommended Approach
The SFEP recommends the formation of an entity to be responsible for coordinating and integrating research and monitoring in the Estuary. This new entity will also report on findings and ensure that the information is available to resource and regulatory managers and to the public.

Research and Monitoring Recommendations

Objective RM-I

Develop an estuarine research institute for the improved coordination and reporting of monitoring and research on the Estuary.

ACTION RM-I.I (1993 CCMP)
Establish and operate a San Francisco Estuarine Institute for research on and monitoring of land use, biological resources, flow regime, pollutants, and dredging and waterway modification.

Who: Aquatic Habitat Institute, San Francisco Bay Regional Water Quality Control Board, academic institutions, and other agencies as necessary

What: Establish a centralized institute for research and monitoring in the Estuary. Such an institute should coordinate research and monitoring, promote coordination and interaction among agency and academic researchers, and could house research and monitoring programs of various agencies or universities.

This institute will:

1. Oversee the implementation of the Regional Monitoring Strategy;

2. Provide advice for individuals or institutions performing needed research;

3. Provide the linkage between science and resource agency management;

4. Coordinate multidisciplinary teams of scientists and technicians to perform complicated or large studies;

5. Develop a long-term research plan for the Estuary;

6. Evaluate the health of the Estuary and make the linkage between observed degradation and causes; and

7. Periodically report to the academic community, agencies, and the public on the results of research, monitoring, and other special studies conducted in the Estuary.

When: Immediately

Cost: $13 million estimated total ($13 million state)
ACTION RM-I.2 (1993 CCMP)
Provide a long...term administrative home and regular funding for the Research Enhancement Program (REP).

Who: Interagency Ecological Studies Program (IESP), San Francisco Estuarine Institute (SFEI), Aquatic Habitat Institute, the University of California, Stanford University, and other public and private academic institutions

What: Increase academic and agency involvement in estuarine research by providing a long-term administrative home for the REP, which will include regular funding and contracting mechanisms. The SFEI could provide such a service for this program. The REP, established by IESP and co-sponsored by SFEP, should be continued in order to fund needed basic and applied research on the Estuary.

When: Immediately

Cost: $900,000 estimated total ($900,000 state)

Objective RM-2

Effectively monitor and conduct research on flow regime, pollutants, dredging and waterway modification, fish and other aquatic resources, wildlife, wetlands, and land use within the boundaries of the Estuary, using new and existing facilities, programs, agencies and public involvement groups.

ACTION RM-2.1 (1993 CCMP)

Develop and implement the Regional Monitoring Strategy, which will integrate and expand on existing efforts and eventually be part of a comprehensive Regional Monitoring Program.

Who: Interagency Ecological Studies Program, Association of Bay Area Governments, Aquatic Habitat Institute, and San Francisco Estuarine Institute, in coordination with many other Estuary organizations (U.S. Geological Survey, U.S. Fish and Wildlife Service, California Department offish and Game, State Water Resources Control Board, Regional Water Quality Control Boards, and other public and private organizations)

What: Establish a comprehensive monitoring program that follows the Regional Monitoring Strategy. Ensure that this information is available at a central location to decision-makers, the research community, and the public. Research and monitoring programs should fit tightly into the Regional Monitoring Strategy that emphasizes the recovery and long-term survival of desirable species. The program should:

1. Establish long-term, Estuarywide monitoring for phytoplankton, zooplankton, benthos, fish, migratory and resident birds, mammals, and other species as necessary. The program shall be coordinated with and the results analyzed in relation to all other relevant environmental measures;

2. Create a standardized data base of bathymetric data and habitat classification for use in hydrodynamic models and mass balance equations;

3. Create and maintain over the long-term an array of "index" water column/benthic stations with a modest sampling regime of physical, chemical, and biological measurements to quantify year-to-year variability and long-term trends;

4. Through intensive studies with periodic follow-up as necessary, establish mass balances for key chemical pollutants or groups of pollutants, including measurement of their sources and their accumulation or disappearance in terms of the relevant physical, chemical, or biological process. Maintain awareness of new pollutants and new methods of measurement;

5. Refine and extend the analysis of the amounts and relative importance of organic carbon sources and sinks for the Estuary. The results shall be made available and analyzed in the context of other data obtained under the Program; and

6. Expand, coordinate, and standardize the existing biological and chemical monitoring program (of the Department of Fish and Game) for toxics, initially including, but not restricted to, the use of bioassays with larval striped bass and opossum shrimp.

