California WaterFix Hearing
Exhibit No. SWRCB-46

The Delta Plan

Ensuring a reliable water supply for California, a healthy Delta ecosystem, and a place of enduring value

2013

Delta Stewardship Council

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Executive Summary

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Executive Summary

The Sacramento-San Joaquin River Delta is the grand confluence of California's waters, the place where the state's largest rivers merge in a web of channels—and in a maze of controversy. The Delta is a zone where the wants of a modern society come into collision with each other and with the stubborn limitations of a natural system. In 2009, seeking an end to decades of conflict over water, the Legislature established the Delta Stewardship Council with a mandate to resolve long-standing issues. The first step toward that resolution is the document you have before you, the Delta Plan.

Though more than 50 miles inland from the Golden Gate, Delta waters rise and fall with ocean tides. The Delta is in fact the upstream, mostly freshwater portion of the San Francisco Estuary, the largest estuarine system on the West Coast of the Americas, and one of California's prime natural assets. It is a major stop on the Pacific Flyway and the portal through which important fish species, including anadromous Chinook salmon, pass on their way to and from their spawning grounds in the interior.

The system of waters in which the Delta is so central has changed dramatically since California became a state. Rivers have been dammed and aqueducts built. Natural flows and fluxes have been disrupted to support cities and make the Central Valley the fruit basket and salad bowl of the nation. Approximately half of the water that historically flowed into and through the Delta is now diverted for human use, never reaching the sea. Much of this diversion occurs at points upstream, before the rivers come down to the Delta; but the last and largest draws take place in the Delta itself. On the southeast edge of the region, near Byron, two sets of mighty pumps extract water for shipment as far south as San Diego.

Two-thirds of California's people and 4.5 million acres of farmland receive some part of their water from the Delta.

The Delta landscape we know is itself the result of a great transformation, from a primeval wetland complex to an archipelago of diked islands, where soils that once grew vast thickets of tules now yield bountiful corn, alfalfa, tomatoes, and many other crops. The Delta is home to about 12,000 people on farms and in small historic communities, and to about half a million in the larger cities that are

pressing into the region from the fringe. More millions come to it for boating, fishing, hunting, bird watching, even windsurfing on its 700 miles of channels. Steeped in history, combining notes of the American heartland and of Holland, the Delta looks and feels like no other place in California. This is a land that people love.

It is not doing so well.

The very shape of the modern Delta is in danger. Farming of peat-rich ground like this always leads to oxidation, the literal vanishing of soil, and thus to subsidence. Many Delta islands now lie 15 feet or more below sea level and depend on aging dikes to prevent the water in adjacent channels from pouring in. Higher river flows in winter or spring, predicted results of climate change, will add to the pressure, and a great earthquake, sooner or later, will shake the region like a paint can on a mixer. Encroaching urbanization, meanwhile, puts more people and property on dangerous ground.

After years of slow decline, the condition of the Delta's watery ecosystem, as measured especially by the population of wild salmon and other native fishes, has gone critical. The list of causes begins, but does not end, with all those water withdrawals, a kind of tax that leaves the system in a condition of chronic drought. The specific, peculiar manner in which the last large gulps of water are withdrawn adds to the ecological cost. The continual introduction of alien aquatic species from around the world is altering the web of life, often at the expense of native and other valued species. Pollution from the vast and busy watershed does its share of harm.

Today, all those who depend on or value the Delta are, in a word, afraid. Delta residents face the possibility of floods from the east when the rivers flow strongly and of salinity intrusion from the west if they flow too feebly. Fishermen, both commercial and recreational, fret about the future of salmon and other species. Water suppliers that receive water from the Delta find those supplies insecure, subject to interruption by weather vagaries, levee failures, or pumping restrictions imposed in the desperate attempt to stem the decline of fish.

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>
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The Coequal Goals, the Delta Stewardship Council, and the Delta Plan

Since the middle 1980s, California has been looking for ways to secure the natural and human values of the Delta while maintaining its place in the state's water plumbing. These efforts have generally started in hope and ended in impasse. In recent years environmentalists turned to the courts, using the blunt tool of the federal Endangered Species Act to force curtailment of water exports at certain times. In reaction, water suppliers south of the Delta have complained of "regulatory drought."

In 2009 the Legislature made its latest, most determined bid to find solutions, passing the Delta Reform Act and associated bills. First and foremost, it declared that State policy toward the Delta must henceforth serve two "coequal goals":

- Providing a more reliable water supply for California, and
- Protecting, restoring, and enhancing the Delta ecosystem.

These goals, the Legislature added, must be met in a manner that:

- Protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

By affirming the equal status of ecosystem health and water supply reliability, the Legislature changed the terms of the conversation. It changed them further with the following pronouncement: "The policy of the state of California is to reduce reliance on the Delta in meeting California's future water supply needs." Here was recognition that, for the sake of the water system and the Delta both, a partial weaning of the one from the other is required.

The Delta Stewardship Council is the body entrusted with giving practical meaning to these directives. Publication of this Delta Plan completes its first assignment. The product of eight drafts, almost 100 public meetings, and nearly 10,000 comments, the Delta Plan pulls together in one place the steps that need to be taken to meet the coequal goals—measures that, in one way or another, could affect almost everyone in California. The Plan is to be revised every 5 years, or sooner as circumstances change.

The Delta Plan contains 87 provisions, some broad and some narrowly technical, some novel, some commonsensically familiar. What, in essence, does the Plan propose be done differently? At the risk of oversimplification, we can say that it asks California and Californians to do six large things:

- In order to improve and secure our water supply, while taking pressure off the Delta, we must use water more efficiently in cities and on farms, and develop alternative, usually local, sources.
- We must also get much better at capturing and storing the surplus water that nature provides in the wettest years, building reserves that can be drawn on in dry ones.
- To revitalize the Delta ecosystem, we must provide adequate seaward flows in Delta channels, on a schedule more closely mirroring historical rhythms: what the Plan calls natural, functional flows.
- We must also bring back generous wetlands and riparian zones in the Delta for the benefit of fish and birds.
- To preserve the Delta as a place, we must restrict new urban development to those peripheral areas already definitely earmarked for such growth, while supporting farming and recreation in the Delta's core.
- And we must floodproof the Delta, as far as feasible, mainly by improving levees and by providing more overflow zones where swollen rivers can spread without doing harm.

What about today's headline issue concerning the Delta—the proposed construction of tunnels to improve the way water destined for export southwards reaches the pump intakes near Byron? This initiative is part of what is called the Bay Delta Conservation Plan (BDCP). The BDCP is a different and more narrowly focused undertaking than the Delta Plan, into which, if certain conditions are met, it will be fused (see section, A Better System: Delta Conveyance).

The Delta Plan is *California's* plan for the Delta, prepared in consultation with, and to be carried out by, all agencies in the field: the State Water Resources Control Board, ultimate arbiter of water rights and water quality; the California Department of Water Resources, the state's water planner and also operator of the great State Water Project; the California Department of Fish and Wildlife, responsible for the welfare of the living system of the Delta; the Delta Protection Commission, which oversees land use and development on low-lying Delta islands; and many more agencies, State and local. Add to the list federal players like the Bureau of Reclamation, which runs the Central Valley Project; the U.S. Fish and Wildlife Service; the National Marine Fisheries Service; and the U.S. Army Corps of Engineers. Their cooperation has been promised, and it is vital.

The working parts of the Plan are 73 *Recommendations* and 14 *Policies*. *Recommendations* call attention to tasks being done or to be done by others. *Policies* are legal requirements that anyone undertaking a significant project in the Delta must meet. See the sidebar, From Plan to Reality, for more on the mechanics of realizing the Plan and pages ES-15 to ES-35 for a survey of all 87 provisions.

Where Is the Money?

The Legislature sees "adequate and secure funding" as a need "inherent in the coequal goals." In order to know what this entails, we need to form a clearer picture of the costs of the work now proposed for the Delta or on its behalf and how those costs might be met. This first edition of the Delta Plan proposes research toward that clarity.

FROM PLAN TO REALITY

The Legislature instructed the Delta Stewardship Council to "direct efforts across state agencies." This "direction" has three distinct aspects.

First of all, the Council is to **coordinate**. It will chair a high-powered committee dedicated to implementing the Plan. The heads of key State and local agencies will be at that table, together with federal representatives. This body will meet for the first time in fall 2013. Agency staffs will work with that of the Council daily.

Second, the Council is to **keep track of progress**. Using specific performance metrics contained in the Plan, and guided by the Delta Science Program (see sidebar, Science at the Center), it will monitor what is actually being done toward Plan goals, and what changes of course may be indicated. The results will be widely publicized.

Third, in certain key areas, the Council can be called upon to **block damaging actions**. The Plan provisions that can trigger this authority are called Policies. To avoid premature encroachment on the work of other agencies, the Legislature devised an indirect path leading to Council intervention.

Actions subject to these Policies are called "covered actions," but the Council itself cannot declare an action to be covered. It is the proposing agency that makes this determination. Legal standards apply, however, and if an action is questionably deemed not to be covered, the Council or any other party can take the agency to court.

Once an action is determined to be covered, the proposing agency must make sure it is in line with the Policies of the Delta Plan, filing a Certification of Consistency with contents specified in Delta Plan **Governance Policy 1**. If the agency says the action is consistent but another party or citizen thinks it is not, the opponent can then appeal to the Delta Stewardship Council. A Council member or the Council's Executive Officer may initiate the appeal.

SCIENCE AT THE CENTER

The Delta Reform Act mandates that the Delta Plan be based on the best available scientific knowledge of our day. It must, moreover, be open to change as knowledge changes—and as paper proposals meet the test of reality. The results of every action are to be closely tracked, so that corrections can be made in a timely way—a process, much discussed but not sufficiently practiced, known as adaptive management.

To be more than a buzzword, adaptive management must bring two things to bear: new information, and a readiness to let new information disrupt old plans. Both, in the past, have been in scant supply.

Though Delta knowledge has expanded hugely in recent years, it is often a challenge to pull that data together and draw conclusions from it. Studies are done by different agencies for specific purposes and in narrow contexts; findings can be hard to integrate. The Delta Science Program, a function of the Council, will seek to overcome these gaps, linking the whole community of scientists at work. Guided by a top-flight Delta Independent Science Board, it will prepare, by December 31, 2013, a companion to the Delta Plan called the Delta Science Plan (**Governance Recommendation 1**).

The Delta Science Plan will propose a collaborative structure for doing science in the Delta. It will suggest ways of improving communication, resolving conflicting results, and accommodating uncertainty. It will offer priorities: how to apportion attention between immediate practical questions, on the one hand, and research aimed at increasing long-term understanding, on the other. It will sketch a more integrated approach to monitoring, so that results from different settings can be compared, and consider how computer modeling of the intricate Delta system might be improved.

Once a year, the Council will bring scientists together to assess what has been learned and what changes in ongoing plans and projects the new knowledge may suggest. Another conference? Yes, but with a difference: These findings will feed directly into ongoing refinement of the Delta Plan.

First step is an inventory: How much is now actually being spent, by all the agencies involved, that can be chalked up to furthering the coequal goals? Second comes an assessment of costs: How much will it take to carry out the projects and programs described in the Delta Plan, and what might the sources of support be for each one? The third step must be a comparison of resources and needs, and a reckoning of gaps: What key elements lack probable funding, and what might be done to fill these holes? (**Funding Principles Recommendations 1 through 3**.)

Providing a More Reliable Water Supply for California…

The Delta's contribution to the overall statewide water supply is smaller than many people think. The proportion drawn directly from the Delta, mostly through the pumps near Byron, is only about 8 percent of the total. The bulk of California's water comes from more local sources, and always has.

Nevertheless, the Delta supply is important to many regions. Southern California imports about 25 percent of its water via the Byron pumps. The Tulare Lake Basin, the southern end of the Great Central Valley, gets 27 percent of its water by that route. Even the San Francisco Bay Area takes 16 percent of its supply from Delta pumps. On a more local scale, several water suppliers rely entirely on the Delta, and others have become dependent on this one overtaxed source to a risky degree.

In addition to water pulled directly from the Delta, a great deal is drawn from the Delta's tributary streams before they come down to sea level. San Francisco Bay Area cities reach far inland to tap the Tuolumne and Mokelumne Rivers in the Sierra Nevada, taking 27 percent of their water needs from these sources. Parts of the Central Valley tributary to the Delta get all of their water from that watershed by definition, as do the people and farms of the Delta itself. (See also sidebar, The Problem with Numbers.)

California water planning is full of good intentions. If the laws and policies that are now on the books were consistently carried out, the state's water system—including that part that is tied to the Delta—would work much better.

The Delta Plan addresses water supply on three scales: California-wide, on the Delta watershed level, and in the areas that receive water from the Delta pumps. (See Figure ES-1, The Delta Watershed and Areas Receiving Delta Water.)

California water planning is full of good intentions. If the laws and policies that are now on the books were consistently carried out, the state's water system—including that part that is tied to the Delta—would work much better. The Delta Plan calls on *all* water suppliers to obey the many laws and guidelines that exist, and on the State's regulatory agencies to insist on compliance (**Water Resources Recommendation 1**).

THE PROBLEM WITH NUMBERS

In talking of California water, we put trust in numbers: flows, usages, capacities, trends. But some seemingly solid and much-quoted figures are little more than guesses. By and large, we do not truly know how much water we are using or how much we are saving through conservation efforts. We know less than we should about Delta inflows and outflows. We know little about groundwater except that water tables in too many places are dropping. What information is available is often packaged in inscrutable ways. The Delta Plan asks all the agencies and water suppliers involved to provide or demand better information, and to communicate it better (**Water Resources Policy 2, WR Recommendations 16 through 19**).

Whatever the outcome of some current debates, California's next large increment of water supply will not come from major new engineering but from water conservation, recycling, local stormwater capture, and reasonable use of aquifers (see section, A Better System: Storing Floods to Ride Out Droughts). These measures can yield an amount of water larger than the total that is drawn from the Delta today. State agencies in charge of water matters should systematically promote these practices, and *all* State agencies should model them in their own water usage. (**Water Resources Recommendations 6, 8, and 14**.)

Zooming in a bit from the statewide picture, the Delta Plan calls for all water users linked to the Delta—whether they take water from it directly, or tap the watershed—to reduce their draws. The State Water Resources Control Board should give special scrutiny to water use applications that could boost demand on the watershed. Urban and agricultural water suppliers are already required to write water management plans; these now should include "water supply reliability elements," discussing, among other things, how to deal with the cascading effects if Delta pumping were halted for as long as 3 years. (**Water Resources Recommendations 3, 4, 5, and 7**.)

The Delta Watershed and Areas Receiving Delta Water

Figure ES-1

The Plan speaks most directly to those suppliers that serve water within the Delta or pump water out of the region—including the State Water Project, the Central Valley Project, and by extension the many agricultural and urban water purveyors that are the customers of these giants. Any organization that receives water from the projects must do its share to reduce reliance on the Delta, setting specific reduction targets and actually putting measures in place.

The State Water Project is called on to write the corresponding provisions into contracts with its clients when these agreements are renewed or revised (**Water Resources Policies 1 and 2, WR Recommendation 2**).

A Better System: Storing Floods to Ride Out Droughts (and Give the Delta a Break)

The measures so far mentioned will take pressure off the Delta while actually increasing California's developed water supply. The further key to both goals is to harvest and store the water that is available from Central Valley rivers in the wettest years, at the least environmental cost. The need is heightened by the fact of climate change, which stands to make rainy years all the wetter, and droughts all the more severe.

There are few opportunities left in California to build large new dams (or to raise the height of old dams), and the options that exist are dauntingly expensive. The California Department of Water Resources and the Bureau of Reclamation have been studying the possibilities. The Delta Plan urges the agencies to wrap up these studies, so that the State can decide the fate of these proposals once and for all (**Water Resources Recommendations 13 and 14**).

Much more water storage space exists right under our feet: in groundwater basins, or aquifers.

California began its history with a vast supply of water stored naturally in underground gravel fields and free for the taking via wells. In parts of the state, including most of the southern Central Valley, this endowment has been squandered, and groundwater levels have dropped, sometimes by hundreds of feet. One of the rationales for sending water south from the Delta has been to recharge aquifers, but not enough recharging has occurred. And the State's last comprehensive assessment of its groundwater situation was published in 1980—a third of a century ago.

The Delta Plan calls for a rededication to the conservative idea of using aquifers like bank accounts: to be filled up in wet times, in order that they may be drawn from in dry. It calls on the State to do the indispensable groundwater update, on local suppliers to write plans for sustainable groundwater management, and on the State Water Resources Control Board to stand ready to intervene in seriously overdrafted areas, if good local plans are not forthcoming, leading perhaps to the court procedure called groundwater adjudication. (**Water Resources Recommendations 9, 10, 11, and 14**.)

The Delta Plan calls for a rededication to the conservative idea of using aquifers like bank accounts: to be filled up in wet times, in order that they may be drawn from in dry.

There is another tool for making the supply stretch further: the sale or trade of water between suppliers, especially in times of shortage. Existing rules governing such transfers are found cumbersome by some and insufficiently protective of water rights and the environment by others. The State Water Resources Control Board should reformulate the guidelines by mid-2016 (**Water Resources Recommendations 14 and 15**).

A Better System: Delta Conveyance

As noted, many of the state's water suppliers take their water from rivers at points upstream of the Delta. The two biggest, however—the State Water Project and the Central Valley Project—are different. Though most of the water they transport has its origin to the north, in the Sacramento River, their withdrawal points are deep in the Delta and well to the south, on the channel called Old River. Unlike most other water withdrawals, these affect the region not only by removing water but also by distorting flows.

The pumps at Byron have so much power that they essentially give the Delta a second mouth. In many channels, water runs backward at times, toward the pump intakes, not toward the sea. This situation is bad for salmon, Delta smelt, and other sensitive and legally protected species. Under the Bay Delta Conservation Plan, the Department of Water Resources and the federal Bureau of Reclamation are planning a kind of arterial bypass, segregating the water meant for the pumps at a new northern intake on the Sacramento River. The water corralled at this point would be sent to the pumps via a pair of tunnels. This arrangement is intended to alleviate the backward flows that harm fish; in conjunction with major habitat improvements and other measures, it is supposed to bring endangered species far enough back from the brink to satisfy protective laws. Many Delta residents and environmentalists, though, fear that the new system will simply allow more water to be shipped south, doing, on balance, more harm than good.

The Delta Stewardship Council is not the author of the BDCP. Its role for now is to advise and to urge timely completion (**Water Resources Recommendation 12**). Later on, though, the Council may have a decisive say. Once the proposal is complete, the Department of Fish and Wildlife must declare that it meets the standards of the Delta Reform Act, and this declaration can in turn be appealed to the Council. If the Council does not concur, certain aspects of the BDCP will lose access to State funding. If all hurdles have been cleared, on the other hand, the BDCP will take its place as a component of the Delta Plan.

...and Protecting, Restoring, and Enhancing the Delta Ecosystem...

The effort to improve the fortunes of the Delta ecosystem has two components that are vital: guaranteeing adequate flows from the rivers feeding into and through Delta channels, and creating new wetlands and other habitats in partial replacement for what has been lost. Three other components are merely very important: combating harmful exotic species, improving the management of salmon hatcheries, and protecting and improving water quality.

Toward "Natural Functional Flows"

Humans have not only reduced the total quantity of runoff through the Delta toward the ocean but also have changed its timing, decreasing the historical torrents of spring and increasing the formerly feeble flows of autumn. In a natural system that evolved with wide variation, this shift toward a steady state is itself a source of harm.

Humans have not only reduced the total quantity of runoff through the Delta toward the ocean but also have changed its timing, decreasing the historical torrents of spring and increasing the formerly feeble flows of autumn.

The minimum seaward flows to be maintained in Delta channels are set by the State Water Resources Control Board, according to season and year type (wet, above normal, below normal, dry, or critical). These required flows help fish; they also prevent saltwater intrusion. As a not-incidental side effect, the rules limit the amount of water that can be exported through the pumps.

The Water Board is now preparing to revise this flow regime, last updated in 2006. As a later step, the Water Board is to issue comparable flow standards for the major tributary rivers of the Delta. The Delta Plan recommends deadlines for these processes (mid-2014 and mid-2018). The adopted regulations will become elements of the Plan. The Delta Stewardship Council can be called upon to review any project that could affect Delta flows in the light of adopted flow criteria (**Ecosystem Restoration Policy 1, ER Recommendation 1**).

Habitat Restoration

In its primeval state, the Delta was no uniform sea of reeds but a vast mesh of habitats including tule marsh threaded with rivers and sloughs, perched lakes filled by floods and very high tides, natural levees with big trees on them, and seasonal overflow basins behind the levees. Most of this mosaic has disappeared, converted to fifty large and many small leveed islands. Evidence of what was remains in agricultural soils of uncommon quality (and fragility).

The old scene will never return, but careful habitat restoration projects can help to reverse the region's ecological decline. Biologists have spent years locating the likeliest areas for such revival. The Delta Plan incorporates the latest thinking, essentially the Conservation Strategy drafted in 2011 by the Department of Fish and Wildlife (formerly the Department of Fish and Game).

Since the heart of the Delta is now well below sea level, due to subsidence, the suitable restoration sites are mostly found near Delta margins, where the soil surface is still high enough to permit marsh plants and riparian vegetation to take root. The Plan outlines six such zones: the Yolo Bypass, the floodplain west of Sacramento into which the Sacramento River spills in wet years; the Cache Slough Complex, where the Bypass rejoins the body of the Delta; a nexus in the eastern Delta, where the Mokelumne River and the Cosumnes River add their strands to the Delta's web; a zone in the southern Delta along the San Joaquin River; a collection of small tracts at the western apex of the Delta, where it narrows to meet Suisun Bay; and finally the Suisun Marsh, fringing that bay to the north. This fresh-to-brackish water marsh, the largest wetland in California, is mostly managed by hunting clubs for seasonal waterfowl ponds, but sizeable areas should be restored to full tidal action. The existing plan for Suisun Marsh, written by the San Francisco Bay Conservation and Development Commission, is 36 years old and does not take into account, for example, probable sea level rise.

