

San Francisco Estuary Partnership

It takes longer but the results are better. After two decades of listening, learning, and debating, most stakeholders from the San Francisco Bay watershed agree that the best way to do business is to work together. We save more species, build more habitat, use less water, spend less money. Partnerships make the water go round.

CCMP
1993-2013
20th Anniversary Review



SCIENCE • RESTORATION • WATERSHED • POLITICS • SPECIES • BAY

ESTUARY



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**AQUATIC**

RESOURCES: Stem the decline of fish & biota, restore healthy natural populations and habitats, ensure recovery of listed species, manage fish and wildlife accordingly.

WETLANDS: Protect, manage and restore existing wetlands; enhance ecological productivity and habitat values; increase quantity as well as quality of wetlands.

WILDLIFE: Stem and reverse decline of estuarine plants and animals, ensure survival and recovery listed species, optimize management for wildlife.

WATER USE: Develop and implement water management measures to increase freshwater availability to the Estuary.

POLLUTION: Prevent pollution at the source, and if not possible, control or reduce pollution of estuary; clean up toxics, and protect against bioaccumulation; enhance stream and wetland functions to promote resiliency and reduce pollution.

LAND USE & WATERSHED MANAGEMENT: Establish land use and transportation practices that protect, restore, & enhance watershed processes & functions; coordinate multi-level planning, development & regulatory programs to improve watershed health; provide incentives for public & private sector involvement in watershed protection.

DREDGING & WATERWAY MODIFICATION: Eliminate unnecessary dredging, maximize beneficial reuse, develop a comprehensive sediment management strategy, manage waterway modification to offset adverse impacts.

RESEARCH & MONITORING: Establish and operate a San Francisco Estuary Institute for research and monitoring the estuary; develop a regional monitoring strategy & program.

PUBLIC EDUCATION & INVOLVEMENT: Promote public involvement, education and advocacy programs around the CCMP; promote direct citizen involvement in managing a healthy estuary.

Photo: Verne Nelson

O V E R V I E W

The CCMP: Long Story Short

It wasn't so long ago that the San Francisco Estuary Project was airing public service announcements that explained the nature of an estuary. The Project had its origins in the Clean Water Act, and its purview is one of America's 28 "estuaries of national significance." In 1987, the Project began assembling a series of ground-breaking status and trends reports on key environmental and management issues troubling San Francisco Bay and the Delta – linking them into one estuary for the first time. Building on this foundation, it developed a grand vision for improving the health of this estuary: the *Comprehensive Conservation and Management Plan* (CCMP).

"The first time we took a serious look at the estuary in a comprehensive way was the CCMP. All successive efforts have built on that foundation," says western water consultant Barry Nelson. Nelson was one of more than a hundred stakeholders from diverse interests, ranging from business and environmental groups to government agencies, invited to pull up a chair at the negotiating table. The resulting 300-page CCMP aimed to restore the ecological functions of an estuary that drains almost forty percent of the state, while at the same time sustaining its use by humans and wildlife.

Within the CCMP process, stakeholders winnowed their ideas down to 145 specific actions tackling pollution, dredging, land use, water use, wetlands, fish and wildlife issues, among others. "Before the CCMP, there was very little coordination among agencies working on water quality and those working on water quantity, for example. But that's essential in a complex system," says Nelson.

Fish biologist Bruce Herbold, formerly with the US EPA, agrees: "Taking the various pieces of the Estuary Project and making it into the CCMP was the start of the CALFED program, and CALFED was the start of everything else, of integrated management and science."

"The CCMP provided a structure for allowing people to do what they care about—a kind of church of the estu-

ary," says Will Travis, former director of the San Francisco Bay Conservation and Development Commission (BCDC).

This special issue of *ESTUARY News* magazine celebrates the CCMP's 20th anniversary. Like the black skimmer (*Rynchops niger*) that frequents San Francisco Bay, it barely breaks the surface of the myriad activities that have either grown out of the CCMP, or contributed to its implementation. A mere 24 pages cannot do justice to twenty years of progress, whether it was planting root balls of eelgrass in the mudflats or warning the public about the dangers of eating too much Bay-caught white croaker. Even just the snapshot review done by the Partnership for this special issue suggests that almost 600 projects, undertaken by diverse partners, have implemented the CCMP in some way or another in the last 20 years.

Among the greatest achievements of the CCMP has been the trust its framers placed in a strong foundation of good science. From the plan's very inception, they recognized that the CCMP needed an independent science entity, one that could rise above the fray of specific agency mandates and integrate the focus areas of the CCMP. "Some entity had to be established that could tell the truth about how effective CCMP implementation was at any given time," says Rainer Hoenicke, former director of the resulting entity, the San Francisco Estuary Institute. "I really think we became an honest broker among parties with different interests to inform management decisions—a true bridge organization." Today, the Institute is known for the relevance and credibility of its data, and the information it has provided to managers now goes far beyond its original scope – an across-the-board CCMP success story.

Perhaps the toughest job for CCMP partners over the past two decades has been continuing their collaborations. The new focus on landscape-scale restoration, which transcends many of the original CCMP program areas, requires building more bridges than ever across jurisdictions.

"In this region, we've recognized that working together cooperatively, we can actually get more done," says BCDC Deputy Director Steve Goldbeck. "But there is a lot of cost with being collaborative. You can't go to endless meetings with every stakeholder every time. We have to find ways that are expeditious but still collaborative."

Many of the more obvious results of the CCMP over the last two decades are described in the pages that follow: cleaner water, nearly 50,000 acres of wetlands in some stage of restoration, thousands of volunteers involved in hands-on stewardship, whole rivers returned to their floodplains. Much of the progress comes thanks to the investment of taxpayers in state water bonds.

Save the Bay recently estimated it would cost \$1.4 billion dollars to do all the habitat restoration and associated flood management now on the drawing boards. Yet doing this work will also save billions of dollars in the future. The upward creep of sea level, brought about by global warming, will alter the Estuary's shorelines and riverbanks forever.

"The implications for Silicon Valley are profound," says Barry Nelson. Projections suggest that storm surges, augmented by sea level rise, could soon flood dozens of corporate campuses in the South Bay, as well as Bay Area airports and freeways. Climate change also threatens California's water supply and pushes the boundaries of wildlife habitats. "In this context, it is very difficult to separate environmental issues from business issues today," says Nelson.

That is why many of the CCMP's first framers are now searching for new funds to tackle these problems. One potential new funding source could be tax revenue specifically set aside for wetland restoration, flood protection,

water quality improvements and public access. Indeed the fledgling, multi-agency San Francisco Bay Restoration Authority is championing a parcel tax measure in all nine Bay Area counties for the 2014 general election (not more than \$10 per parcel).

The proceeds, \$150 million over ten years, would help the region finish wetland restoration projects and protect the region from climate change impacts, among other things. "There are a lot of properties already in public ownership, ready to go," says Contra Costa County Supervisor John Gioia, who serves on the Authority.

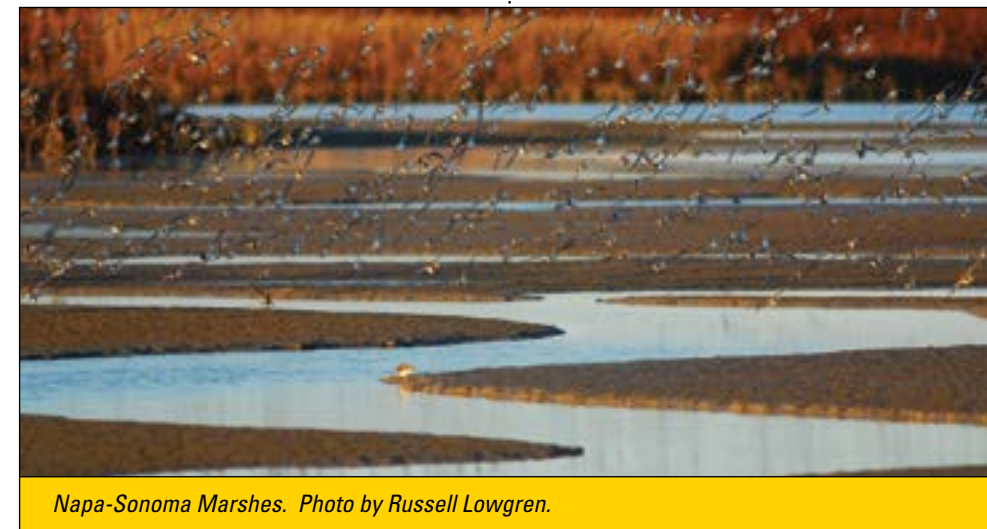
"We need a mix of federal, state and local dollars, and the restoration authority would be a fantastic way to apply local and regional funds to this mix," says Amy Hutzler of the California State Coastal Conservancy.

Gioia says the proposed tax measure has polled well: "Bay Area residents realize an investment of that amount in the health of the Bay is worth it."

What's also been worth it has been the journey to where we are today. "The greatest strength of the San Francisco Estuary Partnership over the years has been the dedicated, long-term commitment of its partners in setting the goals of the CCMP and seeing them acted upon," says director Judy Kelly. "Even though every action was not necessarily done under the banner of the CCMP, it's the spirit of the CCMP that everyone has kept in mind. It's one of the reasons we changed the word Project to Partnership in our name." **ARO**

GOT FEEDBACK? Want to see more detail on CCMP related accomplishments?

GO TO www.sfestuary.org



Napa-Sonoma Marshes. Photo by Russell Lowgren.

GETTING PEOPLE ON THE BANDWAGON

From the outset, few functions have been as important for the San Francisco Estuary Partnership as public education. Its outreach function laid the groundwork for the CCMP, with what would now be called focus groups—targeted workshops for businesses, environmentalists, and other stakeholders.

Since then, the Partnership has hosted biennial and annual science conferences with an Estuary focus, published an award-winning



magazine, and spearheaded campaigns to reduce pollution by recreational boaters, fight aquatic invasions, and keep urban watersheds clean.

"The State of the Estuary Conference is one of our great legacies," says former project director Marcia Brockbank. She and consultant Joan Patton organized the first, held at the Berkeley Marriott in 1991, which featured speakers on all the CCMP program areas and a dinner cruise. "We knew lots of people involved with restoring and protecting the Estuary. We tried to focus on the science—who was doing what, what the outcome was—and translate it into something understandable to the public. There were 200 people at that first conference, then 400, then many more," she recalls.

The event kept outgrowing its venues. Conferences were hosted by the Presidio, the Palace of Fine Arts, the California Academy of Sciences, finally settling in at the Oakland Marriott. The Partnership later was contracted by the state to manage what began as the Bay-Delta Science Conference, in annual alternation with the State of the Estuary Conference. "The conference is something no one else does," says Barbara Salzman of Marin Audubon. "It brings a lot of people together and conveys up-to-date information to the broad public: agencies, scientists, citizens."