Public education is another important aspect of the estuarine monitoring program. Up-to-date information will be provided to the Estuary's public information programs. Working cooperatively with existing volunteer monitoring programs, the estuarine monitoring program will assist in creating new citizen monitoring programs, with professional training and quality assurance provided as necessary. This will contribute to our knowledge of the health and status of the region's streams, wetlands, and wildlife.

When: Immediately

Cost: $292,570,000 estimated total ($4.2 million federal and $288,370,000 state)
The total estimated cost for the Research and Monitoring Program is $306,470,000.

Glossary

Acre-foot- An acre of water one foot deep (approximately 326,000 gallons). The typical California family of five uses an acre-foot of water in and around the home each year.

Agricultural Lands- Refers to a land use rather than a type of wetland or related habitat; it is referred to because the way agricultural lands are managed can retain or inhibit inherent wetland characteristics.

Ahwahnee Principles- A series of land use recommendations written in 1991 by the Local Government Commission providing a blueprint for resource efficient communities paving the way for the smart growth movement and New Urbanism; spawned related Ahwahnee Principles for Economic Development and Ahwahnee Water Principles to cover other aspects of more livable communities.

Ambient- Refers to the overall conditions surrounding a place or thing. For example, ambient monitoring refers to comprehensive monitoring of water quality, biota, sediments, etc.

Anadromous- Fish that live some or all of their adult lives in salt water but migrate to fresh water to spawn (reproduce).

Anthropogenic- Effects or processes that are derived from human activities, as opposed to natural effects or processes, that occur in the environment without human influence.

Aquatic transfer facility - An underwater storage basin in which dredged materials can be placed temporarily before being moved to a beneficial reuse site.

Baylands - The shallow water habitats around the San Francisco Bay between the maximum and minimum elevations of the tides including tidal habitats and lands that would be tidal in the absence of levees, sea walls, or other man-made structures that block the tides. The Baylands Ecosystem includes the baylands, adjacent habitats, and their associated plants and animals.

Beneficial Reuse - The use of dredged materials for ecological restoration projects, levee rehabilitation, or other forms of construction materials instead of disposing of the material.

Beneficial Use- Uses of the waters of the state that must be protected against quality degradation, including domestic, municipal, agricultural, and industrial supply; recreation and navigation; and the preservation of fish and wildlife.

Benthos- Zone at the bottom of a body of water inhabited by mussels, clams, crustaceans, and other aquatic life.

Best Available Technology- The best economically achievable technology that reduces negative impacts on the environment.

Best Management Practice- A method, activity, maintenance procedure, or other management practice for reducing the amount of pollution entering a water body. The term originated from the rules and regulations developed pursuant to the federal Clean Water Act (40 CFR 130).

Best Development Practice- Those codes, procedures, or other land-use practices that minimize adverse environmental impacts.

Bioaccumulation- Accumulation by organisms of contaminants by ingestion or from contact with the skin or respiratory tissue.

Bioassay- A laboratory test using live organisms to measure biological effects of a substance, factor, or condition.

Bioavailability- The extent to which a compound is obtainable for biological use by organisms.

Bioconcentration- Chemicals that increase in living organisms resulting in concentrations greater than those found in the environment.

Biota- All living organisms that exist in a region.

Brackish- Somewhat salty water that is less salty than sea water.

Brine- Concentrated solution of salts.

