CCMP 2016

COMPREHENSIVE CONSERVATION AND MANAGEMENT PLAN

FOR THE SAN FRANCISCO ESTUARY

GOALS FOR 2050 • ACTIONS FOR 2021

SAN FRANCISCO ESTUARY PARTNERSHIP

MAY 2016

The San Francisco Estuary Partnership was established more than 25 years ago by the State of California and the U.S. Environmental Protection Agency to prepare and implement a plan to better protect and restore the Estuary. Today, the Partnership manages over $100 million in regional restoration, water quality and climate resiliency projects. The Partnership is one of 28 National Estuary Programs across the country. The Estuary Partnership's host entity is the Association of Bay Area Governments. More information about the Partnership, our staff, partners, programs, and projects can be found at: www.sfestuary.org

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Letter from the Chair

I. Introduction

INTRODUCTION

In 1992 when the San Francisco Estuary Partnership produced its first *Comprehensive Conservation and Management Plan* (CCMP), the community of participants was looking largely backward in time to the 19th century before massive population growth and ensuing development occurred around the San Francisco Estuary. At the time, the science of how the Estuary worked was in its infancy, and the politics of managing San Francisco Bay and the Delta were embroiled in various battles over water supply, dredging, fish, pollution, and other environmental ills.

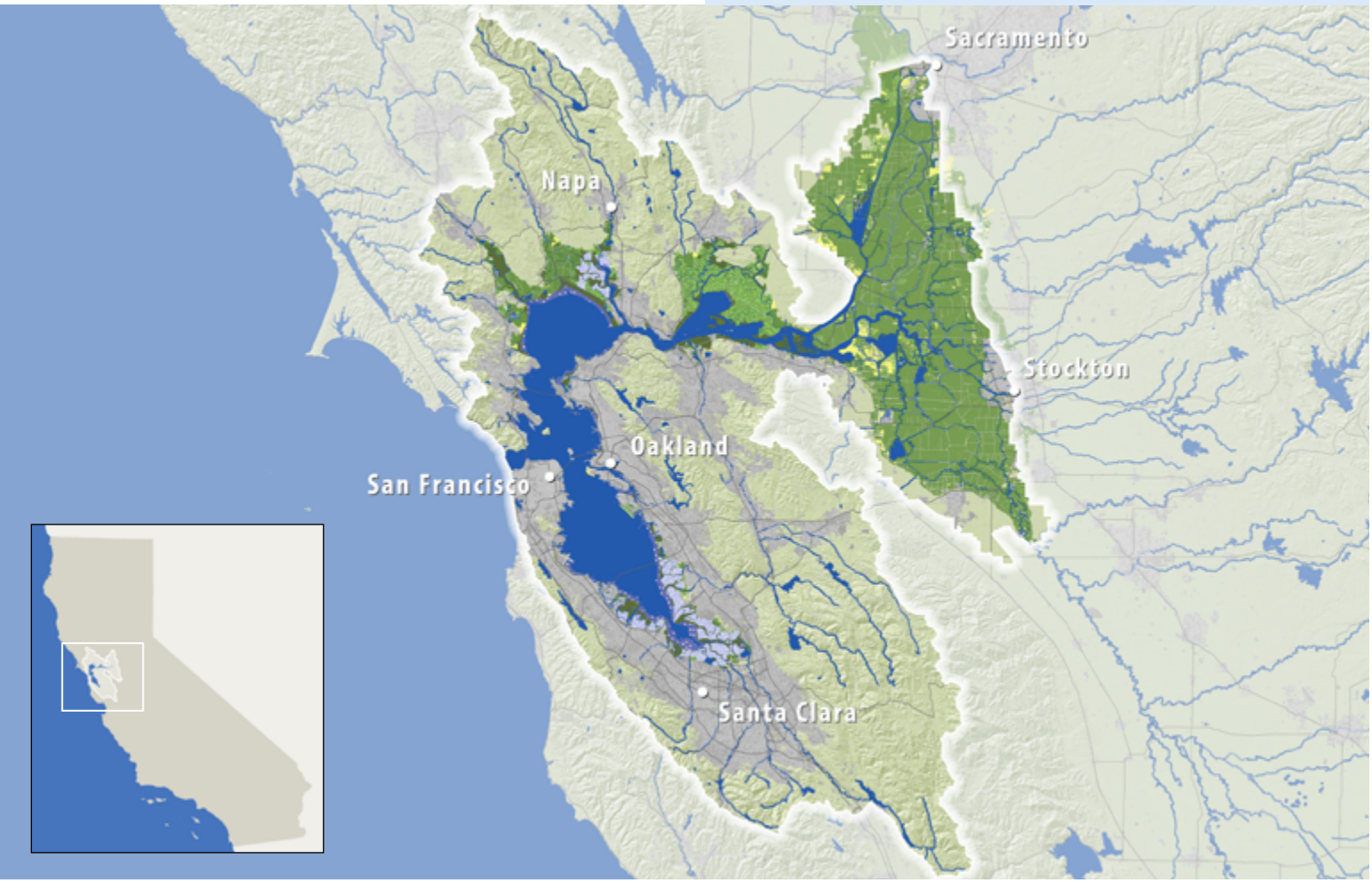
The 1992 CCMP used new science and regional partnerships to begin resolving natural resource conflicts and fix damage to habitats and species of the Estuary. Its framers crafted goals and actions with an eye toward restoring the landscapes and waterways of a less disturbed era. They cast restoration objectives with the intent of bringing the Estuary back to the health and vitality of an earlier time.

Twenty-five years later we know that we can never recover that Estuary; it is too altered by human development, too invaded by alien species, and too changed from the way it used to function historically. We do know, however, that we can bring back vibrant, healthy habitats to some parts of the Estuary, and that they in turn help recover endangered species. We also know that despite population growth, we can still conserve water, grow wetlands, green cities, and protect some wildlife. With these successes in mind, and with access to so many new shorelines for recreation and personal enjoyment, those who live around the Estuary are more eager than ever to help sustain it.

So what is to be the future of the Estuary that sits at the heart of 12 Bay Area and Central Valley counties and serves all of California as the hub of a critical water supply system? How can the people and communities that surround *the* Estuary best protect this economic engine and ecological treasure? Can we sustain all the beneficial uses of its waters—for drinking, irrigation, shipping, fishing, recreation—while reducing stresses on its habitats and wildlife and restoring them to health? If climate change and population growth continue as projected, what will the Estuary look like in 50 years? How do we plan for both expected changes and those we cannot yet foresee? What actions can we take now to help ensure a thriving Estuary in 2050, 35 years in the future?

These are the pressing questions that the San Francisco Estuary Partnership, working with hundreds of partners over the last 20 years, has sought to answer. And it is these questions that shape the core of our new CCMP. The purpose of the 2016 CCMP is to provide all of us who call this place home with a working blueprint for cleaner waters, enhanced habitats, and heathier fish and wildlife in the San Francisco Estuary.

Figure 1. SFEP Planning Area



ABOUT THE PARTNERSHIP

The National Estuary Program (NEP) was established under Section 320 of the 1987 Clean Water Act (CWA) Amendments as a U.S. Environmental Protection Agency (EPA) place-based program to protect and restore the water quality and ecological integrity of estuaries of national significance. The San Francisco Estuary Partnership, one of 28 NEPs around the country, is a collaboration of federal, state, and local agencies and NGOs working to protect and restore water quality and the natural resources of the San Francisco Estuary (including the Bay and Delta). Section 320 of the CWA calls for each NEP to develop and implement a Comprehensive Conservation and Management Plan (CCMP). Using the CCMP as a guiding document, Partnership staff act as both implementers (taking action using grant funds and Partnership dollars) and as facilitators of projects (obtaining and passing along grants and contract dollars to other organizations, and administering funds).

The San Francisco Estuary Partnership directly manages dozens of important projects, including efforts to plan regional green infrastructure and to reduce and manage impacts from aquatic invasive species, urban pesticides, mercury pollution, and direct sewage discharges from recreational boaters. In addition we manage $100 million for our partners for their regional restoration, water quality and resiliency projects. Our education efforts include social media outreach, publishing the award-winning *ESTUARY News* magazine, producing the *State of the Estuary* reports on system health, organizing biennial State of the Estuary conferences and periodic symposiums on timely issues, and publishing numerous fact sheets, booklets, videos, and other materials that educate the public and decision-makers about the Estuary.

ABOUT THE SAN FRANCISCO ESTUARY

Our Estuary, the largest in western North America, encompasses San Francisco Bay and the Delta of the Sacramento and San Joaquin Rivers in California. Unlike most estuaries that spread out into a wide delta of braided channels where rivers meet the sea, the San Francisco Estuary's delta is more than 60 miles inland, trapped behind coastal ridges after rising seas flooded the Bay 10,000 years ago. Managers often divide this complex water body into Bay and Delta, or lower and upper Estuary. It is all one system, however, connected by freshwater outflow to the Pacific and by the ebb and flow of ocean tides far upstream into the Delta.

The Estuary's watershed extends from the ridgeline of the Sierra Nevada mountains to the Golden Gate, including almost 60,000 square miles and nearly 40 percent of California.

The Estuary's waters and wetlands are a biological resource of tremendous importance—providing critical winter feeding habitat for over a million migratory birds, a productive nursery for many species of juvenile fish and shellfish, and a year-round home for a vast diversity of plants and animals. Half of California's surface water supply falls as rain or snow within this region.

Geographically, San Francisco Bay includes four smaller bays. The farthest upstream is Suisun Bay, which includes a vast area of marshes. Suisun Bay lies just below the confluence of the Sacramento and San Joaquin Rivers. Suisun and its neighbor San Pablo Bay, sometimes called the North Bay, are surrounded mostly by rural areas, and are strongly influenced by freshwater outflows from the rivers. The Central Bay, ringed by three bridges, is the deepest and saltiest of the four bays. Cities and industries occupy most of its shores. The more shallow South Bay extends from the San Mateo Bridge south into quiet backwaters surrounded by restored marshes, salt ponds, and suburban office parks and lagoon communities.

Upstream of the Bay, the Sacramento-San Joaquin River Delta is a 1,000 square-mile triangle of diked and drained wetlands. Only small remnants of once-extensive tule marshes still fringe the channels that wind between the flat, levee-rimmed farmlands of the Delta's myriad islands, many of which are now deeply subsided below sea level. Before it was diked and drained, the Delta gathered in the fresh waters of the Sacramento, San Joaquin, Mokelumne, and Cosumnes rivers and moved them all downstream through a complex array of tidally influenced channels into San Francisco Bay. Today, the Delta, with its its rich farmland, is the engineered junction of one of the world's largest plumbing systems, where much of the system's fresh water is diverted to supply California's population centers and Central Valley agriculture.

CCMP HISTORY

The San Francisco Estuary Partnership's CCMP is a collaborative agreement about what should be done to protect and restore the Estuary — a road map for restoring the Estuary's chemical, physical, and biological processes to health. The first CCMP, required under a reauthorization of the Clean Water Act in 1987, was produced in 1993 after several years of status assessments and policy discussions in which over 100 different stakeholder groups took part. It was the first plan to recognize that the Bay and the Delta should be managed as one Estuary, and remains the only plan of such scope to date. After 14 years of implementation, the CCMP was updated in 2007 to include new and revised actions while maintaining many actions from the original.

The 2016 CCMP reflects the changing context of estuary management over the last few decades. While this version incorporates many of the original CCMP goals, it has a new focus on the need to plan and adapt to climate change. In addition, the actions in the new CCMP address the results of our 2015 State of the Estuary assessment. This assessment examined numerous science-based indicators of the health of five Estuary attributes: water, living resources, habitats, ecological processes, and people. This strong link between science and management will allow for a more direct evaluation of the outcome of our CCMP actions.

The 2016 CCMP is also more streamlined, with less than 35 priority actions. By focusing on a more manageable number of priority actions, and updating priorities every five years, the Partnership expects to be more effective in implementing its broader goals for 2050.

2016 CCMP REVISION PROCESS

The revision of the *Comprehensive Conservation and Management Plan* (CCMP) took place over close to three years and is the result of countless hours of effort from a broad range of organizations across the Estuary. The 2016 revision was guided by the following key objectives:

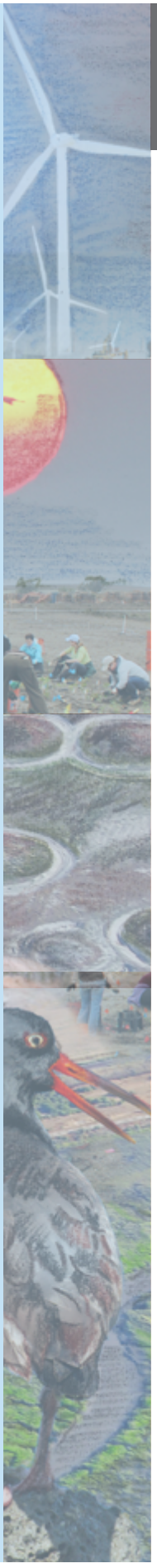
- Implement a focused and strategic revision process that results in less than 50 priority actions.
- Increase coordination and integration within the San Francisco Estuary Partnership's entire planning area, both within the Bay and the Delta.
- Acknowledge key regional plans and policy documents developed since publication of the first CCMP.
- Include measurements to track progress for all actions and develop a tracking tool.
- Integrate the *State of the Estuary Report*, State of the Estuary Conference, the Partnership's *Strategic Plan* and the CCMP in an adaptive management framework for the Partnership.
- Several governing bodies directed the efforts of the CCMP revision.
- San Francisco Estuary Partnership Executive Council: California Natural Resources Agency Secretary; California Environmental Protection Agency Secretary; US Environmental Protection Agency Region 9 Administrator; US Fish and Wildlife Service Regional Pacific Southwest Regional Director; and Association of Bay Area Governments Executive Director. The Executive Council was responsible for final review and approval of the CCMP.
- San Francisco Estuary Partnership Implementation Committee (IC): The 27-member IC is comprised of partners who are engaged in implementing the CCMP. The IC meets quarterly and provided overall guidance, interim input, and final review and approval of the revised CCMP.
- IC CCMP Steering Committee: Comprised of volunteers from IC. The 12-person Steering Committee met periodically to guide and direct the overall update as representatives of the IC, and served as content experts on CCMP Program Area Subcommittees.
- CCMP Program Area Subcommittees: Three initial subcomittees were formed on topic areas corresponding to the attributes of a healthy ecosystem as described in the 2011 State of the Bay Report: Living Resources, Habitats, and Water. The subcommittees were comprised of Steering Committee members, San Francisco Estuary Partnership staff, and 20 additional outside experts. The subcommittees were responsible for developing key content for the revised CCMP. Initially, the subcommittees met separately to develop content. They later joined to review the entire suite of goals, objectives and actions.
- San Francisco Estuary Partnership Staff Team: This team managed the overall CCMP revision process, including: developing agendas for and faciliating Steering Committee meetings; providing guidance for, and participating directly on, Program Area Subcommittees; and compiling all content.
- San Francisco Estuary Partnership Partners and General Public: Interested parties not on the Steering Committee and Program Area Subcommittees provided input on interim products throughout the development process. Staff engaged partners and the general public through various forums including presentations, meetings, the San Francisco Estuary Partnership website, and the State of the Estuary Conferences in 2013 and 2015.

REPRESENTATIVE CCMP PARTNER ACCOMPLISHMENTS 1993-2015*

- Creation of the San Francisco Estuary Institute
- Launch of the Regional Monitoring Program
- Collaboration around the 1994 Bay-Delta Accord
- Science behind the first estuarine habitat standard (X2 salinity)
- Regional coordination on dredged material management, permitting, and beneficial reuse
- Collaboration around regional Baylands, Subtidal, and Uplands Habitat Goals
- About 51,300 acres of Bay wetlands in some stage of restoration as of 2015, more than halfway to the 100,000-acre tidal wetland goal set in in 1999
- More than 24,000 additional acres of Bay wetlands planned and permitted
- Shift from single species to ecosystem-based, landscape-, and watershed-scale management
- Refinement over decades of science-based metrics of Estuary health.
- 12 State of the Estuary conferences and three significant science-based State of the Estuary/Bay reports.
- Decades of Bay and Delta boater education outreach on water quality
- Numerous steps to stem invasions, from ballast water management initiatives to border inspections and control programs
- Outreach and planning around pollution prevention, watershed management, trash capture, and green infrastructure

Thumbnail overview only. See also 20th Anniversary Review www.sfestuary.org/wp-content/uploads/2013/10/EstOct2013-final-Web.pdf

II. Findings



FINDINGS

The Partnership released the latest *State of the Estuary* report in September 2015. The *State of the Estuary Report* is the most comprehensive health report ever completed for the Estuary. It uses the best available science and most recent data contributed by over 30 scientists to assess the status of various parts of the ecosystem. The purpose is to identify problems with estuarine health, so that conservation and restoration efforts can focus on solutions. Of 33 indicators of health evaluated there were mixed results for different areas of the Estuary: 12 indicated poor condition and 21 fair-to-good condition.

The following findings come from the Executive Summary of the 2015 *State of the Estuary Report*, and form the basis for the goals, objectives, and actions of the 2016 CCMP.

HOW HEALTHY IS THE ESTUARY?

- The Upper Estuary (Suisun Bay and the Delta) is in fair to poor condition and getting worse, while the Lower Estuary (San Francisco Bay) is in better health but jeopardized by climate change.
- Human activities have severely altered the physical processes that create and maintain estuarine habitats.
    - Freshwater inflows and beneficial floods now exert such a small fraction of their former influence that they no longer build and maintain the physical structure of habitats in the Estuary, drive historical seasonal changes, or support critical ecological functions.
    - In the lower Estuary, similar changes to the hydrology of Bay watersheds and the diking of tidal areas have deprived estuarine wetlands of the sediment they need to build up their elevation in relation to sea-level rise.
- This impairment of critical physical processes is intertwined with habitat loss, degradation, and fragmentation.
- These losses of physical processes and habitats have reverberated through biological systems, contributing to unproductive food webs, smaller and declining native fish and wildlife populations, and the dominance of invasive species.

CAN WE IMPROVE THE HEALTH OF THE ESTUARY?

- The 2015 *State of the Estuary* suggests that we can restore some aspects of ecosystem health if we choose to make the investment.
    - Water quality has improved over the last few decades due to better management and regulation, though some legacy contaminants remain a problem.
    - Focused collaboration, along with significant funding, has resulted in large gains in tidal marsh restoration over the last two decades. Improvements in marsh-dependent wildlife populations are now detectable.
- Investments in water conservation and recycling in urban areas are reducing demand for potable water, even while population is increasing.
- Despite these gains, impacts from climate change jeopardize the health of all parts of the Estuary.

WHAT WILL IT TAKE TO ACHIEVE A HEALTHY ESTUARY?

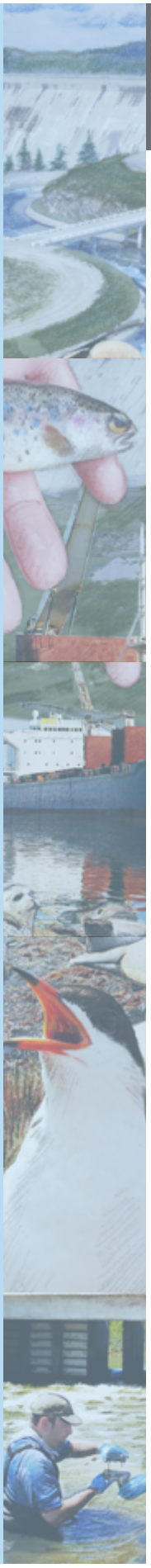
A healthy Estuary needs more freshwater flows through the system, more flooding in the right places, more space for habitats and species and connections between those spaces, more sediment moving through watersheds, and less hardscape, among many needs. A healthy Estuary also needs more real time monitoring of estuarine conditions, as well funding to learn from and adapt to what works and doesn't work in restoration and intervention.

- Restoring the health of the upper Estuary will require significant investment in restoring critical physical processes and habitats, as well as managing nonnative species and preventing new arrivals.
- The health of the whole Estuary would benefit from greater efficiencies in human use of the system's fresh water, as well as changes in upstream water management.
- The Bay's wetlands remain at risk unless we take a watershed-based, regional approach to managing sediment and fresh water as essential resources, and allow for tidal wetlands to migrate landward.
- Wildlife conservation efforts should aim to ensure successful reproduction and habitat connectivity over time as climate change alters landscapes.
- Moving forward, management actions must occur in the context of change. Sustaining a healthy Estuary while addressing climate change, prolonged drought, and rising seas will require collaboration, adaptation, flexibility, and resilience among all engaged communities and agencies from now on.

This 2016 CCMP provides more than 35 immediate priorities for achieving a healthier Estuary.

The full background on the conclusions summarized above, as well as detailed findings, metrics, and technical appendices on Estuary health, can be found at www.sfestuary.org/about-the-estuary/soter/

III. Implementation



WHERE DO WE WANT TO BE IN 2050?
What can we do in the next five years to get started?

The implementation section of the CCMP contains goals, objectives and actions to guide the region towards a healthier Estuary. The goals provide the 35-year vision for the Estuary, the objectives detail desired outcomes that make progress towards achieving goals, while the actions lay out a set of priority tasks for the next five years to reach one or more objective. The 32 actions meet multiple goals and objectives (see Nexus Table p. 14) and represent a cohesive, comprehensive approach to addressing frontiers and gaps in Estuary management.

The CCMP also presents information on some of the foundational integration work behind the plan. Special spotlight sections on CCMP integration explore how the CCMP supports wildlife, resilience and natural infrastructure. Section V highlights threatened and endangered species, and analyzes how specific actions intersect with four core management concepts: habitat recovery and protection, climate resiliency, migratory benefit, and invasive species reduction.

CCMP GOAL 1
Sustain and improve the Estuary's habitats and living resources

OBJECTIVES

a. Protect, restore, and enhance ecological conditions and processes that support self-sustaining natural communities

b. Eliminate or reduce threats to natural communities

c. Conduct scientific research and monitoring to measure the status of natural communities, develop and refine management actions, and track progress towards management targets

CCMP GOAL 2
Bolster the resilience of Estuary ecosystems, shorelines and communities to climate change

OBJECTIVES

d. Increase resilience of tidal habitats and tributaries to climate change

e. Increase resilience of communities at risk from climate change impacts while promoting and protecting natural resources

f. Promote integrated, coordinated, multi-benefit approaches to increasing resiliency

CCMP GOAL 3
Improve water quality and increase the quantity of fresh water available to the Estuary

OBJECTIVES

g. Increase drought resistance and water efficiency and reduce reliance on imported water

h. Improve freshwater flow patterns, quantity, and timing to better support natural resources

i. Reduce contaminants entering the system and improve water quality

CCMP GOAL 4
Champion the Estuary

OBJECTIVES

j. Build public support for the protection and restoration of the Estuary

k. Strengthen regional leadership in support of Estuary health

l. Promote efficient and coordinated regional governance

ACTION X

The language of the action itself, describing the type of action (such as protect, improve, develop), the object of the action (such as habitats, monitoring programs, communities) and any key qualifiers or targets (such as watershed-scale, nature-based, multi-benefit).

The action description provides a slightly expanded, but less precise in intent, version of the action, including additional narrative or details.

TASK X-1 Specific tasks to be accomplished over the next five years to support the action. Task language is among the most carefully chosen language in each action. Tasks describe clear concise "to do" items, and often the context in which the task should take place. Tasks also reflect the consensus building and attention to detail of the committees that crafted each task.

BY 2020 Clear milestones with associated dates to track progress in advancing the action. Milestone years reflect the entire planning horizon of the CCMP, from 2016-2021.

TASK X-2 Most actions include multiple tasks. Some tasks occur in a logical progression, from collecting data or information or building consensus to making a management decision or creating a plan based on that information. Other actions have multiple tasks that address the variety of geographic areas or gaps in achieving a comprehensive action.

BY 2016 A single year milestone means the task should be completed by the end of that year.

BACKGROUND

The background section provides supporting information to further explain the action, why it is a priority, and how the tasks advance the action. It includes information such as the planning context or scientific basis of the action, as well as it's connection or relevance to other efforts, plans or programs.