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Photo: Jacob Katz

Fish Down, Invasions Up, Flooding Soon

Whether you're a fat salmon or a skinny smelt, life in the watershed of the San Francisco Estuary remains far from "natural." Dams and levees block Estuary fish from swimming freely in rivers and creeks and through marshlands and floodplains. Alien clams compete for fish food. Invasive weeds clog habitats. And exotic predators threaten life and fin. Hatcheries crank out thousands of coddled, cookie-cutter Chinook salmon every year, and the best fishery in the Delta is no longer salmon and sturgeon but largemouth bass that hail from the Mississippi basin. A few native species, like Sacramento splittail, are "holding their own" according to scientists, but others, like Delta smelt, have declined to such a degree that there are too few to count.

Clearly, we have failed to "stem the decline" and "ensure the recovery" of native fish as we set out to do twenty years ago in the CCMP. But over the last two decades, we've certainly tried. We've built more habitat, released more water from the reservoirs, made more fish food by restoring floodplains and wetlands. We've battled in court, in the legislature, and in hearings and meetings on this coast and in the nation's capital. In fact, for two solid decades

we've been steadily trying to find a way to bolster the ecosystem without impacts to water available for human uses, and to reroute fish away from the deadly pumps in the South Delta. In all that time, progress has rarely been clear-cut, and the water politics remain heady. But to those in the know, there has been a big change in how we manage the system's aquatic resources.

"When the fish numbers look bad, we no longer point fingers," says biologist Bruce Herbold, an insider on interagency fish issues in the California water wars for thirty years. "Everyone knows now that with different years and different conditions, it's not anybody's particular fault all the time. There's much more communication and shared planning. It's the way we expect to do business now, and the CCMP was where this all started."

Back in the early 1990s, most fish-friendly interests blamed only one thing for species declines: the state and federal water projects. All the focus was on the pumps, and their dysfunctional screens and fish salvage operations, says Herbold. "At the time, we knew very little about contaminants, poaching, food supplies, *Microcystis*, and all the other

interacting, complicated, multifarious factors affecting fish."

In those days, people still counted on ever-expanding water exports from the Delta. "The expectation of San Joaquin Valley farmers was that they could go ahead and plant orchards because there would be a reliable and increasing source of water by way of the pumps," says UC Davis' Peter Moyle, the watershed's most well-known fish scientist. Then came the listing of Delta smelt in 1993. "Endangered species created a reliability issue—the farmers never know, these days, when the pumps are going to be turned off to protect smelt."

Though they can't promise farmers a consistent water supply, especially not with a number of pelagic fish species seemingly in a downward spiral, much has been done to reduce some of the impacts of the projects on sensitive species, says Herbold. The projects are doing more than just installing better screens and following less harmful salvage procedures; they are now managing flows, when they can afford to, to mimic natural conditions.

"In the 1990s, the agencies tended to think more water was needed all



Chinook, also known as king salmon for their large size, spawn in streams up and down California's Great Valley. Two Chinook runs using the San Francisco Estuary are listed under the Endangered Species Act: the threatened Central Valley Spring-run and the endangered Sacramento River Winter-run. Removal and planned dismantling of the Red Bluff Diversion Dam will return many miles of spawning riffles to the Sacramento River Winter-run. Yet the small geographic range of the Central Valley Spring-run streams, the presence of dozens of hydropower and diversion dams, and genetic dilution by hatchery fish is likely to keep this population at risk for the foreseeable future. Photo by Jacob Katz.

the time, there wasn't much thought about subtleties of how and where and when you put the water in," says Moyle. Now, both dam and project operators have been enlisted in providing more or cooler water at certain times of year, with an eye to helping vulnerable young fish or those spawning, growing or migrating. "You can do a lot of things for fish below dams with a fraction of the water we used to think we needed," says Moyle.

A PARADIGM SHIFT

Just how much water fish should get has always been contentious. Indeed, when the CCMP was still a startup, the feds, who were leading the effort, agreed not to focus directly on flows and water rights but instead on demand-side management in their policy discussions. But not everyone was happy about tackling so many important estuarine management topics in the CCMP while not addressing flows. Environmentalists continued to press for more flows as they sat at the CCMP negotiating table and in other forums. Eventually, the solid science that CCMP partners invested in opened a window.

"Twenty years ago, we were still managing the estuary based on the health of an introduced species—striped bass," says Barry Nelson, a veteran environmental advocate who sat at those first negotiating tables when he ran Save The Bay, and who now consults on western water issues. "The CCMP came up with a new paradigm for protecting the Delta, which has become the cornerstone of state oversight of the system, and which recognizes the simplest thing in the world: estuaries need water."

That new paradigm centers on a concept known as "X2." At that time, research had begun to show that if the saltiness of the water in and around Suisun Bay was two parts per thousand (ppt) in spring, the food web was healthier and fish had more to eat. Where that 2 ppt isohaline occurs in the estuary varies with how much fresh water is flowing out, and how strong the tides.

Applying that science into management, the San Francisco Estuary Partnership organized, hosted and mediated a series of high-level technical workshops at which leading scientists eventually agreed upon an estuarine habitat standard, based on the 2 ppt isohaline. The X2 standard, memorialized in the 1994 Bay-Delta Accord and subsequent state water board actions, requires the water projects to release enough fresh water in spring to keep X2 in the most optimal Delta location.

It was more than a decade before another critical milestone in the flow debate occurred, this too fueled by good science. In 2010, the State Water Board reviewed the best-available research and concluded that, at certain times of year, the estuarine ecosystem and its fish need 75 percent of the Delta's flow to be unimpaired in order for the habitat to be healthy. That's a far cry from the 25 percent the fish and the waterway have gotten since the 1970s. While the full 75 percent would be nearly impossible to achieve while supporting all other beneficial uses, such leaps in applied science, embraced at the state level, helped legitimize fish needs for water.

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Like other anadromous fishes in the arid West, the green sturgeon was undone by dams blocking access to its freshwater spawning grounds. The population native to the Sacramento River watershed was first declared federally threatened in 1996. To save this armored throwback to the age of the dinosaurs, the National Marine Fisheries Service closed the recreational fishery in 2010. Meanwhile, lawsuits opened the gates of the Red Bluff Diversion Dam for good in 2011, giving fish year-round access to the most unspoiled reaches of the Sacramento River for the first time since dam construction in 1964. Photo courtesy Brian Schreier, DWR.

LOG
1993-
2013

LISTING & RECOVERY PLANNING

Recovery Plan for Sacramento-San Joaquin Delta Fishes, 1996, NMFS

Delta smelt listing, 1993, NMFS

Four runs Chinook salmon listed, 1995-2005, NMFS

Green sturgeon listed 2006, NMFS

Delta Native Fishes Recovery Plan, Draft 2013, NMFS

INVASIVE SPECIES

West Coast Ballast Water Outreach Project, 1999+

Ballast Water Management Acts (AB 703 & 433), 1999 & 2003

CalFed Non-Native Species Strategic Plan, 1999

Cal Senate Bill 497, 2006

Cal State Lands Commission Ballast Water Regulations, 2006

California Aquatic Invasive Species Management Plan, DFG, 2007

Risk Assessments various vectors, CalOPC

Quagga-Zebra Mussel Action Plan for Western US Waters, 2009

State Lands Commission Review Onshore & Onboard Treatment Technologies, 2010

BAY-DELTA COLLABORATIONS

Bay-Delta Accord, 1994

X2 Salinity Standard, 1993-present

Central Valley Project Improvement Act, 1992

CALFED, 1994

Environmental Water Account, 2000-2006

Delta Stewardship Council, 2009-present

Delta Vision, 2006-08

Fish Restoration Program Agreement, CDFW & DWR, 2010

Bay Delta Conservation Plan & EIS/EIR, 2012 & 2013

KEY DOCUMENTS, ARTICLES & BOOKS

Sierra to the Sea, State of San Francisco Bay, and Ecological Scorecards, The Bay Institute, 1998-2011

Baylands Ecosystem Habitat Goals, 1999 & 2014

State of the Estuary Reports, SFEP, 1992, 1997, 2002-2008

State of San Francisco Bay, SFEP, 2011

Subtidal Habitat Goals, 2012

Historical Ecologies of the Delta, Alameda Creek & Napa River, SFEI, 2010-2013

Comparing Futures for the Sacramento-San Joaquin Delta, Lund et al, 2010

Natural History of San Francisco Bay, Okamoto & Wong, 2011

PUBLIC INVOLVEMENT CONTINUED FROM PAGE 3

Estuary News was another early initiative in public engagement. "We had an in-house newsletter and wanted to make it something bigger," says Brockbank. There was also a lecture series, co-sponsored with Save the Bay and the Sierra Club; workshops geared to specific community groups; a school program, funded by compensation for the 1988 Shell oil spill. Working with the Lindsay Museum, Patton launched the Paint the Drain campaign, in which scout troops and other volunteers stenciled "No Dumping! Drains to Bay" on city stormdrains. Local governments later made that part of their public works agenda. The Brake Pad Partnership was another success.

Two major programs involved targeted outreach. The Boater Education Project teamed with the California Department of Boating and Waterways to reduce pollution from small recreational craft. Partnership staffers gave talks to boaters, networked with marina operators, and developed leaflets and fact sheets. The program eventually expanded to Southern California. The Ballast Water Project, aimed at operators of commercial vessels, produced brochures posters warning of the risks of dumping untreated ballast water containing invasive aquatic organisms into the Bay. An updated "Threats to the West" brochure has been distributed throughout 19 western states.

Many other CCMP partners carried out their own successful public education campaigns: the Bay fish consumption warnings championed by Save the Bay and state health agencies; the coverage of ongoing water supply issues by the Water Education Foundation; the opportunities for hands-on restoration provided by STRAW, many friends-of-creeks groups and Save the Bay; the multi-partner effort to produce the movie "Saving the Bay" directed by Ron Blautman, among others. These days the region has one of the most informed and motivated publics of any estuary on any coast. No one stumbles over how to pronounce "estuary" in this neck of the woods anymore. **JE**

PROJECTS IMPLEMENTING PUBLIC INVOLVEMENT & EDUCATION GOALS 1993-2013: 107

Over time, more and more agencies tasked with protecting fish and wildlife, and the beneficial uses of estuarine waters, have embraced CCMP goals of doing careful ecosystem science, applying it to management, and then monitoring the results. Over the last twenty years, the Interagency Ecological Program, CALFED, the San Francisco Estuary Institute and others have all in some part fulfilled these goals. "We now have incredible amounts of information," says Moyle. "We know better how to manage endangered fish, and how to bring them back, but it may take such massive changes in how we manage water that no one will want to do it."

The leaps in understanding are both foundational and cutting edge. It's only recently, for example, that USGS scientists finally convinced water managers that tides can have just as big of an influence on fish habitat as freshwater flows. Both the fresh and salty sides of the equation are important for fish.

More dazzling, perhaps, is the latest science on fish genetics and behavior. "We've got the whole darn genome for Delta smelt mapped out," says Herbold. "We can tell which parts of the genome react to which stressors, and we can examine their otolith (ear bone) and see what day of their life they entered salt water. We can track individual salmon of a pretty small size as they move through the Delta, and see where each one ends up, and how many make it out to sea. We've even learned what happens to fish run through salvage operations. This is all stuff I never imagined we could do."