Buffer areas- Zones created or sustained to minimize the negative effects of land development on animals and plants and their habitats.

Carcinogenic- Capable of causing or inciting cancer.

Channelization - Straightening and deepening streams so water will move faster, a marsh-drainage tactic that can interfere with waste assimilation capacity, disturb fish and wildlife habitats, and aggravate flooding.

Conjunctive Use- The use of land, air, or water for more than one purpose or by more than one person. Conjunctive uses exist side by side or in tandem.

Conservation Easements- Areas that allow for unrestricted movement of biota by connecting protected wildlife regions to each other. These corridors are usually established by joint agreement between landowners and state or federal agencies and may be temporary or perpetual.

Contamination- The impairment of water quality by waste to a degree that creates a hazard to public health through poisoning or through the spread of disease.

Cross-media impacts - Detrimental effects on an ecosystem caused by the movement of contaminants or pollutants from one area of the environment to another due to invasive

subsurface activities (e.g., Gaseous contaminants emitted by power plants to the sky which may turn into precipitation fall into water bodies, rivers and streams as acid rain).

Cumulative Effects- The combined environmental impacts that accrue over time and space from a series of similar or related individual actions, contaminants, or projects. Although each action may seem to have a negligible impact, the combined effect can be severe.

DDE and DDT- Dichloro-diphenyldichloro-ethlyene and dichloro-diphenyl-trichloroethane are two formerly commonly-used pesticides that are now banned in the United States.

Delta- An area formed by alluvial deposits of sand, silt, mud, and other particles at the mouth of a river.

Detritus- Small particles of organic matter, largely derived from the breakdown of dead vegetation. Detritus is an important source of food in marshes and mudflats.

Diking- A method of artificially changing the direction of a course of water or confining water.

Diversion- The act of turning the natural course of water for use in other purposes.

Draft- The measure of the portion of a ship that is below the water's surface.

Dredging- The removal of sediments from the estuary and ocean floor.

Effluent- Wastewater discharged into the Estuary from point sources.

EIR/EIS- Environmental Impact Reports and Statements that are required by state law (California Environmental Quality Act) and federal law (National Environmental Policy Act) for major projects or legislative proposals that significantly affect the environment. EIRs (state) and EISs (federal) facilitate decision making as they describe the positive and negative effects of the action and prescribe alternative actions.

Emerging Contaminants- Pollutants of concern about which we do not have much historical monitoring information to assess trends, and are not captured within existing water quality regulatory frameworks, but may be found at relatively high concentrations in sediment; a broad class of unregulated chemicals.

Endemic- A native species defined in terms of a restricted geographical range.

Endocrine Disrupting Chemicals/Compounds (EDCs)- Any substance that affects an animal’s ability to reproduce and develop.

Entrainment- Occurs when small aquatic organisms are incorporated or swept along with water flow into intake structures and the machinery of the industrial facility, usually with cooling water.

Entrapment Zone- The area where salty ocean water moving upstream mixes with fresh water flowing downstream. The mixing dynamics in this zone trap nutrients, organic and inorganic materials (e.g., fish and invertebrate eggs), and other food sources. These circumstances enable considerable plant and animal growth, but an entrapment zone's success depends on its location and surrounding conditions.

Environmental Justice- Defined by California statute as "The fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of all environmental laws, regulations, and policies."

Ephemeral Streams- Streams that flow only during and for a short duration after precipitation events.

Estuary- A body of water at the lower end of a river, which is connected to the ocean and semi-enclosed by land. In an estuary, sea water is measurably diluted by fresh water from the land.

Fill- Soil, sand, and debris deposited in aquatic areas, such as wetlands, to create dry land, usually for agricultural or commercial development purposes.

Flood Plain- A flat area adjoining a stream or river that is constructed by the stream or river in the present climate and that receives over-bank flow at times of high discharge.

Food Web- Network of interconnected food chains and feeding interactions among organisms.