OWNERS

Owners of the tasks are entities that have agreed to play a key role in advancing tasks either as implementers, trackers, conveners, or stewards. Each owner is assigned specific tasks, as numbered.

COLLABORATING PARTNERS

Collaborating partners is a list key entities, in addition to the owners, engaged in accomplishing the action. This list describes the most central partners, but may not include all possible partners associated with a collaborative action. Collaborating partners represent organizations that might implement, champion, inform, advise or provide scientific or technical expertise in support of the action, tasks, and milestones.

NEXUS

While the suite of 32 actions together represent an integrated comprehensive approach, the Nexus calls attention to core connections between specific actions, goals and objectives.

NEXUS OF GOALS, OBJECTIVES AND ACTIONS

	GOAL 1: Sustain and improve the Estuary's habitats and living resources.			GOAL 2: Bolster the resilience of Estuary ecosystems, shorelines and communities to climate change.			GOAL 3: Improve water quality and increase the quantity of fresh water available to the Estuary.			GOAL 4: Champion the Estuary.		
OBJECTIVE	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
ACTION												
1 Develop and implement a comprehensive, watershed-based approach to aquatic resource protection	●		●	●	●	●		●	●	●	●	●
2 Establish a regional wetland and stream monitoring program	●		●									●
3 Protect, restore and enhance tidal marsh and tidal flat habitat	●			●	●							
4 Identify, protect, and create transition zones around the Estuary	●	●		●	●							
5 Protect, restore and enhance intertidal and subtidal habitats	●	●		●	●							
6 Maximize habitat benefits of managed wetlands and ponds	●	●	●	●								
7 Conserve and enhance riparian and in-stream habitats throughout the Estuary's watersheds	●	●		●	●							
8 Protect, restore, and enhance seasonal wetlands	●	●										
9 Minimize the impact of invasive species		●	●									
10 Increase the efficacy of predator management		●	●									
11 Increase carbon sequestration through wetland restoration, creation, and management	●		●	●		●						

OBJECTIVES

A. Protect, restore, and enhance ecological conditions and processes that support self-sustaining natural communities
B. Eliminate or reduce threats to natural communities
C. Conduct scientific research and monitoring to measure the status of natural communities, develop and refine management actions, and track progress towards management targets
D. Increase resilience of tidal habitats and tributaries to climate change
E. Increase resilience of communities at risk from climate change impacts while promoting and protecting natural resources
F. Promote integrated, coordinated, multi-benefit approaches to increasing
G. Increase drought resistance and water efficiency and reduce reliance on imported water
H. Improve freshwater flow patterns, quantity, and timing to better support natural resources
I. Reduce contaminants entering the system and improve water quality
J. Build public support for the protection and restoration of the Estuary
K. Strengthen regional leadership in support of Estuary health
L. Promote efficient and coordinated regional governance

Nexus of Goals, Objectives and Actions - *continued*

	GOAL 1: Sustain and improve the Estuary's habitats and living resources.			GOAL 2: Bolster the resilience of Estuary ecosystems, shorelines and communities to climate change.			GOAL 3: Improve water quality and increase the quantity of fresh water available to the Estuary.			GOAL 4: Champion the Estuary.		
OBJECTIVE	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
ACTION												
12 Restore Estuary-watershed connections to the Estuary to improve habitat, flood protection and water quality	●	●	●	●	●	●						
13 Manage sediment on a regional scale and advance beneficial reuse	●		●	●	●	●						●
14 Demonstrate how natural habitats and nature-based shoreline infrastructure can provide increased resiliency to changes in the Estuary environment	●	●	●		●	●						
15 Advance natural resource protection while increasing resiliency of shoreline communities in the Bay Area	●			●	●	●						●
16 Integrate natural resource protection into state and local government hazard mitigation, response, and recovery planning	●	●		●	●						●	●
17 Improve regulatory review, permitting, and monitoring processes for multi-benefit climate adaptation projects	●					●						●
18 Improve the timing, amount, and duration of freshwater flows critical to Estuary health	●							●		●	●	
19 Develop long-term drought plans	●						●				●	●
20 Increase regional agricultural water use efficiency	●						●	●				●
21 Reduce water use for landscaping around the Estuary	●						●			●		
22 Expand the use of recycled water	●						●	●		●		●
23 Integrate water into the updated Plan Bay Area and other regional planning efforts							●	●	●		●	●
24 Manage stormwater with low impact development and green infrastructure	●				●	●			●	●		●
25 Address emerging contaminants	●		●						●	●		
26 Decrease raw sewage discharges into the Estuary	●								●			
27 Implement projects to reduce mercury, methylmercury, pesticides, and areas of low dissolved oxygen in the Estuary	●		●						●	●		

CONTINUED

Nexus of Goals, Objectives and Actions - *continued*

	GOAL 1: Sustain and improve the Estuary's habitats and living resources.	GOAL 2: Bolster the resilience of Estuary ecosystems, shorelines and communities to climate change.	GOAL 3: Improve water quality and increase the quantity of fresh water available to the Estuary.	GOAL 4: Champion the Estuary.

OBJECTIVE	A	B	C	D	E	F	G	H	I	J	K	L
ACTION												
28 Advance nutrient management in the Estuary									●			
29 Engage the scientific community in efforts to improve baseline monitoring of ocean acidification and hypoxia			●									
30 Reduce trash input into the Estuary	●								●			
31 Foster support for resource protection and restoration by providing Estuary-oriented public access and recreational opportunities compatible with wildlife		●								●		
32 Champion and implement the CCMP										●	●	●

OBJECTIVES

A. Protect, restore, and enhance ecological conditions and processes that support self-sustaining natural communities
B. Eliminate or reduce threats to natural communities
C. Conduct scientific research and monitoring to measure the status of natural communities, develop and refine management actions, and track progress towards management targets
D. Increase resilience of tidal habitats and tributaries to climate change
E. Increase resilience of communities at risk from climate change impacts while promoting and protecting natural resources
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H. Improve freshwater flow patterns, quantity, and timing to better support natural resources
I. Reduce contaminants entering the system and improve water quality
J. Build public support for the protection and restoration of the Estuary
K. Strengthen regional leadership in support of Estuary health
L. Promote efficient and coordinated regional governance

Actions

ACTION 1 Develop and implement a comprehensive, watershed-based approach to aquatic resource protection

Develop a watershed-based assessment, planning, management, and reporting process that improves protection for aquatic resources in the context of human population growth and climate change. Improve coordination of public policies and programs related to aquatic resource management including water supply security and usage, water quality, flood control, habitat conservation, and water-dependent recreation.

TASK 1-1 Develop a written framework that explains the need for watershed-based aquatic resource protection; frames an approach to meet this need; and identifies and incorporates supporting technical tools and policies. The framework should also address relevant regulatory and governance issues.

BY 2017 Complete framework.

TASK 1-2 Develop criteria to evaluate watersheds that could be used to pilot the Task 1-1 framework. Select a pilot watershed that drains into San Francisco Bay based on these criteria.

BY 2018 Complete criteria and select pilot Bay watershed.

TASK 1-3 Plan and initiate the pilot project with a steering committee of local, regional, and federal agencies involved in aquatic resources management in the selected watershed. The project should build on related efforts to date, and use scientific understanding of historical (pre-settlement) and present-day conditions within the pilot watershed to identify ways to increase the protection of aquatic resources. Recommendations for more comprehensive, watershed-scale management of aquatic resources (with reference to their distribution, abundance, diversity, and condition) should be consistent with governing policies. The pilot project will also identify the best available regulatory mechanisms for achieving ideal future conditions.

BY 2021 Complete Bay watershed pilot project.

BACKGROUND

Public agencies that administer federal or state policies governing the relationship between people and the environment are facing severe challenges in the San Francisco Estuary region due to rapid population growth and accelerated climate change. In response, agencies need to increase the speed and effectiveness of environmental planning, regulation, and management. To succeed, agencies will need to engage in greater coordination and outreach such that fewer plans and permits can cover more resources with the same or greater level of protection. A flexible approach is needed to address local threats in a regional context, and to overcome the political, bureaucratic and financial challenges of adapting to rapid change.

Watersheds provide natural geographic templates for effectively managing changing relationships between people and aquatic resources such as fish. This CCMP action supports development and implementation of a framework for setting common, watershed-based, scientifically sound, numerical targets for the distribution, abundance, diversity, and condition of aquatic resources. Targets need to be consistent with public policies. Agencies tasked with implementing these policies can benefit from this framework, and from a shared system for data development and delivery, as well as from regular reporting on progress relative to targets.

This CCMP action builds on current and planned efforts to coordinate aquatic resources protection on a watershed basis. Efforts include watershed or landscape approaches to compensatory mitigation planning, stormwater management, wastewater management, flood control, and fisheries protection and recovery.

While this CCMP action is focused on Bay watersheds, it will be closely coordinated with similar science-based, collaborative restoration efforts being undertaken in the Delta (specifically in the Cache Slough Complex and the NE Delta region). The Bay and Delta processes are on parallel tracks and opportunities exist to share information and lessons learned.

OWNERS

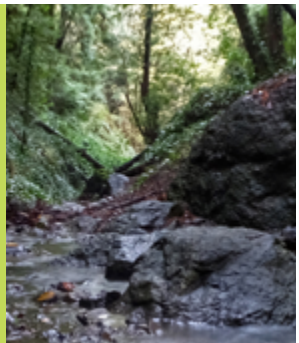
SF Estuary Institute (Tasks 1-1, 1-2, 1-3)
SF Estuary Partnership (Task 1-2 and 1-3)

COLLABORATING PARTNERS

CA State Coastal Conservancy, CA Department of Fish and Wildlife, CA Department of Water Resources, CA State and Regional Water Boards, Delta Conservancy, Delta Stewardship Council and Science Program, National Oceanic and Atmospheric Association, SF Bay Conservation and Development Commission, SF Bay Joint Venture, US Army Corps of Engineers, US Environmental Protection Agency, US Fish and Wildlife Service, special districts, municipalities, NGOs, and other watershed interests.

NEXUS

Actions 2-8, 17, 18-20, 23-26, 28
Goals 1, 2, 3, 4
Objectives a, d, f, h, i, j, k, l



ACTION 2 Establish a regional wetland and stream monitoring program

Plan and implement a regional monitoring program for wetlands and streams in the Bay Area and the Delta to help local, regional, state, and federal agencies evaluate the effectiveness of efforts to sustain healthy aquatic habitats and resources.

TASK 2-1 Develop and implement a Bay Area and Delta regional wetland monitoring plan that establishes separate, yet closely coordinated, steering committees for the upper and lower Estuary. The plan will identify regulatory and management monitoring priorities, as well as existing wetland, stream, or riparian monitoring efforts, to determine where there may be opportunities for partnerships and where there are gaps.

BY 2018 Initial meeting of the steering committees.

TASK 2-2 Determine how much funding is needed to support program management and administration, technology purchase and upgrades, hardware and software operations and maintenance, practitioner training and helpdesk support, and annual data synthesis and reporting; develop a business model to meet these funding needs.

BY 2018 Complete the business model.

TASK 2-3 Complete the California Aquatic Resource Inventory (CARI) for the Delta; complete riparian inventories for the Delta and Bay Area; upload the inventories into the California EcoAtlas information system.

BY 2018 Complete the Delta CARI and the Delta and Bay Area regional riparian inventories.

TASK 2-4 Establish a regional network of sentinel tidal marsh monitoring stations within the Delta and the Bay to support ecological forecasting and planning, incorporating and building on the San Francisco Bay National Estuarine Research Reserve program.

BY 2019 Establish sentinel marsh monitoring network.

TASK 2-5 Establish a network of streamflow gauges and fish population surveys within select tributary streams to assess aquatic habitat conditons for existing or potentially reintroduced steelhead and salmon.

BY 2021 Establish the stream gauge network.

BACKGROUND

The public continues to invest in the restoration of wetlands, streams, and riparian areas in the Estuary region. A strong regional monitoring and assessment program is needed to track the progress of restoration, recovery, enhancement and mitigation projects, troubleshoot their problems, and assess their cumulative effects. Project results also need to be compared over time relative to their specific performance criteria and to changing conditions. While this CCMP action is focused on improved monitoring in light of climate change uncertainty, it also seeks to integrate data into a decision-making framework that relies upon ecological forecasting and tests alternative scenarios.

This CCMP action envisions a monitoring program with separate but coordinated Delta and Bay Area divisions. Each steering committee should reflect its regional restoration community and their different monitoring priorities. It is further envisioned that each of the two regional divisions would have an estuarine and a watershed component.

As part of this stepped up level of regional monitoring, this CCMP action also supports completion of the California Aquatic Resource Inventory (CARI). CARI is a standardized statewide map of surface waters and related habitat types based on the National Wetland Inventory of the US Fish and Wildlife Service and the National Hydrography Dataset of the US Geological Survey, as well as maps from regional and local agencies. Currently the Bay Area Aquatic Resource Inventory (BAARI) is viewable in the California EcoAtlas, but the Delta CARI still needs to be completed.

OWNERS

SF Bay Joint Venture (Task 2-1 through 2-4)
SF Bay National Estuarine Research Reserve (Task 2-4)
SF Bay Regional Water Quality Control Board (Task 2-1)
SF Estuary Institute (Task 2-1, 2-3, 2-5)
SF Estuary Partnership (Task 2-2, 2-4, 2-5)

COLLABORATING PARTNERS

CA State Coastal Conservancy, CalTrout, Central Valley Regional Water Quality Control Board, Delta Stewardship Council, Interagency Ecological Program, Sacramento-San Joaquin Delta Conservancy, SF Bay Conservation and Development Commission, SF Bay Regional Water Quality Control Board, SF Bay Sentinel Site Cooperative, US Army Corps of Engineers, US Environmental Protection Agency, US Fish and Wildlife Service Refuges, US Geological Survey, various special resource management, flood control, water, and parks districts

NEXUS

Actions 1, 3-8, 24; Goals 1, 4; Objective a, c, l

ACTION 3 Protect, restore and enhance tidal marsh and tidal flat habitat

Restore tidal marsh and tidal flat habitats within the Estuary for multiple ecosystem benefits including recovery of threatened and endangered species. Consider connections between habitats. Strive to protect and restore complete tidal wetland systems.

TASK 3-1 Restore tidal habitat in the Estuary.

BY 2021 Restore 15,000 acres of tidal habitat in SF Bay.

BY 2021 Restore 8,000 acres of tidal habitat in the Delta.

TASK 3-2 Protect land to support preservation and enhancement of tidal habitats.

BY 2021 Acquire and protect 500 acres through various mechanisms including transfer of fee title, donation, or easement.

BACKGROUND

Tidal marshes offer diverse ecosystem services to the San Francisco Estuary. They provide habitat for wildlife, support aquatic food webs, and preserve biodiversity. They also stabilize shorelines, protect them from storm damage, absorb floodwaters, and store carbon. Finally, these tidal transitions between urban and rural landscapes and Estuary waters offer unique opportunities for scientific study, education, recreation, and aesthetic appreciation.

For the Bay, the 1999 *Baylands Ecosystem Habitat Goals Report* set a long-term goal of 100,000 acres of tidal marsh, approximately half the acreage that existed in the Bay at the beginning of the 19th century. The 2015 *State of the Estuary Report* calculates there is currently approximately 51,300 acres of tidal marsh in the Bay today. This CCMP action supports an effort to increase tidal marsh area by 15,000 acres, as described in Task 3-1. This milestone derives from the list of active projects in the San Francisco Bay Joint Venture's Project Tracker, an ambitious but achievable outcome.

For the Delta, there is no quantitative, long-term restoration goal equivalent to that set in the *Baylands Goals*. Historically, approximately 360,000 acres of tidal marsh occurred in the Delta. The 2015 *State of the Estuary Report* calculates approximately 8,000 acres remain today.

Beyond restoration goals, tasks and milestones in this action also reflect federal and state opinions and recovery plans concerning critical habitat for sensitive species.

This CCMP action, for example, supports California EcoRestore, a California Natural Resources Agency initiative to help coordinate and advance critical habitat restoration in the Sacramento-San Joaquin River Delta over the next four years. Cal EcoRestore's initial goal includes restoration of 9,000 acres of tidal and subtidal habitat. This CCMP action, however, references the 8,000 acres of tidal restoration in the Delta required by the U.S. Fish and Wildlife Service Delta Smelt Biological Opinion and cited in the National Marine Fisheries Service Salmonid Biological Opinion (Operations Criteria and Plans for coordination of the Central Valley Project and State Water Project, dated 12/15/08 for smelt, and 4/4/09 for salmon).

In terms of critical habitat in the Bay, this CCMP action supports projects identified in the 2013 Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California maps as "near-term tidal restoration" and those meeting San Francisco Bay Joint Venture goals.

As described in Task 3-2, achieving restoration goals may also involve obtaining additional land within the approved acquisition boundary of the San Francisco Bay National Wildlife Refuge Complex. Additional areas may be acquired by the East Bay Regional Park District or by other conservation organizations and agencies.

On a broader ecosystem level, this CCMP action supports the restoration of tidal wetlands as part of a dynamic continuum of habitats connected by physical and biological processes. This continuum extends from the open waters of the Bay and Delta through intertidal mudflats, tidal marshes and sloughs, and up into adjacent terrestrial areas. Although CCMP Actions 3-5 include specific milestones for individual habitat types, these and other actions also recognize the importance of connecting the full gradient of ecological functions and ecosystem services in complete tidal wetland systems. For wildlife, Section V, p. 63, provides more detail on specific threatened and endangered species and links CCMP actions to critical management issues for listed species.

OWNERS

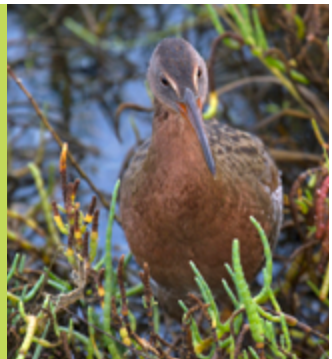
SF Bay Joint Venture (Tasks 3-1 and 3-2)

COLLABORATING PARTNERS

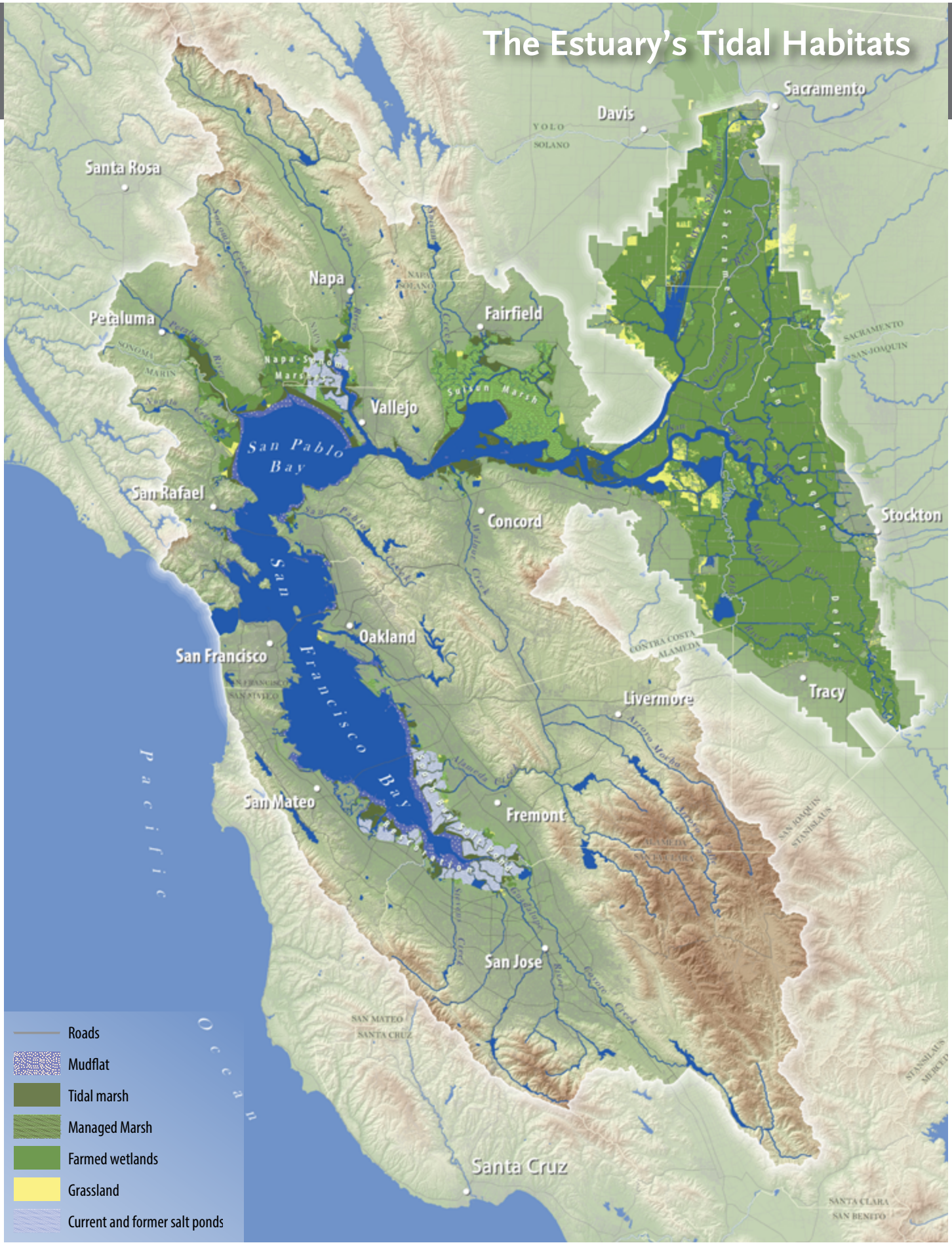
Restoration community and other interested public, private, and non-profit entities.

NEXUS

Actions 1-8, 11, 15-18, 28
Goals 1, 2
Objectives: a, d, e



The Estuary's Tidal Habitats



ACTION 4 Identify, protect, and create transition zones around the Estuary

Protect areas between estuarine and terrestrial ecosystems (transition zones), and their ecosystem services, to help the Estuary adapt to rising sea levels. Integrate transition zones into baylands restoration and enhancement projects to provide both migration space and high water refugia.

TASK 4-1 Convene a regional steering committee and technical advisory committee to guide a bay-wide, science-based, inventory of existing and projected future transition zones. Base the inventory on current baylands restoration projects, land use, ownership, topography, elevation, and other criteria consistent with climate change adaptation science and regional, state, and federal agency initiatives.

BY 2017 Establish transition zone inventory steering and technical advisory committees.

TASK 4-2 Complete a regional inventory of transition zones based on the methodology developed by the technical advisory committee.

BY 2018 Complete Bay transition zone inventory.

TASK 4-3 Protect transition zones, based on identified needs and opportunities, through acquisition of fee title, partnerships to develop conservation easements, or other management agreements.

BY 2021 Protect, or plan to protect, 10 of the identified sites.

TASK 4-4 Include enhancement, restoration, or creation of transition zones in tidal restoration and multi-benefit climate adaptation projects where feasible.

BY 2021 Include transition zones in five tidal restoration projects.

BACKGROUND

Efforts to address the ecological and economic threats imposed by sea-level rise and other aspects of climate change have begun to focus on the estuarine–terrestrial transition zone in areas above the current and future water line. The 2015 *Baylands Habitat Goals Science Update* (Baylands Goals) defines the transition zone as existing and predicted areas of interaction among tidal, terrestrial and fluvial processes that result in mosaics of habitat types, assemblages of plant and animal species, and sets of ecosystem services that are distinct from those of adjoining estuarine, riverine, or terrestrial ecosystems.

As reported in the 2015 *State of the Estuary Report*, the transition zone includes the space for tidal habitat migration upstream and landward (i.e., the migration space). If appropriately conserved, transition zones can accommodate Bay expansion without loss of the ecosystem services provided by tidal marshland or unacceptable flood hazards. They can also provide habitat and foraging areas for native wildlife, refuge from predators and high water, and corridors for wildlife movement.