The Delta Plan calls for the habitat restorations in the Conservation Strategy to be carried out by the Department of Fish and Wildlife and by the Delta Conservancy, a body established for such purposes in 2009; and it calls for a plan update for Suisun Marsh. The Delta Stewardship Council can be appealed to, if necessary, to block development or any other intrusion that might interfere with a restoration site. (**Ecosystem Restoration Policies 2 and 3, ER Recommendations 2, 3, and 5**.)

Much of the remaining good habitat in the Delta is found in strips along the water side of levees, and the Delta Plan looks to protect and widen these green margins. When levees are rebuilt or altered, the possibility of shifting them farther away from the water should always be explored. The growth of trees along the waterline should be encouraged. However, authority over many levees lies with the U.S. Army Corps of Engineers, and the Corps requires removal of trees and shrubs, on the theory that root systems have a weakening effect. (The matter is debated.) Given the value of tall vegetation for habitat, the Delta Plan asks the Corps to exempt Delta levees from this rule, where appropriate. (**Ecosystem Restoration Policy 4 and ER Recommendation 4**.)

Exotic Species

One of the less-visible forces to buffet the Delta ecosystem is the proliferation of nonnative aquatic species—fish, crustaceans, plants, and even the microscopic floating animals of zooplankton. Some were introduced deliberately; others arrived by random routes including the discharge of bilgewater from oceangoing ships and the dumping of goldfish bowls.

New arrivals keep appearing. Some of these intruders affect the system little, but other species, notably certain aquatic plants and filter-feeding clams, transform the web of life profoundly. The Delta Plan prohibits actions that could bring in new exotics or improve conditions for exotics that are here, and endorses the measures the Department of Fish and Wildlife is already planning to take against them. (**Ecosystem Restoration Policy 5, ER Recommendation 7**.)

Among the exotics are game species introduced in the nineteenth century and well-loved by fishermen: striped, largemouth, and smallmouth bass. It has become apparent that these voracious game fish are helping to deplete salmon, Delta smelt, and other species in trouble. The Delta Plan asks the Department of Fish and Wildlife to change angling rules to permit heavier fishing and somewhat suppress the bass population (**Ecosystem Restoration Recommendation 6**).

Management of Hatchery Fish

When dams on many rivers cut off spawning grounds for salmon and steelhead trout, hatcheries were built to compensate. Now there is worry that hatchery-raised salmon, less genetically diverse than their wild cousins, may mix with and reduce the fitness of the wild strains. Various solutions are proposed, including capturing wild fish to add their eggs to hatchery stock. The Delta Plan asks the Department of Fish and Wildlife and the U.S. Fish and Wildlife Service to put these ideas and recommendations into effect (**Ecosystem Restoration Recommendations 8 and 9**).

Water Quality

Pollution from the watershed is bad for the Delta ecosystem and for water users. The Delta Plan urges the responsible agencies—the State Water Resources Control Board, the Central Valley Regional Water Quality Control Board, and the San Francisco Bay Regional Water Quality Control Board—to protect "beneficial uses" of water in the Delta and Suisun Bay. Various ongoing projects of planning, rule-making, and construction should be brought to conclusion. All agencies should look at water quality when weighing actions covered under the Delta Plan. Special attention should be paid to pollution that might degrade habitat restoration sites. (**Water Quality Recommendations 1 through 12**.)

...In a Way that Protects and Enhances the Values of the Delta as an Evolving Place

Because of its role in greater systems—the San Francisco Estuary, the state water plumbing—the Delta is a subject of statewide debate. The conversation can seem to take place over the heads of the people who actually live in the region; and it can seem to overlook the lasting values of the place that is: its thriving agriculture, the beauty of its countryside, its cultural heritage, and its recreational bounty. The Delta Plan strives to redress this balance without promising what is probably impossible: the retention of the landscape exactly as it is today.

Honorific labels do not protect valuable assets, but they can help us recognize them. The Delta Plan asks that the Delta be declared a National Heritage Area by Congress and that Highway 160, its north-south artery, be designated a National Scenic Byway by the U.S. Department of Transportation (**Delta-as-Place Recommendations 1 and 2**).

Many Delta people fear that their concerns will be brushed aside as new water facilities and habitat restorations get under way. While deference cannot be guaranteed, the Delta Plan calls on the agencies to respect local plans in siting such projects, to minimize conflict when possible, and to buy land from willing sellers when they can (**Delta-as-Place Policy 2, DP Recommendation 4**).

The distinctive Delta landscape has been much altered by urban encroachment, often entailing higher flood risk. The Delta Protection Commission, created in 1992 and strengthened by the Delta Reform Act of 2009, oversees development in the core area called the Primary Zone: Local decisions affecting this zone can be appealed to the Commission and overturned by it. However, this authority does not extend to the peripheral Secondary Zone, where the development pressure is strongest. The Delta Plan tightens control further, steering new development to the 26,000 acres in the Peripheral Zone that are already earmarked for urbanization in local plans. Small housing developments that may occur outside these limits must meet high flood control standards (**Delta-as-Place Policy 1, Risk Reduction Policy 2**). (See Figure ES-2, Delta Communities.)

A little more bustle might actually benefit 11 historic small towns or settlements within the Delta, known as the legacy communities. Most are spaced along the Sacramento River: Freeport, Clarksburg, Hood, Courtland, Locke, Walnut Grove, Ryde, Isleton, and Rio Vista. Knightsen and Bethel Island are near the lower channel of the San Joaquin River. Planners at all levels should respect the character, and promote the vitality, of these places (**Delta-as-Place Recommendation 3**).

The Delta Protection Commission has written an Economic Sustainability Plan containing numerous ideas for the support of the region's farm economy, parks and recreation, and roads and infrastructure. The Delta Plan adapts many of these as **Delta-as-Place Recommendations 5 through 19**.

Flood Risk Reduction

In its primeval state, most of the Delta was wetland and slightly above sea level. Since levees created the modern islands and cultivation began, soils have subsided deeply. Many Delta tracts are strikingly below the level of the water in adjacent channels; rising sea level will make the differential worse. While the occasional levee break is part of Delta lore, multiple failures could bring disaster to the Delta landscape, economy, and ecosystem.

The Delta Plan urges all agencies in the Delta to plan for emergencies and to join forces in a regional response consortium, as proposed by the Delta Multi-Hazard Coordination Task Force. Every responsible party, public and private, should allocate money for flood prevention and reaction. Utilities should plan to minimize interruptions of service. The Department of Water Resources should expand its stockpiles of stone and earth for the use of all when breaches require rapid plugging. Higher levels of private flood insurance should be required, and the State should gain immunity from lawsuits related to flooding beyond its power to prevent. (**Risk Reduction Recommendations 1, 9, and 10**.)

It is estimated that only about half the Delta's acreage is adequately protected. There is not enough money for all the desirable improvements, nor is there a mechanism for sharing costs among all who benefit.

Delta Communities

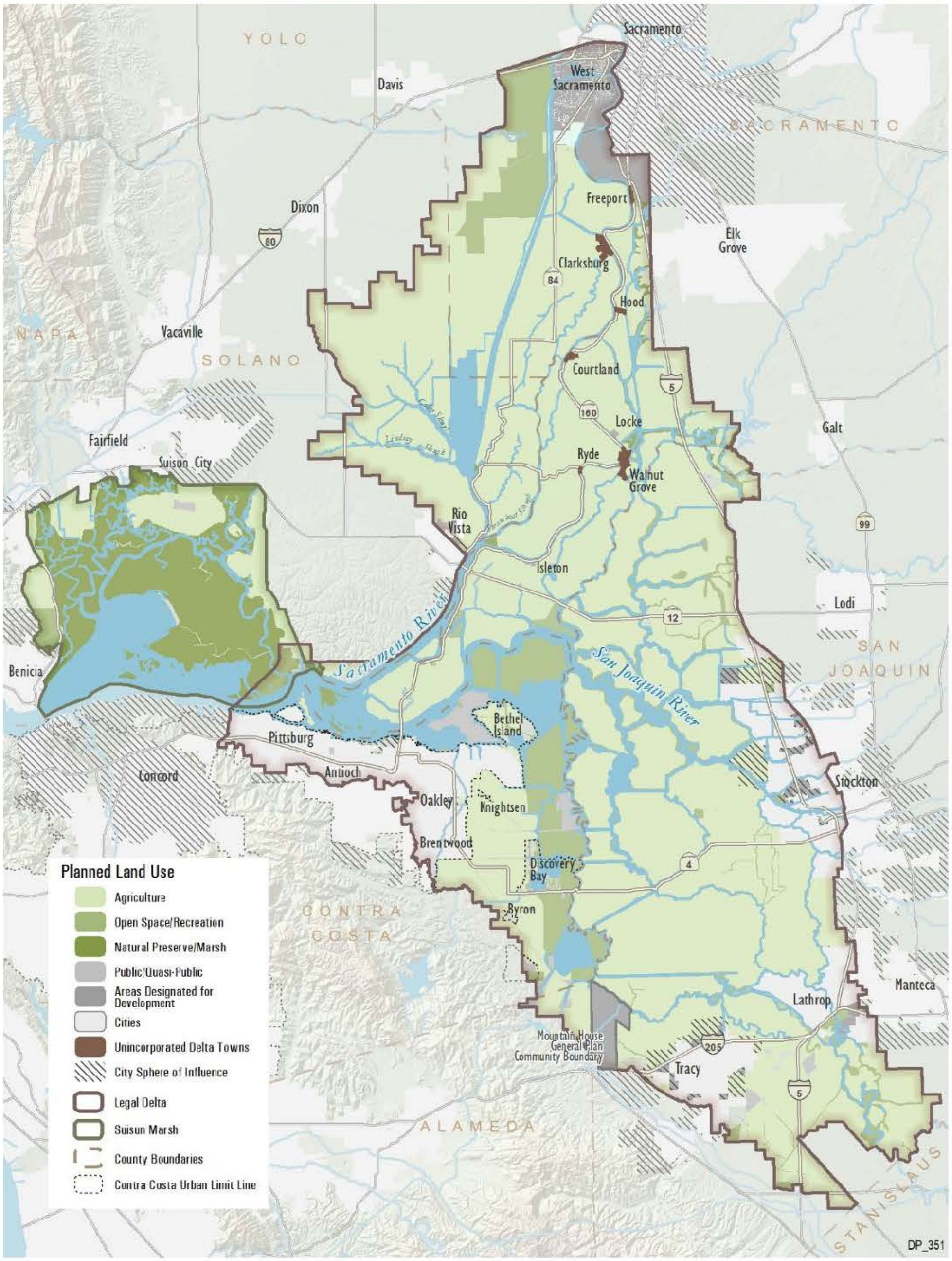

Figure ES-2 *Sources: City of Benicia 2003, Contra Costa County 2008, Contra Costa County 2010, City of Fairfield 2008, City of Lathrop 2012, City of Manteca 2012, Mountain House Community Services District 2008, City of Rio Vista 2001, SACOG 2009, City of Sacramento 2008, Sacramento County 2011, Sacramento County 2012, Sacramento County 2013, San Joaquin County 2008a, San Joaquin County 2008b, Solano County 2008a, Solano County 2008b, City of Stockton 2011a, City of Stockton 2011b, City of Suisun City 2011, City of Tracy 2011a, City of Tracy 2011b, City of West Sacramento 2010, Yolo County 2010a, Yolo County 2010b.*

There are more than 1,000 miles of Delta levees. The State is directly responsible for about one-third of the system; nearly 70 local Reclamation Districts are in charge of the rest. It is estimated that only about half the Delta's acreage is adequately protected. There is not enough money for all the desirable improvements, nor is there a mechanism for sharing costs among all who benefit. The Delta Plan calls on the Legislature to establish a locally based Delta Flood Risk Management Assessment District to raise money for combined defenses. Public and private utilities, too, should invest in defense of their facilities and lines. (**Risk Reduction Recommendations 2 and 3**.)

The State contributes massively to levee costs throughout the Delta, but on a not very systematic basis. The Legislature directed the Delta Stewardship Council to set priorities for these investments. **Risk Reduction Policy 1** offers broad principles. Urban areas come first; special attention must be paid to levees guarding roads and energy facilities. The channels through which water flows toward export pumps require protection, as does the pipeline that brings Sierra water across the Delta for the East Bay Municipal Utility District. Levees on the western islands, whose failure could bring salinity deep into the Delta, are also of high concern.

A more detailed study is to follow. Building on work being done by the Department of Water Resources, the Council will assess, island by island, the state of levees, the degree of subsidence, the extent and value of assets to be protected, and the cost of long-term defense. The result, due at the end of 2014, will be a tiered priority list for the expenditure of State levee funds (**Risk Reduction Recommendation 4**).

To take pressure off the levee system, floodwaters need room to move and to spread without causing harm (and often to the benefit of plants, birds, and fish). Two such safety valves already exist at the Yolo Bypass and the Cosumnes-Mokelumne floodplain; a third such zone is proposed for the lower San Joaquin River at Paradise Cut. The Delta Plan urges expansion of the flood relief system, and requires that present or potential overflow areas be kept free of encroachments. Levee setbacks are also encouraged. (**Risk Reduction Policies 3 and 4, RR Recommendations 5 through 8**.)

Given time, land subsidence can actually be reversed. Experimental plots show that soils can be deepened by growing tules in shallowly flooded fields, at a rate of a little over an inch a year. The tule plots also fix a lot of atmospheric carbon and thus do their bit toward slowing climate change. The Delta Plan encourages expansion of this work (**Delta-as-Place Recommendation 7**).

Finding the Way Through

When the first Spanish explorers took their boats into the Sacramento-San Joaquin River Delta, they were feeling their way. They could see the channel they were in, as far as the next bend or junction of sloughs. They had a general idea of where they were going. Between the near and the far, though, were mysteries. Which waterways connected to others, which petered out in the marshes? Where was the real way through?

Tangible marks of progress may at first be as subtle as shifting shoreline features seen from a Delta boat.

This first edition of the Delta Plan is a little like such an exploration. A short reach of channel is visible; another stretch can be assessed from local information. After that, the route is a matter of educated guesswork.

The Delta Plan can be fairly specific about steps to be taken in the next 5 years. The Delta Science Plan is already under way. The in-depth study of levees will begin by fall 2013. The Interagency Implementation Committee will meet by the end of the year. Just around the next bend, the State Water Resources Control Board will adopt its momentous new flow rules; a final decision on Delta conveyance (the Bay Delta Conservation Plan) looms beyond that.

It will not have escaped the reader how many of these measures seem rather abstract, involving studies, rule-making, the gathering of information, the refining of procedures, the testing of powers—not so much doing as planning, and even planning how to plan. This is simply the phase we are in. Tangible marks of progress may at first be as subtle as shifting shoreline features seen from a Delta boat. Here, though, are some markers to look for. We will be doing well if, in a few years' time:

- Many urban and rural water suppliers that draw on the Delta have taken real steps to reduce that reliance, with measured, reported results.
- Flows in Delta channels, controlled under new State Water Resources Control Board rules, are looking a good deal more like the historical ones.
- Several new habitat restoration projects in the Delta have moved from the planning to the construction stage.
- Subsidence reversal planting has expanded from the small pilot projects seen today.
- Measurably less acreage of Delta waters is dominated by nonnative water plants.
- Stocks of endangered fish are showing a rebound.
- Key levees have been strengthened, especially in the environs of Stockton and Sacramento.
- No further rural farmland has been lost to urbanization.

The next edition of the Delta Plan, due in 2018 or sooner, will be a little longer on specifics and a little shorter on question marks. A few more miles of the channel ahead will have come into view. New uncertainties, no doubt, will have replaced old. The captains will continue to disagree. But, just as it was in the old days, the route through the Delta will be the one way forward.

Beyond all local debates and confusions, the destination is clear. We want a Delta landscape that remains essentially itself while adapting gradually and gracefully to a future marked by climate change and sea level rise. We want a Delta ecosystem that works markedly better than today's, reflected partly in a resurgence of native fish. And we want an end to the endless wrangling about Delta flows and plumbing—a truce that can only be achieved if the entire California water system undergoes a measure of reform.

In solving the "Delta problem," we will not only be doing right by a treasured land- and waterscape. We will be putting the entire state of California on a sounder development path.

Driven by cost, environmental concern, and sheer practicality, the water world is already shifting away from reliance on distant dams and aqueducts and toward trust in conservation, local sources, and better use of groundwater storage. This change is reflected in the fact, startling to many, that California's total water consumption has not climbed in recent years; in fact, despite our increasing population, use has slightly dropped. The Delta Plan gives a push to trends already under way.

In solving the "Delta problem," we will not only be doing right by a treasured land- and waterscape. We will be putting the entire state of California on a sounder development path.

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Chapter divider *(clockwise from top left)***:** California Department of Water Resources, Chris Austin, L.A. Yarbrough, California Department of Water Resources

Delta Plan Policies and Recommendations

The Delta Plan contains a set of regulatory policies that will be enforced by the Delta Stewardship Council's appellate authority and oversight. The Delta Plan also contains priority recommendations, which are nonregulatory but call out actions essential to achieving the coequal goals.

POLICY OR RECOMMENDATION NUMBER	SHORT TITLE	POLICY/RECOMMENDATION LANGUAGE
Chapter 2		
G P1 (23 CCR section 5002)	Detailed Findings to Establish Consistency with the Delta Plan	*(a) This policy specifies what must be addressed in a certification of consistency filed by a State or local public agency with regard to a covered action. This policy only applies after a "proposed action" has been determined by a State or local public agency to be a covered action because it is covered by one or more of the regulatory policies contained in Article 3. Inconsistency with this policy may be the basis for an appeal.* *(b) Certifications of consistency must include detailed findings that address each of the following requirements:* *(1) Covered actions, in order to be consistent with the Delta Plan, must be consistent with this regulatory policy and with each of the regulatory policies contained in Article 3 implicated by the covered action. The Delta Stewardship Council acknowledges that in some cases, based upon the nature of the covered action, full consistency with all relevant regulatory policies may not be feasible. In those cases, the agency that files the certification of consistency may nevertheless determine that the covered action is consistent with the Delta Plan because, on whole, that action is consistent with the coequal goals. That determination must include a clear identification of areas where consistency with relevant regulatory policies is not feasible, an explanation of the reasons why it is not feasible, and an explanation of how the covered action nevertheless, on whole, is consistent with the coequal goals. That determination is subject to review by the Delta Stewardship Council on appeal;* *(2) Covered actions not exempt from CEQA must include applicable feasible mitigation measures identified in the Delta Plan's Program EIR (unless the measure(s) are within the exclusive jurisdiction of an agency other than the agency that files the certification of consistency), or substitute mitigation measures that the agency that files the certification of consistency finds are equally or more effective;* *(3) As relevant to the purpose and nature of the project, all covered actions must document use of best available science;* *(4) Ecosystem restoration and water management covered actions must include adequate provisions, appropriate to the scope of the covered action, to assure continued implementation of adaptive management. This requirement shall be satisfied through both of the following:* *(A) An adaptive management plan that describes the approach to be taken consistent with the adaptive management framework in Appendix 1B, and* *(B) Documentation of access to adequate resources and delineated authority by the entity responsible for the implementation of the proposed adaptive management process.*

POLICY OR RECOMMENDATION NUMBER	SHORT TITLE	POLICY/RECOMMENDATION LANGUAGE
		(c) A conservation measure proposed to be implemented pursuant to a natural community conservation plan or a habitat conservation plan that was: *(1) Developed by a local government in the Delta; and* *(2) Approved and permitted by the California Department of Fish and Wildlife prior to May 16, 2013* *is deemed to be consistent with sections 5005 through 5009 of this Chapter if the certification of consistency filed with regard to the conservation measure includes a statement confirming the nature of the conservation measure from the California Department of Fish and Wildlife.*
G R1	Development of a Delta Science Plan	*The Delta Stewardship Council's Delta Science Program should develop a Delta Science Plan by December 31, 2013. The Delta Science Program should work with the Interagency Ecological Program, Bay Delta Conservation Plan, California Department of Fish and Wildlife, and other agencies to develop the Delta Science Plan. To ensure that best science is used to develop the Delta Science Plan, the Delta Independent Science Board should review the draft Delta Science Plan.* *The Delta Science Plan should address the following:* ▪ *A collaborative institutional and organizational structure for conducting science in the Delta* ▪ *Data management, synthesis, scientific exchange, and communication strategies to support adaptive management and improve the accessibility of information* ▪ *Strategies for addressing uncertainty and conflicting scientific information* ▪ *The prioritization of research and balancing of the short-term immediate science needs with science that enhances comprehensive understanding of the Delta system over the long term* ▪ *Identification of existing and future needs for refining and developing numerical and simulation models along with enhancing existing Delta conceptual models (e.g., the Interagency Ecological Program (IEP) Pelagic Organism Decline (POD) and the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) models)* ▪ *An integrated approach for monitoring that incorporates existing and future monitoring efforts* ▪ *An assessment of financial needs and funding sources to support science*
Chapter 3		
WR P1 (23 CCR section 5003)	Reduce Reliance on the Delta through Improved Regional Water Self-Reliance	*(a) Water shall not be exported from, transferred through, or used in the Delta if all of the following apply:* *(1) One or more water suppliers that would receive water as a result of the export, transfer, or use have failed to adequately contribute to reduced reliance on the Delta and improved regional self-reliance consistent with all of the requirements listed in paragraph (1) of subsection (c);* *(2) That failure has significantly caused the need for the export, transfer, or use; and* *(3) The export, transfer, or use would have a significant adverse environmental impact in the Delta.*