Downstream, meanwhile, the Partnership recently started reminding everyone that the Bay, not just the



Living Shorelines projects like these human-crafted oyster reefs off the San Rafael shoreline restore intertidal and subtidal habitats, and buffer adjacent shorelines. Here, researchers are already seeing high densities of native oysters, crab, shrimp, birds, and many other species using the reefs — as well as reduced wave action. Photo courtesy Coastal Conservancy.

Delta, needs freshwater too. In 2012, the Partnership took Bay Area city and county supervisors on a boat ride to show them why, netting fish from the depths and sharing recent science lessons about the ecosystem at the heart of their municipalities. After that, ABAG took a stronger interest in flows, eventually passing a resolution in 2012 calling for improved flows for the entire Estuary.

"It's important for the Bay Area to speak with one strong voice, and weigh in on how the Bay should be protected in any proposed statewide water plan," says ABAG Executive Board member and Contra Costa County Supervisor John Gioia.

RESTORING HABITATS

Beyond science, there have been many other notable accomplishments on the ground and in the water since the CCMP was published. Most visibly, the upper San Joaquin River is wet for the first time in decades (apart from during big storms). Years of court battles finally gave way to water releases, a restoration plan, and the reintroduction of salmon.

Elsewhere in the system, large-scale restorations along the Tuolumne, Sacramento, Napa and Cosumnes Rivers, among others, have restored flood plains, nursery grounds and fish food supplies. Engineers have also rebuilt gravel beds, and planted shade trees along river banks to cool the water—things fish need to flourish. In the 1990s, water managers removed barriers from Battle, Clear and Butte Creeks so the salmon could move more easily upstream, and in the 2010s more barriers are coming down along the Napa River and Alameda Creek on the edges of San Francisco Bay.



The future was looking so rosy for Delta smelt in the mid-1990s that its delisting was considered a possibility as early as 1999. But by 2005, its populations had plummeted to the point where odds for its effective extinction within 20 years were calculated at 50-50. This once-abundant fish is still considered threatened, its continued survival jeopardized by pump entrainment, water diversion effects on salinity and clarity, and the effects of introduced species.

Major restorations are also planned for the Cache Slough area of the North Delta, and many agreements have been negotiated to release more flows for fish below dams. On the lands along many rivers, meanwhile, farmers are turning to more "fish-friendly" agricultural practices.

CCMP partners carrying torches for such endeavors are too numerous to name. Upstream in the Delta, much of the restoration work evolved out of early Central Valley anadromous fish restoration and recovery plans and the 1992 Central Valley Water Project Improvement Act, then grew through the CALFED Bay-Delta Program. Most recently, they are reflected in the Bay Delta Conservation Plan's habitat conservation program, and the EIR for the plan, scheduled for public review in November. These efforts seek to balance ecosystem health with water supply reliability, the dual goals of recent state legislation. Around San Francisco Bay, the restoration of vast tracts of wetlands, championed by other CCMP partners, has also improved the lot of the Estuary's native fishes. Scientists monitoring levee breaches in both North and South Bay salt ponds are finding fish swim quickly into new habitats.

PREVENTING INVASIONS

Despite the groundswell of habitat enhancements, few ecosystems can be said to be healthy if they are invaded by hundreds of exotic species. Whether it's an Asian overbite clam gobbling up the plankton or a mitten crab burrowing into levees and clogging pump screens, invaders make

estuarine management substantially harder. The CCMP called explicitly for new regulations and controls on this front, with good results.

For one, ships can no longer discharge ballast water taken on in foreign harbors in San Francisco Bay or within 200 miles of the coast. The state has steadily tightened regulations promoting better ballast water management over the last two decades, shifting from voluntary to mandatory compliance, and from covering just ocean-crossing ships to embracing coastal traffic as well. Inspectors now board 26 percent of ships visiting California ports, and review ship's logs and ballast water reports to make sure ballast water has been exchanged in the ocean, rather than in West Coast harbors. More recently, the state has spearheaded research into shipboard treatment systems to kill organisms in ballast before discharge, and is considering new regulations targeting the various organisms that cling to, or foul, vessel hulls.

While the crackdown on new invasions is promising, little can be done about the alien species already turning various parts of the estuarine ecosystem upside down. Using herbicides and mechanical removal methods, however, the state continues to clear Delta waterways of water hyacinth, egeria, and other aquatic weeds, and has also invested in clearing San Francisco Bay wetlands of Atlantic cordgrass. To be effective, such programs often require a level of vigilance and follow-up difficult to sustain amid government budget cuts and impacts on endangered species. But dealing with such challenges and tradeoffs remains the norm for managers of the nation's most altered and invaded estuary.

The newest menace on the invasion horizon are quagga and zebra mussels, whose appearance in California in 2007 and 2008 sparked more border inspections of trailered boats and a new state plan to counter the spread of these mollusks before they can take hold. These mussels clog water pipes and could be the last straw for native fish already fighting for scarce food.

The Partnership has consistently had staff working on the frontlines against invasions — from the first educational outreach programs on the West Coast to tackling the Chinese mitten crab problem to chairing committees, preparing California action plans, and serving on the nation's Aquatic Nuisance Species Task Force.

"We've pushed hard for prevention and early detection programs. We've helped keep the issue on everyone's radar, year after year, so we can be proactive instead of reactive," says the Partnership's Karen McDowell.

The invasions continue, however, a sign that despite all our efforts, the estuarine ecosystem is losing its natural resiliency. Without this resiliency, it's no surprise that fish managers continue to struggle with challenges such as the precipitous decline of several pelagic fish species. Multiple, interactive stressors seem to be gaining on native fish, and climate change could shove them over the brink. Invading species often move into new niches opened up by floods and rising seas with better success than the locals.

Dealing with such complexities, more flooding and associated changes in California's water supply is once again placing the spotlight on San Francisco Bay and the Delta. What were once freshwater habitats for fish could soon become salty, and what were once sunken islands could become new bays. Fortunately, the 20 years of science, management and monitoring have given us great insights into what can and cannot be done to make the Estuary as resilient as possible. Several recent publications bring together these insights in a new way — the new historical ecology of the Delta produced by the San Francisco Estuary Institute, and books exploring and comparing scenarios for delta water management and ecosystem preservation in the future (see Log). Both are accomplishments because they synthesize much that has been learned about the past, and establish parameters for future stewardship.

Herbold is both hopeful for the fish, and impatient with slow pace of reaction to new constraints on the Delta's future. "Fifty years out, we may not be able to take water from the South Delta because either all the levees will have collapsed, or the quagga mussel will have arrived. Instead of having a premise for planning that everything is going to stay the same, the premise needs to be that it won't," says Herbold. **ARO**

PROJECTS IMPLEMENTING AQUATIC RESOURCES GOALS 1993-2013: 129

A Giant Step from Species to Landscapes

Not so long ago, San Francisco Bay was a cornucopia of wildlife. Ducks and geese covered the water and filled the skies. Sea otters cavorted in the Bay. On the shorelines, grizzly bears and California condors scavenged the carcasses of beached marine mammals. Nineteenth-century market hunters supplied the finest restaurants of San Francisco with California clapper rails and red-legged frogs.

By the time the CCMP's framers sat down to consider the state of the Estuary's wetlands and wildlife, 90 percent of the Bay's tidal marshland was gone, and other habitat types critical to wildlife—seasonal wetlands, riparian forest, grassland—had been greatly reduced. Soon afterward, the clapper rail population hit an all-time low of 300 to 500 individuals. Some 60 other wetland animal species were listed as endangered or threatened, or flagged for monitoring between 1975 and 2006.

Before the CCMP, little was done in a consistent manner to protect and restore wetlands. Save the Bay had led a successful campaign to prevent wetland and bay fill, but back then locals were still more likely to consider their baylands malodorous swamps than rich ecosystems. Developers still regularly perched office parks and subdivisions on shores, and cities and counties viewed such schemes as "improvements." Tentative steps had been taken, however, to save a handful of sites with presentable wetlands and conspicuous birdlife, and to restore others. The San Francisco Bay National Wildlife Refuge, subsequently renamed for US Representative Don Edwards, had been established in 1974, although it was still a work in progress. A few small tidal marsh sites had been restored, but habitat protection and restoration was ad hoc, piecemeal, and reactive, often initiated as mitigation for habitat lost elsewhere. There was no overall restoration strategy or philosophy.

"When I started, wetlands were perceived as wastelands—places you could develop," Arthur Feinstein of Citizens Committee to Complete the Refuge recalls. "Over the last few decades we've made an incredible cultural shift. The idea of filling wetlands now is almost like smoking in public." Carl Wilcox of the California Department of

Fish and Wildlife, one of a few living Bay Area residents with his own eponymous marsh, concurs: "When I came to the Bay in 1986, people were still fighting over whether or not we were going to develop rather than restore the wetlands. People need to keep that in mind. A huge amount has been achieved."

Much of that achievement traces back to the CCMP, where business, environmentalists, wildlife managers, landowners, and regulators all sat down to create a new vision for the future and hammer out their differences. They set goals of stemming and reversing the decline of the Estuary's plants and animals, including endangered or special status species. That went hand in hand with restoring the ecological productivity of wetland habitats and rebuilding the Estuary's wetlands portfolio, both in quantity and quality.

THE 100,000-ACRE GOAL

The years after 1993, when the CCMP was finally approved, saw the pace and scale of wetland restoration transformed, and stepped-up attention to the plight of wildlife.

Crucial steps in this process included agreement on the *Baylands Ecosystem Habitat Goals Report* (1999), the first scientific consensus on restoration targets

(100,000 acres of tidal wetlands, among others); new recovery plans from the US Fish & Wildlife Service for endangered species and habitats; the formation of the San Francisco Bay Joint Venture, bringing together government agencies, nonprofits, and business on behalf of wetlands, and the adoption of its 2001 implementation plan; more oversight of restoration and mitigation by regulatory agencies, notably the San Francisco Bay Conservation and Development Commission and the San Francisco Bay Regional Water Quality Control Board; and funding and land-acquisition leadership from the California State Coastal Conservancy. With those pieces in place, the arena changed from pocket marshes to vast, complex bayscapes crafted out of former salt production ponds. The result: a sea change in the quantity and quality of the Bay's wetlands.

As of today, sixty-eight percent of the Joint Venture's baylands acquisition goals have been met. "South of the Bay Bridge you have almost all publicly-owned shorelines from Oakland to Milpitas, most of it undergoing restoration," says Feinstein. "The extent of it is staggering." In total, the US Fish and Wildlife Service and the California Department of Fish and Wildlife acquired 16,500 acres of bayland from the Cargill Salt Com-

pany, and the massively ambitious South Bay Salt Ponds Restoration Project was launched in 2003 in partnership with the Coastal Conservancy, the Santa Clara Valley Water District, and other agencies. So far, over 3,000 acres have been restored or enhanced, and miles of trails have been opened.