An important first step is to identify those transition zones, both existing and predicted, that are not yet developed so they can be protected. Other steps recommended in the *Baylands Goals* are the development of a regional transition zone assessment program and a comprehensive portfolio of strategies for the conservation, restoration, and management of the transition zone.

This CCMP action supports the *Baylands Goals* recommendations by focusing on the regional transition zone inventory, the protection of some identified sites, and the inclusion of transition zones in tidal restoration projects. These tasks will involve using the best available science and technology to forecast sea level rise rates and then visualize the resulting shifts in habitat location and connectivity.

In terms of application to the Estuary watershed, this action focuses on the Bay. However it is also consistent with, and will be coordinated with, existing and emerging regional, state, and federal initiatives and plans relating to sea level rise adaptation. For example, the US Fish and Wildlife Service's *Tidal Marsh Recovery Plan* includes an action focused on allowing for landward transgression of high marsh zones by acquiring and protecting adjacent undeveloped lands not yet serving as habitat. *The Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta* also discusses the importance of transition zones.

As already described in the Background for Action 3, transition zones should be a part of a dynamic continuum of aquatic, tidal and terrestrial habitats. Connecting these habitat types is the most cost-effective way to protect the complete portfolio of their individual and collective ecosystem services.

OWNERS

SF Bay Joint Venture (Task 4-1, 4-2,4-3,4-4)
SF Estuary Partnership (Task 4-1, 4-2,4-3,4-4)

COLLABORATING PARTNERS

Restoration community and other interested public, private, and non-profit entities.

NEXUS

Actions 1-8,1 4, 15, 16, 17, 24
Goals 1, 2
Objectives a, c, d, e

ACTION 5 Protect, restore, and enhance intertidal and subtidal habitats

Protect, restore, and enhance intertidal and subtidal habitats to improve delivery of ecosystem services and water quality benefits to the Estuary. Consider connections between habitats within the full range of tidal elevations, from upland to subtidal, striving to protect and restore complete systems.

TASK 5-1 Increase populations of native eelgrass (*Zostera marina*) by expanding the extent of existing beds or establishing new beds on the bay floor.

BY 2021 Increase eelgrass coverage in the Bay by 25 acres.

TASK 5-2 Increase populations of native oysters (*Ostrea lurida*) by expanding the extent of existing beds or establishing new beds on the bay floor.

BY 2021 Increase native oyster bed coverage in the Bay by 25 acres.

TASK 5-3 Restore intertidal and subtidal habitats other than eelgrass and oyster beds, such as rocky intertidal, sandy beach, and macroalgal beds. Identify appropriate and feasible sites, secure funds, and implement projects to create or improve these types of habitats as well as projects that integrate multiple habitats.

BY 2021 Implement five projects in the Bay that focus on rocky intertidal, sandy beach, macroalgal bed, living shorelines, or other integrated habitats.

BACKGROUND

Intertidal and subtidal habitats are productive and important components of the Estuary ecosystem. Intertidal habitats can include oyster and eelgrass beds, mudflats, rocky areas, sandy beaches, macroalgal beds and wetlands.

Eelgrass enriches the Estuary in many ways. Growing in underwater meadows, it provides shelter and food for many species of birds, and attracts small fish, crabs and other aquatic life. Spawning herring favor eelgrass over other surfaces to attach their eggs. Eelgrass beds also dampen waves, slow currents, trap sediment, reduce turbidity, and protect shoreline areas from erosion.

Shellfish beds also enrich the Estuary and provide ecosystem services. Native Olympia oysters are a "foundation species," building habitat by increasing bottom roughness, reducing the speed of currents, and as a result, trapping sediments. In contrast to other adjacent, less complex habitats, the presence of native oyster beds can locally increase the number of other benthic invertebrates, as well as the abundance and diversity of fish.

These and other intertidal Bay habitats — including mudflats, marshes, and saline ponds — are used by over one million shorebirds each year (>300,000 in winter). The 2015 *State of the Estuary Report* found the status of large and medium shorebirds to be poor, and of small shorebirds to be fair. Ongoing monitoring is needed to better understand whether observed changes represent changes in wintering abundance or shifts in bird distribution.

This CCMP action also supports restoration goals in the 2010 San Francisco Bay *Subtidal Habitat Goals Report* (Subtidal Goals Report). The Subtidal Goals Report recommends increasing eelgrass and oyster populations in the Bay within 8,000 acres of suitable area over a 50-year time frame. The report also recommends a phased approach under a program of adaptive management, with benchmarks to increase eelgrass and oyster coverage by 25 acres within 5 years, 100 acres within 10 years, and up to 8,000 acres within 50 years. The Subtidal Goals Report also contains goals for other intertidal and subtidal habitats, as well as for the use of soft structures and incorporation of living materials into shoreline protection schemes, or "living shorelines."

On an ecosystem level, this CCMP action also supports the restoration of tidal wetlands as part of a dynamic continuum of habitats connected by physical and biological processes. This continuum extends from the open waters of the Bay through intertidal mudflats and tidal marshes, and up into creek mouths and adjacent terrestrial areas. Although CCMP Actions 3-8 include specific milestones for individual habitat types, these and other actions also recognize the importance of connecting the full gradient of ecological functions and ecosystem services in complete tidal wetland systems.

OWNERS

CA State Coastal Conservancy (Tasks 5-1, 5-2, 5-3)
NOAA Fisheries (Task 5-1)

COLLABORATING PARTNERS

CA Department of Fish and Wildlife, National Oceanic and Atmospheric Administration, Romberg Tiburon Center, SF Bay Joint Venture, SF Bay National Estuarine Research Reserve, Smithsonian Environmental Research Center, US Fish & Wildlife Service & SF Bay National Wildlife Refuge Complex

NEXUS

Actions 1-8, 15-18, 28
Goals 1, 2
Objectives a,b,d,e

ACTION 6 Maximize habitat benefits of managed wetlands and ponds

Maximize habitat benefits of managed wetlands and ponds for all species. In the near term, continue to support studies on bird use of managed ponds and sensitive species in managed wetlands to inform long-term management options for how these habitats can sustain these species.

TASK 6-1 Analyze the response of birds to management of wetlands and ponds to provide increased nesting, foraging, roosting, and high tide refuge habitat. Investigate the effectiveness of specific habitat enhancement measures such as management of water levels in and adjacent to ponds, varied pond topography, levee improvements, and the creation of islands. Conduct monthly bird surveys in the Bay to assess species response to these measures.

2016 -2021 Produce a yearly report on bird response to specific management measures, and share progress within five years. .

TASK 6-2 Study the ability of managed ponds to sustain waterbird numbers in the Bay. Analyze regional waterbird monitoring data with regard to managed pond use and bird density over time, as compared to other habitats.

BY 2020 Produce report comparing bird use of various habitat types in the Bay and share results.

TASK 6-3 Study the ability of managed wetlands to sustain diverse species of vertebrates, invertebrates, and endemic and endangered plants over time. Analyze species use, density and diversity as compared to non-managed wetlands.

BY 2020 Produce report comparing species use and diversity in various managed wetlands in the Bay, and share results.

TASK 6-4 Develop a methodology for assessing the long-term costs and benefits of managed wetlands and ponds. Methodology should take into account habitat benefits for multiple species and changes in maintenance requirements resulting from sea level rise and climate change.

BY 2020 Develop and implement a methodology.

BACKGROUND

For more than a century, humans have "managed" tidal action and water levels in some marsh and pond habitats to attract waterfowl for hunting; more recently, diked former wetlands and salt ponds now being converted to tidal habitats need "management" to address subsidence issues, species protection goals, and restoration priorities. The hydrology and salinity in these habitats affects species distribution and health.

Managed ponds (shallow or deep open water areas) can provide feeding, roosting, resting, and breeding areas for a variety of waterbird species. Managed wetlands (such as diked or muted marshes) can provide habitat for critical vegetation, marsh dependent bird species, and small mammals in areas where full tidal restoration is not feasible. The 2015 Baylands Ecosystem Habitat Goals Update recommends actively restoring diverse habitats for waterbirds and small mammals. When possible, it recommends providing sufficient habitat by modifying managed ponds and reconfiguring former salt ponds. (Section V links CCMP actions to critical management issues for listed species.)

Recent efforts to support food chains in these kinds of habitats have been successful. According to the 2015 *State of the Estuary Report*, the South Bay Salt Ponds have become a productive nursery for grass shrimp, diverse native fish species, and other aquatic organisms. Shorebirds are nesting on specialized bird islands and making the most of experimental topographic changes in shallow ponds. More information on how birds respond to habitat changes is being collected by the South Bay Salt Pond Restoration Project. The Project's Pond Management Working Group meets regularly to fine tune management responses.

Managing large areas for targeted water depths and salinity is a time and resource intensive effort. The effects of climate change and sea level rise challenge the long-term viability of managed ponds. Projected higher water levels, more frequent and intense storms, and regional salinity shifts, may make it difficult or even impossible in the future for managers to maintain target habitat conditions inside the ponds.

In addition to climate change challenges, uncertainties remain about how certain avian groups adapted to using managed habitats might be affected as more ponds and shallows are restored to tidal wetlands. This CCMP action reaffirms adaptive management approaches to such challenges and uncertainties, and recognizes that various ecological and economic trade-offs must be assessed in conjunction with other regional planning efforts such as US Fish & Wildlife's *Recovery Plan for Tidal Marsh Ecosystems* and the *Baylands Goals*.

OWNERS

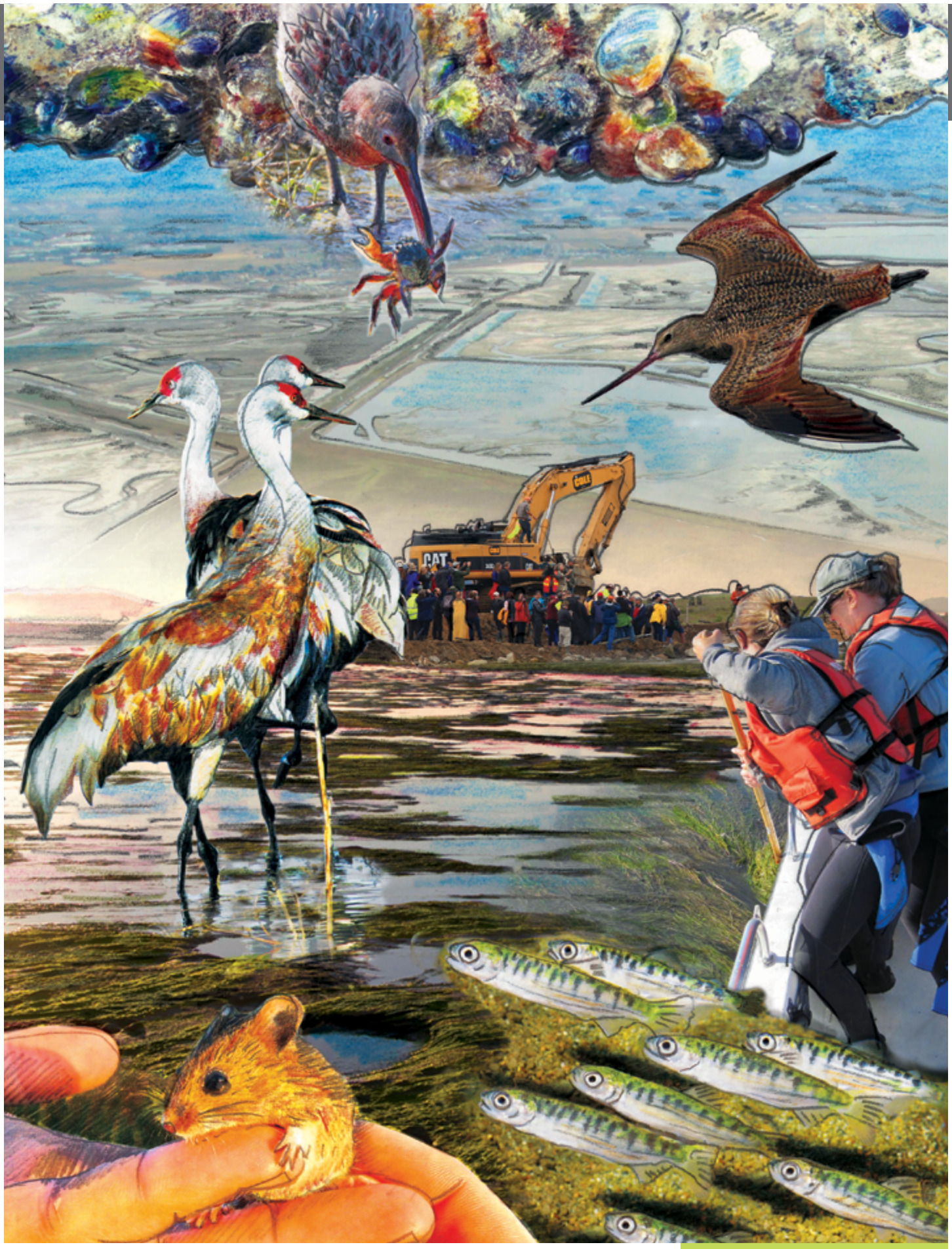
CA Department of Fish and Wildlife (Task 6-1)
CA State Coastal Conservancy (Task 6-1, 6-2, 6-3, 6-4)
US Fish and Wildlife Service (Task 6-1)
US Geological Survey (Task 6-2)

COLLABORATING PARTNERS

Point Blue Conservation Science, SF Bay Bird Observatory, SF Bay Regional Water Quality Control Board

NEXUS

Actions 1-8, 15-18; Goals 1,2; Objectives a,b,d,e



Healthy Habitats by Afsoon Razavi

ACTION 7 Conserve and enhance riparian and in-stream habitats throughout the Estuary's watersheds

Conserve habitats by identifying priority streams and stream reaches, defining impairments and threats, filling data gaps, developing science based tools, and designing, advancing, and collaborating on projects.

TASK 7-1 Merge the San Francisco Bay Joint Venture's project tracking database with California's EcoAtlas. Identify potential additional functions to facilitate riparian and stream projects.

BY 2016 Complete merge of project tracking database with EcoAtlas.

TASK 7-2 Provide technical and policy guidance to the watershed restoration community and decision-makers. Guide the development of needed stream and watershed data sets, the use of appropriate assessment methodologies, and conservation policy. Critical information includes characterization of key habitat areas, fish monitoring and limiting factors analyses, instream flow needs, and process-based assessment of channel and riparian condition for reaches that support salmonids and other native fish assemblages. Policy guidance likely will address issues such as development setback recommendations, conservation easements, and land acquisition.

BY 2021 Make new policy and technical guidance documents available online.

TASK 7-3 Develop projects and programs to conserve and enhance regional priority stream habitats that support the life history requirements of salmonids and other native fish populations. Emphasize protecting and enhancing the sources of flow and structure elements that maintain dry season aquatic habitats, particularly coldwater refugia, and rehabilitating critical channel and riparian reaches. Guidance will be based on information compiled in Tasks 7-1 and 7-2.

BY 2021 Establish specific flow enhancement goals, riparian zone improvements, and channel rehabilitation projects for prioritized streams and stream reaches.

TASK 7-4 Implement riparian corridor and in-stream habitat restoration and conservation projects throughout the region (primarily informed by Tasks 7-1 through 7-3), including at least one pilot effort to protect and enhance the sources of flows that maintain aquatic habitats, particularly coldwater refugia and migratory habitat critical to salmonids.

BY 2021 Restore 10,000 acres of riparian corridor and five miles of creek channel and in-stream habitat.

BACKGROUND

This CCMP action protects and rehabilitates riparian habitat, stream channels and instream flows throughout the region. With iconic fish species—particularly steelhead trout—struggling to maintain populations in Estuary watersheds, managers need to locate and map the Bay Area's most important habitat resources, and identify other impacted areas critical to the needs of native fish species (and other stream dependent species such as frogs, turtles, and shrimp).

Work in support of the flow component of this action will account for three factors in priority aquatic habitats: stream flow sources, instream flow needs (IFN), and impairment (i.e., direct diversion and groundwater withdrawals that affect stream flow). To help managers and water users conserve and enhance stream flow, this action supports outreach, hydrology and IFN studies, and water need evaluation leading to specific project and basin program design.

This action will use ongoing research to refine previously identified key habitat resources, including building off partner efforts. For example, data from salmonid and habitat monitoring and assessment reveal areas of highest potential productivity where conservation and enhancement will achieve greatest advancement toward stated management goals. Once established, these areas should be the primary focus of a regional program that protects and restores their ecological function, particularly in relation to stream flow, channel condition, and riparian corridor health. In addition, as part of the NOAA Fisheries Multi-Species Recovery Plan, a tool has been developed for prioritization of watersheds and restoration projects.

Finally, there is also significant value in opportunistic restoration that considers multi-objective and multi-benefit uses and approaches. While this action emphasizes critical in-stream habitat, it also supports efforts to daylight stream reaches, restore urban waterways, and improve riparian habitat conditions for birds and terrestrial wildlife.

OWNERS

SF Bay Joint Venture (Tasks 7-1 through 7-4)

COLLABORATING PARTNERS

Bay Area Watershed Network, CA Department of Fish and Wildlife, CA State Water Resources Control Board, NOAA Fisheries, SF Bay Regional Water Quality Control Board, Resource Conservation Districts, SF Estuary Institute, SF Estuary Partnership, US Environmental Protection Agency, various local municipalities and non-governmental organizations

NEXUS

Actions 1-8, 15-18: Goals 1, 2; Objectives a,b,d,e

ACTION 8 Protect, restore, and enhance seasonal wetlands

Protect and enhance seasonal wetlands within the region using conservation easements, related protection tools, and improved grazing management practices.

TASK 8-1 Re-establish the Interagency Vernal Pool Stewardship Initiative among state and federal agencies. Build relationships through the Initiative with land trusts and conservancies, landowners, Resource Conservation Districts, and municipalities to coordinate planning efforts.

BY 2017 Re-establish Vernal Pool Stewardship Initiative.

TASK 8-2 Through the Initiative, leverage funding and investments to protect targeted vernal pools.

BY 2018 Protect 25% of the targeted acres through easements and other agreements.

BY 2021 Protect at least 300 acres of vernal pool landscapes in the San Francisco Bay region and an additional 500 acres in the Delta Region.

TASK 8-3 Develop a white paper on best practices for grazing management to protect seasonal wetlands and enhance habitat quality.

BY 2018 Complete white paper.

BACKGROUND

Seasonal wetlands can be found in both upland areas and on former baylands. These types of wetlands are called "seasonal" because they periodically flood or fill with rain, runoff or groundwater. Seasonal wetlands have soils and plant species characteristic of a continuum of salinity regimes (from salty to fresh).

Seasonal wetlands may be former tidal marshes that have been closed off from tidal action by the construction of dikes and levees. With each year's winter rains, these low-lying areas fill with fresh water, and then slowly dry out after the rainy season ends. Salt grass, bulrush, and cattails near the Bay are species typically found in seasonal wetlands. Other depressions in upland areas where saline soils support marsh species may also be seasonal wetlands. Basins in relatively flat areas or on gently rolling ground are typically wetlands and may be labeled vernal pools, seasonal wetlands or marshes, or wet meadows. They typically consist of seeps, wet soils, and pools. These habitats may host large numbers of waterfowl and shorebirds during the winter and spring migratory periods, and support rare or endangered plants and invertebrates.

Seasonal wetlands can co-exist with ranchers but are threatened by conversion to orchards, vineyards, and other land uses. Studies show cattle grazing can keep non-native grasses from crowding out native grasses and drying out areas where water collects. Employing best grazing practices can help sustain ranching communities and retain species diversity.

Efforts to conserve one type of seasonal wetland, vernal pool complexes, have lagged behind the region's collective work on other important aquatic and riparian habitats. As wetlands, vernal pools are protected by state and federal laws, and many of the plants and animals they support (including significant numbers of shorebirds) are listed or special status species. In addition, the SF Bay Regional Water Quality Control Board's Conditional Waiver of Waste Discharge Requirements for Grazing Operations in the Napa River and Sonoma Creek Watersheds (2011) requires rangeland managers to minimize delivery of sediment, pathogens, and nutrients from ranching lands and animal use areas into vernal pools and other surface waters.

Despite these regulatory steps, the loss and fragmentation of vernal pools remain the most serious threats to the survival and recovery of sensitive species as identified in the Vernal Pool Recovery Plan issued by the U.S. Fish and Wildlife Service. In 1996, federal and state agencies convened the Interagency Vernal Pool Stewardship Initiative to collaborate in the conservation of vernal pools. In partnership with land trusts, Resource Conservation Districts, and stewardship-minded landowners, tens of thousands of acres of vernal pool landscapes were permanently protected within the Eastern Delta and targeted areas within the Sacramento and San Joaquin Valleys. Personnel changes at the agencies leading the Initiative, however, led to its suspension (though it was never intentionally disbanded). This CCMP action supports the re-establishment of the Initiative to facilitate interagency and public-private collaboration around vernal pool protection in a manner that promotes sustainable grazing and livestock production.

OWNERS

SF Bay Joint Venture (Task 8-2, 8-3)
SF Estuary Partnership (Task 8-1)

COLLABORATING PARTNERS

Resource Conservation Districts, SF Bay National Estuarine Research Reserve, SF Bay Regional Water Quality Control Board, Sonoma Land Trust, US Environmental Protection Agency

NEXUS

Actions 1-9, 11, 12, 14, 15
Goal 1
Objectives a, b

ACTION 9 Minimize the impact of invasive species

Reduce the impact of invasive species through prevention, early detection, rapid response, eradication, and control. Conduct work with national and regional coordinating bodies and the key agencies implementing specific programs.

TASK 9-1 Expand and improve invasive species prevention programs. Actions may include developing new or expanding existing policies and programs, conducting outreach, and working with existing bodies to identify priority activities.

ONGOING THROUGH 2021 Develop new or expand existing policies and programs to prevent non-native species invasions. Coordinate and streamline programs throughout the western region and identify priority activities.

TASK 9-2 Increase early detection, monitoring, and rapid response programs. Rapid response should be adaptive and include activities such as 1) Assessing and mapping Estuary-wide distribution of key invasive species; 2) Improving the Calflora website and expanding it to include wetland species and to increase citizen reporting of species; 3) Working with professional divers associations and training them to detect new invasive species while cleaning boat bottoms; 4) Increasing scientific monitoring to measure the number of new species coming into the region; and 5) increasing citizen science monitoring.

BY 2021 Identify 3-4 funding sources for early detection, monitoring, and rapid response.

TASK 9-3 Implement eradication and control programs with priority given to species detected early, species that have a chance of being eradicated, and species that have extensive impacts on habitats important to the health of the estuarine ecosystem. Research and test pilot control measures for key invasive species.

ONGOING THROUGH 2021 Reduce acreage of key invasive species.

TASK 9-4 Provide adequate specificity in permit language requirements for restoration projects to include non-native plant monitoring requirements where appropriate; add language about non-native plant monitoring requirements where lacking. Confirm that best management practices are shared for invasive species where they exist (for example: Invasive Spartina Project Best Management Practices 2016). Confirm that "percent cover" requirements in permits are appropriate to individual invasive species.

BY 2021 Increase the number of permits with improved invasive spartina requirements.

BACKGROUND

Invasive species threaten native species and habitats in the Estuary. Prevention is the best, most cost effective method for reducing the rate of invasions by new species. However, invasive species management also benefits from consistent monitoring and targeted early detection programs. Early detection can provide opportunities for eradication before invasions become unmanageable, and for controlling impacts on sensitive Estuary habitats.

The tasks in this action refer to "key" species targeted by management programs in the Estuary. Examples of key species include: invasive *Spartina alterniflora* and *spartina* hybrids, wild mustard (*Lepidium*), water hyacinth (*Eichornia crassipes*), Brazilian waterweed (*Egeria densa*, the Asian clam (*Corbicula fluminea*), the overbite clam (*Potamocorbula amurensis*), and giant reed (*Arundo donax*). Eradication and control programs should be assessed on a regular basis to determine the overall effectiveness of the program as well as potential impacts to threatened and endangered species. Climate change should also be taken into account.