POLICY OR RECOMMENDATION NUMBER	SHORT TITLE	POLICY/RECOMMENDATION LANGUAGE
		(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action to export water from, transfer water through, or use water in the Delta, but does not cover any such action unless one or more water suppliers would receive water as a result of the proposed action. *(c) (1) Water suppliers that have done all of the following are contributing to reduced reliance on the Delta and improved regional self-reliance and are therefore consistent with this policy:* *(A) Completed a current Urban or Agricultural Water Management Plan (Plan) which has been reviewed by the California Department of Water Resources for compliance with the applicable requirements of Water Code Division 6, Parts 2.55, 2.6, and 2.8;* *(B) Identified, evaluated, and commenced implementation, consistent with the implementation schedule set forth in the Plan, of all programs and projects included in the Plan that are locally cost effective and technically feasible which reduce reliance on the Delta; and* *(C) Included in the Plan, commencing in 2015, the expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance. The expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance shall be reported in the Plan as the reduction in the amount of water used, or in the percentage of water used, from the Delta watershed. For the purposes of reporting, water efficiency is considered a new source of water supply, consistent with Water Code section 1011(a).* *(2) Programs and projects that reduce reliance could include, but are not limited to, improvements in water use efficiency, water recycling, stormwater capture and use, advanced water technologies, conjunctive use projects, local and regional water supply and storage projects, and improved regional coordination of local and regional water supply efforts.*
WR R1	Implement Water Efficiency and Water Management Planning Laws	*All water suppliers should fully implement applicable water efficiency and water management laws, including urban water management plans (Water Code section 10610 et seq.); the 20 percent reduction in statewide urban per capita water usage by 2020 (Water Code section 10608 et seq.); agricultural water management plans (Water Code section 10608 et seq. and 10800 et seq.); and other applicable water laws, regulations, or rules.*
WR R2	Require SWP Contractors to Implement Water Efficiency and Water Management Laws	*The California Department of Water Resources should include a provision in all State Water Project contracts, contract amendments, contract renewals, and water transfer agreements that requires the implementation of all State water efficiency and water management laws, goals, and regulations, including compliance with Water Code section 85021.*
WR R3	Compliance with Reasonable and Beneficial Use	*The State Water Resources Control Board should evaluate all applications and petitions for a new water right or a new or changed point of diversion, place of use, or purpose of use that would result in new or increased long-term average use of water from the Delta watershed for consistency with the constitutional principle of reasonable and beneficial use. The State Water Resources Control Board should conduct its evaluation consistent with Water Code sections 85021, 85023, 85031, and other provisions of California law. An applicant or*

POLICY OR RECOMMENDATION NUMBER	SHORT TITLE	POLICY/RECOMMENDATION LANGUAGE
		petitioner should submit to the State Water Resources Control Board sufficient information to support findings of consistency, including, as applicable, its urban water management plan, agricultural water management plan, and environmental documents prepared pursuant to the California Environmental Quality Act.
WR R4	Expanded Water Supply Reliability Element	*Water suppliers that receive water from the Delta watershed should include an expanded water supply reliability element, starting in 2015, as part of the update of an urban water management plan, agricultural water management plan, integrated water management plan, or other plan that provides equivalent information about the supplier's planned investments in water conservation and water supply development. The expanded water supply reliability element should detail how water suppliers are reducing reliance on the Delta and improving regional self-reliance consistent with Water Code section 85201 through investments in local and regional programs and projects, and should document the expected outcome for a measurable reduction in reliance on the Delta and improvement in regional self-reliance. At a minimum, these plans should include a plan for possible interruption of water supplies for up to 36 months due to catastrophic events impacting the Delta, evaluation of the regional water balance, a climate change vulnerability assessment, and an evaluation of the extent to which the supplier's rate structure promotes and sustains efficient water use.*
WR R5	Develop Water Supply Reliability Element Guidelines	*The California Department of Water Resources, in consultation with the Delta Stewardship Council, the State Water Resources Control Board, and others, should develop and approve, by December 31, 2014, guidelines for the preparation of a water supply reliability element so that water suppliers can begin implementation of WR R4 by 2015.*
WR R6	Update Water Efficiency Goals	*The California Department of Water Resources and the State Water Resources Control Board should establish an advisory group with other State agencies and stakeholders to identify and implement measures to reduce impediments to achievement of statewide water conservation, recycled water, and stormwater goals by 2014. This group should evaluate and recommend updated goals for additional water efficiency and water resource development by 2018. Issues such as water distribution system leakage should be addressed. Evaluation should include an assessment of how regions are achieving their proportional share of these goals.*
WR R7	Revise State Grant and Loan Priorities	*The California Department of Water Resources, the State Water Resources Control Board, the California Department of Public Health, and other agencies, in consultation with the Delta Stewardship Council, should revise State grant and loan ranking criteria by December 31, 2013, to be consistent with Water Code section 85021 and to provide a priority for water suppliers that includes an expanded water supply reliability element in their adopted urban water management plans, agricultural water management plans, and/or integrated regional water management plans.*
WR R8	Demonstrate State Leadership	*All State agencies should take a leadership role in designing new and retrofitted State-owned and -leased facilities, including buildings and California Department of Transportation facilities, to increase water efficiency, use recycled water, and incorporate stormwater runoff capture and low-impact development strategies.*

POLICY OR RECOMMENDATION NUMBER	SHORT TITLE	POLICY/RECOMMENDATION LANGUAGE
WR R9	Update Bulletin 118, California's Groundwater Plan	*The California Department of Water Resources, in consultation with the Bureau of Reclamation, U.S. Geological Survey, the State Water Resources Control Board, and other agencies and stakeholders should update Bulletin 118 information using field data, California Statewide Groundwater Elevation Monitoring (CASGEM), groundwater agency reports, satellite imagery, and other best available science by December 31, 2014, so that this information can be included in the next California Water Plan Update and be available for inclusion in 2015 urban water management plans and agricultural water management plans. The Bulletin 118 update should include a systematic evaluation of major groundwater basins to determine sustainable yield and overdraft status; a projection of California's groundwater resources in 20 years if current groundwater management trends remain unchanged; anticipated impacts of climate change on surface water and groundwater resources; and recommendations for State, federal, and local actions to improve groundwater management. In addition, the Bulletin 118 update should identify groundwater basins that are in a critical condition of overdraft.*
WR R10	Implement Groundwater Management Plans in Areas that Receive Water from the Delta Watershed	*Water suppliers that receive water from the Delta watershed and that obtain a significant percentage of their long-term average water supplies from groundwater sources should develop and implement sustainable groundwater management plans that are consistent with both the required and recommended components of local groundwater management plans identified by the California Department of Water Resources Bulletin 118 (Update 2003) by December 31, 2014.*
WR R11	Recover and Manage Critically Overdrafted Groundwater Basins	*Local and regional agencies in groundwater basins that have been identified by the California Department of Water Resources as being in a critical condition of overdraft should develop and implement a sustainable groundwater management plan, consistent with both the required and recommended components of local groundwater management plans identified by the California Department of Water Resources Bulletin 118 (Update 2003), by December 31, 2014. If local or regional agencies fail to develop and implement these plans, the State Water Resources Control Board should take action to determine if the continued overuse of a groundwater basin constitutes a violation of the State's Constitution Article X, Section 2, prohibition on unreasonable use of water and whether a groundwater adjudication is necessary to prevent the destruction of or irreparable injury to the quality of the groundwater, consistent with Water Code sections 2100 and 2101.*
WR R12	Complete Bay Delta Conservation Plan	*The relevant federal, State, and local agencies should complete the Bay Delta Conservation Plan, consistent with the provisions of the Delta Reform Act, and receive required incidental take permits by December 31, 2014.*
WR R13	Complete Surface Water Storage Studies	*The California Department of Water Resources should complete surface water storage investigations of proposed off-stream surface storage projects by December 31, 2012, including an evaluation of potential additional benefits of integrating operations of new storage with proposed Delta conveyance improvements, and recommend the critical projects that need to be implemented to expand the state's surface storage.*
WR R14	Identify Near-term Opportunities for Storage, Use, and Water Transfer Projects	*The California Department of Water Resources, in coordination with the California Water Commission, Bureau of Reclamation, State Water Resources Control Board, California Department of Public Health, the Delta Stewardship Council, and other agencies and stakeholders, should conduct a survey to identify projects throughout California that could be implemented within the next 5 to 10 years to expand existing surface and groundwater storage facilities, create new storage, improve operation of existing Delta conveyance*

POLICY OR RECOMMENDATION NUMBER	SHORT TITLE	POLICY/RECOMMENDATION LANGUAGE
		facilities, and enhance opportunities for conjunctive use programs and water transfers in furtherance of the coequal goals. The California Water Commission should hold hearings and provide recommendations to the California Department of Water Resources on priority projects and funding.
WR R15	Improve Water Transfer Procedures	*The California Department of Water Resources and the State Water Resources Control Board should work with stakeholders to identify and recommend measures to reduce procedural and administrative impediments to water transfers and protect water rights and environmental resources by December 31, 2016. These recommendations should include measures to address potential issues with recurring transfers of up to 1 year in duration and improved public notification for proposed water transfers.*
WR P2 (23 CCR section 5004)	Transparency in Water Contracting	*(a) The contracting process for water from the State Water Project and/or the Central Valley Project must be done in a publicly transparent manner consistent with applicable policies of the California Department of Water Resources and the Bureau of Reclamation referenced below.* *(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers the following:* *(1) With regard to water from the State Water Project, a proposed action to enter into or amend a water supply or water transfer contract subject to California Department of Water Resources Guidelines 03-09 and/or 03-10 (each dated July 3, 2003), which are attached as Appendix 2A; and* *(2) With regard to water from the Central Valley Project, a proposed action to enter into or amend a water supply or water transfer contract subject to section 226 of P.L. 97-293, as amended or section 3405(a)(2)(B) of the Central Valley Project Improvement Act, Title XXXIV of Public Law 102-575, as amended, which are attached as Appendix 2B, and Rules and Regulations promulgated by the Secretary of the Interior to implement these laws.*
WR R16	Supplemental Water Use Reporting	*The State Water Resources Control Board should require water rights holders submitting supplemental statements of water diversion and use or progress reports under their permits or licenses to report on the development and implementation of all water efficiency and water supply projects and on their net (consumptive) use.*
WR R17	Integrated Statewide System for Water Use Reporting	*The California Department of Water Resources, in coordination with the State Water Resources Control Board, California Department of Public Health, California Public Utilities Commission, California Energy Commission, Bureau of Reclamation, California Urban Water Conservation Council, and other stakeholders, should develop a coordinated statewide system for water use reporting. This system should incorporate recommendations for inclusion of data needed to better manage California's water resources. The system should be designed to simplify reporting; reduce the number of required reports where possible; be made available to the public online; and be integrated with the reporting requirements for the urban water management plans, agricultural water management plans, and integrated regional water management plans. Water suppliers that export water from, transfer water through, or use water in the Delta watershed should be full participants in the data base.*

POLICY OR RECOMMENDATION NUMBER	SHORT TITLE	POLICY/RECOMMENDATION LANGUAGE
WR R18	California Water Plan	*The California Department of Water Resources, in consultation with the State Water Resources Control Board, and other agencies and stakeholders, should evaluate and include in the next and all future California Water Plan updates information needed to track water supply reliability performance measures identified in the Delta Plan, including an assessment of water efficiency and new water supply development, regional water balances, improvements in regional self-reliance, reduced regional reliance on the Delta, and reliability of Delta exports, and an overall assessment of progress in achieving the coequal goals.*
WR R19	Financial Needs Assessment	*As part of the California Water Plan Update, the California Department of Water Resources should prepare an assessment of the state's water infrastructure. This should include the costs of rehabilitating/replacing existing infrastructure, an assessment of the costs of new infrastructure, and an assessment of needed resources for monitoring and adaptive management for these projects. The California Department of Water Resources should also consider a survey of agencies that may be planning small-scale projects (such as storage or conveyance) that improve water supply reliability.*
Chapter 4		
ER P1 (23 CCR section 5005)	Delta Flow Objectives	*(a) The State Water Resources Control Board's Bay Delta Water Quality Control Plan flow objectives shall be used to determine consistency with the Delta Plan. If and when the flow objectives are revised by the State Water Resources Control Board, the revised flow objectives shall be used to determine consistency with the Delta Plan.* *(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, the policy set forth in subsection (a) covers a proposed action that could significantly affect flow in the Delta.*
ER R1	Update Delta Flow Objectives	*Development, implementation, and enforcement of new and updated flow objectives for the Delta and high-priority tributaries are key to the achievement of the coequal goals. The State Water Resources Control Board should update the Bay Delta Water Quality Control Plan objectives as follows:* *(a) By June 2, 2014, adopt and implement updated flow objectives for the Delta that are necessary to achieve the coequal goals.* *(b) By June 2, 2018, adopt, and as soon as reasonably possible, implement flow objectives for high-priority tributaries in the Delta watershed that are necessary to achieve the coequal goals.*[1] *Flow objectives could be implemented through several mechanisms including negotiation and settlement, Federal Energy Regulatory Commission relicensing, or adjudicative proceeding.*[2] *Prior to the establishment of revised flow objectives identified above, the existing Bay Delta Water Quality Control Plan objectives shall be used to determine consistency with the Delta Plan. After the flow objectives are revised, the revised objectives shall be used to determine consistency with the Delta Plan.*

[1] SWRCB staff should work with the Council and DFW to determine priority streams. As an illustrative example, priority streams could include the Merced River, Tuolumne River, Stanislaus River, Lower San Joaquin River, Deer Creek (tributary to Sacramento River), Lower Butte Creek, Mill Creek (tributary to Sacramento River), Cosumnes River, and American River. Implementation through hearings is expected to take longer than the deadline shown here.

[2] Implementation through adjudicative proceedings or FERC relicensing is expected to take longer than the deadline shown here.

POLICY OR RECOMMENDATION NUMBER	SHORT TITLE	POLICY/RECOMMENDATION LANGUAGE
ER P2 (23 CCR section 5006)	Restore Habitats at Appropriate Elevations	*(a) Habitat restoration must be carried out consistent with Appendix 3, which is Section II of the Draft Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions (California Department of Fish and Wildlife 2011). The elevation map attached as Appendix 4 should be used as a guide for determining appropriate habitat restoration actions based on an area's elevation. If a proposed habitat restoration action is not consistent with Appendix 4, the proposal shall provide rationale for the deviation based on best available science.* *(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that includes habitat restoration.*
ER P3 (23 CCR section 5007)	Protect Opportunities to Restore Habitat	*(a) Within the priority habitat restoration areas depicted in Appendix 5, significant adverse impacts to the opportunity to restore habitat as described in section 5006, must be avoided or mitigated.* *(b) Impacts referenced in subsection (a) will be deemed to be avoided or mitigated if the project is designed and implemented so that it will not preclude or otherwise interfere with the ability to restore habitat as described in section 5006.* *(c) Impacts referenced in subsection (a) shall be mitigated to a point where the impacts have no significant effect on the opportunity to restore habitat as described in section 5006. Mitigation shall be determined, in consultation with the California Department of Fish and Wildlife, considering the size of the area impacted by the covered action and the type and value of habitat that could be restored on that area, taking into account existing and proposed restoration plans, landscape attributes, the elevation map shown in Appendix 4, and other relevant information about habitat restoration opportunities of the area.* *(d) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers proposed actions in the priority habitat restoration areas depicted in Appendix 5. It does not cover proposed actions outside those areas.*
ER P4 (23 CCR section 5008)	Expand Floodplains and Riparian Habitats in Levee Projects	*(a) Levee projects must evaluate and where feasible incorporate alternatives, including the use of setback levees, to increase floodplains and riparian habitats. Evaluation of setback levees in the Delta shall be required only in the following areas (shown in Appendix 8): (1) The Sacramento River between Freeport and Walnut Grove, the San Joaquin River from the Delta boundary to Mossdale, Paradise Cut, Steamboat Slough, Sutter Slough; and the North and South Forks of the Mokelumne River, and (2) Urban levee improvement projects in the cities of West Sacramento and Sacramento.* *(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action to construct new levees or substantially rehabilitate or reconstruct existing levees.*
ER R2	Prioritize and Implement Projects that Restore Delta Habitat	*Bay Delta Conservation Plan implementers, California Department of Fish and Wildlife, California Department of Water Resources, and the Delta Conservancy should prioritize and implement habitat restoration projects in the areas shown on Figure 4-8. Habitat restoration projects should ensure connections between areas being restored and existing habitat areas and other elements of the landscape needed for the full life cycle of the species that will benefit from the restoration project.*

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		Where possible, restoration projects should also emphasize the potential for improving water quality. Restoration project proponents should consult the California Department of Public Health's Best Management Practices for Mosquito Control in California*.* ▪ ***Yolo Bypass.*** *Enhance the ability of the Yolo Bypass to flood more frequently to provide more opportunities for migrating fish, especially Chinook salmon, to use this system as a migration corridor that is rich in cover and food.* ▪ ***Cache Slough Complex.*** *Create broad nontidal, freshwater, emergent-plant-dominated wetlands that grade into tidal freshwater wetlands, and shallow subtidal and deep open-water habitats. Also, return a significant portion of the region to uplands with vernal pools and grasslands.* ▪ ***Cosumnes River–Mokelumne River confluence.*** *Allow these unregulated and minimally regulated rivers to flood over their banks during winter and spring frequently and regularly to create seasonal floodplains and riparian habitats that grade into tidal marsh and shallow subtidal habitats.* ▪ ***Lower San Joaquin River floodplain.*** *Reconnect the floodplain and restore more natural flows to stimulate food webs that support native species. Integrate habitat restoration with flood management actions, when feasible.* ▪ ***Suisun Marsh.*** *Restore significant portions of Suisun Marsh to brackish marsh with land-water interactions to support productive, complex food webs to which native species are adapted and to provide space to adapt to rising sea level action. Use information from adaptive management processes during the Suisun Marsh Habitat Management, Preservation, and Restoration Plan's implementation to guide future habitat restoration projects and to inform future tidal marsh management.* ▪ ***Western Delta/Eastern Contra Costa County.*** *Restore tidal marsh and channel margin habitat at Dutch Slough and western islands to support food webs and provide habitat for native species.*
ER R3	Complete and Implement Delta Conservancy Strategic Plan	*As part of its Strategic Plan and subsequent Implementation Plan or annual work plans, the Delta Conservancy should:* ▪ *Develop and adopt criteria for prioritization and integration of large-scale ecosystem restoration in the Delta and Suisun Marsh, with sustainability and use of best available science as foundational principles.* ▪ *Develop and adopt processes for ownership and long-term operations and management of land in the Delta and Suisun Marsh acquired for conservation or restoration.* ▪ *Develop and adopt a formal mutual agreement with the California Department of Water Resources, California Department of Fish and Wildlife, federal interests, and other State and local agencies on implementation of ecosystem restoration in the Delta and Suisun Marsh.* ▪ *Develop, in conjunction with the Wildlife Conservation Board, the California Department of Water Resources, California Department of Fish and Wildlife, Bay Delta Conservation Plan implementers, and other State and local agencies, a plan and protocol for acquiring the land necessary to achieve ecosystem restoration consistent with the coequal goals and the Ecosystem Restoration Program Conservation Strategy.*

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		▪ *Lead an effort, working with State and federal fish agencies, to investigate how to better use habitat credit agreements to provide credit for each of these steps: (1) acquisition for future restoration; (2) preservation, management, and enhancement of existing habitat; (3) restoration of habitat; and (4) monitoring and evaluation of habitat restoration projects.* ▪ *Work with the California Department of Fish and Wildlife and the U.S. Fish and Wildlife Service to develop rules for voluntary safe harbor agreements with property owners in the Delta whose actions contribute to the recovery of listed threatened or endangered species.*
ER R4	Exempt Delta Levees from the U.S. Army Corps of Engineers' Vegetation Policy	*Considering the ecosystem value of remaining riparian and shaded riverine aquatic habitat along Delta levees, the U.S. Army Corps of Engineers should agree with the California Department of Fish and Wildlife and the California Department of Water Resources on a variance that exempts Delta levees from the U.S. Army Corps of Engineers' levee vegetation policy where appropriate.*
ER R5	Update the Suisun Marsh Protection Plan	*The San Francisco Bay Conservation and Development Commission should update the Suisun Marsh Protection Plan and relevant components of the Suisun Marsh Local Protection Program to adapt to sea level rise and ensure consistency with the Suisun Marsh Preservation Act, the Delta Reform Act, and the Delta Plan.*
ER P5 (23 CCR section 5009)	Avoid Introductions of and Habitat Improvements for Invasive Nonnative Species	*(a) The potential for new introductions of or improved habitat conditions for nonnative invasive species, striped bass, or bass must be fully considered and avoided or mitigated in a way that appropriately protects the ecosystem.* *(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that has the reasonable probability of introducing or improving habitat conditions for nonnative invasive species.*
ER R6	Regulate Angling for Nonnative Sport Fish to Protect Native Fish	*The California Department of Fish and Wildlife should develop, for consideration by the Fish and Game Commission, proposals for new or revised fishing regulations designed to increase populations of listed fish species through reduced predation by introduced sport fish. The proposals should be based on sound science that demonstrates these management actions are likely to achieve their intended outcome and include the development of performance measures and a monitoring plan to support adaptive management.*
ER R7	Prioritize and Implement Actions to Control Nonnative Invasive Species	*The California Department of Fish and Wildlife and other appropriate agencies should prioritize and fully implement the list of "Stage 2 Actions for Nonnative Invasive Species" and accompanying text shown in Appendix J taken from the* Conservation Strategy for Restoration of the Sacramento–San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions *(DFG 2011). Implementation of the Stage 2 actions should include the development of performance measures and monitoring plans to support adaptive management.*
ER R8	Manage Hatcheries to Reduce Genetic Risk	*As required by the National Marine Fisheries Service, all hatcheries providing listed fish for release into the wild should continue to develop and implement scientifically sound Hatchery and Genetic Management Plans (HGMPs) to reduce risks to those species. The California Department of Fish and Wildlife should provide annual updates to the Delta Stewardship Council on the status of HGMPs within its jurisdiction.*