Good Condition- According to DFG Code 5937 a stream is in good condition if sufficient water is allowed to pass through to keep in good condition any fish that may be planted or exist in the waterway.

Greywater- Untreated wastewater which has not been contaminated by any toilet discharge, has not been affected by infectious, contaminated, or unhealthy bodily wastes, and which does not present a threat from contamination by unhealthful processing, manufacturing, or operating wastes. Graywater includes wastewater from bathtubs, showers, bathroom washbasins, clothes washing machines, and laundry tubs but does not include wastewater from kitchen sinks or dishwashers.

Groundwater recharge- Replenishment of water that circulates in underground aquifers.

Habitat- The specific area or environment in which a particular type of plant or animal lives. An organism's habitat must provide all of the basic requirements for life and should be free of harmful contaminants.

Habitat Conservation Plans- Authorized under section 10(a)(1)(B) of the Endangered Species Act (ESA) and administered by the US Fish & Wildlife Services and National Marine Fisheries Service, these plans, known "HCPs", provide a clear regulatory mechanism to permit the incidental take of federally listed fish and wildlife species by private interests and non-Federal government agencies during lawful land, water, and ocean use activities.

Impermeable layer- Layer of clay below ground surface that can impede downward percolation of water.

Impingement- Occurs when aquatic organisms, such as adult fish and shellfish, are thrust upon fish screens and are trapped, injured, or killed.

Indicator Species- A species whose characteristics show the presence of specific environmental conditions and are representative of a certain habitat type or function.

Indigenous- Species whose origin has not been introduced from elsewhere.

Infrastructure- The basic facilities, services and installations placed in the environment for a public purpose. These may include roadways, flood control facilities, piping, pumping facilities, storm drain facilities, wastewater treatment facilities, detention ponds, etc.

Invertebrates- Small organisms, such as clams and worms, that lack a spinal column. Many of these filter bottom sediments and water for food.

Knockdown- An activity involving the leveling or spreading of shoaled or mounded material in order to maintain a waterway rather than directly removing material from that waterway.

Leach- To pass out or through soil by water percolation.

Leaching- The removal of salts and trace elements from soil by the downward percolation of water.

Levee- Raised bank of earth built to control or confine water (also known as a dike).

Marine Debris- Includes all types of discarded man-made materials, which in this case, end up in the Estuary. The most common objects are plastic and other synthetic products that do not easily biodegrade. Large deposits of marine debris may accumulate on shorelines and reduce the value of, or eliminate, fringe marsh and upland refugia habitats. Wildlife mortality and impairment occur when marine debris entangles or is ingested by birds, mammals, fish and other aquatic organisms.

Marsh- A wetland where the dominant vegetation is non-woody plants, such as grasses and sedges, as opposed to a swamp, where the dominant vegetation is woody plants like trees.

Mean- Mid-point between high and low.

Mercury Methylation- A naturally occurring process in aquatic ecosystems in which sulfate-reducing bacteria convert inorganic divalent mercury into methylmercury, the highly toxic form that readily accumulates in exposed organisms and biomagnifies to high concentrations in fish and wildlife atop aquatic food webs and which can be transported from the site of methylation by several processes, including resuspension of bed sediments, diffusive and tidal solute fluxes, hydrologic transport with sediment or colloids, and uptake into mobile aquatic biota. Methylmercury can be lost by the processes of microbial and photo demethylation, burial in deposited sediment, and emigration or harvest of contaminated biota.

Mitigation- Actions taken to alleviate the negative effects of a particular project. Wetland mitigation usually takes the form of restoration, or enhancement of a previously damaged wetland or creation of a new wetland.

Mitigation banking- The restoration, creation, enhancement or preservation of wetlands expressly for the purpose of providing compensatory mitigation in advance of authorized impacts to similar resources. The objective of a mitigation bank is to provide for the replacement of the chemical, physical and biological functions of wetlands and other aquatic resources which are lost as a result of authorized impacts. Using appropriate methods, the newly established functions are quantified as mitigation credits which are available for use by the bank sponsor or by other parties to compensate for adverse impacts.