In the Estuary's aquatic habitats, activities in support of this action may include improving ballast water management programs, improving management of recreational boats moving species overland (via boat trailers), and preventing introduction and spread of "fouling" species along the coast via several vectors. (Fouling species are those that attach to vessel hulls, piers, and other underwater infrastructure, the accumulation of which can impede functionality.)

This CCMP action supports working through existing organizing and coordinating bodies and key agencies to address invasive species, including, but not limited to, the Federal Aquatic Nuisance Species Task Force, the Western Regional Panel on Aquatic Nuisance Species, the National Invasive Species Advisory Committee, the Pacific Ballast Water Group, the California Invasive Species Advisory Committee, the California State Lands Commission's Marine Invasive Species Program, and the California Department of Fish and Wildlife's Aquatic Invasive Species Program. This CCMP action also supports consulting the *State Aquatic Invasive Species Management Plan* (AIS), *State Weed Plan*, and *State Strategic Framework for Preventing the Spread of Invasive Species* for guidance, as well as the federal task force's strategic plan. It should be noted that the state AIS plan includes a *Rapid Response Plan*, but that there is limited money for training and implementation.

On a regional level, this CCMP action also supports *2015 Baylands Ecosystem Habitat Goals Update* recommendations to ensure the continuity of programs to detect, manage, and eliminate invasive species. The update underscores the importance of early detection and rapid response for novel invasions or outbreaks

ACTION 9 CONT'D

Minimize the impact of invasive species

in a variety of habitats. Estuary management agencies should be prepared for rapid response if a species is detected, and determine if eradication and or containment is possible.

OWNERS

CA State Coastal Conservancy (Task 9-4)
San Francisco Estuary Partnership (Task 9-1, 9-2, 9-3)

COLLABORATING PARTNERS

CA Department of Fish and Wildlife, CA Invasive Plant Council, CA State Lands Commission, CA SCC Invasive Spartina Project, CA State Parks Department of Boating and Waterways, CA State Water Resources Control Board and Regional Water Quality Control Boards, Delta Stewardship Council, NOAA Fisheries, SF Bay National Estuarine Research Reserve, US Army Corps of Engineers, US Coast Guard, US Department of Agriculture, US Environmental Protection Agency, US Fish and Wildlife Service.

NEXUS

Actions 5, 10, 18, 23, 28
Goal 1
Objectives b, c

CCMP INTEGRATION: WILDLIFE

By emphasizing planning and action around diverse habitat mosaics and whole watersheds, the 2016 CCMP supports not only threatened and endangered species but also the health of the larger estuarine ecosystem and natural communities in which they live.

The San Francisco Estuary flows through a variety of urban, rural, and natural habitats and across myriad socioeconomic and political boundaries. The CCMP addresses these challenging and changing conditions for sensitive species in a holistic way. It accounts for conditions across the entire plan area, ranging from stream flows to transitional habitats and migration corridors. It ensures that actions appropriately target critical, science-based recommendations for improving the health of the Estuary.

The 2015 State of the Estuary Report is the most comprehensive health assessment ever completed for the San Francisco Estuary. Its findings are summarized in Section II and meticulously detailed for many species and biological communities, ranging from benthic invertebrates to wintering waterfowl, in the full report and its appendices at: www.sfestuary.org/about-the-estuary/soter/

The report's assessment of ecosystem health includes specific indicators for various sensitive species such as Ridgeway's Rail, as well as for the degree of invasion by non-native aquatic organisms and plants, among other indications of healthy life in the Estuary. These indicators were used to guide development of CCMP goals, objectives, and actions.

Section IV of this 2016 CCMP, *Tracking Progress*, links the species-specific indicators in the State of the Estuary Report to CCMP actions designed to protect native aquatic flora and fauna.

Section V, *Sensitive Species*, details how the recommendations in this CCMP benefit selected threatened and endangered fish, birds, mammals, and plants of critical management concern. Section V ties the CCMP's habitat and watershed approach to central concepts in species protection, including habitat protection and recovery, protection of essential migration routes, resilience to climate change, and reduction of negative impacts from invasive species.

The San Francisco Estuary Partnership recognizes the numerous individuals and organizations working tirelessly to protect the species that make both San Francisco Bay and the Delta special, and has developed a whole-habitat mindset for the 2016 CCMP that supports their efforts and strengthens collaboration on sensitive species issues across the entire Estuary.

ACTION 10 Increase the efficacy of predator management

Increase the efficacy of predator management activities to promote healthy populations of wildlife around the Estuary. Assess and guide management of terrestrial nuisance species with access to shoreline habitats that prey on threatened and endangered species, and on species of special concern.

TASK 10-1 Develop a map showing priority areas in the San Francisco Estuary where actions can be taken to reduce feral cat predation on sensitive species, particularly Ridgway's Rail. This cat predator threat assessment and opportunities map will include: 1) locations of known or suspected feral cat colonies and feeding stations; 2) identification of entity(s) maintaining each cat colony (individual, group-sanctioned, or city and county authorized activity); 3) jurisdictions of landowners with the authority and willingness to enforce the law (map to include all landowners of marshes and adjacent areas); 4) information on city and county cat-feeding station laws; 5) presence of critical Ridgway's Rail populations; and 6) extent of housing and urban development, including landfills and transfer stations.

BY 2018 Produce feral cat threat assessment and opportunities map.

BY 2019 Engage managers on feral cat management and report on findings.

TASK 10-2 Guide predator management on publicly-owned conservation lands that support threatened and endangered species by: 1) assessing the impacts of management strategies (including the direct removal of predators and landscape alterations to reduce predator access to sensitive habitats) on populations of listed threatened and endangered species (in particular Ridgway's rail, Western snowy plover, and California least tern); 2) developing data and protocols for predator management activities (including predator surveys); 3) engaging managers of conservation lands in needs assessments.

BY 2019 Complete and disseminate predator management assessment report and recommendations.

BY 2020 Implement predator management recommendations at Don Edwards National Wildlife Refuge.

BACKGROUND

Predators both disturb and consume not only sensitive resident birds that live and nest in marshes and along sandy beaches, but also songbirds, shorebirds, small mammals, amphibians, and other vulnerable wildlife in the Estuary watershed. Some predators are introduced while others are native, but swelling populations of both kinds of predators increasingly impacts native species of concern to Estuary managers.

The 2011 *State of the Birds San Francisco Bay* (State of the Birds) report identifies introduced and increased predators as a threat to tidal marsh birds. The report highlights predators such as non-native red foxes, Norway rats, and house cats, and native raccoons, corvids, and gulls.

Impacts from predators, both introduced and native, are usually greater near urban areas. Of particular recent concern are growing feral cat colonies in parks and other wildlife habitat areas. Unfortunately, many of these colonies of feral cats also have serious impacts on local wildlife and park ecosystems.

This CCMP action supports *State of the Birds* report recommendations such as controlling introduced predators (particularly in areas with high concentrations of marsh birds), removing feral cat feeding stations supported by advocates, and educating the public about the impact of cats on bird populations.

Through this action, high priority areas for predator control will be defined and mapped. Conservation organizations and resource managers will use the new maps, data, and surveys to collaborate on increasing the effectiveness of predator control, management, and outreach programs. There is also considerable opportunity for community groups to advocate for predator management. Such efforts should, in turn, help protect and increase tidal marsh-dependent wildlife populations.

OWNERS

Point Blue Conservation Science (Task 10-1)
US Fish and Wildlife Service (Tasks 10-1 & 10-2)

COLLABORATING PARTNERS

CA Department of Fish and Wildlife, CA State Coastal Conservancy, East Bay Regional Parks District, San Francisco Bay Joint Venture

NEXUS

Action 9
Goal 1
Objectives b, c

ACTION 11 Increase carbon sequestration through wetland restoration, creation, and management

Sequester carbon in wetland restoration, enhancement, and creation projects to reverse subsidence of agricultural lands, reduce greenhouse gases in the atmosphere, and advance scientific understanding of carbon sequestration. Focus near-term projects in more subsided locations on conversion to managed wetlands and in less subsided locations on conversion to tidal wetlands. Study and quantify the results in support of global and Californian carbon markets.

TASK 11-1 Work with agencies and willing private landowners to identify appropriate sites and funding sources, and to plan and implement projects that create managed and tidal wetlands on former agricultural lands in the Suisun and Delta region.

BY 2021 Convert 3,000 acres to wetlands in the Suisun and Delta region.

TASK 11-2 Continue to conduct applied research to better understand atmospheric carbon sequestration and storage fluxes in wetlands in the Bay and Delta. Work within reference systems and utilize scenario testing to inform management and restoration approaches. Quantify the greenhouse gas emissions (CO_2, CH_4, NO_x) from different types of wetlands and different management regimes.

BY 2021 Complete and publish several (1-3) applied research studies on carbon sequestration, as a product of specific restoration and management approaches.

TASK 11-3 Support the carbon market by completing relevant offset protocols for wetlands and by developing reference sites and standard carbon monitoring and accounting practices that reduce reporting costs for participants.

BY 2021 Completion of relevant offset protocols.

BACKGROUND

Wetlands are important in the global carbon cycle, cycling carbon through plant growth, decomposition, sequestration, and greenhouse gas emissions. Indeed wetlands can be major carbon sinks due to their fast rates of primary productivity, large standing biomass, and tendency to retain carbon as peat. Improving carbon management in wetland restoration, enhancement, and creation projects can prevent further subsidence, increase organic matter accumulation, reduce greenhouse gas emissions, and sequester more carbon. As stated in the 2015 *Baylands Ecosystem Habitat Goals Update*, if tidal marshes in the Bay can grow vertically and migrate laterally with sea-level rise, then they will sequester more carbon. However, if marshes drown and become unvegetated mudflats, they may lose the ability to produce biomass and store carbon.

Deeply subsided agricultural lands in the Delta slated for habitat restoration present different challenges however. In the Delta the majority of former wetland acreage now exists as drained, subsided, organic soils up to 25 feet below sea level. Efforts are underway to choose suitable habitat restoration options based on subsidence levels and opportunities to build up biomass. In the interim, research on wetland greenhouse gas biogeochemistry has also been advanced primarily in the Delta.

Testing methods to increase the elevations of former and current wetlands, whether subsided today or drowning in future, is a critical frontier in sea level rise adaptation for this Estuary. Work is ongoing to develop methods and protocols for such efforts to earn carbon credits in global and California markets.

In 2015, the first globally applicable greenhouse gas accounting methodology for coastal wetland restoration was approved by the Verified Carbon Standard (VCS). This "Methodology for Tidal Wetland and Seagrass Restoration" will allow ecosystems such as salt marsh, mangroves, and other tidal wetland restoration projects to earn carbon credits.

Also in 2015, a draft proposal for a local application of a new carbon offset methodology, which would quantify emissions reductions for the restoration of Delta wetlands, was submitted to the American Carbon Registry.

These methodologies will inform an initiative under California EcoRestore, a program of the California Natural Resources Agency, to help coordinate and advance critical habitat restoration in the Sacramento-San Joaquin River Delta over the next four years. California EcoRestore's initial goal includes creation of 3,500 acres of managed wetlands, specifically for subsidence reversal and carbon management, on Sherman Island and Twitchell Island. Challenges to that goal include finding funding for creation and management.

OWNERS

CA Department of Water Resources (Tasks 11-1, 11-2, 11-3
Delta Conservancy (Tasks 11-1 and 11-3)
SF Bay National Estuarine Research Reserve (Tasks 11-2 and 11-3)

COLLABORATING PARTNERS

CA Department of Fish and Wildlife, CA State Coastal Conservancy, Delta Stewardship Council, Los Angeles Metropolitan Water District, Sacramento Municipal Utility District, US Geological Survey, Univ. of California Berkeley, Univ. of California Davis

NEXUS

Actions 3, 4, 16, 18, 24; Goals 1, 2; Objective a, c, d, f

CCMP INTEGRATION: RESILIENCE

The 2016 CCMP recognizes the extraordinary changes and challenges Estuary managers will face in trying to keep aquatic ecosystems, as well as natural and human shoreline communities, resilient and healthy in the face of projected climate change impacts, including sea level rise and prolonged drought. This recognition is reflected not only in the CCMP's strong goal language concerning resilience, but also woven throughout many objectives and actions in this plan. Supporting plans, policies, and actions that will help the region adapt to, and manage for, changing freshwater flows, habitat, and shoreline conditions is central to this 2016 CCMP.

Scientists and planners project a wide range of impacts to the Estuary from climate change, including more intense periods of precipitation and drought, more extreme temperatures, and a rise in sea level. Rising sea levels, in particular, are of significant concern for both human and habitat investments around Estuary shores; many homes, extensive regional infrastructure, and thousands of acres of restored habitats lie at or below sea level.

With change as the only constant, and the past an unreliable guide for future conditions, the 2016 CCMP contains goals and actions that consider and prepare for the impacts of climate change. Steps to address and prepare for climate change begin with CCMP Goal 2: Bolster the resilience of Estuary ecosystems, shorelines, and communities to climate change. Within this broad and overarching priority, numerous CCMP actions and objectives address more specific characteristics of resilience such as habitat and species diversity, buffer and transition zones, and connectivity and complexity in the design of natural and human infrastructure, among others.

A number of specific CCMP actions aim to protect, restore, and enhance the full range of habitats, from subaquatic to shoreline to upland transition zones and watersheds (actions 3-7, for example), creating the kind of diversity necessary for species to withstand extreme conditions and habitat loss. Other CCMP actions urge municipalities and regional planners to give more consideration to natural resource protection and resilience in future planning initiatives, and promote key climate adaptation actions such as carbon sequestration and regional sediment management (actions 11-17, for example). A number of actions also encourage a focus on projects that combine natural infrastructure (such as buffering wetlands or innovative levees that provide habitat and high water refuge) with efforts to protect sensitive species and communities from flooding. These kinds of multi-benefit, natural infrastructure projects (see also page 40) can create a suite of ecosystem services that enhance the quality of the Estuary for wildlife and strengthen the shoreline against the impacts of climate change.

The 2016 CCMP is also carefully crafted to support and implement relevant recommendations in recent climate-related documents including Baylands and Climate Change: What We Can Do (Baylands Ecosystem Habitat Goals Science Update 2015) and Safeguarding California: Reducing Climate Risk (CA Natural Resources Agency, 2014).

Through the 2016 CCMP, the San Francisco Estuary Partnership will continue to help partners and stakeholders visualize and build a stronger ecosystem and Estuary that is resilient to, and helps bolster the region against, climate change.

ACTION 12 Restore watershed connections to the Estuary to improve habitat, flood protection and water quality

Plan and implement multi-benefit projects that connect watersheds to the Estuary and enhance habitats, natural processes, and ecosystem services. Integrated projects should be able to provide more than one benefit. Potential benefits may include: tidal, intertidal and open water habitat restoration; flood management; water quality improvement; fish passage and food supply; wave energy reduction; groundwater recharge; sediment delivery; and recreational opportunities.

TASK 12-1 Develop and disseminate data, information, and tools to assist with site selection and design of multi-benefit projects.

BY 2016 Disseminate data and tools through a website.

TASK 12-2 Advance a multi-benefit project in the Yolo Bypass by establishing a common vision for improvements supported by local, state, and federal agencies.

BY 2017 Incorporate measurable habitat restoration objectives into the Central Valley Flood Protection Plan.

BY 2017 Initiate construction of multiple fish passage improvement projects within the Yolo Bypass.

TASK 12-3 Use the tools developed in Task 12-1, as well as findings from other research and projects (including the Yolo Bypass project) to identify and select sites for multi-benefit projects. In partnership with property owners and public entities, assess existing conditions in the context of historic and projected conditions (including sea level rise) to develop appropriate project scopes and conceptual restoration designs for selected sites.

BY 2019 Develop project scopes and conceptual restoration designs for four sites.

TASK 12-4 Secure funding in conjunction with partners to complete designs and construction documents. Obtain necessary permits and approvals for selected sites.

BY 2021 Initiate implementation phase of two projects.

BACKGROUND

The Estuary's connections to local creeks and floodplains are integral to its health. Historically, creek mouths were the Estuary's natural deltas, while floodplains provided spreading and groundwater percolation zones for rivers, sloughs and channels. Drainage and runoff once delivered sediment and organic matter (carbon and plant material) to these creek mouths and floodplains, and made them places of high ecological diversity and complexity. Today, as they did historically, creek mouths play a disproportionately important role in sustaining the Estuary's tidal marshland, and in providing transition zones for wildlife moving up and downstream. Floodplains such as the Yolo Bypass, meanwhile, continue to absorb storm flows, filter and improve water quality, and provide habitat, food and nursery grounds for fish and birds.

Over time, humans have built levees, berms, culverts, drains, and roads in these critical transition zones between creeks, rivers, floodplains, and the Estuary. Though originally intended for flood protection or transportation, these and other hard structures now disrupt the natural hydrologic exchange and sediment delivery regimes that nourish complex habitat mosaics for native wildlife. In urbanized watersheds, it is not uncommon to find creeks connecting to the Estuary through open or closed culverts, or for road and railroad infrastructure to infringe on local waterways.

This CCMP action supports the development of multi-benefit projects that redesign the rich zone where freshwater flows from the watershed meet ocean tides (the "tidal-fluvial interface") or spread onto floodplains. It also builds on Flood Control 2.0 and the project's visions for Lower Novato Creek and Lower Walnut Creek. Such projects can help supply sediment from the watershed to habitats along marsh fronts, historic tributary deltas, and beaches, while simultaneously improving flood conveyance, and re-establishing more resilient shorelines. Similar efforts in upper Estuary flood plains can also diversify habitats, improve water quality and flood conveyance, and recharge groundwater.

OWNERS

CA Natural Resources Agency (Task 12-2)
SF Estuary Institute (Task 12-1)
SF Estuary Partnership (12-3, 12-4)

COLLABORATING PARTNERS

Bay Area Flood Protection Agencies Association, Bay Area Ecosystems Climate Change Consortium, Delta Stewardship Council, NOAA Fisheries, SF Bay Conservation and Development Commission, SF Bay Joint Venture, SF Bay National Estuarine Research Reserve, SF Bay Regional Water Quality Control Board, various local municipalities and special districts

NEXUS

Actions 18, 24, 25
Goals 1, 2
Objectives a, b, c, d, e, f

ACTION 13 Manage sediment on a regional scale and advance beneficial reuse

Manage sediment on a watershed and regional scale to enhance Estuary habitats and shoreline flood protection efforts. Assess and harness natural processes and human activities that move sediment (such as dredging, erosion control, and construction) to optimize opportunities for restoration and adaptation to sea level rise.

TASK 13-1 Strengthen Long Term Management Strategy (LTMS) policies on the beneficial reuse of dredged material by expanding programs such as "SediMatch." Resolve logistical issues in matching sediment supply from dredging projects and upland construction sites with habitat restoration and shoreline adaptation projects.

BY 2017 Expand and improve SediMatch.

TASK 13-2 Identify funding to pay for the additional costs of dredged material disposal beyond 'least-cost' options, including costs for offloaders to pump sediment for beneficial reuse projects on Estuary shorelines.

BY 2017 Identify and secure funding.

TASK 13-3 Identify funds and conduct research and monitoring to quantify all potential sediment sources to the Estuary. Determine sediment needs for maintaining current habitats under various sea level rise projections.

BY 2018 Complete study and share results.

TASK 13-4 Advance understanding of how the creation of sandy beaches and their replenishment provides multiple benefits in terms of ecosystem health, shoreline erosion control, and sea level rise adaptation. Create (or enhance an existing) monitoring tool to identify potential sites for sandy beach creation or replenishment projects, chose pilot project sites, and track progress. Provide information about the benefits of sandy beaches to regulators and the restoration community.

BY 2017 Release the monitoring and tracking tool.

BY 2021 Identify pilot project location, coarse grain sediment source(s), funds for implementation, and begin implementation.

BACKGROUND

Sediment, both fine and coarse, provides a critical building material for estuarine ecosystems, habitat restoration, and shoreline protection, especially in light of projected sea level rise. The elevation of many Estuary shorelines now needs to be increased so that marshes and parklands don't drown; likewise many shorelines may require materials to strengthen levees and provide natural vegetated buffers from storm surges.

Watersheds naturally convey sediment with stream and river flows from uplands to Bay shores, but human activities designed to store water, control erosion, and increase capacity of flood control channels trap this sediment behind dams or move it out of the water. Likewise, much material dredged from Bay shipping channels is barged outside the Golden Gate for disposal offshore. Meanwhile, recent Estuary research suggests that the Bay's sediment supply has declined significantly. This decline not only affects natural replenishment of shorelines, beaches, and marshes, but may also increase light penetration into the water column, sometimes with problematic results for Bay water quality.

This CCMP action provides for a reconsideration of current sediment management practices and changes that may benefit the ecosystem and human investments in the shoreline. It supports long-time efforts on the part of Estuary partners to address these issues, and seeks to close remaining knowledge, planning, regulatory, and funding gaps. More specifically, this action targets remaining challenges for beneficial reuse including the identification of sediment sources, the expense of delivering the sediment to reuse sites, and the need for pilot projects. In addition, it supports better coordination between projects clearing and excavating sediment and projects that need sediment. One current tool, SediMatch, needs more support and funding. SediMatch includes a website to match projects, as well as a forum to work through challenges of beneficial reuse.

More research on local sediment dynamics is needed, as are pilot projects to better understand beneficial reuse and dispersal of sediment.

OWNERS

SF Bay Conservation and Development Commission (Task 13-1)
SF Bay Joint Venture (Tasks 13-1, 13-2, 13-3, 13-4)
SF Estuary Institute (Task 13-1, 13-3)

COLLABORATING PARTNERS

LTMS participants, SF Bay Regional Water Quality Control Board, US Army Corps of Engineers, various dredgers, restoration practitioners, flood protection agencies

NEXUS

Actions 1, 3, 14, 18, 23
Goals 1, 2, 4
Objectives a, c, d, e, f, l

ACTION 14 Demonstrate how natural habitats and nature-based shoreline infrastructure can provide increased resiliency to changes in the Estuary environment

Promote projects that demonstrate how tidal habitats, oyster beds, habitat levees, restored beaches, and other natural and nature-based features of Estuary shorelines can make the region more resilient to rising sea level, drought, water pollution, and other future stresses. Identify locations where these kinds of features can provide the most benefits, both independently and in hybrid applications with more traditional approaches to managing flood risk, protecting shorelines, and reusing wastewater.

TASK 14-1 Develop a primer on how bayshore projects can be designed and optimized to achieve multiple rather than single benefits. Challenge designers and planners to look beyond a primary objective and find opportunities to incorporate not only flood protection but also habitat enhancement and recreational access, among other objectives, in proposed projects.

BY 2017 Develop primer and implement outreach strategy.

TASK 14-2 Develop a system for describing the variety of shorelines around the Estuary based on shoreline features, ecosystem processes, land use, and other relevant factors.

BY 2018 Develop shoreline typologies.

TASK 14-3 Based on the primer developed in Task 14-1 and the system developed in Task 14-2, develop best practices guidelines for natural and nature-based shoreline features that increase the resiliency of the Estuary and provide multiple ecosystem benefits.

BY 2019 Develop best practices guidelines and recommendations.

TASK 14-4 Construct pilot projects to test and refine natural and nature-based approaches to resiliency by applying the guidelines developed in Task 14-3. These pilot projects will build on design and adaptation steps established by projects such as the Oro Loma Horizontal Levee project, the San Rafael Oyster/Eelgrass Living Shoreline Project, and the Aramburu Island Beach Restoration Project. Like these projects, the Task 14-4 pilots will address a specific hypothesis, evaluate the performance of multi-benefit restoration design elements, and budget for monitoring, evaluation, and subsequent design refinement. Results from the pilot projects will be incorporated into a revised version of the guidelines developed in Task 14-3.

BY 2021 Identify, design, permit, and implement three additional pilot projects in the Bay.

BY 2021 Update best practices guidelines.