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ER R9	Implement Marking and Tagging Program	*By December 2014, the California Department of Fish and Wildlife, in cooperation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, should revise and begin implementing its program for marking and tagging hatchery salmon and steelhead to improve management of hatchery and wild stocks based on recommendations of the California Hatchery Scientific Review Group, which considered mass marking, reducing hatchery programs, and mark selective fisheries in developing its recommendations.*
Chapter 5		
DP R1	Designate the Delta as a National Heritage Area	*The Delta Protection Commission should complete its application for designation of the Delta and Suisun Marsh as a National Heritage Area, and the federal government should complete the process in a timely manner.*
DP R2	Designate State Route 160 as a National Scenic Byway	*The California Department of Transportation should seek designation of State Route 160 as a National Scenic Byway, and prepare and implement a scenic byway plan for it.*
DP P1 (23 CCR section 5010)	Locate New Urban Development Wisely	*(a) New residential, commercial, and industrial development must be limited to the following areas, as shown in Appendix 6 and Appendix 7:* *(1) Areas that city or county general plans as of May 16, 2013, designate for residential, commercial, and industrial development in cities or their spheres of influence;* *(2) Areas within Contra Costa County's 2006 voter-approved urban limit line, except no new residential, commercial, and industrial development may occur on Bethel Island unless it is consistent with the Contra Costa County general plan effective as of May 16, 2013;* *(3) Areas within the Mountain House General Plan Community Boundary in San Joaquin County; or* *(4) The unincorporated Delta towns of Clarksburg, Courtland, Hood, Locke, Ryde, and Walnut Grove.* *(b) Notwithstanding subsection (a), new residential, commercial, and industrial development is permitted outside the areas described in subsection (a) if it is consistent with the land uses designated in county general plans as of May 16, 2013, and is otherwise consistent with this Chapter.* *(c) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers proposed actions that involve new residential, commercial, and industrial development that is not located within the areas described in subsection (a). In addition, this policy covers any such action on Bethel Island that is inconsistent with the Contra Costa County general plan effective as of May 16, 2013. This policy does not cover commercial recreational visitor-serving uses or facilities for processing of local crops or that provide essential services to local farms, which are otherwise consistent with this Chapter.* *(d) This policy is not intended in any way to alter the concurrent authority of the Delta Protection Commission to separately regulate development in the Delta's Primary Zone.*

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DP P2 (23 CCR section 5011)	Respect Local Land Use When Siting Water or Flood Facilities or Restoring Habitats	(a) *Water management facilities, ecosystem restoration, and flood management infrastructure must be sited to avoid or reduce conflicts with existing uses or those uses described or depicted in city and county general plans for their jurisdictions or spheres of influence when feasible, considering comments from local agencies and the Delta Protection Commission. Plans for ecosystem restoration must consider sites on existing public lands, when feasible and consistent with a project's purpose, before privately owned sites are purchased. Measures to mitigate conflicts with adjacent uses may include, but are not limited to, buffers to prevent adverse effects on adjacent farmland.* (b) *For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers proposed actions that involve the siting of water management facilities, ecosystem restoration, and flood management infrastructure.*
DP R3	Plan for the Vitality and Preservation of Legacy Communities	*Local governments, in cooperation with the Delta Protection Commission and Delta Conservancy, should prepare plans for each community that emphasize its distinctive character, encourage historic preservation, identify opportunities to encourage tourism, serve surrounding lands, or develop other appropriate uses, and reduce flood risks.*
DP R4	Buy Rights of Way from Willing Sellers When Feasible	*Agencies acquiring land for water management facilities, ecosystem restoration, and flood management infrastructure should purchase from willing sellers, when feasible, including consideration of whether lands suitable for proposed projects are available at fair prices.*
DP R5	Provide Adequate Infrastructure	*The California Department of Transportation, local agencies, and utilities should plan infrastructure, such as roads and highways, to meet needs of development consistent with sustainable community strategies, local plans, the Delta Protection Commission's* Land Use and Resource Management Plan for the Primary Zone of the Delta*, and the Delta Plan.*
DP R6	Plan for State Highways	*The Delta Stewardship Council, as part of the prioritization of State levee investments called for in Water Code section 85306, should consult with the California Department of Transportation as provided in Water Code section 85307(c) to consider the effects of flood hazards and sea level rise on State highways in the Delta.*
DP R7	Subsidence Reduction and Reversal	*The following actions should be considered by the appropriate State agencies to address subsidence reversal:* ▪ *State agencies should not renew or enter into agricultural leases on Delta or Suisun Marsh islands if the actions of the lessee promote or contribute to subsidence on the leased land, unless the lessee participates in subsidence reversal or reduction programs.* ▪ *State agencies currently conducting subsidence reversal projects in the Delta on State-owned lands should investigate options for scaling up these projects if they have been deemed successful. The California Department of Water Resources should develop a plan, including funding needs, for increasing the extent of their subsidence reversal and carbon sequestration projects to 5,000 acres by January 1, 2017.* ▪ *The Delta Stewardship Council, in conjunction with the California Air Resources Board (CARB) and the Delta Conservancy, should investigate the opportunity for the development of a carbon market whereby Delta farmers could receive credit for carbon sequestration by reducing subsidence and growing native marsh and wetland plants. This investigation should include the potential for developing offset protocols applicable to these types of plants for subsequent adoption by the CARB.*

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DP R8	Promote Value-added Crop Processing	*Local governments and economic development organizations, in cooperation with the Delta Protection Commission and the Delta Conservancy, should encourage value-added processing of Delta crops in appropriate locations.*
DP R9	Encourage Agritourism	*Local governments and economic development organizations, in cooperation with the Delta Protection Commission and the Delta Conservancy, should support growth in agritourism, particularly in and around legacy communities. Local plans should support agritourism where appropriate.*
DP R10	Encourage Wildlife-friendly Farming	*The California Department of Fish and Wildlife, the Delta Conservancy, and other ecosystem restoration agencies should encourage habitat enhancement and wildlife-friendly farming systems on agricultural lands to benefit both the environment and agriculture.*
DP R11	Provide New and Protect Existing Recreation Opportunities	*Water management and ecosystem restoration agencies should provide recreation opportunities, including visitor-serving business opportunities, at new facilities and habitat areas whenever feasible; and existing recreation facilities should be protected, using California State Parks'* Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh *and Delta Protection Commission's* Economic Sustainability Plan for the Sacramento-San Joaquin Delta *as guides.*
DP R12	Encourage Partnerships to Support Recreation and Tourism	*The Delta Protection Commission and Delta Conservancy should encourage partnerships between other State and local agencies, and local landowners and business people to expand recreation, including boating, promote tourism, and minimize adverse impacts to nonrecreational landowners.*
DP R13	Expand State Recreation Areas	*California State Parks should add or improve recreation facilities in the Delta in cooperation with other agencies. As funds become available, it should fully reopen Brannan Island State Recreation Area, complete the park at Delta Meadows-Locke Boarding House, and consider adding new State parks at Barker Slough, Elkhorn Basin, the Wright-Elmwood Tract, and south Delta.*
DP R14	Enhance Nature-based Recreation	*The California Department of Fish and Wildlife, in cooperation with other public agencies, should collaborate with nonprofits, private landowners, and business partners to expand wildlife viewing, angling, and hunting opportunities.*
DP R15	Promote Boating Safety	*The California Department of Boating and Waterways should coordinate with the U.S. Coast Guard and State and local agencies on an updated marine patrol strategy for the region.*
DP R16	Encourage Recreation on Public Lands	*Public agencies owning land should increase opportunities, where feasible, for bank fishing, hunting, levee-top trails, and environmental education.*
DP R17	Enhance Opportunities for Visitor-serving Businesses	*Cities, counties, and other local and State agencies should work together to protect and enhance visitor-serving businesses by planning for recreation uses and facilities in the Delta, providing infrastructure to support recreation and tourism, and identifying settings for private visitor-serving development and services.*
DP R18	Support the Ports of Stockton and West Sacramento	*The ports of Stockton and West Sacramento should encourage maintenance and carefully designed and sited development of port facilities.*

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DP R19	Plan for Delta Energy Facilities	*The California Energy Commission and California Public Utilities Commission should cooperate with the Delta Stewardship Council as described in Water Code section 85307(d) to identify actions that should be incorporated in the Delta Plan by 2017 to address the needs of Delta energy development, storage, and distribution.*
Chapter 6		
WQ R1	Protect Beneficial Uses	*Water quality in the Delta should be maintained at a level that supports, enhances, and protects beneficial uses identified in the applicable State Water Resources Control Board or regional water quality control board water quality control plans.*
WQ R2	Identify Covered Action Impacts	*Covered actions should identify any significant impacts to water quality.*
WQ R3	Special Water Quality Protections for the Delta	*The State Water Resources Control Board or regional water quality control board should evaluate and, if appropriate, propose special water quality protections for priority habitat restoration areas identified in recommendation ER R2 or other areas of the Delta where new or increased discharges of pollutants could adversely impact beneficial uses.*
WQ R4	Complete Central Valley Drinking Water Policy	*The Central Valley Regional Water Quality Control Board should complete the Central Valley Drinking Water Policy by July 2013.*
WQ R5	Complete North Bay Aqueduct Alternative Intake Project	*The California Department of Water Resources should complete the North Bay Aqueduct Alternate Intake Project Environmental Impact Report by December 31, 2012, and begin construction as soon as possible thereafter.*
WQ R6	Protect Groundwater Beneficial Uses	*The State Water Resources Control Board should complete development of a Strategic Workplan for protection of groundwater beneficial uses, including groundwater use for drinking water, by December 31, 2012.*
WQ R7	Participation in CV-SALTS	*The State Water Resources Control Board and Central Valley Regional Water Quality Control Board should consider requiring participation by all relevant water users that are supplied water from the Delta or the Delta watershed or discharge wastewater to the Delta or the Delta watershed to participate in the Central Valley Salinity Alternatives for Long-Term Sustainability Program.*
WQ R8	Completion of Regulatory Processes, Research, and Monitoring for Water Quality Improvement	*The State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards are currently engaged in regulatory processes, research, and monitoring essential to improving water quality in the Delta. In order to achieve the coequal goals, it is essential that these ongoing efforts be completed and, if possible, accelerated, and that the Legislature and Governor devote sufficient funding to make this possible. The Delta Stewardship Council specifically recommends that:* ▪ *The State Water Resources Control Board should complete development of the proposed policy for nutrients for inland surface waters of the State of California by January 1, 2014.* ▪ *The State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards should prepare and begin implementation of a study plan for the development of objectives for nutrients in the Delta and Suisun Marsh by January 1, 2014. Studies needed for development of Delta and Suisun Marsh nutrient objectives should be completed by January 1, 2016. The water boards should*

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		adopt and begin implementation of nutrient objectives, either narrative or numeric, where appropriate, for the Delta and Suisun Marsh by January 1, 2018. ▪ *The State Water Resources Control Board and the Central Valley Regional Water Quality Control Board should complete the Central Valley Pesticide Total Maximum Daily Load and Basin Plan Amendment for diazinon and chlorpyrifos by January 1, 2013.* ▪ *The State Water Resources Control Board and the Central Valley Regional Water Quality Control Board should prioritize and accelerate the completion of the Central Valley Pesticide Total Maximum Daily Load and Basin Plan Amendment for pyrethroids by January 1, 2016.* ▪ *The State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards have completed Total Maximum Daily Load and Basin Plan Amendments for methylmercury, and efforts to support their implementation should be coordinated. Parties identified as responsible for current methylmercury loads or proponents of projects that may increase methylmercury loading in the Delta or Suisun Marsh should participate in control studies or implement site-specific study plans that evaluate practices to minimize methylmercury discharges. The Central Valley Regional Water Quality Control Board should review these control studies by December 31, 2018, and determine control measures for implementation starting in 2020.*
WQ R9	Implement Delta Regional Monitoring Program	*The State Water Resources Control Board and Regional Water Quality Control Boards should work collaboratively with the California Department of Water Resources, California Department of Fish and Wildlife, and other agencies and entities that monitor water quality in the Delta to develop and implement a Delta Regional Monitoring Program that will be responsible for coordinating monitoring efforts so Delta conditions can be efficiently assessed and reported on a regular basis.*
WQ R10	Evaluate Wastewater Recycling, Reuse, or Treatment	*The Central Valley Regional Water Quality Control Board, consistent with existing water quality control plan policies and water rights law, should require responsible entities that discharge wastewater treatment plant effluent or urban runoff to Delta waters to evaluate whether all or a portion of the discharge can be recycled, otherwise used, or treated in order to reduce contaminant loads to the Delta by January 1, 2014.*
WQ R11	Manage Dissolved Oxygen in Stockton Ship Channel	*The State Water Resources Control Board and the Central Valley Regional Water Quality Control Board should complete Phase 2 of the Total Maximum Daily Load and Basin Plan Amendment for dissolved oxygen in the Stockton Deep Water Ship Channel by January 1, 2015.*
WQ R12	Manage Dissolved Oxygen in Suisun Marsh	*The State Water Resources Control Board and the San Francisco Bay Regional Water Quality Control Board should complete the Total Maximum Daily Load and Basin Plan Amendment for dissolved oxygen in Suisun Marsh wetlands by January 1, 2014.*

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Chapter 7		
RR R1	Implement Emergency Preparedness and Response	*The following actions should be taken by January 1, 2014, to promote effective emergency preparedness and response in the Delta:* ▪ *Responsible local, State, and federal agencies with emergency response authority should consider and implement the recommendations of the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force (Water Code section 12994.5). Such actions should support the development of a regional response system for the Delta.* ▪ *In consultation with local agencies, the California Department of Water Resources should expand its emergency stockpiles to make them regional in nature and usable by a larger number of agencies in accordance with California Department of Water Resources' plans and procedures. The California Department of Water Resources, as a part of this plan, should evaluate the potential of creating stored material sites by "over-reinforcing" west Delta levees.* ▪ *Local levee-maintaining agencies should consider developing their own emergency action plans, and stockpiling rock and flood-fighting materials.* ▪ *State and local agencies and regulated utilities that own and/or operate infrastructure in the Delta should prepare coordinated emergency response plans to protect the infrastructure from long-term outages resulting from failures of the Delta levees. The emergency procedures should consider methods that also would protect Delta land use and ecosystem.*
RR R2	Finance Local Flood Management Activities	*The Legislature should create a Delta Flood Risk Management Assessment District with fee assessment authority (including over State infrastructure) to provide adequate flood control protection and emergency response for the regional benefit of all beneficiaries, including landowners, infrastructure owners, and other entities that benefit from the maintenance and improvement of Delta levees, such as water users who rely on the levees to protect water quality.* *This district should be authorized to:* ▪ *Identify and assess all beneficiaries of Delta flood protection facilities.* ▪ *Develop, fund, and implement a regional plan of flood management for both project and nonproject levees of the Delta, including the maintenance and improvement of levees, in cooperation with the existing reclamation districts, cities, counties, and owners of infra-structure and other interests protected by the levees.* ▪ *Require local levee-maintaining agencies to conduct annual levee inspections per the California Department of Water Resources subventions program guidelines, and update levee improvement plans every 5 years.* ▪ *Participate in the collection of data and information necessary for the prioritization of State investments in Delta levees consistent with RR P1.* ▪ *Notify residents and landowners of flood risk, personal safety information, and available systems for obtaining emergency information before and during a disaster on an annual basis.* ▪ *Potentially implement the recommendations of the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force (Water Code section 12994.5) in conjunction with local, State, and federal agencies, and maintain the resulting regional response system*

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		and components and procedures on behalf of SEMS jurisdictions (reclamation district, city, county, and State) that would jointly implement the regional system in response to a disaster event. ▪ *Identify and assess critical water supply corridor levee operations, maintenance, and improvements.*
RR R3	Fund Actions to Protect Infrastructure from Flooding and Other Natural Disasters	▪ *The California Public Utilities Commission should immediately commence formal hearings to impose a reasonable fee for flood and disaster prevention on regulated privately owned utilities with facilities located in the Delta. Publicly owned utilities should also be encouraged to develop similar fees. The California Public Utilities Commission, in consultation with the Delta Stewardship Council, the California Department of Water Resources, and the Delta Protection Commission, should allocate these funds among State and local emergency response and flood protection entities in the Delta. If a new regional flood management agency is established by law, a portion of the local share would be allocated to that agency.* ▪ *The California Public Utilities Commission should direct all regulated public utilities in their jurisdiction to immediately take steps to protect their facilities in the Delta from the consequences of a catastrophic failure of levees in the Delta, to minimize the impact on the State's economy.* ▪ *The Governor, by Executive Order, should direct State agencies with projects or infrastructure in the Delta to set aside a reasonable amount of funding to pay for flood protection and disaster prevention. The local share of these funds should be allocated as described above.*
RR P1 (23 CCR section 5012)	Prioritization of State Investments in Delta Levees and Risk Reduction	*(a) Prior to the completion and adoption of the updated priorities developed pursuant to Water Code section 85306, the interim priorities listed below shall, where applicable and to the extent permitted by law, guide discretionary State investments in Delta flood risk management. Key priorities for interim funding include emergency preparedness, response, and recovery as described in paragraph (1), as well as Delta levees funding as described in paragraph (2).* *(1) Delta Emergency Preparedness, Response, and Recovery: Develop and implement appropriate emergency preparedness, response, and recovery strategies, including those developed by the Delta Multi-Hazard Task Force pursuant to Water Code section 12994.5.* *(2) Delta Levees Funding: The priorities shown in the following table are meant to guide budget and funding allocation strategies for levee improvements. The goals for funding priorities are all important, and it is expected that over time, the California Department of Water Resources must balance achievement of those goals. Except on islands planned for ecosystem restoration, improvement of nonproject Delta levees to the Hazard Mitigation Plan (HMP) standard may be funded without justification of the benefits. Improvements to a standard above HMP, such as that set by the U.S. Army Corps of Engineers under Public Law 84-99, may be funded as befits the benefits to be provided, consistent with the California Department of Water Resources' current practices and any future adopted investment strategy.*

<table>
<tr><th>POLICY OR RECOMMENDATION NUMBER</th><th>SHORT TITLE</th><th>POLICY/RECOMMENDATION LANGUAGE</th></tr>
<tr><td></td><td></td><td>
Priorities for State Investment in Delta Integrated Flood Management
Categories of Benefit Analysis
<table>
<tr><th>Goals</th><th>Localized Flood Protection</th><th>Levee Network</th><th>Ecosystem Conservation</th></tr>
<tr><td>1</td><td>Protect existing urban and adjacent urbanizing areas by providing 200-year flood protection.</td><td>Protect water quality and water supply conveyance in the Delta, especially levees that protect freshwater aqueducts and the primary channels that carry fresh water through the Delta.</td><td>Protect existing and provide for a net increase in channel-margin habitat.</td></tr>
<tr><td>2</td><td>Protect small communities and critical infrastructure of statewide importance (located outside of urban areas).</td><td>Protect floodwater conveyance in and through the Delta to a level consistent with the State Plan of Flood Control for project levees.</td><td>Protect existing and provide for net enhancement of floodplain habitat.</td></tr>
<tr><td>3</td><td>Protect agriculture and local working landscapes.</td><td>Protect cultural, historic, aesthetic, and recreational resources (Delta as Place).</td><td>Protect existing and provide for net enhancement of wetlands.</td></tr>
</table>
(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that involves discretionary State investments in Delta flood risk management, including levee operations, maintenance, and improvements. Nothing in this policy establishes or otherwise changes existing levee standards.
</td></tr>
<tr><td>RR R4</td><td>Actions for the Prioritization of State Investments in Delta Levees</td><td>The Delta Stewardship Council, in consultation with the California Department of Water Resources, the Central Valley Flood Protection Board, the Delta Protection Commission, local agencies, and the California Water Commission, should develop funding priorities for State investments in Delta levees by January 1, 2015. These priorities shall be consistent with the provisions of the Delta Reform Act in promoting effective, prioritized strategic State investments in levee operations, maintenance, and improvements in the Delta for both levees that are a part of the State Plan of Flood Control and nonproject levees. Upon completion, these priorities shall be considered for incorporation into the Delta Plan.