Second only to the South Bay salt ponds effort in scope, another 10,000 acres of Cargill property in Napa and Sonoma Counties was purchased by the state in the early 90s. With the help of the California Fish and Wildlife Department, the Coastal Conservancy, the U.S. Army Corps of Engineers, and the Sonoma County Water Agency, half of those acres have been restored to tidal wetland and another 1,700 acres enhanced for shorebirds and waterfowl with help from Ducks Unlimited.

Elsewhere around the Bay, in Contra Costa County, the East Bay Regional Park District exercised the right of eminent domain to block a development and allow future restoration of Breuner Marsh. Other restoration projects ring the Bay: Bair Island, Hamilton Field, Bel Marin Keys, Bahia, Cullinan Ranch. At Hamilton (a joint Coastal Conservancy/Corps of Engineers project) and other sites, dredged sediment—once considered a waste product but now viewed as a valuable resource—is being used to recreate the marsh plain. Suisun Marsh, the Estuary's eastern anchor, continues to sustain duck clubs and 'managed wetlands' but has a target of restoring up to 7,000 acres of tidal marsh sometime in the future.

"We've made great strides forward on the wetland restoration front—a lot of land that we need to restore is now in public ownership, or already in some stage of restoration," says the State Coastal Conservancy's Amy Hutzler. She notes that the public has invested almost \$400 million in state bond dollars for San Francisco baylands projects over the past 15 years, and almost \$150 million in federal funds over past seven years. "We have the potential now to double the amount of tidal marsh habitat in the Bay in just the next few decades."

At the time the CCMP was written, however, few imagined the grand-scale transformations described above. The CCMP instead focused on completion of the Don Edwards Refuge, a challenging task that has yet to be accomplished. Despite the original vision for refuge extent, privately owned bayside properties in the City of San Mateo are currently unavailable. Cargill's Saltworks Project in Redwood City is still in contention,

and the Mowry Slough area in Newark, formerly managed by duck clubs, has been proposed for development. In the North Bay, several large parcels in Marin County are still in private hands, and the San Pablo Bay wetlands are a mosaic of public and private ownership.

Even with those gaps, what has been achieved is extraordinary. "Twenty years ago there was a raging legal and regulatory battle between developers and environmentalists over protection of wetlands around the whole Bay," recalls water consultant Barry Nelson. "The development pressure that was once rampant on every shore seems to now be focused on one last crystallizer pond in Redwood City."

TOOLS FOR TWEAKING THE HABITAT MIX

The CCMP called for solid science and strong planning tools to guide wildlife recovery and habitat restoration, and that approach has clearly paid off. For one, the regional consensus around the 1999 *Baylands Ecosystem Habitat Goals* gave restoration a coherent framework. Wilcox says the report helped resolve differences among state and federal agencies about strategy and priorities: "Fish and Game and Fish and Wildlife started working on how restoration could balance seasonal wetlands for waterfowl and shorebirds with tidal marsh restoration for species recovery. That's led to the adaptive management approach we're using with the South Bay Salt Ponds: conducting the restoration and tracking what the effects are on shorebirds and waterfowl, while intensifying management."

All wetlands are not created equal in the eyes of a migratory shorebird or a diving duck. There's growing recognition that restored wetlands should be a complex of habitats for species with different needs, not just unbroken marsh. The fate of non-tidal habitats, notably seasonal wetlands and riparian zones, is still unsettled, and wasn't addressed in the Baylands Goals or called out for particular attention in the CCMP, says Feinstein.

According to Barbara Salzman, seasonal wetlands can be difficult to restore and manage: her organization, Marin Audubon, tried to create unvegetated seasonal habitat for shorebirds at Bahia, but the plants grew right back. "Managing seasonal wetlands is an expensive undertaking, requiring a lot of maintenance," adds Wilcox.

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RECOVERY PLANNING

Recovery plan for five tidal marsh species, draft 2010

Western snowy plover, 2007

Vernal pool ecosystems, 2006

Presidio Manzanita, 2003

East Bay chaparral/scrub communities, 2003

California red-legged frog, 2002

Serpentine soil plants and butterflies, 1998

California freshwater shrimp, 1998

Peregrine falcon and brown pelican delisted

COLLABORATIONS

San Francisco Bay Joint Venture

Suisun Marsh Charter Group

Suisun Marsh Restoration and Management Plan

SediMatch



Peeps & scaups. Photo by Verne Nelson.

HABITAT CHANGES & RESEARCH

Baylands Ecosystem Habitat Goals Report, 1999

Baylands Ecosystem Species & Community Profiles, 2000

Historical Ecology publications, SFEI (Delta, Napa River, Alameda Creek)

Invasive Spartina Project, CCC

National Estuarine Research Reserve sentinel sites and related research

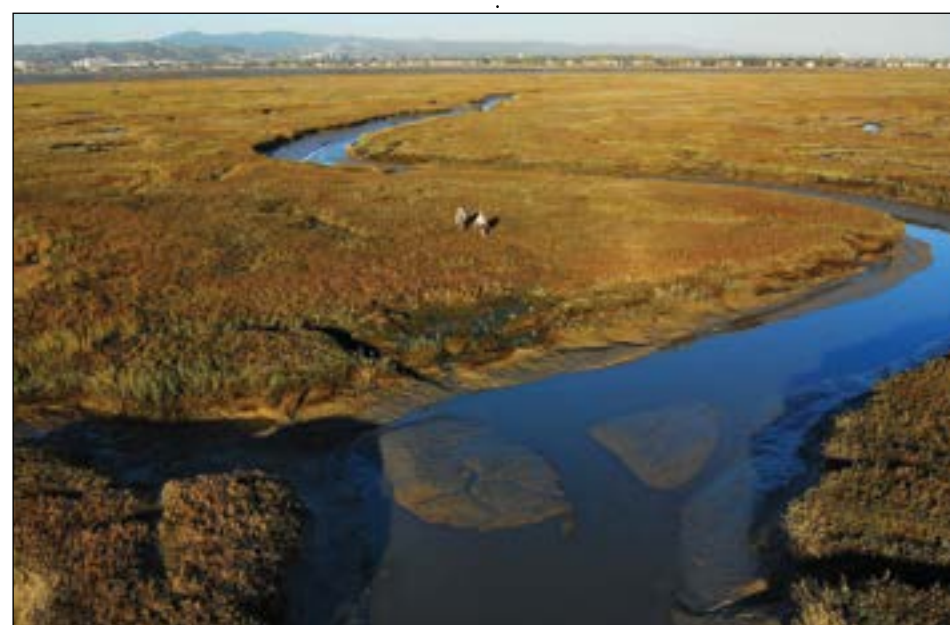
South Bay Salt Ponds Science Program

EcoAtlas

Wetland Tracker

Joint Venture Project Tracking

Bird studies (PRBO/Point Blue, USGS, San Francisco Bay Bird Observatory)



In recognition of the great national treasure that are San Francisco Bay's wetlands, the region was designated a Ramsar site in 2013. Named for an Iranian city, the designation adds San Francisco Bay to a list of 2000 "Wetlands of International Importance" in 164 nations. Photo by Russell Lowgren.

This is one of many areas where GIS and other mapping technologies have helped inform decision-making. According to the Joint Venture's Beth Huning, mapping of seasonal wetlands is complete and the venture is now working on prioritizing those areas of great habitat value or potential restoration value. She notes that the East Bay Regional Park District has been focusing on one special type, the seasonal alkali wetlands near Byron in Eastern Contra Costa County. The State Water Resources Control Board has also moved toward developing a protective policy for freshwater wetlands.

Protecting riparian wetlands has its own hurdles. "A lot of riparian habitat crosses private land and has multiple jurisdictions," Huning says. It's not like the Baylands, where a few public and



Among the more conspicuous mammals living in the Bay, harbor seals appear stable, California sea lion populations are rebounding, harbor porpoises have returned to the Bay after a decades-long absence, and river otters and beavers are making a comeback. Photo by Russell Lowgren.

private entities manage large parcels. "Riparian restoration is happening more on a project-by-project, small-reach-by-small-reach basis, run by small dedicated citizens' groups," says Huning. The Napa River project is the great exception.

Some upstream waterways have also seen remarkable progress. Multi-partner projects have enhanced habitat for riparian songbirds along the undammed Cosumnes River and for the endangered riparian brush rabbit on the San Joaquin. And more recently, computer modeling and field biology have combined to improve maps of wildlife corridors, in hopes of better connecting bayshore and upland habitats.

Beyond tools focused on the restoration of habitats on the ground, planners and resource managers tasked with protecting sensitive species also need legal and policy tools to guide management.

In this realm of accomplishments, the federal recovery plan for five tidal marsh species including the rail (plus the salt marsh harvest mouse and three plant species), which has been in its current draft form since 2010, should be finalized later this year, according to Josh Hull of the U.S. Fish and Wildlife Service. A plan is also in place for the western snowy plover.

Such tools, coupled with good monitoring, can sometimes lead to happy outcomes for wildlife managers. Iconic species like the brown pelican and peregrine falcon have been deemed sufficiently recovered to be removed from federal endangered species lists.

In other good news, surveys indicate stable or increasing populations for several Baylands avian species. The 2011 State of the Birds report from PRBO and the Joint Venture reported upticks in numbers of snowy plovers and several other shorebirds and riparian species.

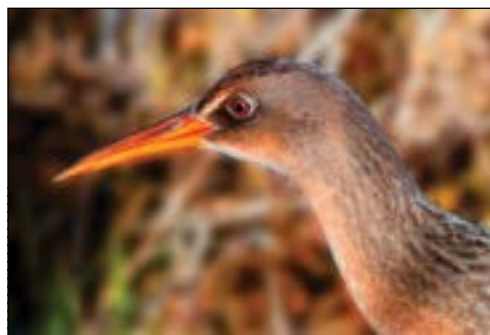
THE HARD PART

Two things no one anticipated have those pushing for completion of the grand scheme to restore 100,000 acres around the Bay reassessing their priorities: a rapidly rising sea level, and a rapidly diminishing bank account.

For the last two decades, buoyed by generous state bond funding and continued EPA support, there was always hope that federal funding would increase in line with the groundswell of restoration work. That didn't happen.

The Bay never received a line item budget like that awarded to Chesapeake Bay, Puget Sound, and the Great Lakes. "We were able to get quite a bit through the federal stimulus package in 2009, but that's mostly gone," says Huning. She credits Senator Dianne Feinstein for assisting with annual EPA appropriations of \$5 to 7 million per year for a competitive grant program that is shared among restoration, water quality and other priority projects. A state water bond measure is on the horizon for 2014, but may include nothing specific to the restoration of the Bay. "We're not able to do everything our partners have identified," she adds. "We have to pick and choose, focus on some projects over others."

Wilcox points out that acquisition is only a first step: "We've had the funding to acquire lands but not to staff and maintain the agencies that manage them. In San Francisco Bay, my department manages upwards of 50,000 acres.