BACKGROUND

This action promotes "natural and nature-based" shoreline features and infrastructure as strategies that leverage natural processes to provide multiple biological and physical benefits. Such strategies may include a combination of natural systems, new habitats, restored processes (such as sediment or water delivery), built structures (such as water control gates, levees, and stormwater and wastewater pipelines), and upgrades or changes to existing infrastructure (such as creek mouth culverts, barriers, and flood control levees). The aim of these nature-based or green infrastructure approaches should not only be to provide flood protection, for example, but also to improve water quality, sequester carbon, and create habitat, among a range of possible benefits. Representative "features" in such nature-based shorelines might include horizontal levees, oyster reefs, islands created in restoration sites where birds can nest and find refuge from high waters, or plantings to speed revegetation ahead of sea level rise or in times of drought. In addition, nature-based or green infrastructure approaches connect to a suite of urban interventions often referred to as low impact development.

This CCMP action builds on *Baylands Ecosystem Habitat Goals Science Update 2015* recommendations that natural infrastructure be utilized to improve shoreline resiliency and support ecosystem services. During the near-term, when sea level rise rates will still be relatively low, immediate actions can to taken to maximize resilience of the shoreline. The 2015 *Baylands Goals* update highlights the importance of partnering with the industrial and residential communities along the shoreline to manage tidal habitat bayward of flood risk management levees through horizontal levees, living shorelines, or other features.

This CCMP action also supports Governor Jerry Brown's 2015 executive order prioritizing natural infrastructure solutions to climate change impacts.

OWNERS

SF Estuary Institute (Tasks 14-1, 14-2,14-3)
SF Estuary Partnership (Task 14-1 through 14-4)

COLLABORATING PARTNERS

Bay Area Ecosystems Climate Change Consortium, CA State Coastal Conservancy, SF Bay Conservation and Development Commission, SF Bay Joint Venture, SF Bay National Estuarine Research Reserve, SF Bay Regional Water Quality Control Board, various special districts and the restoration community

NEXUS

Actions 22, 24
Goals 1, 2
Objectives a,b,c,d,e,f

ACTION 15 Advance natural resource protection while increasing resiliency of shoreline communities in the Bay Area

Protect natural resources such as estuarine habitats and wildlife as an integral part of any effort to increase the resilience of shoreline communities at risk from flooding and rising seas.

TASK 15-1 Coordinate programs to provide technical assistance on best practices in climate change planning and adaptation for cities, counties, and other stakeholders.

BY 2016 Form a multi-stakeholder Bay Area Climate Technical Assistance Task Force and complete a work plan for coordinated assistance.

TASK 15-2 Integrate resiliency and natural resource protection into Plan Bay Area. Lay the groundwork for a more comprehensive regional resiliency effort.

BY 2017 Complete resiliency section in the 2017 update of Plan Bay Area.

TASK 15-3 Support local government efforts to develop shoreline vulnerability assessments that include assessment of natural resources as an asset category.

BY 2021 Complete vulnerability assessments for all nine Bay Area counties.

BACKGROUND

This CCMP action supports local and regional efforts to identify how current and future flooding will affect communities, infrastructure, ecosystems, and the economy, and helps build local and regional capacity to plan for and implement adaptation efforts. The action recognizes and supports the efforts of the Bay Area Regional Collaborative (BARC), its member agencies, and their partnership with the California State Coastal Conservancy, to develop a shared understanding of local and regional vulnerabilities to flooding and rising sea levels by integrating consideration of climate resiliency into next update of Plan Bay Area.

BARC is a consortium of regional agencies that come together to address regional quality of life issues such as climate change that affect the activities of all members. Member agencies include the San Francisco Bay Conservation and Development Commission (BCDC), the Association of Bay Area Governments, the Metropolitan Transportation Commission, and the Bay Area Air Quality Management District. BARC provides a mechanism through which its members can explore, develop and collaborate on regional policies and best practices. Agency leaders can then decide to advance these policies and practices collectively and singularly, and in partnership with local stakeholders.

Each of the Bay Area's regional agencies is deeply engaged in work to mitigate climate change and make the Bay Area more resilient. Each has it's own respective and distinct role and expertise, whether it's transportation, air quality, shoreline protection, or urban planning. Their collective effort through BARC, however, includes creating coordinated policies, increasing efficiencies, leveraging resources, and providing better services to local governments and special districts that are grappling with climate change challenges.

In addition to supporting Plan Bay Area updates, this CCMP action also acknowledges the opportunity for BARC to support expansion of efforts such as BCDC's Adapting to Rising Tides Program (ART Program). ART has conducted several vulnerability assessments for specific stretches of the East Bay shore that encompass both developed infrastructure and natural resources, and that can inform additional assessments throughout the nine county region.

Finally, this CCMP action reaffirms the importance of evaluating the vulnerability of natural shoreline systems to rising sea levels and extreme events as part of climate adaptation planning. Similarly, planning and evaluation should acknowledge the critical contribution of natural shoreline systems to reducing wave energy, storm surge, and flood risk for adjacent communities.

OWNER

Bay Area Regional Collaborative (Tasks 15-1, 15-2, 15-3)
CA Coastal Conservancy (Task 15-2)

COLLABORATING PARTNERS

California Coastal Conservancy, Association of Bay Area Governments/San Francisco Estuary Partnership, Bay Area Air Quality Management District, CA State Coastal Conservancy, Metropolitan Transportation Commission, SF Bay Conservation and Development Commission, SF Bay Regional Water Quality Control Board, various local municipalities

NEXUS

Actions 14, 16
Goals 1, 2, 4
Objectives a, e, f, l

Resilience to stresses by Afsoon Razavi

ACTION 16 Integrate natural resource protection into state and local government hazard mitigation, response, and recovery planning

Provide technical support and resources to local governments so they can better protect and support the value of natural resources in resilience and hazard planning.

TASK 16-1 Establish and implement innovative approaches for integrating natural resources into hazard mitigation, response, and recovery planning in the Delta.

BY 2017 Complete the Delta Levee Investment Strategy.

TASK 16-2 Provide technical assistance to Bay Area cities and counties including guidance, case studies, and suggested approaches for integrating natural resource protection into hazard mitigation planning. Facilitate completion of hazard mitigation plans (emphasizing the co-benefits of integration with climate change adaptation plans) that include specific actions to protect natural resources. Plans should take into account the contribution of natural resources to reduced hazard impacts and increased resiliency.

BY 2021 Complete 30 Bay Area city or county hazard mitigation plans that include natural resources as an asset category.

TASK 16-3 Provide information and technical assistance to Bay Area cities and counties on how to include natural resource considerations in disaster recovery planning. Facilitate completion of Disaster Recovery Plans that include 'Recovery Support Functions' (RSFs) for natural resources as described in the Federal Emergency Management Association's *National Disaster Recovery Framework* (FEMA's NDRF).

BY 2021 Complete ten local (city or county) Disaster Recovery Plans that include FEMA's NDRF RSFs for natural resources.

BACKGROUND

Natural resources such as subtidal habitats, tidal marshes, and floodplains provide many important ecological services, including flood protection and water conservation. However, these natural resources, and the species that live in them, can be damaged by earthquakes, fire, floods, levee failures, spills, and other hazardous or extreme events, just as humans can. Emergency response and recovery efforts can also have unintended impacts on natural resources if not carefully planned.

The Federal Emergency Management Agency's (FEMA) *National Mitigation Framework* points out that community resilience depends in part on "recognizing and communicating the reinforcing relationships between environmental stewardship and natural hazard risk reduction (e.g., enhancement of flood storage through wetland protection and restoration and holistic floodplain management)." FEMA is now integrating consideration of climate change into its National Preparedness System.

This CCMP action supports efforts to address similar preparedness issues on the regional level. The Association of Bay Area Governments (ABAG) and the San Francisco Bay Conservation and Development Commission (BCDC) are working with cities and counties to develop and update local resilience plans, aligning hazard mitigation, climate adaptation, and general plans. ABAG and BCDC are providing technical assistance to streamline the planning process and facilitate implementation. The two agencies are also working to advance a newer asset category for natural resources, so the vulnerability of these resources can be assessed in hazard mitigation and climate adaptation planning alongside other valuable assets. One BCDC-led effort, the Adapting to Rising Tides Program, has already begun providing models of how natural resource protection and hazard mitigation can be integrated into climate adaptation plans.

This CCMP action also supports similar efforts in the Delta including the *Delta Levee Investment Strategy*. The Delta Stewardship Council is currently developing this strategy, which includes natural resources as an asset category. In 2016, the Council completed a supporting report entitled *Improving Habitats along Delta Levees: A Review of Past Projects and Recommended Next Steps*. This report provides guidance on ensuring that state levee investments include habitat enhancements that provide a net benefit for aquatic species in the Delta.

To support such local efforts across the country to prepare for disasters and adapt to climate change, FEMA has developed a number of guides. This CCMP action emphasizes use of FEMA's NDRF RSFs, as stated in Task 16-3. According to this NDRF model, the core recovery capability for natural and cultural resources is the ability to protect the resources through response and recovery actions, and to restore them as necessary post-disaster. Some Bay Area cities, such as Oakland, are currently engaged in using the NDRF as the framework to develop the city's Recovery Plan, which includes a section focused on natural resources.

OWNERS

Association of Bay Area Governments (Task 16-2, 16-3)
Delta Stewardship Council (Task 16-1)

COLLABORATING PARTNERS

SF Bay Conservation and Development Commission, various local municipalities

NEXUS

Actions 15, 17, 23
Goals 1, 2, 4
Objectives a, b, d, e, k, l

ACTION 17 Improve regulatory review, permitting, and monitoring processes for multi-benefit climate adaptation projects

Improve and update regulatory processes to facilitate innovative multi-benefit climate adaptation projects such as new approaches to integrated flood management, shoreline alteration, sediment disposal, and habitat restoration. Support and assist existing efforts to address permitting challenges posed by changing conditions and coordinate permitting to encourage synergies and efficiencies among projects.

TASK 17-1 Identify opportunities and recommendations for improved regulatory processes for multi-benefit flood control and habitat restoration projects through the existing Flood Control 2.0 project.

BY 2016 Regulatory guidance and recommendations reports, workshops, and podcasts.

TASK 17-2 Analyze current San Francisco Bay Conservation and Development Commission policies governing fill in the Bay in light of sea level rise and the need for adaptation strategies, and revise as necessary.

BY 2016 At least three workshops to discuss policy issues relating to the Commission's work on rising sea level issues.

BY 2021 Revised policies.

TASK 17-3 Analyze current San Francisco Bay Regional Water Quality Control Board regulations and policies governing the permitting of multi-benefit projects designed to address sea level rise. Develop findings, alternatives, and recommendations to support the Board's evaluation of baylands climate adaptation projects. Address concerns about balancing long-term wetlands protection, restoration, and enhancement against short terms losses in ecosystem function.

BY 2017 Report with recommendations; (as necessary) revised policies by 2021.

TASK 17-4 Bring major permitting and regulatory agencies together with project implementers and other key stakeholders in workshops to facilitate the creation of a more transparent and predictable system for the review and approval of multi-species and multi-benefit projects over the long-term. Design a model process and overall system that reduces time and conflicts while also outlining a roadmap for those entering into this process for the first time. By providing examples and case studies of successful multi-benefit projects, these workshops can share lessons learned and best practices.

BY 2017 Institute a once or twice yearly workshop.

BACKGROUND

Estuary planners are grappling with a need to increase resiliency to climate change with shoreline adaptation projects that provide multiple benefits yet may not fit into conventional permit categories for regulatory approval. Processes for getting these kinds of innovative projects permitted can be cumbersome, conflicting, or out-of-date given changing conditions. A concerted effort to realign and improve approval processes should be a priority for project proponents and regulatory agencies interested in climate change adaptation.

Managing sediment on a watershed scale is one example of an emerging challenge. Sediment supply to marshes and mudflats has decreased while demand for sediment to protect and restore baylands is increasing. The Long-Term Management Strategy (LTMS) for dredged material, created in 1999, includes a coordinated permit application review process for dredging and disposal projects, as well as goals for beneficial reuse of dredged sediment. Agencies participating in the LTMS are working to advance innovative climate adaptation efforts that include beneficial reuse of sediment.

Innovations to existing restoration processes and variation in regulatory approvals may be necessary to facilitate sediment delivery to tidal marshes. Redesigning flood-control channels to allow natural processes to move sediment from channels (where it impedes capacity) to the baylands (where it is needed to increase elevations in relation to sea level rise) is one high priority example. Another priority is to take full advantage of other sources of sediment in the system, such as navigational dredging projects. Sediment may also be needed to expand levees to support more habitat and provide better flood protection, necessitating some filling of the Bay and some discharge of treated wastewater onto levee landscapes to irrigate vegetation — activities that may be currently challenging to permit. This action identifies opportunities for improved regulatory processes, supports the work of regulatory agencies that are leading the way in analyzing and potentially revising policies to better facilitate innovate climate adaptation projects, and provides a forum for continued coordination.

Any policy realignment will require a comprehensive analysis of the specific regulatory challenges paired with an understanding of the distinctions among historical agency practices, internal guidelines, enforceable policies, and laws and regulations. Certain regulatory challenges may be resolved in a shorter time frame through modifications of existing regulatory frameworks. Other challenges may require a longer-term process that includes revisions to laws and enforceable policies. Ongoing regional coordination among regulatory agencies and the scientific community is critical to develop broad consensus on solutions.

ACTION 17 CONT'D

Improve regulatory review, permitting, and monitoring processes for multi-benefit climate adaptation projects

OWNERS

Coastal Hazards Adaptation Resiliency Group (Task 17-4)
SF Bay Conservation and Development Commission (Task 17-2)
SF Bay Regional Water Quality Control Board (Task 17-3)
SF Estuary Partnership (Task 17-1)

COLLABORATING PARTNERS

Bay Area Ecosystems Climate Change Consortium, Bay Area Flood Protection Agencies Association, CA State Lands Commission, NOAA Fisheries, SF Bay Joint Venture, US Army Corps of Engineers

NEXUS

Actions 13, 14, 20-24
Goals 1, 2, 4
Objectives a, f, l

CCMP INTEGRATION: NATURAL INFRASTRUCTURE

The shorelines of the San Francisco Estuary continue to soften, as former military bases, salt production ponds, flood control channels, and sewage treatment plants are updated or restored to include wetlands, creek mouths, floodplains, and other natural features. Encouraging the development of this kind of "natural infrastructure," as a tool for meeting multiple objectives and adapting to rising sea levels, is an important component of the 2016 CCMP.

Natural infrastructure encompasses a range of strategies that work with natural processes to provide multiple benefits, such as greater flood protection, improved habitat, better water quality, or carbon sequestration. These strategies can be applied at a variety of scales, from re-vegetating the banks of a single creek or filtering stormwater through green street verges block-by-block, to planning for flood protection on a regional level.

In the San Francisco Estuary, natural infrastructure approaches range from preserving natural systems to implementing projects that combine ecological restoration and engineered structures. Components may include, but are not limited to, green infrastructure, low impact development, nature-based infrastructure, horizontal levees, and living shorelines.

The 2016 CCMP includes a number of actions to promote consideration and implementation of natural infrastructure (actions 3-8, 11–16, and 24, for example). Some actions focus on improving habitat, which can provide ecosystem benefits such as flood protection, enhancement of riparian corridors, and carbon sequestration. Other actions focus on resiliency and provide ecosystem benefits by improving flows in the head of tide (tidal-fluvial interface), controlling erosion, and promoting multi-benefit planning for climate adaptation. Additional CCMP actions address ways in which natural infrastructure can help reduce flooding and pollution from stormwater runoff, at both local and watershed scales.

In the Bay Area, one kind of multi-benefit natural infrastructure project called the "horizontal levee" is the focus of regional experimentation concerning how best to implement complex natural infrastructure projects. Building on prior concepts of levees that not only provide flood protection but also wildlife habitat, horizontal levees can combine gentler slopes, plantings to provide vegetation and habitat, the use of treated wastewater for irrigation, and links to nearby Bay habitats, among other features.

Horizontal levees are just one example of the kind of multi-benefit thinking various CCMP actions seek to support and address. Farther upland from the shoreline, natural infrastructure can manage stormwater runoff by mimicking natural processes. In highly developed areas with lots of pavement, rainwater can run off streets, sidewalks, and roofs, picking up contaminants along the way. Softening this hardscape with low impact development, or green streets, can provide multiple benefits such as flood protection and better water quality.

Planning for natural infrastructure is ideally done on a watershed basis and by analyzing topography, flood risk, imperviousness, pollution hot spots, the need to upgrade aging existing infrastructure, and myriad other factors. Planning across watersheds and ecosystems, and with regard for various needs and partner priorities, remains an important strategy of the 2016 CCMP.

ACTION 18 Improve the timing, amount, and duration of freshwater flows critical to Estuary health

Educate elected officials and the public about the critical importance of freshwater flows from the watershed through the Estuary. Work with partners and through other CCMP actions to adjust the timing and amount of freshwater flows through the Delta and San Francisco Bay to better support all public trust uses.

TASK 18-1 Fund and complete an expert legal evaluation to determine the potential for application of the state's waste and unreasonable use doctrine in the Estuary, within the context of public trust law and the State Board's existing authority, as a means of protecting freshwater flows.

BY 2016 Complete evaluation.

TASK 18-2 Work with partners to disseminate a report highlighting the contribution of freshwater flows to the health of the lower Estuary, San Francisco Bay.

BY 2017 Disseminate report.

TASK 18-3 Assist the State Water Resources Control Board in updating the *San Francisco Bay/Sacramento-San Joaquin River Delta Water Quality Control Plan* (Bay-Delta WQCP) by providing concise, scientifically sound data to the State Board during its deliberations and by keeping the public and local officials informed.

BY 2018 Complete update of the Bay-Delta WQCP with updated flow objectives.

TASK 18-4 Work with relevant partners and agencies to more broadly incorporate freshwater flows messages and information in public outreach materials of relevant programs.

BY 2018 Add messages to the materials of at least 3 partners.

BACKGROUND

The inflow of fresh water to the Estuary from the watershed, and the outflow of this water to the Pacific Ocean, is a critical hydrologic process influencing the health of many estuarine organisms. Management of these flows for human purposes has altered the amount, duration, and timing of flows left to sustain Estuary ecological processes and species.

According to the Delta Plan, water flow is a 'master variable', driving the ecological health of rivers and their ability to support valued environmental services. In estuaries, the interaction of river flows and ocean tides produces a salinity gradient from fresh water to brackish and salty water. River flows and ocean tides also deposit and erode sediment to shape the estuarine landscape and its habitats. Estuarine species are adapted to the complex natural flow, salinity, and sediment dynamics in their native estuaries. Altered freshwater flow regimes are just one of many powerful stressors affecting the health of the Estuary today.

The best available science suggests that current flows are insufficient to protect public trust resources according to the State Water Resources Control Board's Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem. Numerous scientific and regulatory authorities concur: that existing Delta outflow conditions are insufficient for protecting the aquatic ecosystem and multiple fish species. Multiple federal and state regulatory agencies (including the California Department of Fish and Wildlife, National Marine Fisheries Service, US Environmental Protection Agency, and US Department of the Interior) have commented on the need for improvements to the current standards for freshwater flows, based on the State Water Resources Control Board's 1995 Water Quality Control Plan for the San Francisco Bay-Sacramento/San Joaquin Delta Estuary.

In addition, according to the California Water Action Plan, "The state must continue to consider how to provide water flows necessary to meet current state policy, such as significantly increasing salmon, steelhead, and trout populations while also supporting viable, self-sustaining populations of a broad range of other native aquatic species. . . [the state must] ensure sustainable river and estuary habitat conditions for a healthy, functional Bay Delta ecosystem."

This CCMP action underscores the work the San Francisco Estuary Partnership and its partners can do to advance the cause of improved flows for the Estuary.

This CCMP action is consistent with the work of the State Water Board, the Governor's California Water Action Plan, the Delta Plan and other key efforts to bring about needed changes. Key tasks are to highlight the importance of freshwater to the lower Estuary, and to examine the "reasonable use" doctrine .

OWNERS

SF Estuary Partnership (Tasks 18-1, 18-2, 18-3, 18-4)

COLLABORATING PARTNERS

CA State Water Resources Control Board, Friends of the San Francisco Estuary, The Bay Institute

NEXUS

Actions 1, 3, 5, 7, 9, 11-13, 19-24, 28
Goals 1, 3, 4
Objectives a, h, j, k

ACTION 19 Develop long-term drought plans

Incorporate planning for long-term drought of at least five years duration into all levels of water supply planning. Document efforts that will help sustain the Estuary through future extended droughts.

TASK 19-1 Fund an assessment that analyzes which retail and wholesale water supply agencies around the Estuary have long-term water supply plans for five to 10 year drought.

BY 2017 Complete assessment.

TASK 19-2 Working through the multi-agency Bay Area Regional Reliability (BARR) partnership, or through individual water agencies, refine or adaptively manage long-term water supply plans to include plans for 5-10 year drought.

BY 2020 Engage at least three water agencies in the region in long-term drought planning.

TASK 19-3 Highlight the best of the region's efforts by compiling BMPs for Bay Area and Delta agencies. Gather input from agencies throughout the Estuary region.

BY 2020 Compile and distribute BMPs.

BACKGROUND

Climate change is anticipated to make California's climate more variable in the future, increasing the frequency of both droughts and floods, and reducing average Sierra Nevada snowpack. While water agencies are currently required to create contingency plans, these plans only address water shortages or interruptions of up to thirty-six months. Since California has, as of this date, completed the fourth year of a drought cycle, drought plans should assume droughts of five to 10 years in duration. Some water suppliers are already doing so.

This CCMP action supports long-term water supply planning processes that: 1) address the hydrologic conditions of the service area; 2) plan for multiple scenarios, including extended multi-year droughts of five to 10 years; and 3) document efforts to implement programs and investments that will help the Estuary respond to future extended droughts at the individual agency level and through multi-agency coordination efforts such as Bay Area Regional Reliability feasibility studies and Integrated Regional Water Management Planning.

This CCMP action is identified in both the Governor's California Water Action Plan: Revise Operations to Respond to Extreme Conditions and in the NGO drought response publication "Wetter or Not". Preparation for extended droughts should flow from state and regional analyses of potential disruptions that could be caused by events like the decade-long drought recently experienced in Australia. Planning should consider the impacts of long-term drought to natural resources, businesses, regional agriculture, and communities, including the most vulnerable communities. For instance, the impacts of long-term drought on the Estuary's fish and wildlife, wildlife refuges, and natural habitat are often exacerbated by a greater diversion of their water sources to meet human needs.

This action also supports the Delta Plan's Expanded Water Supply Reliability Element (WR R4). This element calls for suppliers that receive water from the Delta watershed to detail how the water supplier is measurably reducing reliance on the Delta and improving regional self-reliance, consistent with Water Code section 85201, through investments in local and regional programs and projects. These plans are supposed to prepare for a possible interruption of Delta water supplies up to 36 months due to catastrophic events, evaluate the regional water balance, assess vulnerability to climate change, and analyze the extent to which the supplier's rate structure promotes and sustains efficient water use.

A regional approach, such as the Bay Area Regional Reliability (BARR) Partnership, may provide a model for how to approach long-term drought planning. This partnership is relatively new and will require evaluation as it develops programs and strategies. Research currently underway on long-term drought in the Russian River, led by the California Water Science Center, Sonoma County Water Agency, the USGS National Research Program, and Scripps Institution of Oceanography, may help with defining long-term drought scenarios and characterizing long-term drought readiness.

OWNERS

SF Estuary Partnership (Task 19-1, 19-2, 19-3)

COLLABORATING PARTNERS

Association of Bay Area Governments, Bay Area Water Agencies Coalition, Bay Area Regional Reliability Partnership, NOAA Fisheries, various water supply agencies

NEXUS

Actions 1, 18, 20-24
Goals 1, 3, 4
Objectives a, g, k, l

ACTION 20 Increase regional agricultural water use efficiency

Assess opportunities to expand implementation of agricultural water use efficiency practices in the region. With partners, promote modification of small, private water storage methods with the intent of reducing direct instream diversions, promoting groundwater recharge, and providing greater water supply reliability for Bay and Delta farmers.

TASK 20-1 Fund and complete a report assessing one Bay and one Delta area in the Estuary region, evaluating current practices against the range of applicable water use efficiency methods and management practices. Outline the mechanisms by which conserved water could produce greater instream flow and groundwater recharge.

BY 2019 Complete report.