The priorities should identify guiding principles, constraints, recommended cost share allocations, and strategic considerations to guide Delta flood risk reduction investments,</td></tr>
</table>

POLICY OR RECOMMENDATION NUMBER	SHORT TITLE	POLICY/RECOMMENDATION LANGUAGE
		supported by, at a minimum, the following actions to be conducted by the California Department of Water Resources, consistent with available funding: ▪ *An assessment of existing Delta levee conditions. This should include the development of a Delta levee conditions map based on sound data inputs, including, but not limited to:* ▪ *Geometric levee assessment* ▪ *Flow and updated stage-frequency analysis* ▪ *An island-by-island economics-based risk analysis. This analysis should consider, but not be limited to, values related to protecting:* ▪ *Island residents/life safety* ▪ *Property* ▪ *Value of Delta islands' economic output, including agriculture* ▪ *State water supply* ▪ *Critical local, State, federal, and private infrastructure, including aqueducts, state highways, electricity transmission lines, gas/petroleum pipelines, gas fields, railroads, and deep water shipping channels* ▪ *Delta water quality* ▪ *Existing ecosystem values and ecosystem restoration opportunities* ▪ *Recreation* ▪ *Systemwide integrity* ▪ *An ongoing assessment of Delta levee conditions. This should include a process for updating Delta levee assessment information on a routine basis.* *This methodology should provide the basis for the prioritization of State investments in Delta levees. It should include, but not be limited to, the public reporting of the following items:* ▪ *Tiered ranking of Delta islands, based on economics-based risk analysis values* ▪ *Delta levee conditions status report, including a levee conditions map* ▪ *Inventory of Delta infrastructure assets*
RR P2 (23 CCR section 5013)	Require Flood Protection for Residential Development in Rural Areas	*(a) New residential development of five or more parcels shall be protected through flood-proofing to a level 12 inches above the 100-year base flood elevation, plus sufficient additional elevation to protect against a 55-inch rise in sea level at the Golden Gate, unless the development is located within:* *(1) Areas that city or county general plans, as of May 16, 2013, designate for development in cities or their spheres of influence;* *(2) Areas within Contra Costa County's 2006 voter-approved urban limit line, except Bethel Island;* *(3) Areas within the Mountain House General Plan Community Boundary in San Joaquin County; or* *(4) The unincorporated Delta towns of Clarksburg, Courtland, Hood, Locke, Ryde, and Walnut Grove, as shown in Appendix 7.* *(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that involves new residential development of five or more parcels that is not located within the areas described in subsection (a).*

POLICY OR RECOMMENDATION NUMBER	SHORT TITLE	POLICY/RECOMMENDATION LANGUAGE
RR P3 (23 CCR section 5014)	Protect Floodways	*(a) No encroachment shall be allowed or constructed in a floodway, unless it can be demonstrated by appropriate analysis that the encroachment will not unduly impede the free flow of water in the floodway or jeopardize public safety.* *(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that would encroach in a floodway that is not either a designated floodway or regulated stream.*
RR P4 (23 CCR section 5015)	Floodplain Protection	*(a) No encroachment shall be allowed or constructed in any of the following floodplains unless it can be demonstrated by appropriate analysis that the encroachment will not have a significant adverse impact on floodplain values and functions:* *(1) The Yolo Bypass within the Delta;* *(2) The Cosumnes River-Mokelumne River Confluence, as defined by the North Delta Flood Control and Ecosystem Restoration Project (McCormack-Williamson), or as modified in the future by the California Department of Water Resources or the U.S. Army Corps of Engineers (California Department of Water Resources 2010); and* *(3) The Lower San Joaquin River Floodplain Bypass area, located on the Lower San Joaquin River upstream of Stockton immediately southwest of Paradise Cut on lands both upstream and downstream of the Interstate 5 crossing. This area is described in the Lower San Joaquin River Floodplain Bypass Proposal, submitted to the California Department of Water Resources by the partnership of the South Delta Water Agency, the River Islands Development Company, Reclamation District 2062, San Joaquin Resource Conservation District, American Rivers, the American Lands Conservancy, and the Natural Resources Defense Council, March 2011. This area may be modified in the future through the completion of this project.* *(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that would encroach in any of the floodplain areas described in subsection (a).* *(c) This policy is not intended to exempt any activities in any of the areas described in subsection (a) from applicable regulations and requirements of the Central Valley Flood Protection Board.*
RR R5	Fund and Implement San Joaquin River Flood Bypass	*The Legislature should fund the California Department of Water Resources and the Central Valley Flood Protection Board to evaluate and implement a bypass and floodway on the San Joaquin River near Paradise Cut that would reduce flood stage on the mainstem San Joaquin River adjacent to the urban and urbanizing communities of Stockton, Lathrop, and Manteca in accordance with Water Code section 9613(c).*
RR R6	Continue Delta Dredging Studies	*The current efforts to maintain navigable waters in the Sacramento River Deep Water Ship Channel and Stockton Deep Water Ship Channel, led by the U.S. Army Corps of Engineers and described in the Delta Dredged Sediment Long-Term Management Strategy (USACE 2007, Appendix K), should be continued in a manner that supports the Delta Plan and the coequal goals. Appropriate dredging throughout other areas in the Delta for maintenance purposes, or that would increase flood conveyance and provide potential material for levee maintenance or subsidence reversal should be implemented in a manner that supports the Delta Plan and coequal goals. Coordinated use of dredged material in levee improvement, subsidence reversal, or wetland restoration is encouraged.*

POLICY OR RECOMMENDATION NUMBER	SHORT TITLE	POLICY/RECOMMENDATION LANGUAGE
RR R7	Designate Additional Floodways	*The Central Valley Flood Protection Board should evaluate whether additional areas both within and upstream of the Delta should be designated as floodways. These efforts should consider the anticipated effects of climate change in its evaluation of these areas.*
RR R8	Develop Setback Levee Criteria	*The California Department of Water Resources, in conjunction with the Central Valley Flood Protection Board, the California Department of Fish and Wildlife, and the Delta Conservancy, should develop criteria to define locations for future setback levees in the Delta and Delta watershed.*
RR R9	Require Flood Insurance	*The Legislature should require an adequate level of flood insurance for residences, businesses, and industries in floodprone areas.*
RR R10	Limit State Liability	*The Legislature should consider statutory and/or constitutional changes that would address the State's potential flood liability, including giving State agencies the same level of immunity with regard to flood liability as federal agencies have under federal law.*
Chapter 8		
FP R1	Conduct Current Spending Inventory	*An inventory of current State and federal spending on programs and projects that do or may achieve the coequal goals will be conducted. Data sources to be used include the CALFED cross-cut budget, State bond balance reports, and the annual State budget, among others. Consideration will be given to selecting an independent agency (which could include a non governmental organization) to conduct the inventory.*
FP R2	Develop Delta Plan Cost Assessment	*Costs will be assigned to the projects and programs proposed in the Delta Plan (Chapters 2 through 7) and sources of funding will be identified.*
FP R3	Identify Funding Gaps	*Current State and federal funding gaps will be identified that are determined to hinder progress toward meeting the coequal goals.*

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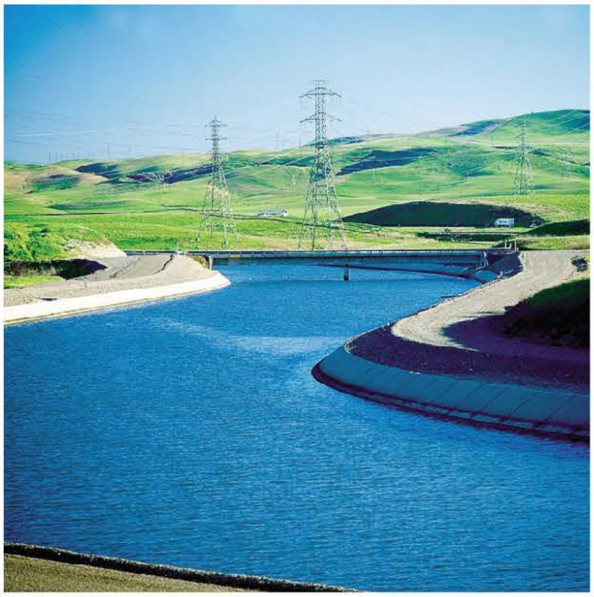
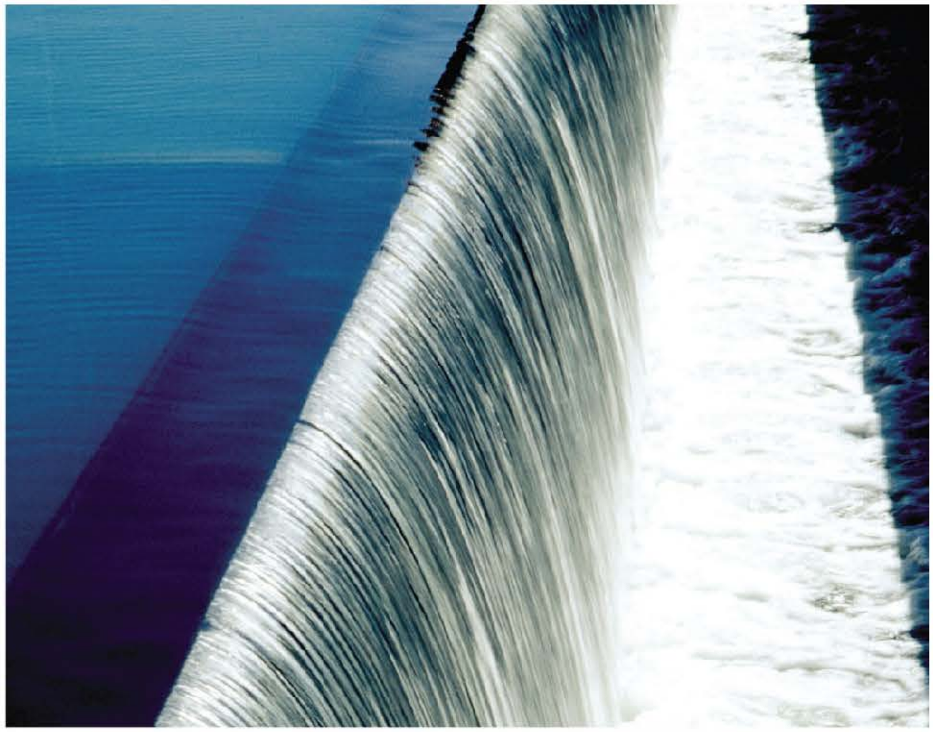
CHAPTER 1

Introduction





ABOUT THIS CHAPTER

This chapter offers historical and current contextual information about the uses and conflicts that besiege the Sacramento-San Joaquin Delta (Delta). The reader will come to understand how and why the West Coast's largest estuary has evolved from a huge tidal marsh to the maze of islands and channels it is today – shaped over more than a century and a half by the effects of hydraulic mining, flood control, agricultural and urban development, and its placement as the "hub" of California's major water systems.

The chapter then delves into the realities of decades of stand-offs among the key interests in the Delta and resulting years of relative inaction, leading finally to the bipartisan movement that created the Sacramento-San Joaquin Delta Reform Act of 2009 (Delta Reform Act or Act) and its mandate to develop a long-term sustainable management plan for the Delta. The chapter concludes with an overarching explanation of how this Delta Plan (or Plan) will bring about a fundamental and positive sustainability and reformation of this immense natural resource.

CHAPTER 1

Introduction

Throughout the past 160 years, the delta formed by California's two largest rivers, the Sacramento and the San Joaquin, has been a gateway to many of the state's collective hopes and dreams. Once the pathway to the Gold Country, it is today a critical component of the state's water supply infrastructure, a source of sustenance for farmers and fishermen, and home to half a million people and a vast array of fish, birds, and wildlife.

The Sacramento-San Joaquin Delta and Suisun Marsh are referred to throughout this Plan collectively as "the Delta," unless otherwise specified (see Figure 1-1).[1] Once a great marsh, the Delta now is a network of channels and sunken "islands" that cover—together with Suisun Marsh—about 1,300 square miles. Laid over those islands and channels is the infrastructure of a twenty-first century economy: water supply conduits; major arteries of the state's electrical grid; natural gas fields, storage facilities, and pipelines; highways and railways; and shipping channels, all surrounded by an increasingly urban landscape. Water from the vast Delta watershed, spanning over 45,000 square miles (30 million acres), fuels both local economies and those in export areas hundreds of miles away (see Figure 1-2).

Today the Delta is many things to many people, and is universally regarded in "crisis" because people have not yet been able to find balance in the tradeoffs among competing demands for the Delta's resources. Tradeoffs and integration define the Delta dilemma: water conveyance facilities that built strong urban and agricultural economies threaten ecosystem health. Water that is beneficial for fish is alive with plankton and organic material, but sources of drinking water are best in as pure a form as possible. The pollutants of upstream urban and agricultural uses cause problems for downstream fish and water diverters alike. The same oceangoing ships that opened the Central Valley to world trade also introduced nonnative species that alter the Delta ecosystem. High water flows that historically improved habitat and a diverse food web come with the threat of lost homes, flooded farmland, and disaster for Delta residents and the California economy.

Conceived decades ago, a series of water projects has engineered the Delta estuary over time to perform as a water conveyance system, moving water stored upstream to users throughout the state who hold State of California (State) or federal water contracts. This system relies on dredged channels, which at times run counter to natural flow directions as the result of export pumping that occurs in the south Delta. For a number of years, and currently at the publishing time of this Plan, State and federal agencies are exploring options to reconfigure the manner in which the Delta is used to convey water in a way that lessens ecosystem impacts and improves water supply reliability. At this time, the Delta Plan does not make recommendations regarding Delta conveyance (see Appendix A).

As a result of imperfect tradeoffs, key species are endangered or threatened, the amount of water that can be exported from the Delta is determined not just by the state's variable precipitation and storage but also by court order to protect endangered species, and geologists and engineers continue to worry that the Delta itself is one of the greatest flood risks in the West.

[1] The Sacramento-San Joaquin Delta is defined in Water Code section 12220, and Suisun Marsh means the area defined in Public Resources Code section 29101 and protected by Division 19 (commencing with section 29000).

The evolution of the Delta has come in fits and starts, driven by individual initiative, governmental incentive, and crisis. John Hart, writing for *Bay-Nature*, puts it this way:

> *The History of the modern Delta belies the image of the region as a static landscape. Reclamation was a battle with many setbacks, almost given up for lost in the 1870s. In the 1880s the 'crisis' was the clogging of channels by hydraulic mining debris. In the 1920s, salinity was on the march. A brief calm at midcentury gave way to the ever-spiraling tension over water exports and ecosystem decline. The Delta seems always to have been in crisis, under intensive study, and at the intersection of hostile interests.*

Governmental institutions have reacted to each crisis predictably, often treating individual problems rather than taking a systemwide approach. Over the years, dozens of agencies, task forces, and working groups have been created in a series of sometimes overlapping efforts to find the right combination of leadership and collaboration—incentives and regulation—to provide clean, reliable water; protect our environment; and reduce the risk of flooding.

After decades of conflict and unsuccessful efforts to comprehensively address the many problems and challenges of the Delta, the California Legislature (or Legislature), water agencies, and environmental groups throughout the state united in an unprecedented manner in 2009 to pass a series of water-related measures, including the Delta Reform Act.

The Delta Reform Act created the Delta Stewardship Council (Council) with a primary responsibility to develop and implement a legally enforceable, long-term management plan for the Delta. The Legislature required the Delta Plan to advance the coequal goals of protecting and enhancing the Delta ecosystem and providing for a more reliable water supply for California, and to do so in a manner that protects and enhances the Delta as an evolving place.

This Delta Plan is intended to be a foundational document that prioritizes actions and strategies in support of key objectives such as the State's requirement to reduce reliance on the Delta to meet future water supply needs. It also restricts actions that may cause harm; serves as a guidebook for all plans, projects, and programs that affect the Delta; and calls for further investigation and focused study of specific issues.

Successful implementation of the Delta Plan depends not only on the Council, but also on coordinated actions by other government agencies—federal, State, and local—and by the stakeholders to whom these agencies are responsible. To be effective, decision making in a dynamic context such as the Delta must be flexible and have the capacity to change policies and practices in response to what is learned over time. Through this Delta Plan, the Council details an interagency structure for decision making that fosters communication among scientists; local, State, and federal decision makers; and stakeholders. Future Plan iterations will build on successes as well as lessons learned in order to achieve the coequal goals.

The Delta and California's Water Supply

The story of California's annual water supply is one of great variability in amount, timing, and distribution, and of the human desire to impose certainty and order. Rain and snow fall mostly in the northern and eastern portions of the state, but most Californians live along the coast and in the south. Most of the state's precipitation occurs in only 5 to 15 days, and that rain and snowfall result in an annual supply that is ample in average years, too little in dry ones, and too much in wet years (see Figure 1-3).

The Sacramento-San Joaquin Delta and Suisun Marsh

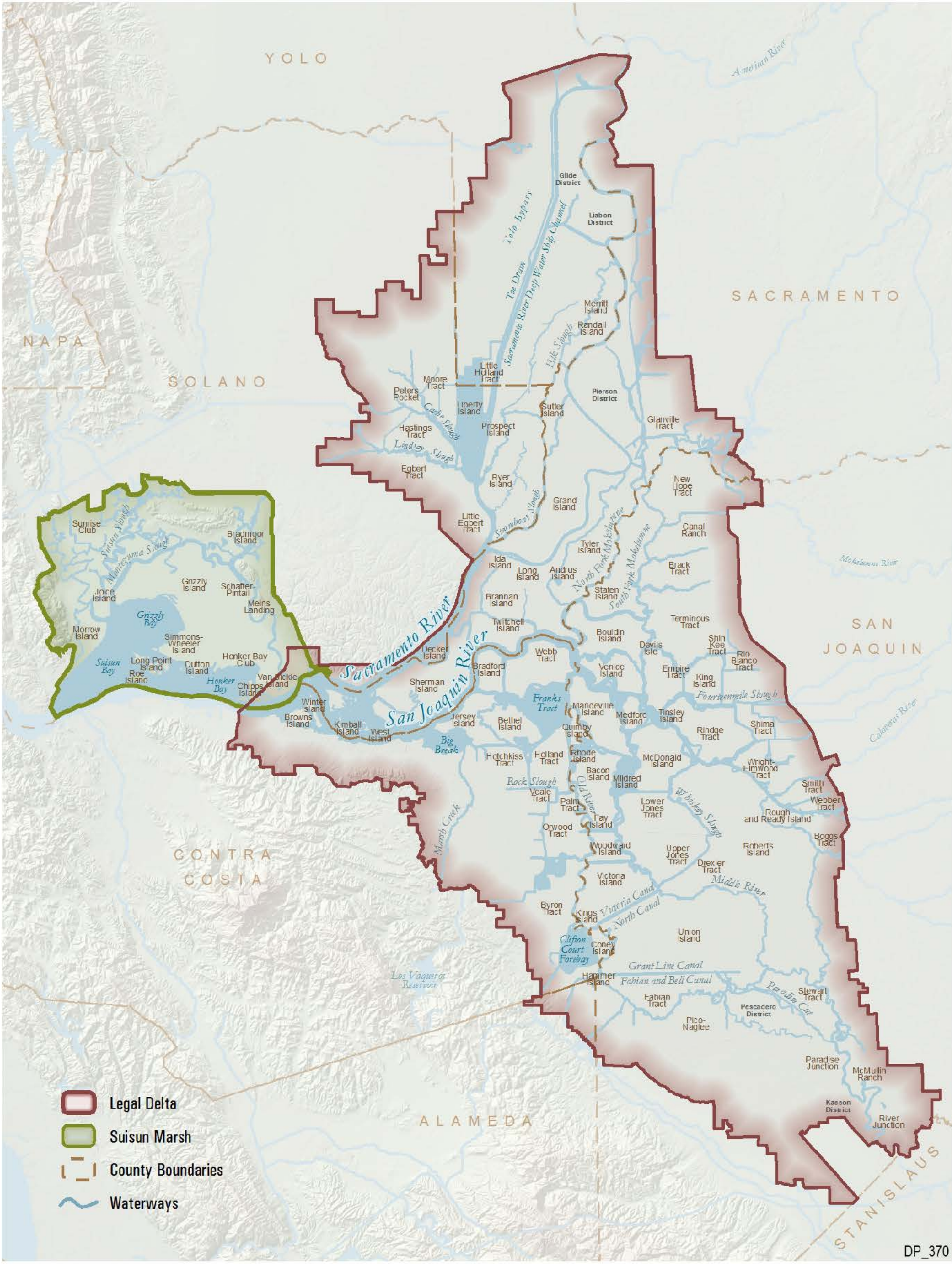


Figure 1-1 *Source: DWR 2011a*

The Delta Watershed and Areas Receiving Delta Water

Figure 1-2

To meet water demand, Californians over the past 160 years have built a vast array of reservoirs, canals, pipelines, and tunnels, all in an effort to capture water when it was available, store it for when it was not, and to move it to the people when and where they wanted it.

As residents in both Northern and Southern California feared they would outgrow their local supplies, they turned to the vast Delta watershed for relief. The river systems flowing into the Delta drain about 40 percent of the land in California and carry about half of the state's total annual runoff.

And so, at the turn of the twentieth century, San Francisco tapped the Tuolumne River, diverting water through an aqueduct that bypasses the San Joaquin River and Delta. Shortly thereafter, Oakland and the eastern San Francisco Bay Area tapped the Mokelumne River, diverting water through a pipeline across the Delta. Later, construction of the federal Central Valley Project (CVP) and the State Water Project (SWP) resulted in additional diversions directly from the Delta for the Bay Area, Central Valley, and Southern California.