Mounding- Refers to dredged sediments disposed of in the water that build up instead of dispersing with currents and tides.

Mutagenic- A substance that tends to increase mutations or chromosomal alterations.

Native- Refers to those species originating naturally in a particular region.

Non-native or Nonindigenous species: Any species or other variable biological material that enters an ecosystem beyond its historic geographic range, including such organisms that have been transferred from one country to another.

Nonpoint Source Pollution- Pollution that enters water from dispersed and uncontrolled sources, such as surface runoff, rather than through pipes. Nonpoint sources (e.g., forest practices, agricultural practices, on-site sewage disposal, automobiles, and recreational boats) may contribute pathogens, suspended solids, and toxicants. While individual sources may seem insignificant, the cumulative effects of nonpoint source pollution can be significant.

NPDES- National Pollutant Discharge Elimination System, a provision of the Clean Water Act that prohibits discharge of pollutants into waters of the United States unless a special permit is issued by EPA, a state, or another delegated agency.

Organophosphate-Applies to a wide range of chemicals derived from phosphoric and similar acids which are used as highly effective pesticides; their toxicity to nontarget animals, including people, echoed the perils of DDT. Regulators responded, and by the middle 1990s, once-popular members of this class of agents such as dursban, malathion, and chlorpyrifos, were being phased out or severely restricted in their uses.

PAHs- Polycyclic or Polynuclear Aromatic Hydrocarbons. A class of complex organic compounds, some of which are persistent and cancer-causing. These compounds are formed from the combustion of organic material and are ubiquitous in the environment. PAHs are commonly formed by forest fires and by the combustion of gasoline and other petroleum products. They often reach the environment through atmospheric fallout and highway runoff.

PCBs- Polychlorinated Biphenyls. A group of manufactured chemicals, including about seventy different but closely related compounds made up of carbon, hydrogen, and chlorine. If released to the environment, PCBs persist for long periods and can biomagnify in food

chains because they have no natural usage in the food web. PCBs are suspected of causing cancer in humans and other animals. PCBs are an example of an organic toxicant.

Peat- Partially carbonized vegetable tissue that forms as plants decompose in water and are deposited and compacted.

Pelagic Organism Decline (POD)- Pelagic organisms are open water species that live in the ocean or estuaries like the San Francisco Bay- Delta. For the three-year period, from 2002 to 2004, IEP monitoring identified declines in numerous pelagic fish in the Bay-Delta. The abundance indices include record lows of delta smelt and young striped bass, and near-record lows of longfin smelt and threadfin shad and other organisms including zooplankton that are dependent on the Bay-Delta.

Performance Measure Indicators- Chosen parameters (e.g., riparian habitat, fish assemblage, stream channel condition) which can provide measurements of the current condition of a resource.

Permeable- Able to be infiltrated by water.

Phytoplankton- Tiny floating plants that are eaten by minute animals, fish larvae, and other larger organisms.

Plankton- Microscopic plants and animals that drift with the currents.

Plume- An elongated cloud of suspended sediment.

Point Source Pollution- A source of pollutants from a single point of conveyance, such as a pipe. For example, the discharge from a sewage treatment plant or a factory is a point source.

Pollutant- A harmful chemical or waste material discharged into the environment. Persistent pollutants are those that do not degrade, causing potential long-term chronic toxicity to biotas.

Pollution- Impairment of land, air, or water quality by agricultural, domestic, or industrial waste to a degree having an adverse effect on beneficial uses or the facilities that serve such beneficial uses.

POTWs- Publicly Owned Treatment Works treat municipal sewage and waste water before discharging it into the Estuary.