TASK 20-2 Facilitate a forum to explore the challenges and opportunities associated with the development of small offstream storage and modification of small instream impoundments. Forum should include regulatory agencies, resource conservation districts, stakeholder groups, farmers, and other partners. Forum should also identify funding needs, landowner and agency constraints, and barriers to implementation.

BY 2020 Complete three new or modified storage projects.

BACKGROUND

Agriculture throughout the San Francisco Estuary region is highly variable in terms of the types of soils and crops, the acreage of farms, average rainfall, and irrigation practices and water use. Farmlands around the Estuary do share several important characteristics not found in other agricultural regions of the state: a temperate climate, powerful development pressure, and greater water supply reliability than the Central Valley.

To assess the efficiency of agricultural water use practices around the San Francisco Estuary, this CCMP action recommends determining whether significant opportunities exist to conserve water for instream uses in the region.

Conducting this assessment in two areas — a Bay Area tributary watershed with high restoration potential for salmonids and an area of the Delta — will not capture the full range of agricultural variability in the region, but will provide a foundation for future assessments. The review will compare current practices to the range of applicable water use efficiency methods and management practices available for each area, taking into account site feasibility, geographic constraints, and possible barriers to greater water conservation. This CCMP action also supports a cost-benefit analysis to assist in the adoption of recommendations. This analysis could demonstrate the long-term cost savings of incorporating water efficiency BMPs.

The resulting report will be a model for assessment of agricultural practices throughout the Estuary region and offer regionally based, vetted information on the opportunities for, and barriers to, increased agricultural water conservation.

This CCMP action also recognizes that alterations in the timing of water diversions in tributary streams can yield significant benefits to coldwater fish species like salmonids. By modifying the operation of small instream dams and developing small offstream storage as an alternative to instream impoundments, agricultural producers can not only provide greater instream flow during key periods in the life cycle of aquatic species but also protect their water supply reliability. Lack of funding and regulatory constraints often impede implementation of these kinds of projects. By providing a forum for multiple stakeholders to address these barriers, this CCMP action will facilitate successful implementation of more of these types of projects.

OWNERS

SF Estuary Partnership (Tasks 20-1, 20-2)

COLLABORATING PARTNERS

Bay and Delta Resource Conservation Districts, CA Department of Fish and Wildlife, Natural Resources Conservation Service, NOAA Fisheries, State and Regional Water Boards, US Fish and Wildlife Service, various agricultural associations

NEXUS

Actions 1, 17, 18, 19, 20, 23, 27, 28
Goals 1, 3, 4
Objectives a, g, j

ACTION 21 Reduce water use for landscaping around the Estuary

Facilitate more efficient use of water, whether recycled or potable, on landscaping. Collaborate with municipalities, water supply agencies, land use agencies, and others to reduce overall water use on landscaping. Create standards for measuring progress regionwide.

TASK 21-1 Work with water supply agencies, municipalities, the California Department of Water Resources (DWR), the California State Water Resources Control Board, and others to develop a standardized approach to quantifying and reporting on water use for all new and existing landscaped areas. Use the latest available technology, as well as the methodology developed by DWR for the updated 2015 Model Water Efficiency Landscape Ordinance (MWELO), and other methods as appropriate.

BY 2018 Ensure standardized reporting in place.

TASK 21-2 Working with the partners identified in Task 21-1, develop permanent (i.e., non-drought) performance standards against which progress in reducing landscape water use region-wide will be measured.

BY 2018 Ensure performance standards in place.

TASK 21-3 Support expansion of local or regional water efficient landscape maintenance training programs that use the watershed approach. Support use of models such as the California Friendly Landscape Training Program and Bay-Friendly Landscape (Rescape California) Program.

BY 2019 Launch training programs in three new regions around the state.

TASK 21-4 Collaborate with municipalities, land use agencies, and others to create pilot programs that expand the application of efficiency standards to all new and existing landscaping projects.

BY 2020 Establish pilot programs in three municipalities.

BACKGROUND

Outdoor water use is responsible for about 40 percent of total water use in the Estuary's urban environment, and higher in hotter inland portions of the region. Existing state law calls for a 20 percent reduction in per capita water use by 2020. Although many parts of the region have already met or exceeded that goal under the recent drought regulations, these reductions may be short-lived according to the 2015 *State of the Estuary Report.*

While additional indoor water use efficiency is possible through the installation of low-flow toilets, shower heads, leak detection, and other steps, getting to the next level of long-term reduction will require focused attention on outdoor water use, including housing and development planning (see Action 23).

Reductions in water use for landscaping and gardening can benefit stormwater management, water quality, and water supply. Water use policies that include reductions for landscaping can both increase water supply reliability and offset use of imported water, as well as groundwater and local streamflows.

This CCMP action supports the Department of Water Resources' revised Model Water Efficient Landscape Ordinance (MWELO, 2015). The revised ordinance applies to new landscaping projects over 500 square feet and rehabilitated landscapes over 2,500 square feet. The MWELO also encourages the use of a watershed approach and collaboration among industry, government, and property owners to achieve multiple benefits, and provides a methodology for calculating the upper limit for water use on a particular landscape. This methodology, or a similar approach, could be applied to all existing landscaped areas.

In the long term, incentive programs such as lawn-to-garden or "cash-for-grass" rebates, stormwater capture, greywater reuse, and other on-site reuse by both residential and commercial water users will be key to reducing urban water use. This CCMP action has been identified in the California Water Action Plan, Executive Order B-29-15, and Wetter or Not, and has been written into state law through the Water Conservation in Landscaping Act of 2006 (AB 1881). The State Water Resources Control Board is also formulating performance standards for long-term water use reduction, which will help inform the tasks associated with this action.

OWNERS

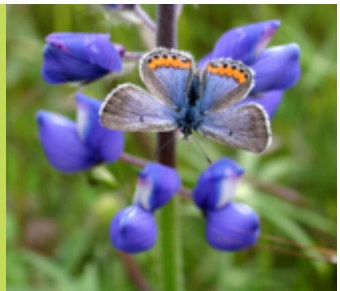
Rescape California (Task 21-3)
SF Estuary Partnership (Tasks 21-1 through 21-4)

COLLABORATING PARTNERS

CA Department of Water Resources, CA Urban Water Conservation Council, The Bay Institute, State Water Resources Control Board various local and regional governments and planning agencies, and local water agencies

NEXUS

Actions 18, 19, 22-24, 27
Goals 1, 3, 4
Objectives a, g, j



ACTION 22 Expand the use of recycled water

Work with water agencies, municipalities, and stakeholders to reduce barriers to the broader use of recycled water. Encourage the use of the right water at the right time and in the right place.

TASK 22-1 Promote existing outreach activities educating the public about recycled water. Encourage the sharing of informational materials, resources, and program models among municipalities, wastewater agencies, and drinking water agencies.

BY 2017 Develop platform for sharing resources.

TASK 22-2 Engage with the Bay Area Clean Water Agencies' Recycled Water Committee and others to increase coordination among municipalities, wastewater agencies, and drinking water agencies to expand incorporation of recycled water into local and regional water resources planning. Collaborate to identify opportunities for the broader use of recycled water as well as ways to overcome funding and planning gaps, and regulatory and permitting constraints.

BY 2018 Hold three meetings.

BACKGROUND

Recycled water refers to water treated to either non-potable or potable standards to provide a beneficial use. Recycled water is an increasingly important part of the Bay Area's water portfolio, yet ample opportunities remain to expand its use around the region according to the 2015 *State of the Estuary Report*. Until recently, most of the surface and ground water consumed in the Bay Area was treated to drinking water standards, used once, treated again to remove pollutants, and discharged to the Bay from wastewater treatment plants. Increasing competition for high quality fresh water in a time of prolonged drought, with resulting conflicts between environmental and human uses, make water recycling more important than ever.

This CCMP action supports efforts underway to make more efficient use of the Bay Area's potable water supply by using recycled water to 1) irrigate landscapes and crops, 2) cool the processing water in refineries and power plants, 3) create wetlands and other habitats, and 4) supplement instream flow where other alternatives are not available. Recycled water can also be used to expand water supplies by recharging groundwater, as is already done in other areas of California or, after it is purified, to supplement the surface storage and distribution system.

This CCMP action endorses the "right use of the right water at the right time and in the right place" approach. This approach seeks to optimize recycled water use within existing constraints. Constraints may include a lack of infrastructure for recycled water delivery, limited funding for pumping or pipeline construction, and planning gaps.

One effort to address planning gaps has been the 2013 *Bay Area Integrated Regional Water Management Plan* (BAIRWMP). The plan projects that recycled water use will more than double over the next 20 years, to 120,000 acre-feet per year. Local wastewater agencies are working individually and through partnerships such as the Bay Area Clean Water Agencies (BACWA), the North Bay Water Reuse Authority, and the Western Recycled Water Coalition to implement projects identified in the BAIRWMP.

Recent efforts are coalescing around the concepts of indirect potable reuse (IPR) and direct potable reuse (DPR). IPR supplements drinking water supplies indirectly by recharging groundwater aquifers with highly treated or purified wastewater. DPR is the introduction of highly purified recycled water directly into the raw water supply immediately upstream of a water treatment plant, or into the distribution system downstream of a water treatment plant. As DPR expands, there's also the challenge of how to dispose of the additional waste created by advanced recycled water purification systems, such as reverse osmosis concentrate. This waste can contain high concentrations of contaminants that have been removed from the water.

This CCMP action supports regional partnerships like BACWA in efforts to share resources and reduce barriers to the broader use of recycled water.

OWNERS

Bay Area Clean Water Agencies (Tasks 22-1, 22-2)
SF Estuary Partnership (Tasks 22-1,22-2)

COLLABORATING PARTNERS

Association of Bay Area Governments, CA Department of Water Resources, North Bay Water Reuse Authority, WateReuse California, WateReuse Northern California Chapter, State Water Resources Control Board, Western Recycled Water Coalition, various municipalities and water and wastewater agencies

NEXUS

Actions 14, 17-23, 25
Goals 1, 3, 4
Objectives a, g, h, j, l

ACTION 23 Integrate water into the updated Plan Bay Area and other regional planning efforts

Expand the focus of the Plan Bay Area update to incorporate a full range of issues related to water and San Francisco Bay. Incorporate water related issues in other regional planning efforts related to transportation, housing, and greenhouse gas reduction.

TASK 23-1 Organize a regional water summit to help incorporate related water issues in regional planning efforts and *Plan Bay Area*, in support of Task 23-2. San Francisco Estuary Partnership staff will coordinate with Association of Bay Area Governments planning staff to complete this task.

BY 2016 Hold water summit.

TASK 23-2 Incorporate water and San Francisco Bay related issues into the *Plan Bay Area* 2017 update. Consider issues such as reducing per capita water use, landscape water use, water quality, stormwater management (low impact development and green infrastructure), drought preparedness, and maximizing opportunities for water recycling in the update.

BY 2017 Complete an update of Plan Bay Area.

TASK 23-3 Evaluate opportunities to take similar action through state mandated *Sustainable Communities Strategies* in the Delta region, using the *Plan Bay Area* update process as a model.

BY 2019 Complete evaluation.

BACKGROUND

The Sustainable Communities and Climate Protection Act of 2008 (SB 375) reflects California's commitment to greenhouse gas reduction (GHG) and climate change adaptation. SB375's requirement that metropolitan planning organizations develop "*Sustainable Communities Strategies*" is an important step forward in integrating GHG reduction efforts with transportation, housing and land use planning in urban areas. The act falls short, however, of making a strong link to water and resource protection issues.

In the Estuary region, the *Sustainable Communities Strategy* has been incorporated in *Plan Bay Area*. *Plan Bay Area* is a long-range (through 2040) integrated transportation, land use and housing strategy for the region developed by the Association of Bay Area Governments (ABAG) and the Metropolitan Transportation Commission (MTC).

The 2013 version of *Plan Bay Area* was jointly approved by the ABAG Executive Board and MTC, and also includes the 2040 Regional Transportation Plan. The update of *Plan Bay Area* is anticipated in 2017, presenting an important opportunity for the region to demonstrate the benefits of integrating water issues into the SB 375 process.

Updates to Sustainable Communities Strategies for Delta metropolitan areas offer a similar opportunity for integration of water and resource protection issues. This CCMP action supports an integrated approach to the Plan Bay Area update. Integrated projects can provide multiple benefits: new transportation projects can be designed to improve stormwater management, and infill development to incorporate green infrastructure and use greywater and recycled water, for example. Infill projects can also contribute to efforts to reduce per capita water use and prepare for future droughts. Participants in the Climate Readiness Institute's 2015 workshop, "Bay Area Water in a Changing Climate" identified the inclusion of water issues in *Plan Bay Area* and other regional planning efforts as a priority action to address drought and long-term water uncertainties.

OWNERS

SF Estuary Partnership/Association Bay Area Governments (Tasks 23-1, 23-2, 23-3, 23-4)

COLLABORATING PARTNERS

Metropolitan Transportation Commission, SF Bay Area Integrated Regional Water Management Coordinating Committee, State Water Resources Control Board

NEXUS

Actions 1, 9, 13, 16-22, 24, 26, 30
Goals 3, 4
Objectives g, h, I, k, l

Water for all by Afsoon Razavi

ACTION 24 Manage stormwater with low impact development and green infrastructure

Implement green infrastructure (GI) and low impact development (LID) to reduce pollution from stormwater runoff into the Estuary. Develop planning and tracking tools, technical materials, policy recommendations, and financing strategy guidance to aid local and regional public agencies with implementation.

TASK 24-1 Develop outreach materials on lessons learned and the current state of LID benefit knowledge.

BY 2017 Develop materials.

TASK 24-2 Improve the San Francisco Estuary Institute's LID tracking tool "GreenPlan-IT." Enhance all components of the LID planning tool, "GreenPlan-IT."

BY 2017 Complete refined GreenPlan-IT.

TASK 24-3 Partner with local jurisdictions to analyze LID and GI potential in select areas using Green Plan-IT and other applicable planning tools, and integrate findings into relevant agency planning mechanisms and policies for adoption and implementation.

BY 2018 Complete identification and analysis.

TASK 24-4 Develop and promote a comprehensive regional road map that identifies key policies, documents, legislation, agencies, and specific actions needed for integrating GI with future climate change, transportation, and other infrastructure investments within the region, including looking for opportunities to implement large regional projects.

BY 2018 Complete work plan.

TASK 24-5 Create and make available to municipalities and other interested parties design tools for LID retrofits, such as: cost-effective, low maintenance standard design details for LID retrofits of typical road configurations; unit cost estimates for both LID retrofit practices and non-LID standard street details; and "lessons learned" reports on previous grant- or local agency-funded LID retrofit projects.

BY 2018 Complete design tools and make available

TASK 24-6 Create a GIS-based database to track completed LID and GI projects in the public and private realms; coordinate the database with Total Maximum Daily Load (TMDL) accounting systems developed by other local partners to identify and quantify the load reduction benefits of LID and GI.

BY 2018 Launch database.

BACKGROUND

Green infrastructure (GI) and low impact development (LID) are a broad suite of techniques that municipalities can use to reduce the impacts of urbanization on local hydrology and water quality. As cities were built, much of the natural landscape was paved over. Impervious sidewalks and streets typically represent 15-25 percent of land cover in many Bay Area cities. Rain and runoff from storms and human activities flows over these paved impermeable surfaces and into storm drains and ultimately San Francisco Bay, often carrying pollutants like oil, grease, pesticides, and heavy metals, among others. In this way, paved areas contribute greatly to urban runoff peak flows, volumes, and pollutant loads.

GI and LID techniques include rain gardens, vegetated swales, and green walls that slow and filter polluted runoff, as well as permeable pavements which allow water to infiltrate the soil beneath the pavement, where it is then filtered by the soil.

This CCMP action supports San Francisco Bay Regional Water Quality Control Board initiatives addressed in the current Municipal Regional Stormwater Permit, which requires 76 cities, counties and other entities to develop GI action plans, use GI and LID to capture PCB- and mercury-laden runoff, and track GI and LID implementation. These requirements were informed by GI ordinances passed by San Francisco and North Bay counties.

In the Estuary region, parcel-level new and re-development projects of a certain size are also required by the current Municipal Regional Stormwater Permit to use certain LID and GI techniques, but local agency projects in the public right-of-way are not.

This CCMP action supports the San Francisco Estuary Partnership's work to speed the adoption of green infrastructure throughout the region. It also supports the Partnership's work with the San Francisco Estuary Institute on Green Plan-IT, a planning tool that supports the cost-effective selection and placement of GI at a watershed scale.

OWNERS

San Francisco Estuary Partnership (Tasks 24-1 through 24-6)
US Environmental Protection Agency (Tasks 24-1 through 24-6)

COLLABORATING PARTNERS

Bay Area Stormwater Management Agencies Association, SF Bay Regional Water Quality Control Board, SF Estuary Institute, various municipalities

NEXUS

Actions 1, 2, 4, 6, 11, 12, 14, 17-19, 21, 27, 30
Goals 1, 2, 3, 4
Objectives a, e, f, i, j, l

ACTION 25 Address emerging contaminants

Advance the existing regional management strategy for contaminants of emerging concern (CECs), action plans for specific CECs, and the associated Regional Monitoring Program (RMP) CECs monitoring strategy. Support and expand existing education and public outreach efforts to reduce CECs.

TASK 25-1 Review and update San Francisco Bay CECs management strategy, action plans, and monitoring strategy every two years.

2016, 2018, 2020 Complete reviews and updates.

TASK 25-2 Support the continuation and evaluate the effectiveness of the regional education program aimed at reducing or eliminating the use of triclosan and triclocarban. Evaluate tools, such as non-purchase agreements, ordinances, or inclusion as a priority product by the California Department of Toxic Substances Control, to reduce personal care products containing triclosan or triclocarban.

BY 2018 Complete evaluations.

TASK 25-3 Support pharmaceutical CECs reduction efforts, like the Alameda County Safe Drug Disposal program and similar ordinances. Expand to other counties around the Bay and Delta. Work with counties to develop unified regional messaging to promote these ordinances.

BY 2020 Pass three additional ordinances in Bay and Delta counties.

BACKGROUND

Over 100,000 chemicals have been registered or approved for commercial use in the United States, and chemical production is growing globally. Lack of complete information about these chemicals limits the ability of scientists to assess their potential risk; as a result, many chemicals that have not been adequately tested for their potential impacts to humans and wildlife are continuously released into the environment, ultimately washing into aquatic ecosystems such as the San Francisco Estuary.

Some of these chemicals have been classified by the scientific community and regulators as contaminants of emerging concern. Characteristics used to identify CECs include high volume use, potential for toxicity in aquatic species, and occurrence in the environment. Determining which of the thousands of chemicals in commerce are CECs and whether or not they may be a problem is a formidable challenge. There are not enough data about the occurrence, persistence, and toxicity of the vast majority of chemicals in use today. Those data are needed to protect the beneficial uses of aquatic ecosystems.

Despite the information gaps about many CECs, San Francisco Bay is one of the most thoroughly monitored aquatic ecosystems in the world with respect to these chemicals, largely as a result of the collaborative Regional Monitoring Program (RMP) established through the 1993 CCMP. RMP studies are providing evidence that actions taken to reduce the uses of CECs and their input to the Estuary can be effective in lowering concentrations in the wildlife, as seen with flame retardants (PBDEs).

Monitoring CECs is also essential for protecting the beneficial uses of the waters of the Delta. Partnerships are evolving as the Delta Regional Monitoring Program takes advantage of the lessons learned in the Bay. As stated in the 2011 *Pulse of the Delta*, collaboration on prioritization approaches and projects of mutual interest can reduce costs, maximize program effectiveness, and increase the collective understanding of CEC occurrence and fate in the upper and lower Estuary.

A recent pilot study of microplastic pollution in San Francisco Bay has demonstrated higher levels of microplastics in the Bay than in either the Great Lakes or Chesapeake Bay. Microplastics come from personal care products with microbeads, synthetic clothing, plastic bags, polystyrene foam packaging, and other disposable plastic items. These tiny particles can pass through wastewater treatment plants and be carried by stormwater into the Estuary. Toxins in the plastics can contaminate water and enter aquatic food chains. Fish and wildlife can mistake microplastics and other trash particles for food.

This CCMP action supports continued efforts to address CECs through both research and monitoring and, in related actions, through trash capture and abatement.

OWNERS

Bay Area Pollution Prevention Group-BAPPG (Tasks 25-2, 25-3)
California Product Stewardship Council (Tasks 25-2, 25-3)
SF Bay Regional Water Quality Control Board (Task 25-1)
SF Estuary Institute (Task 25-1)
SF Estuary Partnership (Tasks 25-2, 25-3)

COLLABORATORING PARTNERS

Municipalities

NEXUS

Actions 1, 12, 27, 30
Goals 1, 3, 4
Objectives a, c, i, j

ACTION 26 Decrease raw sewage discharges into the Estuary

Reduce the input of raw sewage into the Estuary by supporting and expanding sewer lateral repair programs and developing resources for marinas and recreational boaters to better manage sewage discharge. Create a mobile application for boaters to find pumpout stations and report repair needs.

TASK 26-1 Review sewer lateral repair ordinances currently in operation around the region, and target 30 percent of the uncovered jurisdictions for assistance in developing and passing a sewer ordinance modeled on existing regional programs such as those of Berkeley and the East Bay Municipal Utility District (EBMUD).

BY 2017 Complete review and identify jurisdictions.

TASK 26-2 Produce and promote a white paper that describes existing and potential funding mechanisms for residents to help pay for private sewer line repair and replacement, such as grant programs and financing strategies.

BY 2018 Complete white paper.

TASK 26-3 Publish an industry-supported, technically vetted sewage management manual for marinas.

BY 2019 Complete sewage management manual for marinas.

TASK 26-4 Develop a mobile app for boaters to report broken pumpouts, and for marinas to report pumpout use and operational status; pilot a mobile pumpout program for marinas and recreational boaters in the Oakland Estuary. Install 10 new dockside pumpout systems in marinas to increase the size and availability of the pumpout network.

BY 2017 Launch application and pilot program.

BY 2021 Install 10 new pumpouts.

TASK 26-5 Work with the Bay Area Pollution Prevention Group (BAPPG) to identify new audiences for outreach messages about reducing non-flushable items to sanitary sewers.

BY 2017 Identify new audiences.

BACKGROUND

Most of the sewage systems in the Bay Area are over 50 years old and in poor condition. General wear-and-tear and pressure from tree roots have caused pipes to crack over time. Cracks allow rain water to seep into the sanitary sewer system during storms (called inflow and infiltration, or I&I), which overloads the limited capacity of the treatment plants and leads to illegal discharges of raw sewage into the Bay. An analysis in 2010 found that only 15 out of 115 wastewater agencies in the Bay Area have enacted sewer lateral ordinances. Draft ordinances have been developed by the North Bay Watershed Association and other groups; other jurisdictions can use these as models. Financing for private sewer lateral upgrades can be an impediment to full implementation; alternative finance methods could speed replacement efforts and should be explored.

Recreational boating practices have the potential to quickly and significantly affect water quality if proper management and pollution prevention practices are not followed. According to a 2011 California Department of Boating and Waterways report, over half of the vessels in San Francisco Bay have a sewage system on board. These systems can be either discharged overboard into the water, or pumped into a land-based sewage system for treatment. When discharged overboard, this concentrated sewage has dramatic localized effects on water quality, especially in shallow or low-flush areas like marinas and harbors. The Richardson Bay pathogen TMDL, passed in 2009, cites vessel discharges as a significant potential source of pathogen pollution in the Bay. While outreach is a critical component of addressing this issue, a multi-pronged approach to reduce the likelihood of sewage discharge into San Francisco Bay should be undertaken.

This CCMP action supports stronger local oversight of sewer lateral repair. It also supports efforts by marinas and boaters to properly manage sewage, and ensure that land-based sewage disposal facilities for boaters are abundant and functional.