California's Variable Precipitation

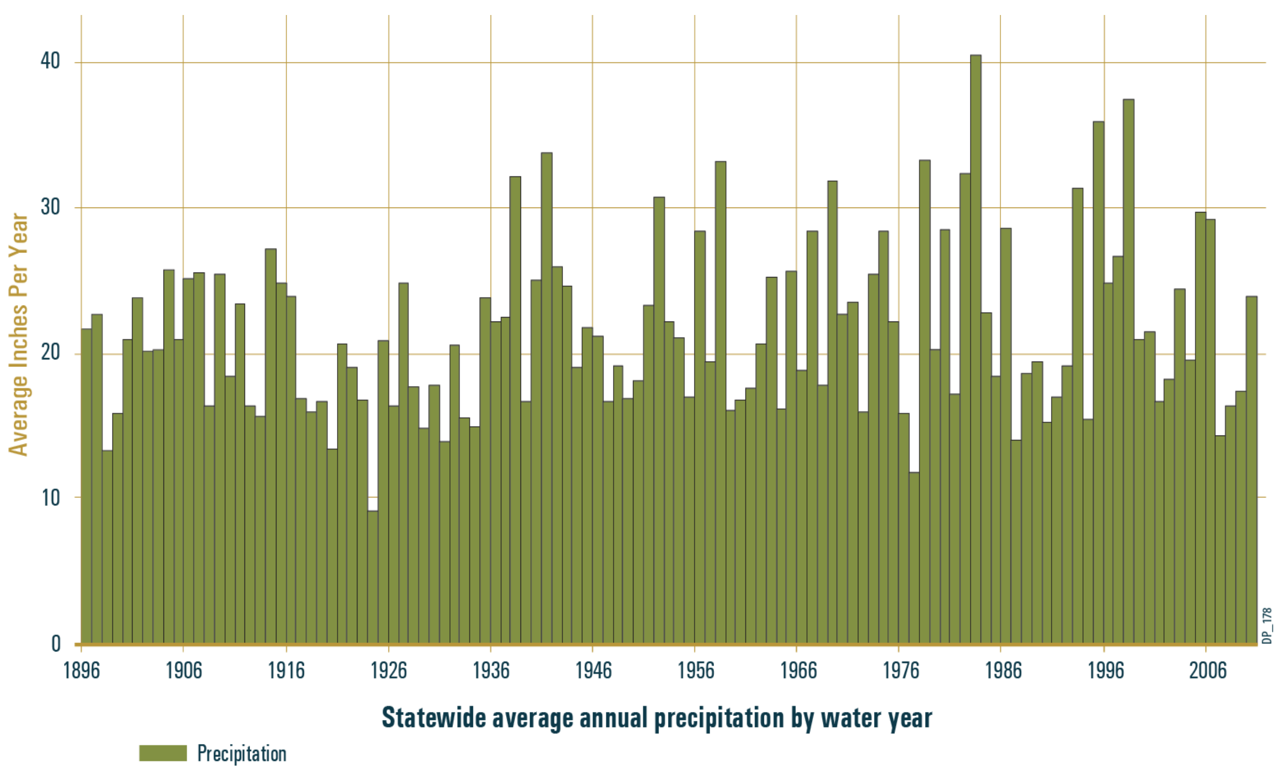


Figure 1-3 The unpredictability of the state's rainfall and its history of multiyear droughts make the management of water to reliably meet environmental and human uses extremely challenging. Yearly precipitation was calculated from the average of 95 stations located across California. Data were collected by Jim Goodridge, former State climatologist.

Source: Western Regional Climate Center 2011

Today, some two-thirds of the state's population (approximately 27 million people) depend on water from the Delta watershed for some portion of their water supply, as do more than 3 million acres of irrigated farmland that grow crops for in-state, national, and international distribution. That said, water exported through the Delta represents approximately 8 percent of the state's annual average water supply. Local and regional water resources, including surface diversions, groundwater, local and out-of-state imports, and water reuse, meet the remaining 84 percent.

Who uses all that water, how it is used, how much returns to the rivers and streams for downstream users, and in what quality, is less than certain on a statewide basis. Data for actual water use and water quality suffer from significant gaps, which may affect the ability of California's water managers to make timely and better-informed decisions. Since 1914, the State Water Resources Control Board (SWRCB) has issued permits to post-1914 appropriative-right water diverters in the Delta, but actual annual diversion amounts are not thoroughly measured or reported. Owners and operators of nearly one-third of irrigated lands in the Delta watershed do not participate in programs to meet water quality standards, and their compliance with State law is unclear.

Although groundwater and surface water are often interconnected, the SWRCB has limited authority to regulate groundwater. Groundwater is sustainably managed in some

areas of the state through either adjudication or special districts, but other areas suffer from unsustainable overdraft and require improved management efforts. Attempts to correct this overdraft often put more pressure on water supplies from the Delta, demonstrating once again the interconnectedness of California's water systems.

The Delta and Its Ecosystem

Although much of the debate over the Delta has centered on events in the last 50 years, the roots of its problems run much deeper. A Delta that for millennia had been a land and waterscape of dynamic floodplain and tidal marshland, rich in flora and fauna, was changed forever by passage of the federal Swamp Land Act of 1850 and similar State legislation in 1861, which provided incentives for the "reclamation" of "nuisance" swampland to reduce threats of vector-borne disease and to gain productive land for farming. Within the Delta, seasonally and tidally flooded land impeding agricultural development led to land reclamation and channelization, and subsequent habitat loss. More than a century ago, with little or no engineering analyses and limited construction tools, Delta residents began to build an intricate levee system to channel water and dry out land, which converted hundreds of thousands of acres of seasonally and tidally flooded wetlands into fertile agricultural fields. As a result of continued land use change and urbanization, 95 percent of the historical tidal marsh in the Delta has been lost. Further detail regarding the historical Delta landscape is provided in Chapter 4.

Hydraulic gold mining, which reached its peak in the 1860s, sent tons of mercury-laden debris down toward the Delta, clogging channels and streams, and leading to devastating floods. Corrective actions—dredging and new levee construction—resulted in the loss of 90 percent of the Central Valley's riparian habitat (Katibah 1984). This massive-scale destruction has had lasting consequences for ecosystem health and, in turn, declining ecosystem health has had direct consequences for water supply operations.

The Hetch Hetchy and Mokelumne aqueducts diverted water (as they do currently) before it reached the Delta, and water use upstream increased considerably during the mid- and late 1900s. Construction of the CVP and SWP in the 1940s and 1960s, respectively, introduced new pressures on the Delta. Indeed, it is unusual to use an estuary—normally where fresh and salt water mix according to variable tidal and tributary flows—as a conveyance system for large amounts of fresh water to meet seasonal user demands.

The resulting configuration today causes river channels at times to run backward; and some fish, lacking clear migration corridors and/or migration cues, end up in dead-end channels or, worse yet, "salvaged" at the export pumps. Conflict between these competing uses was soon apparent and continues to plague water policy today.

Fish species have changed over time in response to changing habitat and flows, and from introductions both planned and accidental. Among the first introductions, in 1879, were two eastern game fish—striped bass and American shad. Today, striped bass, which are voracious predators, both support a major sport fishery and are blamed by some for the decline of smelt and salmon. Among the accidental tourists who came to stay are Asian clams, voracious eaters who can deplete the water of nutrients for native species. Of the more than 50 species of fish in the Delta today, more than half, including the most successful, are nonnative.

In addition, growing agricultural production in the Central Valley has resulted in increased runoff of pesticides and fertilizer flowing to the Delta. Runoff and wastewater discharges from increasing upstream urbanization have altered Delta water quality and, thus, its ecosystem. Increased commercial and recreational boat traffic in the Delta, as well as other causes, have introduced many nonnative species that have altered the Delta ecosystem.

The Delta as a Unique and Evolving Place

The Delta is a unique place distinguished by geography, legacy communities, a rural and agricultural setting, vibrant natural resources, and a mix of economic activities. Much has changed over the past 160 years; and although some may desire to maintain a static picture of the Delta as it is today, the past, as well as emerging science, predict constant change.

Once a marshland that was the drain of the vast Central Valley watershed, the Delta changed dramatically following the discovery of gold on the American River in 1848. Suddenly, large numbers of prospectors and service providers were beating a pathway through the Delta to the foothills and, at the peak of the rush, more than 300 steamboats plied the waters between San Francisco and Sacramento. Twenty-one years later, completion of the transcontinental railroad in 1869 freed a huge workforce, many of whom found alternative work dredging Delta channels and building levees.

Communities developed to support river traffic to and from the gold country, and later to transport agricultural products from the newly productive farmland reclaimed from the Delta marshes. The advent of the automobile resulted in a flurry of ferry construction and bridge building in the 1920s; by the 1930s, cars and trucks were replacing steamships for transportation and commercial shipping. The Stockton Deepwater Ship Channel was completed in 1933, opening a direct connection from the San Joaquin Valley to the world, and 30 years later, the Sacramento Deepwater Ship Channel did the same for the Sacramento Valley. Not coincidentally, these channels also opened the Delta to a host of exotic invasive species that hitched rides on the bottoms and in the ballast of oceangoing freighters.

Central Valley Chinook salmon have long been a critically important part of California's fishing industry, passing through the Delta on their way from and to spawning grounds in upstream rivers and streams. Between 1900 and 1950, the fall run numbered more than a million fish returning annually to the Sacramento and San Joaquin river systems. Drought and changing Delta and ocean conditions, however, reduced those numbers to only 66,000 in 2008, resulting in a closure of the salmon fisheries off California and restrictions that lingered into 2010, devastating fishing economies (DFG 2009).

Dredging opened many of the Delta channels for sport fishing, recreational boating, and commercial enterprise. Today there are more than 100 marinas and waterside resorts, RV parks, grocery stores, and dockside restaurants; and house boating remains popular. The Delta is dotted with numerous public parks and fishing sites as well.

The Delta now is a major producer of corn, alfalfa, pasture, and tomatoes; and wine grapes are growing in prominence. Residents and visitors alike celebrate the Delta's agricultural heritage with the Asparagus Festival in Stockton and the Courtland Pear Fair.

Today, although still largely rural, the Delta is crisscrossed by interstate electric transmission lines, natural gas pipelines, and interstate roads and railroads; and it faces increasing pressure—at least on its periphery—for additional housing development. Those elements, combined with the increasing certainty of sea level rise and changing climate patterns, mean continual change for the Delta.

The Delta Problem

In California, sustainable management of the Delta is an exceedingly complex topic fraught with longstanding conflicts and challenges. The Delta and Suisun Marsh ecosystem is the largest estuary on the West Coast and a critical stopping point on the Pacific flyway. The estuary extends westward to the Golden Gate and southward to San Jose. Delta water also flushes southern San Francisco Bay. It is also the hub of the state's major water supply systems. But the Delta today is failing to balance the tradeoffs inherent in these functions, as well as to provide a place to live, work, and play for residents and visitors alike.

Today the Delta is relied upon for many services and, as a result, is not meeting the demands of farmers and urban water users who want assurances of supply and, in some cases, more water. Nor does the Delta adequately serve the needs of fish and wildlife—some threatened or endangered species' numbers remain perilously low. And the Delta itself remains inherently floodprone.

Fish Declines. In late 2004, scientists noted that several fish species in the upper San Francisco estuary (delta smelt, young striped bass, longfin smelt, and threadfin shad) had remained unusually low since 2001. Although the numbers had historically fluctuated, this steep and lasting dropoff signaled an ecological crisis. Scientists acknowledged many causes such as invasive and predatory species, upstream agricultural and urban runoff, and diminished Delta habitat. The export pumps of the SWP and CVP were culpable as well, and restrictions ensued.

Water Exports Cut. These regulatory and court-ordered restrictions on State and federal pumping, in combination with the 2007–2009 drought, significantly reduced exported water deliveries to SWP and CVP contractors. As a result, some San Joaquin Valley farmers pumped groundwater from already overtapped aquifers, fallowed fields, and, in some cases, plowed under permanent crops. The national economic recession, combined with reduced water deliveries, hit the San Joaquin Valley hard. Although the plight of farmers captured much media attention, the salmon fishery was shut down in 2008 and was restricted in 2009–2010, causing economic hardship for the commercial and recreational fishing industries. Urban water managers in the Bay Area and Southern California drew down storage and increased conservation efforts until the rains and snows of 2011 saved the day.

DELTA BY THE NUMBERS

- The 45,600-square-mile Delta watershed provides all or a portion of surface water or groundwater supplies to more than 27 million California residents.
- Approximately 8 percent of the state's water supply is exported from the Delta (DWR 2009).
- The Delta and Suisun Marsh support more than 55 fish species and more than 750 plant and wildlife species. Of these, approximately 100 wildlife species, 140 plant species, and 13 taxonomic units of fish are considered special-status species and are afforded some form of legal or regulatory protection (CNDDB 2010, USFWS 2010, CNPS 2010).
- The Delta and Suisun Marsh are home to more than one-half million residents living in dozens of communities, including portions of 12 incorporated cities such as Stockton and Sacramento, and support more than 146,000 jobs (DPC 2010).
- Approximately 57 percent of the Delta and Suisun Marsh—more than 480,000 acres of agricultural land—currently supports a highly productive agricultural industry that is valued at hundreds of millions of dollars annually (DWR 2007a, DWR 2007b, DOC 2008, DPC 2010).
- The Delta and Suisun Marsh levees and lands support interstate and state highways and railroad tracks that support intrastate and interstate traffic, more than 500 miles of major electrical transmission lines, 60 substations, and more than 400 miles of major natural gas pipelines that provide energy throughout Northern California, as well as critical pipelines that carry transportation fuels to airports and other fuel depots throughout the San Francisco Bay Area and Sacramento (DPC 2010, DWR 2009).
- The Delta and Suisun Marsh have more than 1,335 miles of levees that protect more than 800,000 acres of land and play a role in the water supplies conveyed through the Delta.
- The Delta experiences more than 12 million visitor days annually from recreational boaters (DPC 2012).* Fishing, hunting, birdwatching, and camping draw even more visitors to the area.

* The *Sacramento–San Joaquin Delta Boating Needs Assessment* (2000-2020) estimated 6.4 million annual boating-related visitor days and 2.13 million boating trips to the Delta in 2000 (DBW 2002).

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Lawsuits. Over the years, improved understanding about water quality needs and environmental protection in the Delta launched an era of complex regulation that today governs SWP and CVP water supply operations. Litigation over a host of issues related to the CVP and SWP has created a recent spate of water management actions guided by courtroom decisions. Incomplete understanding about how water project operations, pollution, invasive species, and other factors affect native Delta fish species has resulted in a regulatory scheme affecting water supplies that is characterized by uncertainty. Changing rules to curtail pumping and increase Delta outflow have compounded water supply uncertainty for agencies that use water conveyed through the Delta, particularly in drier years when ecosystem conflicts are most pronounced. Some of those agencies have contributed to the uncertainty by becoming increasingly reliant on Delta exports that were intended to be supplemental supplies, but in some cases are now relied upon as core water supplies.

Flood Threats. Adding to the complexity of these problems is the increasing volatility of Delta water supplies as a consequence of climate change, including more rain and less snow, earlier snowmelt, and higher winter and lower spring-summer runoff patterns. The potential for catastrophic levee failure in the Delta and the risk to residents and infrastructure alike posed by floods, sea level rise, earthquakes, and land subsidence is real, growing, and has outpaced the State's ability to manage and fund risk-reduction measures.

Pursuit of Balance. Finding the right balance of these competing needs and demands on the Delta has bedeviled California policy makers for decades. The media and the political system tend to focus on water supply shortages, droughts, flood risk, and the decline of fisheries. Although notable and consequential, these events are all symptoms of a greater resource problem. Not unlike other policy areas, when it comes to natural resource issues, California has long attempted to manage symptoms rather than treat core problems.

Governance and the Delta Reform Act of 2009

California has a history of addressing each problem with yet another project and/or program, each generally left to find its own way among all others already set in motion or completed. Today, more than 200 federal, State, regional, and local agencies have responsibility for some aspect of the Delta. As each agency focuses on its specific mission, cooperation, collaboration, and cohesiveness have at times been elusive.

Although the seeds were sown in governmental decisions throughout the early twentieth century, California's water "wars" came to a head during the years 1987 through 1992, when a 6-year drought in California slowed water deliveries, water quality deteriorated, and two fish species unique to the Delta—the delta smelt and winter-run Chinook salmon—were pushed to the brink of extinction. During these 6 drought years, average runoff to the state's two largest rivers dipped dramatically: 44 percent into the Sacramento River and 53 percent into the San Joaquin.

State and federal officials tried, often in conflict with each other, to deal with issues of water quality, protection of Delta fisheries, and water impacts on the state's urban and agricultural water users. In the early 1990s, endangered species listings by federal fish agencies imposed export restrictions on water users. SWRCB efforts to address aquatic resource degradation under State water laws ground to a halt after the governor complained about excessive federal interference under both the Endangered Species Act and the Clean Water Act. In 1991, the U.S. Environmental Protection Agency (USEPA) formally disapproved the SWRCB water quality control plan; and in 1992, Congress passed the Central Valley Project Improvement Act (CVPIA), which reallocated a significant portion of federal (CVP) water supplies to environmental purposes. Virtually every action taken by a State or federal agency during this period ended up in court.

Amid this chaos of competing interests and regulations, the cornerstone for future cooperation was laid when three long-time adversarial interests—environmentalists, agriculture, and urban water users—agreed to work together to find common ground. Four federal agencies—the USEPA, Bureau of Reclamation, National Marine Fisheries Service, and U.S. Fish and Wildlife Service—began collaboration on Delta issues and became known as "Club Fed." After being on the losing side of a 5-year-long State-federal tug of war over water quality standards, the State and federal administrations negotiated updated water quality standards and, in 1995, created the CALFED Bay-Delta Program.

After 5 years of negotiations and planning, the CALFED agencies completed an ambitious 30-year plan and record of decision heavily dependent on goodwill, generous State and federal funding, and Delta conditions remaining generally as they had in the immediate past. Instead, goodwill and funding evaporated in the face of fiscal crisis, scientists learned more about looming effects of climate change and emerging stressors on the Delta, and competing interests turned back to the courts to force one viewpoint or the other.

While CALFED attempted to bring a holistic focus, it was criticized for not having authority to hold individual agencies and projects accountable for interrelationships and progress and—toward the end of its first 7 years (Stage 1, 2000 through 2008)—for not being focused enough on the Delta. And yet the inescapable truth remains: actions that affect the Delta's ecosystem and its ability to provide a reliable amount of water for export are inextricably linked. The Delta Vision Task Force, created by then-Governor Arnold Schwarzenegger in 2006 to point the path forward from CALFED, reinforced the need for integration and linkage in both its 2008 *Vision for the Delta* and its *Strategic Plan*.

IS MORE GOVERNANCE REFORM NEEDED?

Senate Bill X7 1 (SBX7 1), which included the Delta Reform Act, enacted the most significant governance reform related to water and the Delta since the mid-twentieth century. Two new bodies were formed, the Sacramento-San Joaquin Delta Conservancy and the Council; the Delta Protection Commission was reorganized; and a new Delta Watermaster position was created at the SWRCB. However, some argue that governance change should not stop there.

In recent years, two nonpartisan and independent entities have proposed new water and Delta governance models, with the State's Little Hoover Commission (LHC) releasing reports in 2005 and 2010, and the Public Policy Institute of California (PPIC) releasing reports in 2007 and 2011.* Their conclusions are summarized here.

Little Hoover Commission: LHC is an independent state oversight agency established in 1962. It has a mission to identify and spur government reform in various policy areas, and has confronted the topic of water governance multiple times. In August 2010, LHC proposed dramatic restructuring of Delta and water governance in its report *Managing for Change: Modernizing California's Water Governance* (www.lhc.ca.gov).

Public Policy Institute of California: Established in 1994, the mission of PPIC is to inform and improve public policy in California through independent, objective, nonpartisan research. In 2011, PPIC released *Managing California's Water: From Conflict to Resolution* (Hanak et al. 2011), which focused more on thematic reforms building on current practices such as increasing urban water conservation and streamlining water transfers (www.ppic.org).

Although PPIC and LHC would remake water governance differently, both proposals have considerable thematic overlap:

- California lacks a system to adequately incorporate the needs of public trust resources with water supply management and planning.
- California lacks a centralized leadership structure to set statewide policy goals and manage inevitable conflicts.
- The institutional separation of water rights planning, administration, and enforcement responsibilities from water supply management complicates policy making.
- Insufficient incentives exist to promote regional cooperation and local consistency with State policy directions.
- There is concern that the demands of California Department of Water Resources' role in managing the SWP conflicts with its overall statewide water planning responsibilities.

This Delta Plan recommends governance reform related to regional Delta participation in flood management activities. As part of its role in coordinating overall efforts in the Delta, the Council will hold hearings and recommend additional governance reform to the Legislature.

** LHC 2005, LHC 2010, Lund et al. 2007, Hanak et al. 2011*

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The recommendations from the Delta Vision Task Force, along with general understanding and support from a wide variety of competing interest groups, allowed the Legislature, in 2009, to craft a package of bills that would, for the first time, begin to define those linkages in law and require accountability for implementation. In addition to the Delta Reform Act, the package included measures that set ambitious water conservation policy (20 percent reduction in statewide urban per capita water use by 2020), ensure better groundwater monitoring, and provide for increased enforcement to prevent illegal water diversions. It also included a bond measure that would help fund implementation of various parts of the package, and local and regional water supply and ecosystem projects.

The fifth bill in the package was Senate Bill X7 1 (SBX7 1), which included the Delta Reform Act. With its passage, California embarked upon a new era in Delta governance with creation of the Council, and established as overarching State policy coequal goals of a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. Through its hybrid approach—both regulatory and collaborative—the Council now has the task of facilitating coordination across a broad range of entities to achieve the State's water policy objectives.

The Delta Reform Act includes an important caveat: while past Delta efforts focused almost exclusively on water supply reliability or ecosystem protection, the Delta Reform Act requires that the coequal goals be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

In addition, the Delta Reform Act recognized the need to change the way the Delta is viewed, asking not what can be taken, but instead what can be given back. Thus, the Legislature established that the policy of the State is to reduce reliance on the Delta in meeting future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency. The Delta Reform Act specifies that each region depending on water from the Delta watershed shall improve its regional self-reliance for water through investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts.

Finally, in a distinct departure from CALFED and the status quo of disparate agencies struggling to tackle complex modern resource problems, the Council was established with the authority and responsibility to develop a legally enforceable Delta Plan, and to coordinate and collaborate across the myriad governmental agencies that have responsibility for some aspect of the Delta. The Council also was charged with ensuring that actions by State and local agencies in the Delta are consistent with the Delta Plan, and adequately incorporate the best available science and adaptive management principles.