After a dip a few years ago, California clapper numbers appear stable. Point Blue Conservation Science (formerly PRBO) reported this year that this endangered Bay-endemic bird responds to tidal marsh restoration with dramatic increases in population density, although it may take a while for the rails to move in. Photo by Verne Nelson.

The resources we have to manage that are no different than when we had only 15,000 acres."

Funding shortfalls also constrain monitoring. The FWS was only able to perform its annual midwinter waterfowl survey last year with financial help from the Joint Venture and other partners. The status of this year's survey is uncertain. "There's hardly any money around for specific programs," says Salzman. Working collaboratively, various entities are trying to pick up the slack on wildlife and habitat monitoring.

While still feeling the pinch from the lack of money to complete projects, the region's wetland and wildlife initiatives now face another game-changer: sea level rise.

In this new light, wetlands built to provide healthier habitats for wildlife now provide invaluable buffers for human developments. Rising seas, and storm surges like the one experienced by those in the path of hurricane Sandy, are better absorbed by soft, spongy wetlands than concrete levees. "We can't afford to put a wall around the Bay," Feinstein says.

We can't afford not to step up our restoration plans either. Recent US Geological Survey computer models predict large-scale conversion of tidal marsh to mudflat by the end of this century. While these forecasts have alarmed marsh managers, they also suggest there's still about fifty years of wiggle room before sea level rise rates accelerate and outpace marsh buildup.

Though none of this loomed very large on the radar when the CCMP was being written in 1993, it's front and center now.

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Keep it Out, Clean it Up & Get Ready for Surprises

While it's hard to believe today, the San Francisco Estuary was one big dumping ground for cities and industry just decades ago. "The Bay was at its most contaminated from the 1950s to the early '80s," says Sam Luoma, a UC Davis ecologist who has spent half his life studying the Bay. "There was an oil spill a day and a fish kill a week." Fish regularly went belly-up due to lack of oxygen, which in turn was caused by sewage-fed algal blooms. Adds Luoma, "Since then, we've fixed the most egregious problems, and the CCMP was part of all of us getting together to talk about it and to figure out the fixes."

At the CCMP's outset 20 years ago, the worst concerns included heavy metals and legacy contaminants such as mercury and polychlorinated biphenyls (PCBs). A big part of addressing these and other problems was the Regional Monitoring Program (RMP), which for the first time gave us a comprehensive look at the health of the Bay (see insert). At least on the downstream end of the Estuary, the RMP shows where contaminants come from and how to reduce them, advancing CCMP goals of controlling pollution at the source, remediating pollution that can't yet be controlled or is already in the water, protecting wildlife and people, and restoring wetlands. Solid information based on independent science helped industry and municipal

water treatment systems clean up their acts.

But monitoring also revealed that a huge amount of water pollution came from runoff from urban areas during storms — a source that was not regulated when the CCMP began and required a whole new approach. "Urban runoff doesn't lend itself to end-of-the-pipe treatment," says Tom Mumley of the San Francisco Bay Regional Water Quality Control Board, who implemented the Bay Area's municipal stormwater regulations. Urban runoff comes from a daunting hodgepodge of sources, from streets to yards to roofs. And although they may be small individually, these sources can add up fast. For example, urban runoff is particularly high in PCBs and copper.

While there is no easy fix for the former, the San Francisco Estuary Partnership helped resolve the latter. "In the early days, copper in urban runoff was equal to or even greater than that from wastewater treatment plants," Mumley says. But no one knew where all that copper was coming from. Then studies linked this heavy metal to brake pads, which was a big surprise. "We weren't even thinking about brake pads back then," he adds.

This discovery prompted manufacturers, regulators, and environmentalists to form the Brake Pad Partnership (BPP) in 1996. "This was facilitated by



Most of the time it's safe to swim in the Bay, or to windsurf and parasail over its waters — at least from a water quality perspective. Those interested in getting their feet wet can even find up to date local water quality assessments online — a major improvement in services for the public. Photo by Kathleen Wong.

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PLANS & POLICIES

Bay Protection and Toxic Cleanup Plan

California Code of Regulations update to include Universal Hazardous Waste Rule

Municipal Regional Permit (NPDES permit), Provision C3

Safer Consumer Product Regulations, California EPA Dept. of Toxic Substances Control

Site specific objectives for copper & cyanide

Stormwater Permits for all Bay Area Municipalities

TMDLs for PCBs, pathogens, mercury, and pesticides

COORDINATING PROGRAMS

Bay Area Pollution Prevention Group

Bay-Friendly Landscaping & Gardening Coalition

Brake Pad Partnership

Clean Estuary Partnership

LID Leadership Group

Long Term Management Strategy for Dredged Material

Our Water, Our World

Regional Monitoring Programs, Delta and Bay

Urban Pesticides Pollution Prevention Project

USGS Toxic Substances Hydrology, and National Water Quality Assessment, Programs

KEY DOCUMENTS & PUBLICATIONS

Bay & Delta Pump Out Guide & Maps, 2011-2012

Estuarywise, SFEP, 1992 & 1993

Pulse of the Delta, SWRCB, 2012

Pulse of the Estuary, SFEP, 2000-2013

the Estuary Project, which had created a framework of positive relationships between industry and government," says Kelly Moran, a chemist at TDC Environmental who helped found and implement the BPP. Fast forward to today, and the BPP's success is evident. Under Senate Bill 346, brake pads sold in California must be down to 5 percent copper by 2021 and down to 0.5 percent by 2025. Even better, Moran expects that most brake pads will meet the final target much sooner.

Another early surprise was that the pesticides that replaced DDT were widespread in urban creeks and toxic to aquatic life. "Modern pesticides were not on our radar screen at the

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The peeling and rusting flanks of the military's mothball fleet in Suisun Bay have been a thorn in the side of environmentalists for decades. But in 2007, Arc Ecology, San Francisco Baykeeper, and Natural Resources Defense Council brought a Clean Water Act lawsuit against the US Maritime Administration to compel a clean up. The Regional Board intervened on behalf of the plaintiffs and a legal agreement was signed in 2010 to require careful oversight. As a result, more than two hundred tons of lead-laced paint have already been removed from the 25 worst vessels in dry dock, and others safely towed to a permanent graveyard in Texas. Only 13 of the original 57 ships remain – a major water quality improvement for the Bay. Photo courtesy San Francisco BayKeeper.

beginning of the CCMP," Mumley says. To reduce pesticide runoff into streams, the regional water board brought pesticide users and manufacturers, municipalities, and regulators to the same table in the mid-1990s. In the 2000s, the Estuary Partnership facilitated the growth of this cooperative program, which was ultimately called the Urban Pesticide Pollution Prevention Project.

This effort led to new state regulations for pyrethroid pesticides, which are sprayed in a band around buildings. "We found that the band could be reduced from 7 feet to two inches and still control ants," Moran says. "We're expecting an 80 percent to 90 percent reduction of pyrethroids in streams." In addition, the California Department of Pesticide Regulation is now reconfiguring their review process to avoid registering future pesticides that will pollute water.

A more recent concern is trash, which blows out of open dumpsters and builds up near fast food restaurants, transit centers and "anywhere there are large numbers of people in our throwaway society," Mumley says. Besides being unsightly, trash — like urban runoff — is untreated and so is important to keep out of stormwater. Control options include working with businesses to limit trash generation in the first place, and intercepting trash before it washes down storm drains.

The Partnership is just wrapping up a 5-year demonstration project

that entailed placing and assessing more than 4,000 trash capture devices in storm drains in 64 Bay Area municipalities. "This is full trash capture," says Janet Cox, who directs the project. "The devices catch anything bigger than five millimeters." Another facet of the project is a website where cities can upload information on how well the devices work. Next steps include extending this site into a statewide water quality portal showcasing trash hotspots and cleanup events.

These are just a few highlights of the CCMP's many contributions to preventing or reducing pollution in the Estuary over the last 20 years. "Essentially all industrial and military sites around the Bay have been, or are, being cleaned up," Mumley says. Most visible, perhaps, are the half dozen military bases which have been retired, purged of their poisons, and converted into shoreline parks, wetlands and developments.

Despite great strides in controlling what comes out of the pipe and through storm drains, the biggest, most unpredictable threat to Bay life continues to be oil spills. Most recently, the *Cosco Busan* ran into the Bay Bridge in 2007 and leaked 58,000 gallons of bunker fuel. The region is now better prepared to respond than it was 20 years ago, and shippers must follow more stringent containment efforts. But herring, waterfowl and other Bay life suffer every time it happens. Funds from oil spill settlements have sought to make amends,

underwriting research on how oil affects herring eggs and duck feathers, and buying salt ponds for habitat restoration, among other good works.

Other smaller but important accomplishments in the last 20 years include enlisting the help of dentists in recycling mercury-tainted fillings, rather than flushing them down the drain. And dredging — which once raised a hue and cry about stirring up old contaminants buried in the bay mud — now has stricter protocols (see opposite).

Upstream, many similar pollution prevention efforts have been underway in the more agricultural regions of the watershed. In the Brentwood Area of Contra Costa County, where large numbers of farmers flood their furrows to irrigate their canning tomatoes, corn, and other crops, the Natural Resources Conservation Service and the Contra Costa Resource Conservation District have had success showing them how much sediment and runoff comes from this practice. As a result of the outreach, more than 600 acres have been converted in recent years to drip irrigation. "It's not so much that people aren't willing to do it, it's that they don't realize it's occurring or it's a problem," says the Service's Alyson Aquino.

For all the successes in pollution prevention and control among CCMP partners, there is still a ways to go. "Some regulations and permits should be strengthened," says Deb Self, who directs San Francisco Baykeeper, which champions water quality in the Bay. "What the Bay needs are regulations and permits with teeth, adequate monitoring to assess compliance, and aggressive enforcement of permit limits."

The last two decades have yielded a cleaner, healthier Estuary but have also revealed pollution that is either intractable or comes from sources we hadn't even considered such as air fresheners and birth control pills. "It's a never-ending but evolving story," Mumley says. "The challenges continue to grow." Thanks partly to the CCMP, so do solutions. **RM**

PROJECTS IMPLEMENTING POLLUTION GOALS 1993-2013: 91

From Bay Mud to Building Material, From Lockdown to Smooth Sailing

With so much of San Francisco Bay so shallow, the U.S. Army Corps of Engineers has long had to dredge out channels and harbors so ships don't run aground, an activity not without its ill effects on the ecosystem. In the 1980s, fishers complained about turbidity driving away their catch — both from the dredging activity itself and from the dumping of the material back into the Bay at more than a dozen aquatic disposal sites. At the same time, water quality watchdogs worried that all the scooping and dumping not only stirred up long-buried contaminants but also re-suspended and redistributed them. To make matters worse, the depth finder of an inbound

ship, out in the main Central Bay shipping channel, suddenly flashed "0" one day. A 72-foot mound of dredged material had accumulated just 30 feet below the surface at the Alcatraz disposal site.