OWNERS

SF Estuary Partnership (Tasks 26-1 through 26-5)

COLLABORATING PARTNERS

Bay Area Pollution Prevention Group, North Bay Watershed Association, SF Bay Regional Water Quality Control Board, various municipalities and wastewater agencies

NEXUS

Actions 1, 23, 30
Goals 1, 3
Objectives a, i

ACTION 27 Implement projects to reduce mercury, methylmercury, pesticides, and areas of low dissolved oxygen in the Estury

Develop and fund projects to reduce mercury loads from the Guadalupe watershed and to San Francisco Bay. Reduce pesticide impacts to the region's urban streams. Explore opportunities to manage low dissolved oxygen and methylmercury in Suisun Marsh.

TASK 27-1 Develop and implement a multi-media outreach campaign aimed at reducing household indoor and outdoor pesticide use.

BY 2017 Complete final report on outreach campaign.

TASK 27-2 Evaluate Best Management Practices (BMPs) in Suisun Marsh to improve marsh water quality and address dissolved oxygen and methylmercury impairment. Characterize managed wetland responses to BMPs through water quality modeling.

BY 2018 Develop water quality model.

TASK 27-3 Address the Guadalupe River mercury TMDL by implementing RMP monitoring of mercury loads during flood conditions, and by undertaking remediation projects within the Almaden Quicksilver County Park.

BY 2020 Complete monitoring.

BY 2021 Complete remediation projects.

BACKGROUND

Total Maximum Daily Loads (TMDLs) are action plans to restore clean water. Section 303(d) of the federal Clean Water Act requires states to identify water bodies that do not meet water quality standards and their associated pollutants. TMDLs examine water quality problems, identify pollutant sources, and specify actions that create solutions. They are adopted by the Regional Water Quality Control Boards as amendments to the region's Water Quality Control Plan.

Currently the San Francisco Bay Regional Water Quality Control Board has 22 TMDLs completed or under development. Two TMDLs are bay-wide (mercury and polychlorinated biphenyls, or PCBs) and an additional TMDL covers all the urban streams in the region for pesticide toxicity. This CCMP action focuses on current tasks to address the region's TMDLs for mercury and methylmercury (baywide and Guadalupe River Watershed specific), as well as for dissolved oxygen and pesticides. Taken together, this and other CCMP actions provide an integrated approach to reducing pollution to the Estuary.

Mercury contamination remains a priority concern in the San Francisco Estuary and its watersheds. The South Bay's Guadalupe River Watershed is the location of a legacy mercury mining district and several reservoirs and lakes that generate methylmercury, a chemical form of the metal that can bioaccumulate in higher level predators and fish consumers.

One tool that has been shown to reduce both mercury and PCB loads to the Estuary is green infrastructure (GI). This greening and softening of the urban hardscape is identified as a priority strategy for these TMDLs in the current *Municipal Regional Stormwater Permit* for San Francisco Bay, and is the focus of related CCMP actions. Another tool supported by this action is remediation of contaminated soils and landscapes in former mining areas.

To address pesticide toxicity, this CCMP action supports outreach promoting consumer behavior change. Research has shown that pesticides applied around homes—even when applied according to label instructions--lead to toxicity in local water bodies and urban streams. Outreach can reduce this threat.

In the upper Estuary, about 52,000 acres of wetlands managed to attract ducks in Suisun Marsh present a specialized suite of pollution problems. Vegetation manipulation, in conjunction with flooding of these areas for hunting in the fall, periodically results in discharges of low dissolved oxygen water from the diked marshes. The discharges, laden with decaying plant matter, can cause severe dissolved oxygen depletion in the adjoining channels and sloughs, which often leads to fish kills. The prolonged periods of flooding and drying, together with a buildup of organic carbon in the soils, can also enhance methylmercury production. This CCMP action supports the development of BMPs to tackle these water quality issues in Suisun Marsh.

OWNERS

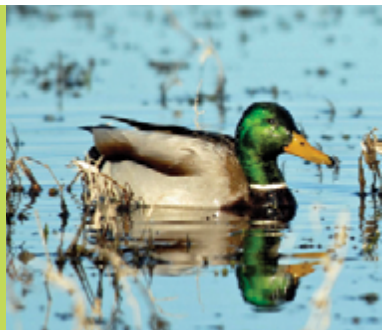
SF Bay Regional Water Quality Control Board (Tasks 27-2, 27-3)
SF Estuary Partnership (Tasks 27-1, 27-2, 27-3)
Suisun Resource Conservation District (Task 27-2)

COLLABORATING PARTNERS

CA Department of Pesticide Regulation, Santa Clara County Parks and Recreation Department, Santa Clara Valley Water District, SF Estuary Institute, US Environmental Protection Agency, various municipalities

NEXUS

Actions 6, 20, 21, 24, 25
Goals 1,3,4
Objectives a, c, i, j



ACTION 28 Advance nutrient management in the Estuary

Support water quality investigations, consistent monitoring and modeling, and analysis of management alternatives for nutrients.

TASK 28-1 Secure additional funding to ensure continuation of long-term monitoring of nutrient-related parameters in the Bay through the San Francisco Bay Regional Water Quality Control Board's Nutrient Management Strategy.

BY 2017 Secure funding.

TASK 28-2 Undertake and fund water quality research to attain an improved quantitative understanding of San Francisco Bay's "dose response" to nutrients.

BY 2017 Secure funding.

TASK 28-3 Update the Nutrient Management Strategy for San Francisco Bay based on monitoring and modeling and load reduction study results from Tasks 28-1 and 28-2.

BY 2018 Update Nutrient Management Strategy.

TASK 28-4 Develop a Nutrient Research Plan for the freshwater Sacramento-San Joaquin Delta through the Central Valley Regional Water Quality Control Board. Use the plan to determine whether nutrient objectives are needed to protect beneficial uses in upper Estuary.

BY 2017 Complete Delta Nutrient Research Plan.

TASK 28-5 Synthesize existing data and models in the Delta to update and expand the Department of Water Resources' report entitled, *Characterizing and quantifying nutrient sources, sinks and transformations in the Delta: synthesis, modeling, and recommendations for monitoring*. Use this synthesis to inform the design of the Delta Regional Monitoring Program and develop assessment questions.

BY 2019 Update report.

TASK 28-6 Undertake studies in the Estuary related to developing and evaluating alternatives for nutrient management actions, including initial considerations of costs and environmental effects.

BY 2020 Complete initial studies.

BACKGROUND

In the San Francisco Estuary, observations over the past two decades suggest that the Bay's resistance to the harmful effect of nutrient enrichment is weakening. This information underscores the need for robust long-term monitoring of nutrient conditions and continuing research investigations on this issue. However, federal funding to continue long-term monitoring is not keeping pace with the increased need for better information.

This CCMP action supports continued implementation of the five-year Nutrient Management Strategy for San Francisco Bay (November 2012). The Strategy's goals are to define the problem, establish guidelines for adverse effects of nutrient over-enrichment, implement a monitoring program, develop and utilize nutrient-load response models to support management decisions, evaluate control strategies, and consider alternative regulatory scenarios for future management.

This CCMP action also supports Delta Plan priorities on nutrients. The Delta Plan calls for the determination of safe nutrient levels in the Delta and, as necessary, development of nutrient water quality objectives. Accordingly, the Central Valley water board has initiated development of a Nutrient Research Plan for the Sacramento-San Joaquin Delta. Recent studies in the Delta have examined whether nutrient over-enrichment is a driver for cyanobacteria blooms and non-native, invasive floating and submerged aquatic vegetation. Similarly, nutrients may play a role in the shift in phytoplankton species and decrease in abundance coincident with pelagic organism decline. Nutrient loads from the Delta also reach Suisun and San Pablo Bays, highlighting the need for a holistic understanding of the issue throughout the Estuary.

OWNERS

Central Valley Regional Water Quality Control Board (Tasks 28-4, 28-5, 28-6)
SF Bay Regional Water Quality Control Board (Tasks 28-1, 28-2, 28-3, 28-6)
SF Estuary Institute (Tasks 28-1, 28-2, 28-3, 28-6)

COLLABORATING PARTNERS

Bay Area Clean Water Agencies, SF Bay National Estuarine Research Reserve, SF Estuary Partnership, US Environmental Protection Agency, US Geological Survey, various publicly-owned wastewater treatment plants

NEXUS

Actions 1, 3,5, 9, 18, 20
Goals 1,3

ACTION 29 Engage the scientific community in efforts to improve baseline monitoring of ocean acidification and hypoxia

Research and monitor the potential threats to the Estuary of ocean acidification and hypoxia.

TASK 29-1 Convene scientists from around the San Francisco Estuary, including from leading marine laboratories and universities, to identify potential impacts of ocean acidification and hypoxia on beneficial uses of the state's waters. Build a conceptual model that can inform design and implementation of monitoring approach.

BY 2018 Convene workshop and complete a meeting summary with recommended actions.

TASK 29-2 Expand monitoring efforts by deploying equipment such as high precision ocean acidification sensors at the Romberg Tiburon Center for Environmental Studies at San Francisco State University as well as by adding complementary sensors across the Estuary. Link monitoring efforts to the outer coast and Bay. Build on existing monitoring efforts.

BY 2020 Deploy and maintain monitoring equipment.

BACKGROUND

Although ocean acidification is a global phenomenon, emerging research indicates that the west coast of the United States and Canada will face some of the earliest, most severe changes in ocean carbon chemistry. However, the current status and impacts of ocean acidification on the San Francisco Estuary are largely unknown.

Advice from Bay Area and West Coast experts is needed to understand the likely impacts of ocean acidification in the Estuary and to develop cost effective monitoring strategies. Not only is ocean acidification a global effect of increasing atmospheric carbon dioxide levels, but it is also exacerbated in urbanized, eutrophic estuaries (local hypoxia and acidification go hand-in-hand). A growing body of research indicates that ocean acidification might affect water quality and biological communities in the Bay, but it is not clear where this problem should sit on the priority list for water quality managers or regulators. In particular, ocean acidification could impact species such as the Olympia oyster (now making a local recovery and considered a useful shoreline protection builder); chinook, coho and steelhead salmon; as well as the pelagic food web. Impacts can be complicated by changes in nitrogen cycling.

This CCMP action supports the recommendations of a report from the West Coast Ocean Acidification and Hypoxia Science Panel calling for better monitoring. According to the report, the proposed monitoring network should 1) support the needs of decision-makers; 2) measure an array of physical, chemical, and biological values; 3) build on ongoing efforts; 4) develop and sustain intellectual capacity. Groups such as the Greater Farallones National Marine Sanctuary and the San Francisco Bay National Estuarine Research Reserve have already begun to integrate some of these monitoring protocols into planning efforts.

OWNERS

SF Estuary Institute (Task 29-1)
SF Estuary Partnership (Task 29-1 and 29-2)
SF State University's Romberg Tiburon Center for Environmental Studies (Task 29-2)

COLLABORATING PARTNERS

CA Ocean Protection Council, CA Ocean Science Trust, Central and Northern California Ocean Observing System, Greater Farallones National Marine Sanctuary, SF Bay National Estuarine Research Reserve, US Environmental Protection Agency

NEXUS

Action 5
Goal 1
Objectives b, c

ACTION 30 Reduce trash input into the Estuary

Assist regional municipalities and agencies in attaining trash reduction objectives by supporting ordinances and other extended producer responsibility strategies that can reduce trash before it reaches the Estuary. Help establish and report on a regional trash reduction indicator to evaluate source reduction efforts.

TASK 30-1 Partner with municipalities, counties, pollution prevention organizations, and other stakeholders to research and implement effective extended producer responsibility (EPR) strategies for food and beverage packaging in the Estuary. Highlight successful strategies and develop recommendations for regional and well as local approches.

BY 2020 Implement four new EPR ordinances or other strategies based on recommendations.

TASK 30-2 Develop a scientifically vetted trash reduction indicator for the State of the Estuary Report.

BY 2021 Develop a metric for inclusion in next report.

BACKGROUND

Trash is a serious problem in the urbanized Estuary. Every year 1.36 million gallons of trash flows into San Francisco Bay and its creeks from storm drains. Plastic makes up approximately 49 percent of the trash; followed by paper products (bags, newspapers, receipts) at 21 percent, beverage containers and miscellaneous (including cigarette butts) at 15 percent, single-use plastic bags at approximately eight percent, and polystyrene foam at seven percent.

Trash is one of the easiest pollutants to see but one of the most difficult to measure, which creates challenges for developing accurate and feasible tracking methods. The development of a trash reduction indicator for the State of the Estuary Report will rely on standards developed for the state and regional water boards, and other vetted methodologies. Once adopted, the State Water Resources Control Board's statewide policy for trash control will also guide this action.

The current Municipal Regional Stormwater Permit requires municipalities and local agencies in Alameda, Contra Costa, San Mateo, and Santa Clara counties, and the cities of Fairfield, Suisun City, and Vallejo, to meet the goal of 100 percent trash load reduction or no adverse impact to receiving waters from trash by July 1, 2022. All other Bay Area and Delta municipalities are covered by Trash Amendments adopted by the State Water Resources Control Board in 2015.

In recent years, cities and counties around the Estuary have passed a number of ordinances banning plastic bags, polystyrene, and other items commonly found in the region's waterways. Extended producer responsibility (EPR) ordinances and legislation, which require waste product producers to take responsibility for treating or disposing of the trash produced at the end of a product's use, are gaining momentum. Take-back programs are one effective EPR strategy.

Food and beverage packaging from grocery stores and restaurants and other materials made from plastic are the most frequently occurring forms of trash in the region's waterways, and therefore should be prioritized in EPR strategies for the Estuary. Because so much of this packaging is made of plastic, these efforts may also help reduce the rising problem of microplastics identified as an emerging concern in San Francisco Bay and the nearby ocean.

This CCMP action supports filling critical gaps in the battle to reduce trash impacts on the Estuary and regional quality of life.

OWNERS

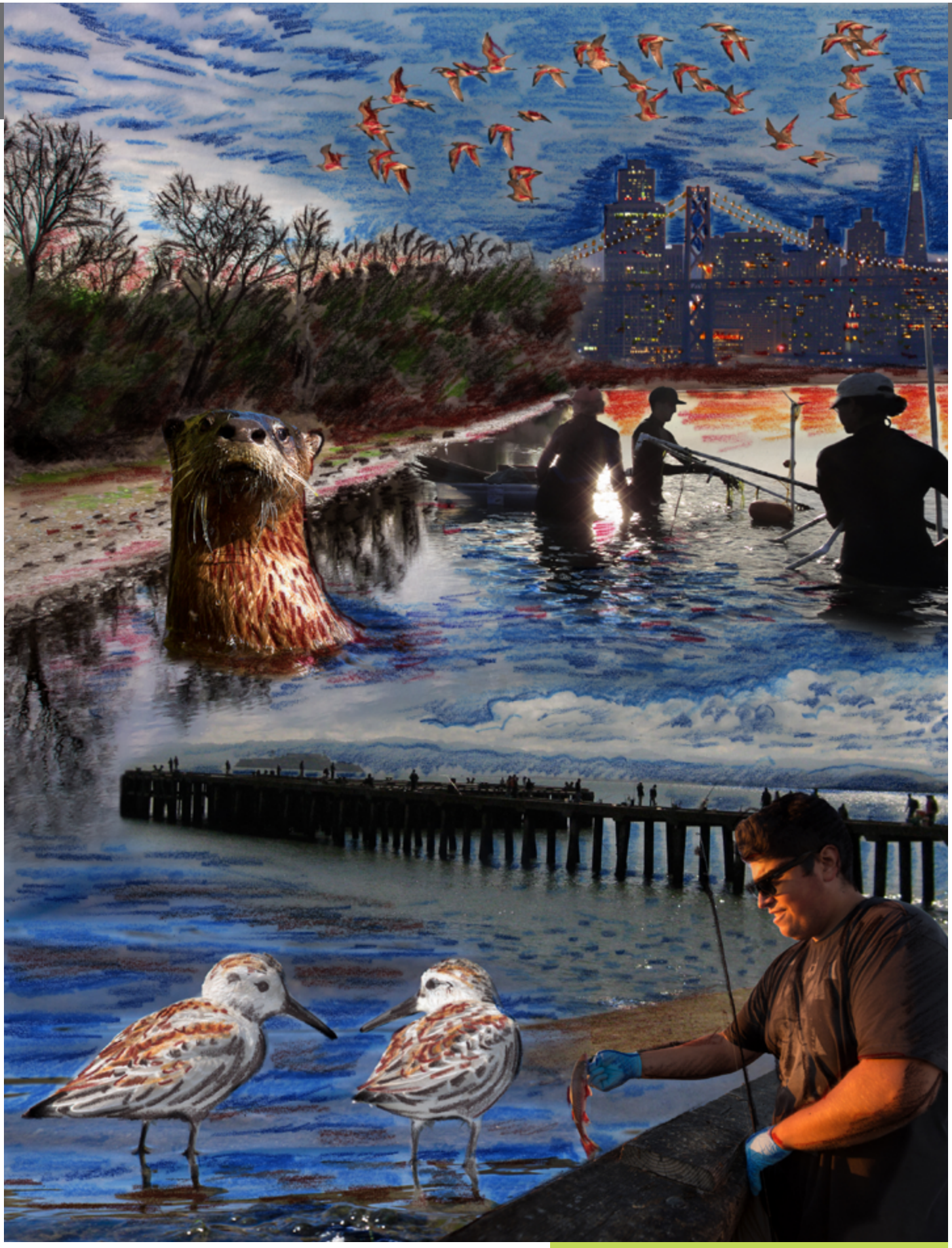
SF Estuary Partnership (Tasks 30-1 through 30-2)

COLLABORATING PARTNERS

Bay Area Pollution Prevention Group, Bay Area Stormwater Management Agencies Association, SF Bay Regional Water Quality Control Board, Save the Bay, US Environmental Protection Agency, various municipalities

NEXUS

Actions 23-26, 31, 32
Goals 1, 3
Objectives a, i



Experiencing and saving the Estuary by Afsoon Razavi

ACTION 31 Foster support for resource protection and restoration by providing Estuary-oriented public access and recreational opportunities compatible with wildlife

Provide Estuary-oriented public access and recreational opportunities that avoid or minimize adverse impacts to sensitive habitats and wildlife while accommodating environmental education, biking, hiking, paddling, wildlife viewing, and other activities. These opportunities will increase citizen and decision-maker appreciation of the value of natural resources, and foster support for Estuary resource protection and restoration.

TASK 31-1 Develop and distribute educational materials and maps to boaters and various partners that identify areas where shorebirds, waterfowl, and harbor seals forage, rest, and roost; these materials will help eliminate or minimize intrusion.

2016-2021 Work with stakeholders to develop region-specific maps, signs, and other educational materials; identify two appropriate mechanisms for distributing materials to boaters two to three times per year.

TASK 31-2 Add to the San Francisco Bay Trail, closing critical gaps in the main alignment (the "spine") that links the shoreline of all nine Bay Area counties, while avoiding adverse effects on sensitive resources and wildlife.

BY 2021 Add 40 miles of new trail segments to the Bay Trail spine.

TASK 31-3 Add to the San Francisco Bay Area Water Trail, creating or enhancing high quality public water access every three miles, and paddle-in camping opportunities every eight miles. Access should be designed to avoid adverse impacts to sensitive resources and wildlife.

BY 2021 Complete six new or enhanced San Francisco Bay Area Water Trail sites, including two new or enhanced kayak-in campgrounds.

BACKGROUND

The Estuary and its shoreline provide important refuge, foraging, and nesting habitat for wildlife. These areas also provide opportunities for unique recreational and educational experiences. Participating in recreational activities along the shoreline, or in and on the water, allows the public to discover and appreciate the Bay's natural resources, and inspires them to take an active interest in Estuary protection and restoration efforts.

The Estuary provides several regional trail systems. The San Francisco Bay Trail is 68 percent complete, with 345 of 500 planned miles of trail open around the Bay. The Bay Area Ridge Trail (with views of the Bay) is 65 percent complete, with 360 of 550 planned miles open. The San Francisco Bay Water trail has designated 20 of 111 planned sites that meet criteria for public access to the water. In the Delta progress is harder to quantify but residents currently enjoy numerous Sacramento River trails; the planned Great California Delta Trail will traverse all five Delta counties. In addition to (or in lieu of) new trail miles, development and restoration projects around the Estuary may also provide desirable recreational experiences.

Public access to the shoreline can have adverse effects on wildlife and even cause long-term impacts to populations and species. The type and severity of effects on wildlife depend on many factors, including how the sites are planned and built, the type and number of species present, and the intensity and nature of human activity. Recreational activities can be located, designed, and managed to prevent significant adverse impacts from human intrusion on sensitive habitats and wildlife species. Signage and other educational methods, such as docent programs, can be employed to promote stewardship, inform the public of the sensitivity of certain habitats and wildlife, and encourage safe, environmentally responsible recreation.

This CCMP action supports efforts to avoid adverse impacts to wildlife and recommendations such as those developed by California State Parks' Division of Boating and Waterways, the Seabird Protection Network, the SF Bay Conservation and Development Commission, the SF Bay Trail Project, and the SF Bay Joint Venture. It also supports including these considerations in plans for new public access projects in transition zones and uplands, which may be impacted by rising seas.

OWNERS

Association of Bay Area Governments (Task 31-2, 31-3)
CA State Parks' Division of Boating and Waterways (Task 31-1)
SF Estuary Partnership (Task 31-1)

COLLABORATING PARTNERS

Bay Area Ridge Trail Council, CA State Coastal Conservancy, SF Bay Area Water Trail project, SF Bay Conservation and Development Commission, SF Bay Joint Venture, SF Bay National Estuarine Research Reserve, SF Bay Trail Project

NEXUS

Actions 1, 3, 12, 26, 30, 32
Goals 1, 2, 4
Objectives b, e, j, l

ACTION 32 Champion and implement the CCMP

Educate partners, stakeholders, national, local and regional leaders, and other targeted audiences about the CCMP and engage them in advancing its goals, objectives and actions. Provide local decision makers and the public with the kind of reliable information necessary to make policy and personal decisions in favor of Estuary health. Support and advance tracking of Estuary health and response to management measures.

TASK 32-1 Educate and engage targeted audiences in Estuary protection and restoration. Expand communication avenues for the San Francisco Estuary Partnership, including social media presence. Provide educational materials to boaters and boating facilities. Leverage existing programs to support public outreach efforts on the CCMP.

2016-2021 Provide communication materials to public audiences one to three times annually.

TASK 32-2 Educate the regional community by hosting the biennial State of the Estuary conference, supporting the biennial Bay-Delta Science Conference, and supporting *ESTUARY NEWS* magazine.

2016-2021 *ESTUARY NEWS*
2017, 2019, 2021 State of the Estuary Conferences
2016, 2018, 2020 Delta Science Conferences

TASK 32-3 On a five-year cycle, provide current information about the health status of the Estuary through an updated *State of the Estuary Report*. Continue to gather data for current indicators and develop new indicators that provide needed information regarding Estuary health and align with actions in the CCMP.

BY 2018 Develop a strategy for updating the 2015 *State of the Estuary Report*, including advancing new indicators.

BY 2021 Update State of the Estuary Report.

TASK 32-4 Create and implement an online CCMP reporting process to track progress being made on each of the CCMP actions and provide compiled reporting information twice per year. Update the CCMP on a five-year cycle based on assessed progress and updated scientific information in the *State of the Estuary Report,* and in response to emerging issues.

2017-2021 Report on CCMP progress twice per year.
2021 Initiate CCMP update.

TASK 32-5 Engage local community organizations in implementing the CCMP. Share information with, and coordinate, professionals and community members working to protect local watersheds through the Bay Area Watershed Network (BAWN). Secure funds to promote community-based watershed stewardship efforts through a small grants program.

2016-2021 Maintain the BAWN webpage and email newsgroup, and host or co-host a BAWN annual meeting. Design and implement a small grants program on a bienniel schedule.

TASK 32-6 Identify and expand funds available to partners at all levels to implement the CCMP. This includes tracking, commenting, and sharing information on existing and emerging grant programs, legislation, and other funding mechanisms.

2016-2021 Maintain and distribute matrix of available funding programs.

BACKGROUND

The future health of the Estuary depends on support from engaged and diverse audiences (including local leaders), and support for local environmental education and outreach in select Bay watersheds, as well as on federal and state funding. The San Francisco Estuary Partnership is actively developing and expanding public engagement in work that supports the CCMP and will result in increased awareness about Estuary health and restoration among Bay Area residents. This work will also increase national, state, and local support and funding for CCMP objectives.