The Delta Plan

The foundation of the Delta Reform Act is the adoption of the coequal goals and direction to the Council to develop an enforceable Delta Plan to further those goals. Figure 1-4 shows the primary area covered by the Delta Plan, including features and uses referred to in policies and recommendations. Accordingly, the Council presents a Delta Plan that is practical, foundational, integrated, and adaptive:

- **Practical:** The Delta Plan builds on years of planning efforts and incorporates actions, recommendations, and strategies developed by other entities—governmental and nongovernmental—that have already invested countless hours on Delta issues and have specialized expertise.
- **Foundational:** The Delta Plan addresses intertwined challenges and establishes foundational actions for Delta management throughout this century. It lays the groundwork for near-term actions for improvement and focuses on the immediate avoidance of further harm or increased risk to the Delta. The Delta Plan shines a spotlight on urgently needed Delta habitat projects and the significant potential for local and regional water supply development. Similarly, the Delta Plan seeks to immediately halt practices known to be detrimental to the sustainability of the Delta's many functions and services.
- **Integrated:** The Delta Plan establishes an open and accountable governance mechanism for coordinating actions across agency jurisdictions and statutory objectives.

The Delta Plan

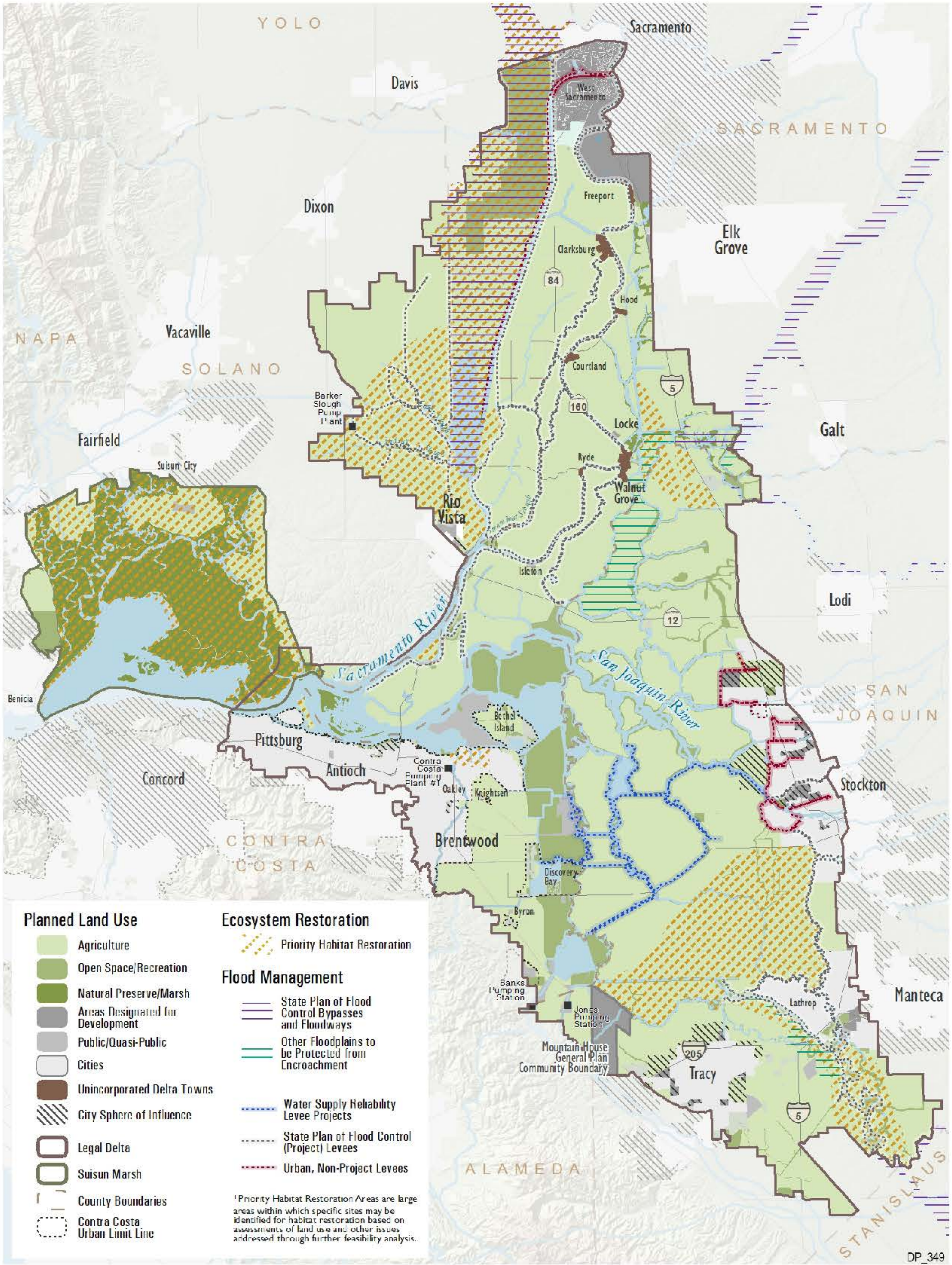

Figure 1-4 The map shows land uses designated by city and county general plans. Within cities' spheres of influences (SOIs), the map shows land use designations proposed in city general plans, where available. In cases where cities have not proposed land uses within their SOIs, the map shows land uses designated by county general plans.

Sources: City of Benicia 2003, Contra Costa County 2008, Contra Costa County 2010, DWR 2011b, DWR 2011c, DWR 2011d, City of Fairfield 2008, Jones & Stokes 2007, City of Lathrop 2012, City of Manteca 2012, Mountain House Community Services District 2008, City of Rio Vista 2001, SACOG 2009, City of Sacramento 2008, Sacramento County 2011, Sacramento County 2013, Sacramento County 2013, San Joaquin County 2008a, San Joaquin County 2008b, Solano County 2008a, Solano County 2008b, South Delta Levee Protection and Channel Maintenance Authority 2011, City of Stockton 2011a, City of Stockton 2011b, City of Suisun City 2011, City of Tracy 2011, City of Stockton 2011b, City of West Sacramento 2010, Yolo County 2010a, Yolo County 2010b.

- **Adaptable:** The Delta Plan sets direction through policies and recommendations and can incorporate other plans and new information as it becomes available. Informed by science and consistent monitoring, portions of the Delta Plan that do not adequately meet or make progress toward stated goals over time will be refined or revised. The Delta Plan will be updated at least every 5 years, and likely sooner, given the major changes facing the Delta under the Bay Delta Conservation Plan (BDCP) and the Council's commitment to Delta levee prioritization.

It is inevitable that the Delta Plan will generate controversy. This Delta Plan integrates existing State and federal laws and policies and ongoing programs, and is informed by the best available science to chart a course to further the coequal goals. The Council is one of many agencies with an interest in the Delta, and it was not granted unlimited authority over actions related to water supply and the environment. Specific and targeted authority and actions, however, were included by the Delta Reform Act; these form the basis for the Delta Plan's enforceable policies and nonenforceable recommendations.

The Delta Plan's policies and recommendations are based on the following imperatives:

- **Act now.** We have been studying the problems of California's water supply and the declining Delta ecosystem for decades. While all parties agree the *status quo* is not acceptable, failure to take action only prolongs a worsening *status quo*. Near-term actions must move forward while the long-term conveyance, storage, and ecosystem solutions are being decided over the next 5, 10, and 15 years. Waiting is NOT an option. We must continue to invest in the Delta ecosystem and in the improvement of California's water supplies and water use efficiency.
- **Success depends on integrated approaches and awareness of tradeoffs.** Tradeoffs are inherent in managing a supply for multiple benefits. Water exports out of the Delta can harm the ecosystem unless carefully managed. Protecting the Delta as a place means focusing development in urban areas to reduce effects on agricultural land, and risk to people, property, and state interests. Multiple stressors affect the ecosystem in ways that are not yet fully understood and which may be impossible to completely control. The most effective actions will depend upon the coordinated actions of multiple actors.
- **Improve water supply reliability.** Fundamentally, water supply reliability means that California must better match its demands for and use of water to the available supply. Everyone in California must conserve water and must increase their efforts to do so. New surface and groundwater storage is necessary to manage the timing of water for people and for fish. Done right, additional storage can make efficient water management possible and better allow for water use that is wildlife friendly. Improved Delta conveyance, including successful completion of the BDCP, is essential; and it should be done as soon as possible.
- **Commit to Delta ecosystem restoration.** We must preserve land in the Delta for future habitat restoration, and we must immediately begin restoration efforts on long-studied priority areas. In the Delta, the conflict between the way we move water and the health of native species must be resolved. A successfully permitted BDCP is key to that, including water quality objectives updated by the SWRCB for beneficial uses including the Delta's ecosystem. Without adequate water flow (the right mix of timing and amount), we cannot expect fisheries to recover, no matter how well we deal with the range of other stressors.
- **Preserve Delta as a place.** The Delta serves many demands, but we must preserve and protect a unique sense of place distinguished by geography, legacy communities, a rural and agricultural setting, vibrant natural resources, and a mix of economic and recreational activities.

What the Delta Plan Will Achieve

The Delta Plan seeks to further the coequal goals and their inherent objectives in the face of dramatically changing conditions. The Delta of 2100 likely will be very different from the Delta of today (see Table 1-1 for examples of anticipated changes). Some of the changes will be intentional or predictable, and others will be unintended and surprising. Changes are likely or expected to result from population growth, climate change and sea level rise, land subsidence, and earthquakes—most beyond human ability or willingness to control. Human-made changes in land use and water use are also expected to continue.

All of this will involve tradeoffs between competing—in some cases, mutually exclusive—values, goals, and objectives. The Delta Plan seeks to ensure that these decisions are made in a timely and open manner, and based on best available information and science as a predictor of the future. The law requires that the Delta Plan be updated every 5 years, and each update is intended to build on an evolving base of knowledge, directing near- and mid-term actions, and preserving and protecting longer-term opportunities as yet unknown.

Summary of Anticipated Changes Affecting the Delta by 2050 and 2100

TABLE 1-1

Anticipated Change	Change Predicted by 2050	Change Predicted by 2100
Population of California[a]	Increase from 37.2 million in 2010 to 51 million	Continued increase in population
San Francisco Bay/East Bay Area earthquake affecting Delta by 2032[b]	63% probability of at least one magnitude 6.7 or greater earthquake	
Probability of island flooding from high water, relative to 2005 conditions[c]	In range of 200% increase (medium risk scenario)	In range of 450% increase (medium risk scenario)
Increased weather variability, including longer-term droughts[d]	Models and analyses of tree rings and other evidence back to the year 800 suggest greater variability and long periods of drought, especially for the Colorado River Basin, a current source of some water to California.	
Sea level rise, relative to 2000[e]	14 inches	55 to 65 inches
Snow pack, relative to 1956–2000 average of 15 MAF[f]	Reduction of 25% (4.5 MAF) to 40% (6 MAF)	Continued reduction expected

a California Department of Finance 2012

b 2007 Working Group on California Earthquake Probabilities 2008

c DWR 2008

d For examples, see research by Richard Seager, Columbia University, available at http://www.ldeo.columbia.edu/res/div/ocp/drought/, or the California Global Climate Change Portal, available at http://www.climatechange.ca.gov

e California Ocean Protection Council 2011; other sources include higher projections

f DWR 2010

MAF: million acre-feet

The Delta Plan lays out 14 regulatory policies and 73 recommendations that start the process of addressing the current and predicted ecological, flood management, water quality, and water supply reliability challenges. As required by statute, the Delta Plan adopts a science-based adaptive management strategy to manage decision making in the face of uncertainty (Water Code section 85308(f)). All of these changes—some foreseeable, some not—will create a dynamic context in which the Delta Plan must adapt.

Over the life of the Delta Plan, the coequal goals of providing a more reliable water supply for California and restoring the Delta ecosystem are the foundation of all State water management policies. No water rights decisions or water contracts that directly or indirectly impact the Delta are made without consideration of the coequal goals. Over time, balanced application of the Public Trust Doctrine and the California Constitution, Article 10, Section 2 (requirements for beneficial use, reasonable water use, and no waste), have produced optimized water use, including high levels of water use efficiency and protection of public trust resources throughout the state. California has a comprehensive, fully integrated system for tracking and evaluating actual water use and water quality for both surface water and groundwater supplies.

The Delta Plan seeks first to arrest declining water reliability and environmental conditions related to the Delta ecosystem, and ultimately to improve them. It seeks to achieve a more resilient ecosystem that can absorb and adapt to current and future effects of multiple stressors. Additionally, it seeks to reduce flood risk, improve water quality, increase recreation opportunities in the Delta, and protect Delta legacy communities. Generally speaking, these are long-term goals to reduce and reverse increasing long-term environmental impacts caused by inaction. The vision of the Delta in 2100 will be realized through a series of near-term and longer-term actions informed by performance measures and overall adaptive management.

By 2100:

- **California's water supply** will be considerably more efficient, local and regional projects will be online to increase supplies and meet the demands of a growing population, and storage will have increased to meet the challenge of climate change and the needs of water transfer systems. Regions reliant on receiving some portion of their water from the Delta watershed will have reduced their reliance and improved regional self-reliance through increased conservation and diversification of their local and regional sources of supply. Delta conveyance will be managed in an adaptive manner that successfully balances ecosystem restoration and protection with more reliable water deliveries. Water quality in the Delta will support a healthy ecosystem and the multiple beneficial uses of water, including municipal supply and recreational uses such as fishing and swimming.
- **The Delta and Suisun Marsh ecosystem** will have the capacity to provide the environmental and societal benefits the public demands (viable populations of desired species, wild habitats for recreation and solace, land for agriculture, and the conveyance of reliable and high-quality fresh water). Large areas of the Delta will be restored in support of a healthy estuary. A diverse mosaic of interconnected habitats will be re-established in the Delta and its watershed. Migratory corridors for fish, birds, and terrestrial wildlife will be largely protected and restored. Actions have been taken to ensure that sufficient freshwater flows following a more natural, functional hydrograph are now dedicated to support a healthy ecosystem. Actions have reduced the impacts caused by stressors such as invasive species, poor water quality, loss of habitat, and urban development, resulting in improved conditions for native species of fish, birds, and wildlife that depend on the Delta and its watershed.

- **The Delta itself** will be a safe, nationally recognized and vibrant place, with well-defined cities and towns, a strong agricultural sector, and a well-deserved reputation as a recreational destination. Despite an increase in sea levels and altered runoff patterns, risks will be reduced, and residents and agencies will be prepared to respond when floods threaten. In 2100, the Delta will retain its rural heritage and be a place where agricultural, recreational, and environmental uses are uniquely integrated and continue to contribute in important ways to the regional economy.

Timeline for Implementing Priority Actions of the Delta Plan

Figure 1-5 contains a timeline for implementing the priority actions contained in the Delta Plan. The timeline emphasizes near-term and intermediate-term actions. In some instances, precedent or complementary actions need to be undertaken by other agencies or entities to ensure success of the Delta Plan.

Priority Action Timeline

TIMELINE **CHAPTER 1: Priority Actions**

	ACTION (REFERENCE #)	LEAD AGENCY(IES)	NEAR TERM 2012–2017	INTERMEDIATE TERM 2017–2025	ACTION DEPENDS ON
POLICIES	**Reduce reliance on the Delta through improved regional water self-reliance** (WR P1)	Council, DWR, SWRCB	●	●	State, local water agency cooperation and compliance
POLICIES	**Delta flow objectives** (ER P1)	SWRCB	●	●	SWRCB completes on time
POLICIES	**Prioritization of State investments in Delta levees and risk reduction** (RR P1)	Council, DWR	●	●	Council completion; legislative adoption and implementation
RECOMMENDATIONS	**Update Delta flow objectives** (ER R1)	SWRCB	●	●	SWRCB completes on time
RECOMMENDATIONS	**Prioritize and implement projects that restore Delta habitat** (ER R2)	DFW, DWR, Delta Conservancy	●	●	Funding, multiagency cooperation
RECOMMENDATIONS	**Designate the Delta as a National Heritage Area** (DP R1)	DPC	●		Federal action, Congress
RECOMMENDATIONS	**Finance local flood management activities** (RR R2)	DPC	●	●	
RECOMMENDATIONS	**Actions for the prioritization of State investments in Delta levees** (RR R4)	Council, DWR	●		Council completion; legislative adoption and implementation
RECOMMENDATIONS	**Complete Bay Delta Conservation Plan** (WR R12)	DWR, Council incorporates	●	●	State, federal agency action
RECOMMENDATIONS	**Complete surface water storage studies** (WR R13)	DWR	●	●	
RECOMMENDATIONS	**Completion of regulatory processes, research, and monitoring for water quality improvements** (WQ R8)	SWRCB, RWQCBs	●		
RECOMMENDATIONS	**Development of a Delta Science Plan** (G R1)	Council	●	●	
OTHER	Complete Delta Finance Plan	Council	●		Ongoing funding
OTHER	Initiate Delta Plan Interagency Implementation Committee	Council	●	●	Agency cooperation
OTHER	Evaluate and update Delta Plan	Council	●		Ongoing funding

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Agency Key:
Council: Delta Stewardship Council
Delta Conservancy: Sacramento-San Joaquin Delta Conservancy
DFW: California Department of Fish and Wildlife
DPC: Delta Protection Commission
DWR: California Department of Water Resources
RWQCB: Regional Water Quality Control Board
SWRCB: State Water Resources Control Board

Figure 1-5

Organization of the Delta Plan

The Delta Plan is organized around the coequal goals and specific subgoals, strategies, actions, and measures set forth in the Delta Reform Act. The following chapters describe in detail the problems, expected outcomes, and performance measures associated with the various policies and recommendations:

- Chapter 2, The Delta Plan
- Chapter 3, A More Reliable Water Supply for California
- Chapter 4, Protect, Restore, and Enhance the Delta Ecosystem
- Chapter 5, Protect and Enhance the Unique Cultural, Recreational, Natural Resource, and Agricultural Values of the California Delta as an Evolving Place
- Chapter 6, Improve Water Quality to Protect Human Health and the Environment
- Chapter 7, Reduce Risk to People, Property, and State Interests in the Delta

In addition, Chapter 8, Funding Principles to Support the Coequal Goals, provides history and background for water project and program financing by discussing various funding schemes and by providing some current data on water-related expenditures in California. It also outlines guiding principles for developing stable financing for Delta Plan implementation and describes urgently needed near-term funding requirements for certain critical activities.

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CHAPTER 2

The Delta Plan

ABOUT THIS CHAPTER

This chapter discusses the purpose and role of the Delta Stewardship Council (Council) in the context of Sacramento-San Joaquin Delta (Delta) governance. It also describes the Council's approach to developing, implementing, and updating the Delta Plan, all within the framework of adaptive management. It describes why best available science and adaptive management are particularly important tools in the Delta, and proposes the development of a new Delta Science Plan to aid in the coordination and focus of science efforts across agencies. For State of California (State) or local agencies that propose a plan, program, or project occurring in whole or in part in the Delta, this chapter contains a description of the regulatory application of the Delta Plan. For instance:

- What is a covered action?
- Certifications of consistency
- Covered action consistency appeals

The chapter includes one policy and one recommendation.

RELEVANT LEGISLATION

The Sacramento-San Joaquin Delta Reform Act of 2009 established the Delta Stewardship Council to achieve more effective governance while providing for the sustainable management of the Delta ecosystem and a more reliable water supply, using an adaptive management framework, as reflected in the Water Code sections below.

85001 (c) By enacting this division, it is the intent of the Legislature to provide for the sustainable management of the Sacramento-San Joaquin Delta ecosystem, to provide for a more reliable water supply for the state, to protect and enhance the quality of water supply from the Delta, and to establish a governance structure that will direct efforts across state agencies to develop a legally enforceable Delta Plan.

85020 (h) Establish a new governance structure with the authority, responsibility, accountability, scientific support, and adequate and secure funding to achieve these objectives.

85022 (a) It is the intent of the Legislature that state and local land use actions identified as "covered actions" pursuant to Section 85057.5 be consistent with the Delta Plan. This section's findings, policies, and goals apply to Delta land use planning and development.

85052 "Adaptive management" means a framework and flexible decision making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvement in management planning and implementation of a project to achieve specified objectives.

85204 The council shall establish and oversee a committee of agencies responsible for implementing the Delta Plan. Each agency shall coordinate its actions pursuant to the Delta Plan with the council and the other relevant agencies.

85211 The Delta Plan shall include performance measurements that will enable the council to track progress in meeting the objectives of the Delta Plan. The performance measurements shall include, but need not be limited to, quantitative or otherwise measurable assessments of the status and trends in all of the following:

(a) The health of the Delta's estuary and wetland ecosystem for supporting viable populations of aquatic and terrestrial species, habitats, and processes, including viable populations of Delta fisheries and other aquatic organisms.

(b) The reliability of California water supply imported from the Sacramento River or the San Joaquin River watershed.

85225.5 To assist state and local public agencies in preparing the required certification, the council shall develop procedures for early consultation with the council on the proposed covered action.

85225.10 (a) Any person who claims that a proposed covered action is inconsistent with the Delta Plan and, as a result of that inconsistency, the action will have a significant adverse impact on the achievement of one or both of the coequal goals or implementation of government-sponsored flood control programs to reduce risks to people and property in the Delta, may file an appeal with regard to a certification of consistency submitted to the council.

(b) The appeal shall clearly and specifically set forth the basis for the claim, including specific factual allegations, that the covered action is inconsistent with the Delta Plan. The council may request from the appellant additional information necessary to clarify, amplify, correct, or otherwise supplement the information submitted with the appeal, within a reasonable period.

(c) The council, or by delegation the executive officer, may dismiss the appeal for failure of the appellant to provide information requested by the council within the period provided, if the information requested is in the possession or under the control of the appellant.

85300(c) The council shall review the Delta Plan at least once every five years and may revise it as the council deems appropriate. The council may request any state agency with responsibilities in the Delta to make *recommendations with respect to revision of the Delta Plan.*

(d) (1) The council shall develop the Delta Plan consistent with all of the following:

(A) The federal Coastal Zone Management Act of 1972 (16 U.S.C. Sec.1451 et seq.), or an equivalent compliance mechanism.

(B) Section 8 of the federal Reclamation Act of 1902.

(C) The federal Clean Water Act (33 U.S.C. Sec. 1251 et seq.).