Pyrethroids- synthetic derivatives of the chrysanthemumic acids developed as insecticides to replace the organophosphates but which have been discovered to have serious environmental impacts. At concentrations found in streams, the chemicals can kill beneficial insects and crustaceans and may even be acting "below the radar screen" to poison fish and lizards.

Recycled Water- Water which, as a result of treatment of waste, is suitable for a direct beneficial use.

Reference site - A specific location in a waterbody which is unimpaired or minimally impaired and is representative of the expected biological integrity of other localities on the same waterbody or nearby waterbodies. For dredging projects, reference sites serve as points of comparison to identify the potential effects of contaminants in material proposed for disposal. Reference sites are generally selected based on similarities to the grain size, composition, geology, and habitat of a designated aquatic disposal site.

Remediation- A way of correcting or alleviating a problem or situation. Legally, remediation is either a means of compensating for a violation of the law or for unavoidable impacts resulting from legal activities.

Restore- For the purposes of the CCMP, restoration implies improving the health of the Estuary. Rather than attempting to completely restore the Estuary to its historical state, the CCMP strives to maintain, protect, and enhance the ecological integrity of the Estuary within the given urban context. The CCMP attempts to regain as much of the altered or destroyed wetlands as possible, to establish the highest restoration or target goals, to ensure continuance of beneficial uses, and to generally provide a sustainable ecosystem.

Reverse flows- When freshwater inflow is low and export pumping is high, the lower San Joaquin River changes direction and flows upstream.

Riparian- Habitat occurring along the bank of a natural and freshwater waterway (e.g., a river, stream, or creek) that provides for a high density, diversity, and productivity of plant and animal species.

Runoff- Water from rain, melted snow, or agricultural or landscape irrigation that flows over the land surface.

Salts- A class of compounds that includes common table salts, sodium chloride, as well as salts of concern in irrigated agriculture, e.g., the various carbonated, bicarbonates, sulfates, phosphates, and chlorides of sodium, calcium, potassium, and magnesium.

Saltwater intrusion - the invasion of fresh surface or ground water by salt water. If it comes from the ocean it may be called sea water intrusion.

Savanna- A grassland area containing scattered trees and drought-resistant undergrowth.

Seasonal Wetlands- An area that is only saturated or inundated for part of the year usually during heavy winter or spring precipitation events.

Sediment- Mud, sand, silt, clay, shell debris, and other particles that settle on the bottoms of waterways.

Sediment budget - A sediment budget is a balance of the quantity of sediment entering and leaving a selected segment of coast or estuary.

Sediment dynamics - The natural movement of sediment through a riverine, marine or estuarine environment due to flow, tidal forces, currents, or wave action.

Selenium- A naturally occurring element essential to human and animal sustenance. However, selenium is toxic at little over the suggested nutritional levels. Selenium is used in a variety of products, is a bi-product of many industrial activities, and is leached from the soil and becomes agricultural runoff.

Slough- A channel through a marsh or mudflat.

Slurry- Sediments mixed with water.

Source Reduction- An approach that uses raw material substitution and technological improvements to eliminate toxic wastes at their source.

Spawn- The act of reproduction of fish, which includes egg laying and fertilization, and sometimes nest building (e.g., salmon).

Special Status Species- Federal and state classifications for plant and animal species that are either listed as threatened or endangered, are formally recognized candidates for a listing, or are declining to a point where they may be listed.

Stormwater- Discharges generated by runoff from land and impervious areas such as paved streets, parking lots, and building rooftops during rainfall and snow events that often contain pollutants in quantities that could adversely affect water quality. Most stormwater discharges are considered point sources and require coverage by an NPDES permit.

Subsidence- Lowering or sinking of land caused by compaction, wind and water erosion, oxidation of peat soils, and other causes.

Subsurface Drainage- When an impermeable clay layer causes water to accumulate just beneath the land's surface. Tile drains remove water from the root zone to a stream, drainage ditch, or evaporation pond.