Key education and engagement efforts include the San Francisco Estuary Partnership's website, the State of the Estuary Conference and the Bay-Delta Science Conference, *ESTUARY NEWS* magazine, the *State of the Estuary Report*, and the CCMP itself. Annual reporting on the CCMP includes progress made towards completing actions as well as improving the health of the Estuary. The San Francisco Estuary Partnership will continue to provide administrative and coordinating services to the BAWN. In addition, as funds are available, the Partnership will run a small grants program for watershed work based on its pilot effort in 2013.

OWNERS

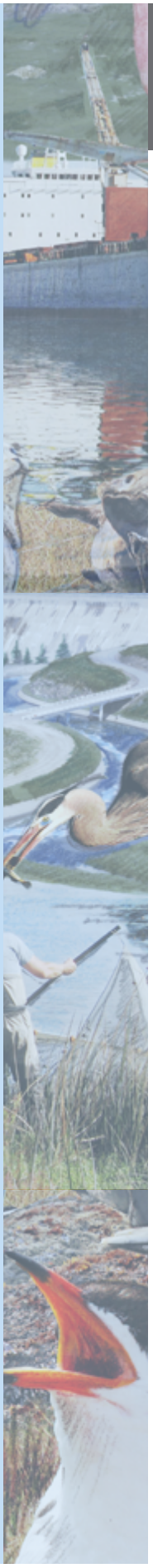
SF Estuary Partnership (Tasks 32-1 through 32-6)
SF Bay Joint Venture (Task 32-6)

COLLABORATING PARTNERS

CCMP Action owners and collaborating partners, SF Estuary Partnership Implementation Committee, stakeholders engaged with the *State of the Estuary Report* and the State of the Estuary Conference

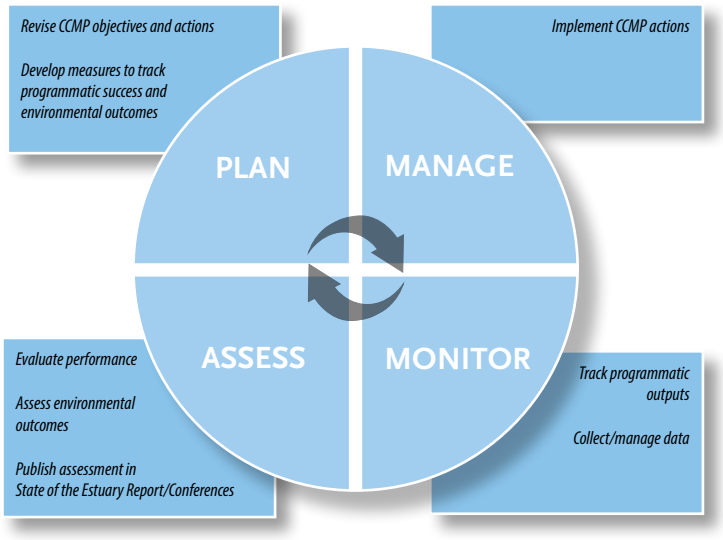
NEXUS Actions all; Goals: 4; Objectives: j, k, l

IV. Tracking Progress



INTRODUCTION

Monitoring represents a critical component of an adaptive management cycle. For the 2016 CCMP, our monitoring approach includes two primary components: 1) linking environmental outcomes in the CCMP to the State of the Estuary Report, and 2) linking programmatic success, or outputs, through implementation of tasks with clear milestones distributed throughout the five-year implementation horizon of the CCMP.



Adaptive Management Cycle for SFEP

TRACKING ENVIRONMENTAL OUTCOMES

The State of the Estuary Report is the most comprehensive health report ever completed for the San Francisco Bay-Delta Estuary. The report uses the best available science and most recent data to assess the status of various parts of the ecosystem. The purpose is to identify problems with estuarine health, so that conservation and restoration efforts can focus on solutions. The report is published every five years and based on painstaking work to assess status and trends.

Indicators used in the State of the Estuary Report range across five topic areas: Water, Habitat, Wildlife, Processes, and People. For wildlife, the Sensitive Species tables in Section V also provide a resource for understanding linkages between CCMP actions and critical management issues for threatened and endangered species.

For this revision of the CCMP, efforts were made to link CCMP goals, objectives and actions to environmental indicators in the State of the Estuary Report. The table below depicts these linkages. When considering the stressors, threats, and existing conditions described for each health indicator, most have direct ties to the CCMP at all levels. There is no direct indicator for the CCMP's final action, Champion and implement the CCMP, however, because it represents a programmatic approach to engaging related audiences.

Some aspects of Estuary health cannot yet be measured by scientifically-defensible indicators. These are described as "emerging indicators" in the table below. These emerging indicators will inform priorities in future CCMPs and should be added to future State of the Estuary reports.

Finally, there are many management decisions at multiple scales of governance, from local to federal, that have bearing on any evaluation of our progress in sustaining estuarine health but that are not called out specifically in the CCMP. In future revisions of both reports, we will have the opportunity to identify new points of alignment, and to make even stronger linkages between science, assessment, and management actions.

TRACKING PROGRAMMATIC OUTPUTS

Programmatic outputs reflect the work of many partners who have carefully provided input to develop outputs that are both achievable and that reflect a larger, ambitious vision for the Estuary. Each task in the CCMP links to a milestone with a year assigned for completion. In addition, tasks are linked to "owners" in the document. Owners are entities convening, stewarding, tracking, or implementing an action. "Collaborating partners" include entities working to support and sometimes implement tasks.

The San Francisco Estuary Partnership will be working to encourage ongoing partner engagement. It will also look to the State of the Estuary Report, and its ongoing alignment with the CCMP, as a powerful tool for detecting and interpreting trends in reaching Estuary goals related to ecosystem health, resilience, water quality and quantity, and stewardship. However, because of the natural variability of the Estuary, and the time it may take to detect improvements based upon the goals in the CCMP, management actions are also tracked to provide early indications of program success. This information provides the basis for expected changes in environmental conditions as described in CCMP goals, objectives and actions.

Partnership staff have developed a suite of resources to track and communicate programmatic outputs. An internal tracking database will allow staff to report on progress for tasks and milestones. This database will link directly to an external tracking system and made available online.

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STATE OF THE ESTUARY 2015 INDICATORS AND THE CCMP

State Of The Estuary 2015 Indicator	CCMP Goals	CCMP Objectives	CCMP Actions
WATER			
Safe For Swimming	Goal 1, 3	Objective a, b, i	Action 26
Safe For Aquatic Life	Goal 1, 3	Objective a, b, i	Action 24, 25, 27, 30
Fish Safe to Eat	Goal 1, 3	Objective a, b, i	Action 25, 27, 28
Freshwater Inflow	Goal 3	Objective a, b, h	Action 18
HABITAT			
Open Water Habitat	Goal 3	Objective h	Action 26
Eelgrass	Goal 1, 2	Objective a, d, e	Action 1, 2, 4, 5, 9, 12, 15, 17
Tidal Marsh Extent	Goal 1, 2	Objective a, d, e	Action 1, 2, 3, 11, 15, 16
WILDLIFE			
Benthic Invertebrates	Goal 2	Objective a, e	Action 9
Fish	Goal 2, 3	Objective a, e, h	Action 1, 5, 6, 7, 9
Harbor Seals	Goal 2, 3	Objective a, e, i	Action 27, 28, 31
Winter Waterfowl	Goal 1, 2	Objective a, b, e	Action 3, 6, 8
Breeding Waterfowl	Goal 1, 2	Objective a, b, e	Action 3, 6, 8, 10
Shorebirds	Goal 1, 2	Objective a, b, e	Action 3, 6, 10
Herons & Egrets	Goal 1, 2	Objective a, b, e	Action 3, 6, 10
Tidal Marsh Birds	Goal 1, 2	Objective a, b, e	Action 3, 6, 9, 10, 12
Ridgway's Rail	Goal 1, 2	Objective a, b, e	Action 3, 6, 9, 10, 12
PROCESSES			
Migration Space	Goal 1, 2, 4	Objective a, b, d, f, k	Action 2, 3, 4, 13, 15, 16, 17
Beneficial Floods	Goal 2	Objective d, e	Action 12, 26
Zooplankton as Food	Goal 1, 3	Objective a, b, c, h	Action 9, 18
Feeding Chicks	Goal 1	Objective b, e	Action 3, 6, 10
PEOPLE			
Urban Water Use	Goal 3	Objective g	Action 18, 19, 20, 21, 22, 23, 24
Recycled Water Use	Goal 3	Objective g	Action 19, 22, 23
Public Access/Trail Access	Goal 4	Objective j, k, l	Action 31
State Of The Estuary 2015 Emerging Indicator	**CCMP Goals**	**CCMP Objectives**	**CCMP Actions**
Pervasive Pesticides	Goal 1, 3	Objective b, i	Action 7, 27
Oyster Beds	Goal 1, 2	Objective a, d, e	Action 5, 14, 29
Woody Riparian	Goal 1, 2	Objective a, e	Action 7
Watersheds	Goal 1	Objective a	Action 1, 2, 24
Managed Ponds	Goal 1	Objective a	Action 6
Sediment	Goal 1, 2	Objective a, d, e	Action 13, 24
Invasions	Goal 1, 3	Objective a, b, i	Action 9, 19

V: Sensitive Species

Sensitive Species

The San Francisco Estuary Partnership recognizes the numerous individuals and organizations working tirelessly to protect and promote the fish and wildlife that make the San Francisco Estuary unique. The CCMP supports their efforts by examining the connections between processes in San Francisco Bay (the lower Estuary) and the Delta (upper Estuary). This approach leads to actions that build stronger systems across the Estuary as a whole. The CCMP does not focus on individual species, but on actions that can have a broad range of impacts on fish and wildlife, including bringing attention and funding to restoration efforts, as well as building species-level resilience to climate change. This section provides an overview of these impacts. Fifteen species of concern were selected for analysis. While this list is not exhaustive, it represents some of the Estuary's species, especially those that are already threatened or endangered.

OVERVIEW OF CCMP IMPACTS

The overarching goals of the CCMP, especially Goal 1, to "sustain and improve the Estuary's habitats and living resources," aim to promote and protect species in this Estuary. Here, the impacts of the CCMP are broken into more granular, species-specific topics, to provide a better understanding of the benefit of each action to species of concern in the Estuary.

LEGEND	
	HABITAT PROTECTION & RECOVERY: Actions that protect, enhance, restore, or rebuild both aquatic and terrestrial habitat of species of concern
	MIGRATORY BENEFIT: Actions that protect or restore essential migration routes for species of concern
	ADVOCACY FOR SPECIES: In alignment with CCMP Goal 4, these actions bring attention, funding, and research to species of concern.
	RESILIENCE TO CLIMATE CHANGE: Actions that enhance the ability of species of concern to withstand impacts of climate change
	INVASIVE SPECIES REDUCTION: Actions that remove or reduce the efficacy of invasive species that threaten species of concern

SOURCES

http://www.dfg.ca.gov/wildlife/nongame/t_e_spp/
https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=109405&inline
https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=7103&inline=1
https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=1508&inline=1
https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=1713&inline=1
https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=1711&inline=1
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https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=1727&inline=1
https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=2497&inline=1
http://www.fws.gov/sfbaydelta/species/delta_smelt.cfm
http://www.fws.gov/sfbaydelta/species/delta_smelt.pdf
http://www.fws.gov/ecos/ajax/docs/five_year_review/doc3227.pdf
http://www.fws.gov/sfbaydelta/species/suisun_thistle.pdf
http://www.fws.gov/sfbaydelta/species/soft_birds_beak.pdf
http://www.fws.gov/sfbaydelta/species/ca_clapper_rail.htm

SPECIES OF CONCERN

Species Name & Type	Status	Primary Habitat	Greatest Threats
Red-legged Frog *Amphibian*	Federal: Threatened State: Threatened	• Quiet pools of streams, marshes, and occasionally ponds • Permanent pools for larval development	• Habitat loss (draining of wetlands and pools)
California Tiger Salamander *Amphibian*	Federal: Endangered State: Threatened	• Annual grass, with seasonal ponds and/or vernal pools	• Habitat loss
Ridgway's Rail *Bird*	Federal: Endangered State: Endangered	• Saline or brackish emergent wetlands dominated by picklewood, cordgrass, and bulrush	• Habitat loss (filling and diking of emergent wetland) • Fragmentation through disruption of habitat corridors • Predation by non-native red fox and feral cats
California Black Rail *Bird*	Federal: Not listed State: Threatened	• Tidal emergent wetlands dominated by pickleweed, or brackish marshes supporting bulrushes	• Habitat loss (tidal marsh)
California Least Tern *Bird*	Federal: Endangered State: Endangered	• Migratory Can be found in abandoned salt ponds and along estuarine shores	• Habitat loss (dredging and nesting disturbance)
Snowy Plover *Bird*	Federal: Threatened State: Not listed	• Sandy marine and estuarine shores. • Salt pond levees can be used as nesting habitat.	• Habitat loss (tidal marsh dredging and nesting disturbance)
Delta Smelt *Fish*	Federal: Threatened State: Endangered	• Migratory • Brackish-water associated with the mixing zone • Disperse widely into river channels and tidally influenced backwater sloughs • Spawn in shallow, fresh, or slightly brackish water upstream of the mixing zone	• Direct entrainments by State and Federal water export facilities • Summer and fall increases in salinity and water clarity • Predation by introduced species
Steelhead Trout *Fish*	Federal: Threatened State: Not listed	• Migratory • Freshwater streams and rivers for spawning, travel from ocean	• Habitat loss and degradation • Fragmentation and deterioration of natural linkages for migration and spawning • Range minimization
Coho Salmon *Fish*	Federal: Threatened State: Threatened	• Migratory • Freshwater streams and rivers for spawning, travel from ocean	• Habitat loss and degradation • Fragmentation and deterioration of natural linkages for migration and spawning • Range minimization
Chinook Salmon *Fish*	Federal: Endangered State: Endangered	• Migratory • Freshwater streams and rivers for spawning, travel from ocean	• Habitat loss and degradation • Fragmentation and deterioration of natural linkages for migration and spawning • Range minimization
Green Sturgeon *Fish*	Federal: Threatened State: Not listed	• Migratory. • Freshwater streams and rivers for spawning, travel from ocean	• Habitat loss and degradation • Fragmentation and deterioration of natural linkages for migration and spawning • Range minimization
Salt Marsh Harvest Mouse *Mammal*	Federal: Endangered State: Endangered	• Saline emergent wetlands and marshes • Pickleweed and adjacent grasslands are preferred for cover.	• Habitat loss (filling, diking, and urban development of diked salt marshes)
California Sea-blite *Plant*	Federal: Endangered State: Not listed	• Tidally influenced salt marsh and estuaries • Most commonly found in the narrow ecotone between salt marsh and stable dune scrub communities occurring at the edge of the salt marsh	• Habitat loss • Range reduction
Suisun thistle *Plant*	Federal: Endangered State: Not listed	• Upper intertidal marsh plain near the smallest branches of natural, small tidal creeks, banks, ditches, and marsh edges that are very infrequently flooded	• Habitat loss (diking of Suisun Marsh, conversion of tidal brackish marsh to non-tidal wetlands) • Invasive species (Lepidium latifolium in brackish tidal marsh)
Soft bird's-beak *Plant*	Federal: Endangered State: Rare	• Upper reaches of salt grass/pickleweed marshes Near the limits of tidal action	• Habitat loss (diking of Suisun Marsh, conversion of tidal brackish marsh to non-tidal wetlands) • Invasive species (Lepidium latifolium in brackish tidal marsh)

CCMP BENEFITS TO SPECIES OF CONCERN

	1. Develop and implement a comprehensive, watershed-based approach to aquatic resource protection	2. Establish a regional wetland and stream monitoring program	3. Protect, restore, and enhance tidal marsh and tidal flat habitat	4. Identify, protect, and create transition zones around the Estuary
Red-legged Frog	✓	✓	✓	✓
California Tiger Salamander	✓	✓		✓
Ridgway's Rail		✓	✓	✓
California Black Rail		✓	✓	✓
California Least Tern		✓	✓	✓
Snowy Plover		✓	✓	✓
Delta Smelt	✓	✓	✓	✓
Steelhead Trout	✓	✓	✓	✓
Coho Salmon	✓	✓	✓	✓
Chinook Salmon	✓	✓	✓	✓
Green Sturgeon	✓	✓	✓	✓
Salt Marsh Harvest Mouse		✓	✓	✓
California Sea-blite		✓	✓	✓
Suisun thistle		✓	✓	✓
Soft bird's-beak		✓	✓	✓

CCMP BENEFITS TO SPECIES OF CONCERN (CONTINUED)

	5. Protect, restore, and enhance intertidal and subtidal habitats	6. Maximize habitat benefits of managed wetlands and ponds	7. Conserve and enhance riparian and in-stream habitats throughout the Estuary's watersheds	8. Protect, restore, and enhance seasonal wetlands
Red-legged Frog				
California Tiger Salamander				
Ridgway's Rail				
California Black Rail				
California Least Tern				
Snowy Plover				
Delta Smelt				
Steelhead Trout				
Coho Salmon				
Chinook Salmon				
Green Sturgeon				
Salt Marsh Harvest Mouse				
California Sea-blite				
Suisun thistle				
Soft bird's-beak				

CCMP BENEFITS TO SPECIES OF CONCERN (CONTINUED)

	9. Minimize the impact of invasive species	10. Increase the efficacy of predator management	11. Increase carbon sequestration through wetland restoration, creation, and management	12. Restore watershed connections to the Estuary to improve habitat, flood protection, and water quality
Red-legged Frog				
California Tiger Salamander				
Ridgway's Rail				
California Black Rail				
California Least Tern				
Snowy Plover				
Delta Smelt				
Steelhead Trout				
Coho Salmon				
Chinook Salmon				
Green Sturgeon				
Salt Marsh Harvest Mouse				
California Sea-blite				
Suisun thistle				
Soft bird's-beak				

CCMP BENEFITS TO SPECIES OF CONCERN (CONTINUED)

	13. Manage sediment on a regional scale and advance beneficial reuse	14. Demonstrate how natural habitats and nature-based shoreline infrastructure can provide increased resiliency to changes in the Estuary environment	15. Advance natural resource protection while increasing resiliency of shoreline communities	16. Integrate natural resource protection into state and local government hazard mitigation, response, and recovery planning
Red-legged Frog				
California Tiger Salamander				
Ridgway's Rail				
California Black Rail				
California Least Tern				
Snowy Plover				
Delta Smelt				
Steelhead Trout				
Coho Salmon				
Chinook Salmon				
Green Sturgeon				
Salt Marsh Harvest Mouse				
California Sea-blite				
Suisun thistle				
Soft bird's-beak				

CCMP BENEFITS TO SPECIES OF CONCERN (CONTINUED)

	17. Improve regulatory review, permitting, and monitoring processes for multi-benefit climate adaptation projects	18. Improve the timing, amount, and duration of freshwater flows critical to Estuary health	19. Develop long-term drought plans	20. Increase regional agricultural water use efficiency
Red-legged Frog				
California Tiger Salamander				
Ridgway's Rail				
California Black Rail				
California Least Tern				
Snowy Plover				
Delta Smelt				
Steelhead Trout				
Coho Salmon				
Chinook Salmon				
Green Sturgeon				
Salt Marsh Harvest Mouse				
California Sea-blite				
Suisun thistle				
Soft bird's-beak				

CCMP BENEFITS TO SPECIES OF CONCERN (CONTINUED)

	21. Reduce water use for landscaping around the Estuary	22. Expand the use of recycled water	23. Integrate water into the updated Plan Bay Area and other regional planning efforts	24. Manage stormwater with low impact development and green infrastructure
Red-legged Frog				
California Tiger Salamander				
Ridgway's Rail				
California Black Rail				
California Least Tern				
Snowy Plover				
Delta Smelt				
Steelhead Trout				
Coho Salmon				
Chinook Salmon				
Green Sturgeon				
Salt Marsh Harvest Mouse				
California Sea-blite				
Suisun thistle				
Soft bird's-beak				

CCMP BENEFITS TO SPECIES OF CONCERN (CONTINUED)

	25. Address emerging contaminants	26. Decrease raw sewage discharges into the Estuary	27. Implement projects to reduce mercury, methylmercury, pesticides, and areas of low dissolved oxygen in the Estuary	28. Advance nutrient management in the Estuary
Red-legged Frog				
California Tiger Salamander				
Ridgway's Rail				
California Black Rail				
California Least Tern				
Snowy Plover				
Delta Smelt				
Steelhead Trout				
Coho Salmon				
Chinook Salmon				
Green Sturgeon				
Salt Marsh Harvest Mouse				
California Sea-blite				
Suisun thistle				
Soft bird's-beak				

CCMP BENEFITS TO SPECIES OF CONCERN (CONTINUED)

	29. Engage the scientific community in efforts to improve baseline monitoring of ocean acidification and hypoxia	30. Reduce trash input into the Estuary	31. Foster support for resource protection and restoration by providing Estuary-oriented public access and recreational opportunities compatible with wildlife	32. Champion and implement the CCMP
Red-legged Frog				
California Tiger Salamander				
Ridgway's Rail				
California Black Rail				
California Least Tern				
Snowy Plover				
Delta Smelt				
Steelhead Trout				
Coho Salmon				
Chinook Salmon				
Green Sturgeon				
Salt Marsh Harvest Mouse				
California Sea-blite				
Suisun thistle				
Soft bird's-beak				

VI: Next Steps

NEXT STEPS

Looking ahead, the 2016 CCMP provides the only comprehensive plan addressing both San Francisco Bay and Delta concerns about estuary health and natural resource management to be developed to date. It provides ambitious, meaningful, goals for all its partners to achieve by 2050 and a prioritiized five-year action plan for advancing those goals in the immediate future. In 2021, partners will develop and negotiate priorities for the next five years, and incorporate them in the next version of the CCMP. The 2021 CCMP will include a comprehensive update of the 32 actions in its Implementation section that reflects accomplishments, builds on new science and planning, and moves the region closer yet to the goals for 2050.

As the tangible and collaborative outgrowth of more than 25 years of planning and partnership, the 2016 CCMP offers an inspiring call to continue, expand, and improve all our efforts to protect the San Francisco Estuary. As we face more challenges, ranging for the changing climate and rising sea level to reduced public spending on environmental protection, the CCMP offers a strategic path to progress.

In particular, the 2016 CCMP makes critical advances in several key areas, including focusing on a limited number of priority actions that strategically and collaboratively move the region towards our long term goals, building the flexibility and adaptability required by projected climate change, and providing a structure to track programmatic and environmental progress.

Several areas of the 2016 CCMP will provide important building blocks for the 2021 update. A few are highlighted below:

- Integration with the State of the Estuary Report. The 2015 State of the Estuary Report included 33 indicators of environmental health that were linked to a variety of 2016 CCMP actions, advancing an adaptive management cycle for the region. The 2016 CCMP also highlighted areas, however, where the connections between actions and environmental indicators aren't strong enough. These areas provide an opportunity during the next revision cycle of both the State of the Estuary Report and the CCMP to strengthen our ability to track environmental outcomes.
- Integration of Bay and Delta. The 2016 CCMP makes great strides towards a more comprehensive approach to managing the Estuary as a whole. The next update of the CCMP will build on these efforts to further advance coordination throughout the entire Estuary.
- Integration of Estuary Health with Community Health. The 2016 CCMP recognizes that the health of the Estuary and the health of our communities are interdependent. The 2016 CCMP provides a foundation for a more integrated perspective. In particular, due to socioeconomic factors, some human communities are more vulnerable to impacts of climate change than others. Using resiliency planning to address issues related to environmental justice and social equity is critical.
- Balancing and Adapting to a Changing Environment. By the time the 2021 CCMP update occurs, we may be facing yet more difficult trade offs between species at risk, communities at risk, and shrinking resources such as fresh water. Continuing to provide a forum and plan for conversations and strategic decisionmaking concerning these difficult choices will remain, as it has for the past 25 years, a priority among CCMP partners.

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PARTNERSHIP IN ACTION