By the time dredgers, fishers, regulators, and ports sat down at the CCMP negotiating table, the region was in the midst of a "mudlock." To help break it, regional interests and the San Francisco Estuary Partnership underwrote the first serious research on how turbidity affected fish, and whether dredging activities disturbed bottom dwelling organisms. They also began studying how quickly sediment

dispersed from disposal sites, and where it ended up. At the time, no one could have imagined that the region would be even more obsessed with what any layperson would call "mud" 20 years later.

"Dredged material has gone from something called a 'spoil' to something viewed as a resource," says Al Paniccia of the US Army Corps of Engineers. "It's now considered so valuable, nobody wants it to be hauled off to a deep ocean site for disposal anymore. There's been a 180-degree change in attitude."

Paniccia is one of four managers from key agencies who now work together to manage Bay dredging. But they weren't working together yet in 1993, during the mudlock. Back then, 80 percent of the dredged mate-

rial was put back in the Bay at various sites, only the most contaminated materials were placed on upland sites, and there was no EPA-approved ocean disposal site as there is today.

Enter the CCMP process. Participants set straightforward goals: eliminate unnecessary dredging and manage waterway modification to offset adverse impacts. To accomplish these goals, the Corps, BCDC, the Regional Water Quality Control Board, and port representatives worked with the fish and wildlife agencies that had to be consulted about impacts to endangered species on a long term management strategy for the placement of dredged material in the region ("LTMS"). The strategy called for reducing disposal in the Bay to 20 percent by 2013, and for maximizing the beneficial reuse of dredged material — another CCMP goal.

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PLANS & POLICIES

Inland Testing Manual for Dredged Material, 1998

Public Notices from DMMO (PN99-3, PN01-01)

LTMS Programmatic Biological Opinions resulting in Environmental Work Windows

LTMS Science Framework

Essential Fish Habitat Programmatic Consultation

DMMO Annual Review

Six Year Program Evaluation

Twelve Year Program Evaluation

COORDINATING PROGRAMS

Long Term Management Strategy for Dredged Material

Dredged Material Management Office

Environmental Windows Work Groups

Public "Listening Sessions"

MAJOR SCIENCE RESEARCH

LTMS studies

USACE Value Engineering Report for the Corps Dredging Program

USGS and other sediment transport studies, to be published in forthcoming issue of *Marine Geology*.



Referred to as a suction hopper dredger, *Essayons* is able to vacuum up nearly 6,000 cubic yards of ocean sand in one hour using its two drag arms. Photo courtesy USACE.



More than five million cubic yards of sediment dredged from the Oakland Harbor deepening project and maintenance projects around the Bay gave this 960 acre wetland restoration site at the former Hamilton Army Airfield a much needed lift. The material had to be pumped five miles across Bay shallows in a pipe especially created for this purpose (bottom center of photo). After years of clean up, dirt moving, and implementation of a complex habitat design, Hamilton's builders hope to open the site to tidal action in 2014. The dredged material helped bring the site up to elevations where marsh plants could take root. Without the long term commitment of the Corps, the Coastal Conservancy, the Port of Oakland, the LTMS program and other partners, Hamilton would not be the showcase of large scale landscape restoration through public-private collaboration that it is today. Photo courtesy USACE.

"The CCMP called for a new management strategy, and for putting in place a strong sediment testing program, so we created a cooperative program to manage it all, the LTMS and the DMMO," says BCDC's Deputy Chief Steve Goldbeck, referring to the one-stop interagency Dredged Material Management Office. The office was set up with input not only from the agencies issuing dredging permits, but also from the ports and marinas trying to

get them, represented through the Bay Planning Coalition. "We really worked hard to deliver on all the promises we had made," says Goldbeck.

Another accomplishment was agreement on "environmental work windows" over the course of the year. In these week-by-week windows, dredging activities could proceed with fewer hoops to jump through than at other times when fish and wildlife might be more sensitive, such as when birds are breeding or salmon migrating.

Between the LTMS, the DMMO, and the windows, dredgers got a lot more clarity on how they could proceed, and wasted less time idling expensive equipment. Further clarity came from strong research and analytical work on the part of US EPA, the Water Board and regional water quality monitoring programs (see insert) to develop clear sediment testing guidelines, and sediment quality objectives for beneficial reuse. Knowing which materials were too contaminated to put back in the Bay really settled fears about making contamination worse.

"Our dredging program runs so much more smoothly these days because of interagency partnerships we've developed over the years through LTMS," says Paniccia. "Our permitting process and sediment testing are pretty streamlined and straightforward now – we all know what we're doing. We don't always get to dredge in the window, but even dredging outside the window isn't a crisis anymore."

The results have been encouraging. A newly published 12-year LTMS review found that all targets for reducing in-Bay disposal volumes were met – decreasing from 80 to 20 percent. More than 44 percent of the material dredged from the Bay was beneficially reused in restoration projects, ranging from building beaches and raising wetland elevations to providing the muddy foundations of new eelgrass beds. In addition, more than 80 percent of dredging and disposal activities are now completed within the windows protective of wildlife.

Looking ahead, many challenges remain – despite the significant ac-

complishments in this CCMP program area. One federal policy, for example, could do with an update more in tune with regional priorities. The policy requires the Corps to always chose the "least cost environmentally acceptable" alternative for dredged material disposal. Unfortunately the more you handle the material, the more it costs. So moving it from the Bay bottom to a transport scow to an off loader, and then finally pumping it miles across mudflats onto a wetland is costly, especially with diesel fuel now so much more expensive.

"It's a double whammy," says Goldbeck. "The Corps no longer has enough money nationally to dredge even critical channels, and lots of small harbors that support small fishing fleets don't get dredged at all."

With the fierce competition for each smaller sequestered dollar, as well as least-cost policy obstacles and skyrocketing fuel costs, the Corps struggles to help the region make the most of its mud. In the coming year, however, the Corps will be able to beneficially reuse some sediment from its annual Oakland Harbor dredging project through an innovative placement strategy. "By allowing some material to go in-bay, we've been able to offset the cost of taking some material upland, so in that way we can comply with federal standards but still be flexible enough to help with restoration," says Paniccia.

What LTMS agencies remain most concerned about today is the loss of federal funding to sustain the extraordinary science and monitoring programs that have helped all stakeholders feel comfortable with the impacts of dredging in the Bay. As vast new wetland restoration sites clamor for more mud to fill up subsided salt ponds and diked baylands so they can keep pace with sea level rise, most stakeholders are starting to feel no material at all should be "wasted" by being dumped at the ocean disposal site. But at what cost, and to whom? Working out such thorny multi-objective issues sounds like grist for future CCMPs. **ARO**

PROJECTS IMPLEMENTING DREDGING ACTIONS: LOTS

LAND USE & WATERSHED MANAGEMENT

Thinking Like a Region, No Walk in the Park

Creeks and rivers are the living veins of the Estuary. A hundred-plus streams flow into San Francisco Bay proper. Together with the Sacramento and San Joaquin Rivers and their tributaries, they drain 40 percent of the state. These waterways provide habitat for river otters and mergansers, passage for salmon and steelhead, and sediment to build the Bay's mudflats. Flowing through cities and farmlands, they also pick up less welcome ingredients: mercury from nineteenth-century mine tailings, copper from worn brake pads, and a toxic brew of pesticides, herbicides, and fungicides. These compromise the health of the Estuary and all its inhabitants. Converting natural landscape to hardscape not only adds to the pollutant load; it changes natural flows. With higher flows, streams cut deeper, banks erode, habitat is lost; with lower flows, groundwater doesn't get recharged.

The damage, for the most part, is unintentional. For all those "Flows to Bay" signs on city sidewalks, many people don't realize that what they do on land eventually gets into waterways and affects everything downstream. With land use regulation still the third rail of California environmental policy, we continue to build in floodplains and on creek banks—with unfortunate results for both human residents and aquatic ecosystems.

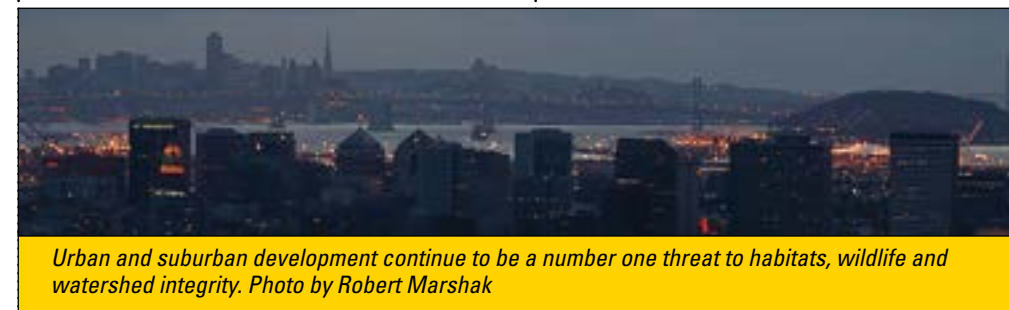
In general, land use actions suggested in the CCMP include broad concepts, such as not building in sensitive habitats or on floodplains, and planning growth with the watershed in mind. Or they include more targeted actions like setbacks to discourage creek side construction, Bay-friendly landscaping practices, or keeping cows out of streams. All of these measures are easier said than done.

The group that met in 1993 to develop CCMP objectives for land use and watershed management stepped gingerly out into a regulatory minefield. "We were trying to address environmental issues that went beyond the purview of existing government entities, and affected stakeholders at opposite ends of the spectrum, from builders' trade groups to creek advocates," says Steve McAdam, then with BCDC. Land use decisions had always

been made at the local level, and with watershed, stream and Bay protection taking a back seat to more pressing development issues. Even after CCMP participants took regional limits on land uses impacting waterways off the table for political reasons, the group struggled to reach consensus.

management plans exists in the Bay Area. Nor does a standard template for drafting such plans.

To get a better handle on the level of watershed planning across the region, the San Francisco Estuary Partnership distributed a survey to



Urban and suburban development continue to be a number one threat to habitats, wildlife and watershed integrity. Photo by Robert Marshak

McAdam says the hope was that local governments would adopt co-management of watersheds that ran through multiple jurisdictions. The CCMP attempted to suggest how that might happen. When stakeholders met again in 2007 to update the CCMP's land use management objectives, their new approach encouraged local watershed management plans and stewardship councils. Alongside those were broader objectives: regional policies to protect and restore natural floodplains, promote compact contiguous development, and—a departure from 1993—develop consistent policies for coping with climate change.

Compared to other arenas of change proposed in the CCMP, watershed management was a hard nut to crack, according to Harry Seraydarian, who once chaired the CCMP management committee and now runs the North Bay Watershed Association. Six years later, local initiatives abound, but regional-scale and interagency coordination remains elusive. "We're still doing a poor job of collaborating on land use decisions that impact water resources," Seraydarian contends.