Subtidal- Aquatic areas and their associated physical, chemical, and biological properties that are used by organisms for their entire life cycle, including the water column, unconsolidated sediment, hard bottom, structures underlying the waters, submerged aquatic vegetation, native shellfish, and associated biological communities.

Suspended Sediments- Undissolved particles floating in water.

Sustainable Development- Balancing the fulfillment of human needs, economic and social, with protection of the natural environment so that these needs can be met not only in the present but without compromising the ability of future generations to meet their own needs.

Tailwater and Seepage- Tailwater is the excess irrigation water that runs off the surface of a field; seepage is the excess that sinks in.

TBT- Tributyltin. An organic compound used as an additive in many marine antifoulant paints used to prevent algal and barnacle growth. Tributyltin is highly toxic to many marine organisms.

THMs- Trihalomethanes are carcinogens that are by-products of the water disinfection process. They are formed when organic compounds found in water come into contact with chlorine used for disinfection during water treatment.

Tide- The alternating rise and fall of the ocean and bay surface that occurs twice a day, caused by the gravitational pull of the sun and moon upon the earth and by the rotation of the earth, moon, and sun.

Tile Drains- A network of pipes, formerly made of ceramic tile but now usually plastic, buried in fields below the root zone of plants. The drains are designed to collect excess water and carry it by gravity flow to one point where it can be pumped out to a canal, stream, or evaporation pond.

Toxic hot spot - A location in enclosed bays, estuaries, or adjacent waters where hazardous substances have accumulated in the water or sediment to levels which (1) may pose a substantial present or potential hazard to aquatic life, wildlife, fisheries, or human health, or (2) may adversely affect the beneficial uses of the bay, estuary, or ocean waters as defined in the water quality control plans, or (3) exceeds adopted water quality or sediment quality objectives.

Trace Elements- Members of the set of ninety-two naturally occurring elements (such as selenium and silver) found in low concentrations, usually less than one part per million. Trace elements can be found in rocks, soil, and water.

Transition Habitat- Areas between habitat types which are of critical importance due to their ability to modify impacts from nearby habitats (to "buffer"), and which also have intrinsic value as habitat for endangered and threatened species. They are differentiated from "buffers" (which broadly are thought of as ameliorating the effects of human activities), and transition zones, which are essentially boundaries between (usually natural) habitats.

Treatment- Waste water treatment is divided into three steps: primary, secondary, and tertiary. Primary treatment uses screens and sedimentation tanks to remove most materials likely to float on the water or settle on the bottom. Secondary treatment uses a biological process to consume organic materials in the waste and disinfect the effluent. Tertiary treatment removes additional nutrients, suspended solids, and other pollutants.

Turbidity- The clouding of a naturally clear liquid due to suspension of fine solids. Because turbidity reduces the amount of light penetrating the water column, high turbidity levels are harmful to aquatic life.

Upland Habitat- All habitats found above the Baylands Ecosystem.

Urban Runoff- Uncontrolled or untreated runoff from the urban environment and from construction activities that runs off the landscape into surface waters. This runoff can include such pollutants as sediments, pathogens, fertilizers/nutrients, hydrocarbons, and metals.

Water Column- The layer of water between surface and bottom sediments. The water column contains dissolved and particulate matter and provides habitat for plankton, fish, and marine mammals.

Watershed Plan- An integrated habitat management plan using a watershed-based approach to water and wetlands protection which considers the whole hydrologic system, including other resources that address land, air, and water, to successfully manage problems for a given aquatic resource.

Wetlands- Lands that are transitional areas between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Two major wetland types of concern are seasonal wetlands inundated by winter and spring rainfall and flooding, and tidal wetlands flooded daily by ocean tides.

Vector- Used here in the biotic sense, the physical means or agent by which a species is transported between regions.

Vernal Pools- Depressions that fill with rain water in the wet season and dry out in late spring. Vernal pools often contain plants that can withstand extremes in water availability.