DRILLING DOWN ON WATERSHEDS

From the outset, one of the biggest obstacles to coherent watershed management has been coordinating across multiple jurisdictions. Much is happening at the local level, but quantifying just how much isn't easy. No central regulatory authority or informational clearinghouse for watershed

101 Bay Area cities and all 9 counties in 2012. They received responses from 52 cities and 8 counties. Based on those responses, ten cities had watershed plans. A few others, including San Francisco, had plans under review. On the county level, Marin, Contra Costa, Alameda, and Napa reported that they had watershed plans. Over half the responding cities had also enacted creek setback ordinances. Some cities have folded watershed management into their general plans: "Watershed planning objectives are being met in a variety of ways at the local level," says the Partnership's Caitlin Sweeney.

On a parallel track, the San Francisco Bay Regional Water Board has been promoting watershed management slowly but steadily since the early 1990s. It has been requiring cities and counties to have stormwater management plans, the logic being that where stormwater drains, so drains the watershed. The Board also requires on-site stormwater treatment or retention in new and redevelopment building projects involving over 10,000 square feet of impervious surface, and even lowers that limit to 5,000 square feet for uses such as gas stations and uncovered parking lots.

Many Bay Area cities have embraced the stormwater management approaches pioneered in Portland and Seattle, and put low-impact design standards for municipal buildings in

continued on next page



Public access to the bayshore has increased exponentially since the 1990s, and the quality of life in the Bay Area has increased with it. But these homes sit squarely in the flood zone of storm surges that promise to plague the region's shoreline developments and infrastructure more frequently in the future. The San Francisco Bay Conservation and Development Commission estimates that 270,000 residents, mostly in the South Bay, are at risk of inundation in the decades ahead due to the rise in sea level caused by global warming. Photo by Kathleen Wong

place. Berkeley, which took on a pilot study for two of its eleven watersheds—the “ghost creeks” once known as Potter/Derby as well as largely natural Codornices Creek—may be representative. Josh Bradt, now with the Partnership, helped develop the plan. “The core component was combining green infrastructure approaches with needed upgrades to the existing drainage infrastructure to achieve water quality improvements, flood reductions, community beautification, and habitat improvement,” he explains. The process included a consultant’s analysis of the two watersheds and back-and-forth with city public works staff to ensure the plan accounted for increased maintenance workloads. Berkeley’s city council adopted the plan in 2012 and made it part of a capital improvement bond measure, which voters approved.

Beyond the official plans, the attempt to promote watershed-based stewardship groups, an action item added to the CCMP in 2007, is a clear success. “You’ve got a ‘Friends of’ group on almost every significant tributary,” says Seraydarian. But the effectiveness of such groups varies. Beyond hands-on creek cleanups and replanting, some are doing serious restoration. Surveying the North Bay watershed scene, Seraydarian calls out the Sonoma Ecology Center—“a mini-San Francisco Estuary Institute, with technical people doing technical work”—for its achievements on Sonoma Creek. In Marin County, Friends of Corte Madera Creek is also addressing the flood control/habitat nexus. The North Bay group, he says, is “trying to push more integrated concepts to get healthier watersheds. The fundamental difference between the North Bay and the rest of the Bay

Area is population density. The North Bay’s tributaries are less impacted, and there’s more opportunity to protect them.”

With the help of many partners, the San Francisco Estuary Partnership coordinates the Bay Area Watersheds Network, a regional forum where these groups can share information, ideas, and tools through workshops and an online “Collaboration Corner.” The Partnership has also championed initiatives for low impact development and green infrastructure, and a Small and Micro Grants Program for watershed health. Last year urban planner Adrien Baudrimont took on a Bay Area creek mouth assessment for the Partnership, cataloging details on site history, substrate quality, and vegetation conditions, and looking for restoration triggers like the presence of endangered species or steelhead spawning habitat. Governments and citizens will be able to access the resulting inventory.

Another project, Flood Control 2.0, has pilot sites on San Francisquito Creek near Palo Alto, Novato Creek in Marin County, and on Walnut Creek. “We’re taking advantage of a time in history where the flood control infrastructure around the Bay needs maintenance,” says the Partnership’s Sweeney. “We want to seize the opportunity to think more broadly and redesign flood control facilities to increase the resiliency of watersheds in the face of sea level rise. And we want to incorporate habitat benefits too.”

A third of the cities surveyed by the San Francisco Estuary Partnership had creek restoration projects or programs. Those principles are

being applied on a larger scale in watersheds that cross city lines. “The cutting edge in restoration is the Napa River,” Seraydarian adds. “In the past, the Army Corps of Engineers’ solution to flood control was to channelize everything. Napa was the first to come up with the ‘living river’ concept, an alternative design that protected downtown Napa from flooding and enhanced habitat. That’s the project that changed things.”

In the South Bay, the Santa Clara Valley Water District created a Water Resources Protection Collaborative, which has promulgated standards for development along streams. The county adopted those standards, including slope stability triggers for construction setbacks, as did most of the county’s cities. The District also developed stewardship plans for four watersheds within its jurisdiction. Though not as proactive as Santa Clara, many other counties have taken similar steps at different levels to promote sound watershed stewardship and flood control along waterways.

RECENT MILESTONES IN REGIONAL PLANNING

One step closer to the CCMP’s goal of regional coordination was the passage of Proposition 50 in 2002, which established the Integrated Regional Water Management Program, a nine-county effort to address water supply reliability, water quality, flood protection, and habitat. Seraydarian explains that IRWMP’s coverage doesn’t completely coincide with that of the CCMP, since it includes North Bay watersheds that don’t drain to San Francisco Bay yet excludes Delta counties. “But there’s been good constructive overlap between the two perspectives,” he adds. “When

the CCMP looked at the health of the Estuary, they couldn’t ignore water supply diversions. When the state came up with IRWMP, they couldn’t ignore all the other aspects that are impacted by water supply reliability. Both reinforce the coequal goals.”

One of the most hopeful regional initiatives is *Plan Bay Area*, a joint venture of the Association of Bay Area Governments and the Metropolitan Transportation Commission. The Plan, developed over the past four years and approved this June, encourages compact contiguous development with emphasis on urban infill, and the integration of new housing and transportation needs.

Although cities and counties retain local land use authority, areas that have identified themselves as welcoming denser development will get extra funding from MTC. That will spare small cities, single-family neighborhoods, and rural areas from inappropriate growth. “We’ve had a lot of plans over the decades,” says Contra Costa County Supervisor John Gioia, “but Plan Bay Area is different because it links development patterns to how we spend transportation money. It’s meant to encourage people to drive less and take more mass transit.”

Pursuant to the Delta Protection Act of 1992, the Delta Protection Commission has also adopted regionally significant policies. These protect the rural character of the Delta’s Primary Zone, directing new residential devel-

opment toward existing unincorporated towns and encouraging clustered housing, buffers between farmland and residential or industrial development, plus setbacks from levees.

Some see hopeful signs of a new development paradigm. “There have been fundamental changes in the way we use land, our approach to urban growth, housing demand, and construction,” says consultant Barry Nelson. “Instead of building out into diked baylands over the last 20 years, we’ve revitalized our cities.”

The region has had to be forward-thinking, because so much valuable real estate and infrastructure is built on bay fill at sea level. To this end, local agencies recently launched a project called Adapting to Rising Tides (the ART Project), a collaborative planning effort to help San Francisco Bay Area communities be more resilient in the face of storm event flooding and rising seas.

Looking back, McAdam considers the CCMP a qualified success in the land use arena: “It was helpful in pointing out areas the region needs to address and having state agencies address them. It also succeeded in getting the EPA to be more active in a local land-use role and educating the Corps of Engineers about protection of seasonal wetlands. Since 1993, there’s more communication between local government entities on issues that pass out of their jurisdiction.”

Today’s harsh economic climate has made it harder for the govern-



By several measures, Bay Area creeks are in trouble. Loss of physical complexity is a big part of the problem. Assessments for the 2011 State of the Bay Report showed riparian areas such as San Mateo Creek, pictured above, have narrowed compared with historical conditions, stream beds are far lower than their natural heights, flows are higher and flashier, and floodplains have disappeared. Only 57 percent of streams assessed were judged to be in excellent or good condition. Photo by Kathleen Wong.

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STATE INITIATIVES

CalGreen Building Codes

Regional Planning

Integrated Regional Watershed Management Program

ABAG/MTC’s *Plan Bay Area*

ABAG/MTC/BCDC’s FOCUS

Delta Protection Commission

Adapting to Rising Tides, ART, BCDC & NOAA

COUNTY & WATERSHED COORDINATION

North Bay Watershed Association

Marin County-wide Plan

Santa Clara Valley Water Resources Protection Collaborative

California Partnership (San Joaquin Valley)

RESEARCH & TOOLS

Bay Area Watershed Network

Flood Control 2.0

SFEP Creek Mouth Assessment Project

SFEP 2013 Small & Micro Grants Program (watershed health)

Low Impact Development & Green Infrastructure (El Cerrito)

ment to acquire more open space, protect more watersheds, and curb greenhouse gas emissions. Some things can be done without funding, but not all things. “It’s a question of political will,” says McAdam. “Are we ready to take steps to regulate land use more strongly, even if it means saying no to developers and their promised tax revenues?”

However it happens, land use has to be addressed. Benicia’s mayor, Elizabeth Patterson, worked on developing the CCMP as a state water scientist. She calls land use management “the most cost effective, reliable and long-term beneficial strategy across the platform of subject areas of the CCMP. Maybe land use is not considered a science or is too politically challenging, but the failure to embrace land use makes it harder for other resource management strategies to adapt to climate change.” **JE**

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More Efficiencies, But Not More Water

The primary water use goal of the 1993 CCMP was to “develop and implement aggressive water management measures to increase freshwater availability to the estuary.” Given that one of the actions to meet that goal was water recycling, it is ironic that one of the best models of recycling in the Bay Area at the time had been designed to cut back on freshwater flows to the estuary.

The City of Santa Clara had started a program in 1989 to recycle treated wastewater after biologists discovered that freshwater coming into the bay from their treatment plant was converting salt marshes to brackish marshes. These habitat changes didn’t help the endangered salt marsh harvest mouse or California clapper rail.

The Regional Water Quality Control Board placed a limit on the amount of water they could discharge, says Steve Ritchie of the San Francisco Public Utilities Commission, and “as a result they started to develop a fairly aggressive recycled water program, and that was a big step forward.”

Their project came online just as California had entered the worst multi-year drought in the state’s recorded history. “The 1988-92 drought reinforced the reality that California has a Mediterranean climate and that water supplies can



Recycled water isn’t just for irrigation. When this former Cargill Salt property in the North Bay was restored, beginning with excavation of the historic slough as shown above, a new pipeline brought recycled water in to dilute the toxic residue left behind by salt processing. The pipeline will continue to provide 1,700 acre-feet of recycled water per year to the former bittern ponds (potable water would have been prohibitively expensive). In the East Bay, Hayward’s Ora Loma Sanitary District has offered recycled water to help restoration engineers recreate the natural freshwater seeps that once bordered marsh systems. Photo courtesy Russell Lowgren.

be very limited,” says Peter Brostrom with the California Department of Water Resources. “Limited water supplies and battles over water go back to the gold mining days, but big dams and other water projects allowed the general public to forget about water for awhile.” The 1988-92 drought brought back that reality, he says, and the year we came out of that drought was the first of what was to become a 20-year effort to reduce water use in the state.

Reclaimed water has been used in California on a small scale for more than a century. A major factor limiting reuse is the cost of distribution, says Ritchie. “At the same time, it seems a pity to take very pure water from the Sierra Nevada, use it once, and throw it away.”

Water agencies in the region have added significant recycling capacity over the last 20 years. A 1987 report issued by the Water Resources Control Board said there were 18 reclamation plants in the Bay Area that recycled and reused 13,016 acre-feet of water per year. Today, 30 systems recycle about 60,000 acre-feet a year.

“Public opinion of recycled water has gotten better,” says Ritchie. “No matter what the commodity is, it’s second nature to recycle things now.”

The San Francisco Estuary Partnership’s 2011 *State of San Francisco Bay* report sought to tease out more detailed information on how recycled water might be putting a dent in demand for fresh Sierra snowmelt or groundwater. The report suggested that more than 35,000 acre-feet of recycled water is being used in the Bay Area to irrigate landscaping and cool and clean industries and oil refineries, freeing up an equivalent amount of potable, stream or groundwater. The report also found that between 2001 and 2010, total recycled

water use in the Bay Area increased by more than 50 percent.

Recycled water use has greater possibilities. Ritchie believes that we will likely be drinking recycled water in the future. “It’s not going to happen tomorrow, but there’s more research going on now than has occurred any time in my career,” says Ritchie, who has worked for water agencies for nearly 30 years.

The CCMP also identified urban and agricultural conservation as an action needed to increase freshwater availability to the estuary. And nothing inspires real behavioral change like a drought. By 1993, water agencies were forced to implement conservation measures, and the state put a number of measures into place to encourage more conservation, such as low-flow toilet standards. A number of water districts followed suit, particularly those in Southern California.

Though the City of Los Angeles has a million more people than it did 20 years ago, it is using the same amount of water. “That’s a huge improvement in efficiency,” says Brostrom.

Western water consultant Barry Nelson also praises the work being done in Southern California. “Los Angeles recently launched the biggest groundwater clean up ever attempted, Orange County has built the largest water recycling facility in the world, and Santa Monica is planning to eliminate the use of imported water by 2020.” Similarly, the City of Los Angeles’ latest goal is to buy half as much imported water by 2035. To get that done, the city is utilizing water conservation, groundwater clean-up, storm water capture, and wastewater recycling, “the exact tools that environmentalists have been recommending for years,” says Nelson.

The cities to the south aren’t the only ones that can point to progress. Until a few years ago, Fresno and Sacramento were the largest cities in the state lacking water meters. “Just by selling water meters, and by telling folks they are going to get billed based on the amount of water they used, water use in Fresno has fallen from 320 gallons per capita per day to 250 gallons per day,” says Nelson. Other water agencies are doing innovative work with metering, conjunctive use, and partnering with other agencies, such



SFEP has led Low Impact Development efforts on both sides of San Francisco Bay. In San Francisco’s Bayview district, SFEP helped the 1700 block of Newcomb Avenue become the city’s first true green street. The makeover, completed in 2011, included stormwater-filtering planters and drought-tolerant street trees. Another LID project installed 19 vegetated stormwater-treatment cells in downtown El Cerrito in 2010, the cells, planted with drought-tolerant native species, slow down runoff and remove pollutants before stormwater reaches Baxter and Cerrito Creeks. Photo by Josh Bradt.

as the Sonoma County Water Agency and the San Francisco Public Utilities Commission.

Peter Brostrom says it looks like the state as a whole is on track to reach its goal of reducing water use by 20 percent in 2020, though the official report won’t be out until June 2014. “The question is, as the economy bounces back, will water use go back up with it?”

There have been changes on the agricultural front, too. Brostrom, a former farmer, says that many farmers have shifted towards drip irrigation, and have seen that better water management results in better yields. “Statewide there’s an estimate that we’re over-drafting groundwater aquifers by a million acre-feet annually,” says Brostrom. Farmers are feeling the same pressure as everyone else.

“There’s no doubt that agriculture is still fighting hard to get more water out of the Delta,” says Nelson. “But if you look at what’s happening on the ground, the change is interesting. Farmers in the Westlands Water District are growing on less land than they were 20 years ago, moving to more high value crops, and investing in drip irrigation and other conservation practices. As a result, they

are making more money with less water. Westlands and environmentalists still often disagree, but the farmers have shown an incredible ability to adapt.”

A revised CCMP in 2007 recognized that many challenges remain but it also recognized some successes. The CCMP pushed for integrating management across the region, for example, and Ritchie, who chairs the coordinating committee of the Bay Area Integrated Regional Water Management Plan, says they are close to finalizing an update of the plan. “It forces us to think across issue areas. It gets people out of the silos they sit in.”

On a more local level, many office parks and shopping centers have replaced water and chemical-intensive lawns with drought-friendly native plants, and are using recycled water to irrigate. For its part, the Partnership has been championing green infrastructure and low impact development.

When the people interviewed for this story were asked if we were on track to meet the water use goal of the CCMP, the majority said they felt optimistic about the work being done and the direction we’re headed. Leo Winternitz, the senior policy advisor for water programs at the Nature Conservancy, felt otherwise.

“The answer is no,” he says. The point of increasing freshwater availability to the estuary is to attain an even greater goal, he says, which is to restore ecological processes.

“We have a very, very changed system,” he says. There’s been a 50 percent decline in Delta outflow because of exports and upstream development; the whole system has become less variable, which favors invasive, not native, species; and fish have been in decline since the 1970s (see p. 4).

“It wasn’t good in 1993. How bad is it now? Well, it’s worse,” he says.

“Developing water recycling and water use conservation efficiency measures, while necessary and important, don’t necessarily—and have not—increased fresh water availability, because demand for water in this state is higher than available water supplies,” he says. The water we save is going towards other demands, like more people, or new ones, like fracking.

Clearly we need to both live more within our water means, or make more water. But ocean or bay water desalination have not fared that well, according to Rich Mills with the California Depart-

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PLANS, POLICIES & AGREEMENTS

Bay Area Regional Water Recycling Program Master Plan, 1999

MOU Re Urban Water Conservation in California, 1991 (last amended 2011)

North Bay Water Reuse Authority, 2003 [master plan 2005?]

State Water Plan Update, 2005

CALFED Water Use Efficiency Comprehensive Evaluation, 2006

Sonoma Valley Groundwater Management Plan, 2007

Department of Water Resources List of Efficient Water Management Practices (agriculture), 2010

COORDINATING PROGRAMS

State Recycled Water Task Force, 2002

State Landscape Task Force, 2005

Integrated Regional Water Management Program

INFRASTRUCTURE

Napa-Sonoma Marsh recycled water pipeline, SCWA, 2013

TECHNICAL ASSISTANCE

California Water 2030, *An Efficient Future*, Pacific Institute (and dozens of studies on water efficiency and conservation)

Building Water Efficiency Tool Kit, Environmental Defense Fund (and research on the environmental costs of water)

National Resources Conservation Service programs promoting soil conservation and agricultural efficiencies.

ment of Water Resources. Winternitz sees a future with greater emphasis placed on a market approach guided by regulatory mechanisms.

Trade in this area may already be starting. “One of things happening in the Central Valley is a much larger water market than 20 years ago, farmers buying water from other farmers,” says Nelson.

With the Bay Area population still expanding, and continuing uncertainty about the replumbing of the Delta waterworks, not to mention shifts in water availability due to climate change, there are more reasons than ever to practice wise water use. “We’ve got limits in the Bay-Delta system,” says Nelson, “and those limits are pushing everyone in the system to adapt.” **AG**

PROJECTS IMPLEMENTING WATER USE GOALS 1993-2013: UNKNOWN



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San Francisco Bay and the Sacramento-San Joaquin River Delta comprise one of 28 "estuaries of national significance" recognized in the federal Clean

Water Act. The San Francisco Estuary Partnership, a National Estuary Program, is partially funded by annual appropriations from Congress. The Partnership's mandate is to protect, restore, and enhance water quality and habitat in the Estuary. To accomplish this, the Partnership brings together resource agencies, non-profits, citizens, and scientists committed to the long-term health and preservation of this invaluable public resource.

We're back! You didn't miss our August issue, we just took a dollar-saving break. Things are looking good for an even bigger and better magazine next year, but if you can help with a donation go to: www.sfestuary.org/estuary-news! Thank you to everyone who helped this summer with contributions!

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GOT FEEDBACK ?

We know we can't cover every accomplishment in the last 20 years in just 20 pages. If you have additions or comments, please go to our "20th CCMP Anniversary Review" page at www.sfestuary.org/

WETLANDS - Continued from page 10

Compared to many other areas of the country, however, our region has many wetland restoration projects poised to act as storm surge buffers. And there is still some space for wetlands to migrate inland. The obstacles, major freeways and transportation infrastructure along the shoreline, are more daunting in urbanized areas. "The suburban places will be the fighting grounds," says Salzman. "There are really only a limited number of places where wetlands can migrate landward, and some are on private lands," adds Huning. "There may be creative ways we can work with landowners."

Scientists and resource managers, meanwhile, are responding proactively to this wetter playing field. The original 1999 habitat goals are now being updated with sea level rise in mind; and recent upland and subtidal

goals reports have completed the profile of habitats starting from the shallows of the Bay and climbing slowly above the high water mark (see p. 5).

Regional managers have also agreed on sentinel sites in the San Francisco Bay National Estuarine Research Reserve (NERR) for cutting-edge monitoring of changes in sea level and sediment supply over time. They've also started coming up with options for beefing up transition zones on both sides of the marsh – at the upland edge and along the shore. A new campaign recasting wetlands as "horizontal levees" offering cheaper and better flood protection than conventional levees was recently unveiled by The Bay Institute.



Livestock ponds provide reliable water for cattle operations, keeping them out of creeks, and supplementary breeding habitat for native amphibians whose natural habitats have been lost. Photo courtesy NRCS.

"Because of our past investment in baylands, we now have a unique opportunity to do innovative, nature based, multi-objective projects that involve restoring more wetlands, providing flood protection, completing the Bay trail, and protecting the wildlife we all enjoy seeing on the waterfront, says Hutzel. "It's kind of amazing, and I may sound like Rosie the Riveter, but 'We can do it.' And we should do it now."

Public support for wetlands and wildlife will be critical in the years ahead, as we struggle to adapt to the rising Bay. In the 2014 election, regional managers hope to see the public approve a parcel tax measure (not more than \$10) in all 9 Bay Area counties to support the fledgling San Francisco Bay Restoration Authority (see p. 2).

"People love the Bay," notes Huning. "The intrinsic value of the Bay polls well with voters. They appreciate having large national wildlife refuges in their back yards." **JE**

PROJECTS IMPLEMENTING WETLANDS & WILDLIFE GOALS 1993-2013: 127