(2) If the council adopts a Delta Plan pursuant to the federal Coastal Zone Management Act of 1972 (16 U.S.C. Sec. 1451 et seq.), the council shall submit the Delta Plan for approval to the United States Secretary of Commerce pursuant to that act, or to any other federal official assigned responsibility for the Delta pursuant to a federal statute enacted after January 1, 2010.

85300(a) The Delta Plan shall include subgoals and strategies to assist in guiding state and local agency actions related to the Delta.

85302(e) The following subgoals and strategies for restoring a healthy ecosystem shall be included in the Delta Plan:

(1) Restore large areas of interconnected habitats within the Delta and its watershed by 2100.

(2) Establish migratory corridors for fish, birds, and other animals along selected Delta river channels.

(3) Promote self-sustaining, diverse populations of native and valued species by reducing the risk of take and harm from invasive species.

(4) Restore Delta flows and channels to support a healthy estuary and other ecosystems.

(5) Improve water quality to meet drinking water, agriculture, and ecosystem long-term goals.

(6) Restore habitat necessary to avoid a net loss of migratory bird habitat and, where feasible, increase migratory bird habitat to promote viable populations of migratory birds.

85300(a) The Delta Plan may also identify specific actions that state or local agencies may take to implement the subgoals and strategies.

85302(a) Implementation of the Delta Plan shall further the restoration of the Delta ecosystem and a reliable water supply.

85302(b) The Delta Plan may include recommended ecosystem projects outside the Delta that will contribute to achievement of the coequal goals.

85302(c) The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem:

(1) Viable populations of native resident and migratory species.

(2) Functional corridors for migratory species.

(3) Diverse and biologically appropriate habitats and ecosystem processes.

(4) Reduced threats and stresses on the Delta ecosystem.

(5) Conditions conducive to meeting or exceeding the goals in existing species recovery plans and state and federal goals with respect to doubling salmon populations.

85302(d) The Delta Plan shall include measures to promote a more reliable water supply that address all of the following:

(1) Meeting the needs for reasonable and beneficial uses of water.

(2) Sustaining the economic vitality of the state.

(3) Improving water quality to protect human health and the environment.

85302(h) The Delta Plan shall include recommendations regarding state agency management of lands in the Delta.

85303 The Delta Plan shall promote statewide water conservation, water use efficiency, and sustainable use of water.

85304 The Delta Plan shall promote options for new and improved infrastructure relating to the water conveyance in the Delta, storage systems, and for the operation of both to achieve the coequal goals.

85305(a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting effective emergency preparedness, appropriate land uses, and strategic levee investments.

85305(b) The council may incorporate into the Delta Plan the emergency preparedness and response strategies for the Delta developed by the California Emergency Management Agency pursuant to Section 12994.5.

85306 The council, in consultation with the Central Valley Flood Protection Board, shall recommend in the Delta Plan priorities for state investments in levee operation, maintenance, and improvements in the Delta, including both levees that are a part of the State Plan of Flood Control and nonproject levees.

85307(a) The Delta Plan may identify actions to be taken outside of the Delta, if those actions are determined to significantly reduce flood risks in the Delta.

85307(b) The Delta Plan may include local plans of flood protection.

85307(c) The council, in consultation with the Department of Transportation, may address in the Delta Plan the effects of climate change and sea level rise on the three state highways that cross the Delta.

85307(d) The council, in consultation with the State Energy Resources Conservation and Development Commission and the Public Utilities Commission, may incorporate into the Delta Plan additional actions to address the needs of Delta energy development, energy storage, and energy distribution.

85308 The Delta Plan shall meet all of the following requirements:

> *(a) Be based on the best available scientific information and the independent science advice provided by the Delta Independent Science Board.*
>
> *(b) Include quantified or otherwise measurable targets associated with achieving the objectives of the Delta Plan.*
>
> *(c) Where appropriate, utilize monitoring, data collection, and analysis of actions sufficient to determine progress toward meeting the quantified targets.*
>
> *(d) Describe the methods by which the council shall measure progress toward achieving the coequal goals.*
>
> *(e) Where appropriate, recommend integration of scientific and monitoring results into ongoing Delta water management.*
>
> *(f) Include a science-based, transparent, and formal adaptive management strategy for ongoing ecosystem restoration and water management decisions.*

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CHAPTER 2

The Delta Plan

No single entity in California has the sole responsibility or authority for managing water supply and the Delta ecosystem. Instead, authority, expertise, and resources are spread out among a cadre of federal, State, and local agencies, with no single government agency empowered to provide leadership or a long-term vision. This is why governance reform enacted by the Delta Reform Act is fundamentally different from past approaches to managing the Delta. The milestone legislation created the Council, and gave it the direction and authority to serve two primary governance roles: (1) set a comprehensive, legally enforceable direction for how the State manages important water and environmental resources in the Delta through the adoption of a Delta Plan, and (2) ensure coherent and integrated implementation of that direction through coordination and oversight of State and local agencies proposing to fund, carry out, and approve Delta-related activities.

Recommended in significant part by the Delta Vision Task Force effort in 2008, this new approach is different from governance attempts over the past several decades that have tried, but largely failed, to provide effective and stable leadership. The *Delta Vision Strategic Plan* referred to some 200 agencies that play some role in managing the Delta's varied resources (Delta Vision 2008). One of the major goals articulated in that strategic plan was the establishment of a new governance structure with sufficient authority, responsibility, accountability, science support, and secure funding to achieve the coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The creation of the independent Council was a significant step toward implementing this goal. The Council is made up of seven members who provide a broad, statewide perspective and diverse expertise, and is advised by a 10-member board of nationally and internationally renowned scientists, the Delta Independent Science Board (ISB). The Delta Reform Act instructs the Council to "direct efforts across state agencies," but considerable challenges lie ahead in coordinating and supporting the multitude of agencies to achieve the goals of the Delta Plan.

The first major task for the newly created Council is the development of this Delta Plan. The Delta Reform Act requires the Council to develop and adopt a legally enforceable, long-term management plan for the Delta that uses best available science and is built upon the principles of adaptive management. The Delta Reform Act also established the Delta Science Program within the Council to provide the best possible unbiased scientific information to inform water and environmental decision making in the Delta. Because California's Delta is linked to so many statewide issues, described in Chapter 1, the Delta Plan's scope and purview encompasses statewide water use, flood management, and the Delta watershed, but with a specific focus on the legal Delta and Suisun Marsh. The Delta Plan contains a set of regulatory policies that will be enforced by the Council's appellate authority and oversight, described in this chapter. These regulatory policies and supporting documents are contained in Appendix B. The Delta Plan also contains priority recommendations, which are nonregulatory but call out actions essential to achieving the coequal goals. The Council has chosen to apply its regulatory authority in a targeted manner, and does so in an effort to ensure that all significant activities occurring in whole or in part in the Delta become better aligned over time with State policy priorities, including—and especially—the achievement of the coequal goals. The process for demonstrating compliance with Delta Plan policies is described in detail in this chapter.

In developing the first Delta Plan, the Council sought extensive public, stakeholder, and government agency input and, based on that input, developed the foundational set of policies and recommendations detailed in the following chapters to guide actions over the first few years of Plan implementation. Every stage of implementing the Delta Plan will necessitate leadership by the Council and ongoing coordination across a broad range of agencies, nongovernmental entities, and stakeholders.

The Delta Stewardship Council

As described in Chapter 1, the Delta of today is the result of centuries of natural and human-made actions and reactions. Government historically has worked to treat individual problems rather than adopt a systemwide approach. Dozens of agencies, task forces, and working groups have struggled to find the right combination of policy, science, and structure to address what are now California's fundamental goals for managing the Delta, the coequal goals.

The mission of the Council is to further the achievement of the coequal goals. To do so, the Council was charged with the development of a legally enforceable, long-term management plan for the Delta. To accomplish this, the Council will apply a common-sense approach based on a strong scientific foundation in an adaptive management framework to protect and restore the Delta ecosystem; improve the quality and reliability of California's water supplies; reduce risk to people, property, and State interests; and protect and enhance the Delta as an evolving place.

The Council's most important and challenging role is the facilitation, coordination, and integration of a range of actions and policies in support of the coequal goals. Implementation will occur through the Council's leadership of a formal Interagency Implementation Committee, ongoing informal staff-to-staff agency coordination, development of science to support the Delta Plan, and use of the Council's various authorities to ensure progress and accountability in how the Delta is managed. See Table 2-1 for a reference list of agencies with responsibilities in the Delta or related to the management of the Delta.

In addition to its role in setting State policy for the Delta in the Delta Plan, and in facilitating and coordinating agencies to achieve policy objectives, the Council was granted specific regulatory and appellate authority over certain actions that take place in whole or in part in the Delta. To do this, the Delta Plan contains a set of regulatory policies with which State and local agencies are required to comply. The Delta Reform Act specifically established a certification process for compliance with the Delta Plan. This means that State and local agencies that propose to carry out, approve, or fund a qualifying action in whole or in part in the Delta, called a "covered action," must certify that this covered action is consistent with the Delta Plan and must file a certificate of consistency with the Council that includes detailed findings. This process is described in the section "Covered Actions and Delta Plan Consistency" later in this chapter.

Agencies with Responsibilities in the Delta

TABLE 2-1

State	
Delta Stewardship Council	Established in 2009 by the Delta Reform Act to further the achievement of the coequal goals through the development and implementation of a legally enforceable Delta Plan.
California Department of Fish and Wildlife	Provides fish and wildlife protection and management, including management of wildlife areas and ecological reserves, public access, conservation planning, permitting, and implementation of the Ecosystem Restoration Program.
California Department of Water Resources	Owns and operates the State Water Project (which stores water upstream and conveys water through the Delta), has emergency response and flood planning responsibilities, holds water quality/supply contracts with Delta water agencies, and coordinates overall statewide water planning.
Delta Protection Commission	Prepares a comprehensive long-term resource management plan for land uses within the approximate 500,000-acre Primary Zone. Local government plans must be consistent.
Sacramento-San Joaquin Delta Conservancy	A primary State agency to implement ecosystem restoration in the Delta and also to assist/protect the region's agricultural, cultural, economic, and historical value.
State Water Resources Control Board	Required to develop in 2010 nonregulatory flow criteria for the Delta ecosystem necessary to protect public trust uses to inform planning proceedings for the Delta Plan and Bay Delta Conservation Plan (BDCP). Responsible for developing and implementing the Bay-Delta Water Quality Control Plan to establish water quality objectives, including flow objectives, to ensure reasonable protection of beneficial uses in the Bay-Delta. Responsible for establishing, implementing, and enforcing water right requirements to ensure the proper allocation and efficient use of water in and out of the Delta, including the role of the Delta Watermaster and implementation of the Bay-Delta Water Quality Control Plan. With regional boards, responsible for developing and implementing other water quality standards and control plans consistent with State and federal laws to reasonably protect aquatic beneficial uses.
California Emergency Management Agency	Plans, prepares emergency response, and coordinates the activities of all State agencies in connection to an emergency in the Delta; provides resources if local agencies are overwhelmed.
Central Valley Flood Protection Board	Plans flood control along the Sacramento and San Joaquin rivers and their tributaries in cooperation with the U.S. Army Corps of Engineers.
Office of the Delta Watermaster	Created in 2009 to oversee day-to-day administration of water rights, enforcement activities, and reports on water right activities regarding diversions in the Delta.
California Natural Resources Agency	Coordinates with a group of local water agencies, environmental and conservation organizations, State and federal agencies, and other interest groups developing the BDCP, a conservation strategy to be compliant with the Endangered Species Act (ESA) and Natural Community Conservation Planning Act, to be implemented over the next 50 years.
Other State agencies	Have various roles or responsibilities in the Delta relevant to the agency's concern (for example, California Department of Food and Agriculture, California Department of Transportation, California State Parks, California Department of Boating and Waterways, State Lands Commission, California Environmental Management Agency, and others).

Agencies with Responsibilities in the Delta

TABLE 2-1

Federal	
Bureau of Reclamation	Owns and operates the Central Valley Project, which, among other activities, pumps water through and out of the Delta.
U.S. Fish and Wildlife Service	Develops plans for the conservation and recovery of fish and wildlife resources, and addresses the variable needs of fish and wildlife pursuant to the ESA.
U.S. Army Corps of Engineers	Involved with both federal and nonfederal partners in assessing channel navigation, ecosystem, and flood risk management projects in the Delta. Works cooperatively with its nonfederal partners regarding the regulation, maintenance, and improvement of project levees in the Delta.
National Marine Fisheries Service	Develops plans for the conservation and recovery of salmonids in the Delta pursuant to the ESA.
U.S. Environmental Protection Agency	Responsible for protection and restoration of water quality in the Delta, pursuant to the Clean Water Act, which regulates the discharge of pollutants into waterways and sets standards for water quality. Oversees implementation of Clean Water Act programs and policies delegated to the State.
Other federal agencies	Various roles or responsibilities in the Delta relevant to the agency's concern (for example, U.S. Department of Agriculture, Natural Resources Conservation Service, and others).
Local	
Hundreds of local reclamation districts, resource conservation districts, water districts, city and county governments, and other special districts.	

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To be effective, governance to support science and implement adaptive management for a changing Delta must be flexible and have the capacity to change policies and practices in response to what is learned over time. An adaptive management approach as detailed in this chapter will ensure that the Delta Plan is updated as often as necessary to incorporate new information or modify policies and recommendations to ensure achievement of the coequal goals. The following section discusses the particular importance of science and adaptive management as they relate to the Delta.

Science and Adaptive Management in the Delta

The Delta Reform Act requires that the Delta Plan be based on and implemented using the best available science, and requires the use of science-based, transparent, and formal adaptive management strategies for ongoing ecosystem restoration and water management decisions. This section describes the importance of science, especially as it relates to the Delta, describes how the Delta Plan itself uses an adaptive management plan, and proposes the development of a Delta Science Plan as a companion to the Delta Plan.

The State of Bay-Delta Science report concluded that most of the decision making in the Delta was occurring on the basis of a false understanding that the Delta was a static system, and that "the Delta of the future would be much the same as the Delta of today" (Healey et al. 2008). Science indicates that significant changes are expected in the Delta over the coming decades, including climate change and the potential for earthquakes and flooding, as described in Chapter 1. In addition, current planning processes for habitat restoration, changes to water conveyance in the Delta, urban expansion, and other human drivers could reshape the Delta as we know it today.

The State of Bay-Delta Science urged a new perspective for decision making in the Delta (Healey et al. 2008). Decision making should be based on best available science, should account for risk and uncertainty, should acknowledge the dynamic nature of ecosystems, and should be responsive and adaptive to future change. The Delta Reform Act, enacted 1 year after that report, requires a strong science foundation for Council decisions. This includes the ongoing provision of scientific expertise to support the Council and other agencies through the Delta Science Program and Delta ISB. The Delta Science Program's mission is to provide the best possible scientific information for water and environmental decisions in the Bay-Delta system. The Delta ISB provides oversight of the scientific research, monitoring, and assessment programs that support adaptive management of the Delta to ensure that the application of the best science is used in Delta programs. The Delta ISB reviewed early drafts of this Delta Plan to ensure that the best science was used in the Delta Plan.

Why is it important that the Delta Plan emphasize science? First, science provides the basis of nearly all current understanding of the Delta's status (Healey et al. 2008, Lund et al. 2010). Second, new perspectives on science and policy in the Delta instill urgency for addressing the health of Delta ecosystems and the need for a more reliable water supply. Third, the interaction of multiple stressors to the ecosystem must be understood if they are to inform effective policy decisions.

Science and adaptive management are not simply academic exercises; they are tools that provide managers and decision makers an approach for using public funds more effectively, and increase the likelihood of success for a given project. Science by itself does not make or prioritize management decisions; it only informs actions and proposals. "Using the best science is only part of what is needed to resolve the competing interests…" that clamor over the Delta (NRC 2012).

The next sections describe what the Council means when it comes to best available science and adaptive management in the context of the coequal goals.

Best Available Science

Not all science is created equal nor deserves equal weight in decision making. Best available science provides the knowledge base for making sound decisions and is foundational for adaptive management. Best available science provides understanding for defining problems, developing conceptual models, identifying potential management actions, monitoring ecological and physical responses, and analyzing responses relative to the actions taken. Adaptive management both uses best available science and contributes to the creation of the best available science.

Best available science is specific to the decision being made and the time frame available for making that decision. There is no expectation of delaying decisions to wait for improved scientific understanding. Action may be taken on the basis of incomplete science if the information used is the best available at the time.

Best available science is developed through a process that meets the criteria of (1) relevance, (2) inclusiveness, (3) objectivity, (4) transparency and openness, (5) timeliness, and (6) peer review (NRC 2004). Best available science is consistent with the scientific process (Sullivan et al. 2006). Ultimately, best available science requires scientists using the best information and data to assist management and policy decisions. The processes and information used should be clearly documented and effectively communicated to foster improved understanding and decision making.

Under the Delta Plan, covered actions are required to demonstrate the use of best available science in their decision making (see policy G P1 in this chapter). Guidelines and criteria for identifying or developing best available science are provided in Appendix C.

SCIENCE IN THE DELTA – ADVANCES IN UNDERSTANDING

The following is a partial list of scientific advances that have changed understanding of the Delta and California's water supply over the last decade.

Effects of Climate Change on People and the Environment

- Increased frequency of (1) extreme water heights that cause floods, (2) water temperatures lethal to salmon and delta smelt, and (3) flooding in the Yolo Bypass, which will be much more common by the latter half of this century (Cloern et al. 2011).
- Trends in snowfall versus rainfall precipitation in the western United States show that temperatures have warmed during winter and early spring storms; and, consequently, the fraction of precipitation that falls as snow has declined while the fraction that falls as rain has increased. This shift from snowfall to rainfall will reduce natural water storage and is likely to increase risks of winter and spring flooding (Knowles et al. 2006).
- By mid-century, the Colorado River Reservoir System will not be able to meet all of the demands placed on it, including water supply for Southern California and the inland southwest, because reservoir levels will be reduced by over one-third and releases reduced by as much as 17 percent. Reductions in precipitation for the Colorado River Basin will threaten the ability to meet mandated water allocations (Barnett et al. 2004).

Water Supply Reliability

- The rate of groundwater depletion in the Central Valley was quantified using satellite imaging; approximately 2.5 million acre-feet per year of groundwater was lost during the period from October 2003 to March 2010 (Famiglietti et al. 2011).
- Precipitation and streamflow are proportionally more variable from year to year in California than in any other part of the United States (Dettinger et al. 2011).

Ecosystem Restoration

- Several open-water (pelagic) fish species have undergone steep declines known as the Pelagic Organism Decline (POD) (Sommer et al. 2007). The Interagency Ecological Program investigation of these declines led to new insights about the effects of multiple stressors on these species and the Delta ecosystem (summarized in Baxter et al. 2010). Improved knowledge about the POD also led to regulatory changes for water exports and pollutant discharges.
- In 86 percent of approximately 3,000 assessed streams across the United States, streamflow magnitudes (especially flow maxima and minima) were altered. In comparison to other evaluated stressors, streamflow alterations were found to have the greatest significance for explaining ecological impairment (Carlisle et al. 2011).
- Altered flow regimes by human activities influence the ecological impact of drought anomalies and increase the susceptibility of ecosystems to biological invasion. Extreme climatic events act together with environmental disturbances to enable the establishment of invasive species (Winder et al. 2011).
- Ratios of nutrients in Delta waters have been hypothesized to be a primary driver in the composition of aquatic food webs in the Bay-Delta (Glibert et al. 2011).

Water Quality

- Ammonium concentrations may be having a significant impact on phytoplankton composition and open-water food webs because of suppression of diatom blooms in the Bay-Delta (Dugdale et al. 2007).
- Pyrethroid pesticides largely derived from urban and suburban runoff are regularly found at levels that are toxic to aquatic invertebrates (Weston et al. 2005, Weston and Lydy 2010).

Risk Reduction

- With permanently flooded conditions and managed water depths, short-term sediment accretion rates as high as 7 to 9 centimeters per year can be obtained to help reverse subsidence on Delta islands (Miller et al. 2008).
- Atmospheric rivers (narrow corridors of concentrated moisture in the atmosphere) contribute 33 to 50 percent of the total average amount of rainfall for California and have been the source of many floods along the West Coast of the United States. California's water resources and floods come from the same storms to an extent, which makes integrated flood and water resources management all the more important (Dettinger et al. 2011).

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Adaptive Management

Adaptive management is defined in the Delta Reform Act as:

> *a framework and flexible decision making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvements in management planning and implementation of a project to achieve specified objectives (Water Code section 85052).*

Adaptive management is useful in that it provides flexibility and feedback to manage natural resources in the face of often considerable uncertainty. This approach requires careful science-based planning followed by measurement to determine whether a given action actually achieves intended goals.

If goals are not achieved, informed adjustments can be made. This is especially important in the context of the Delta because, in some instances, competing and uncertain explanations arise, and decision making cannot be delayed until causes are better understood (Healey et al. 2008). The Council has adopted a three-phase adaptive management framework for the purposes of developing, implementing, and updating the Delta Plan, described later in this chapter, and also for use by ecosystem restoration and water management covered actions, as set forth in G P1 with additional detail in Appendix C.

A Delta Science Plan

Multiple frameworks for science in the Delta have been proposed, but a comprehensive science plan that specifies how scientific research, monitoring, analysis, and data management will be coordinated among entities has yet to be developed. Currently, science efforts in the Delta are performed by multiple entities with varying missions and mandates, and without an overarching plan. The National Research Council (NRC) found that "only a synthetic, integrated, analytical approach to understanding the effects of suites of environmental factors (stressors) on the ecosystem and its components is likely to provide important insights that can lead to enhancement of the Delta and its species" (NRC 2012). Therefore, a comprehensive science plan for the Delta is needed to organize and integrate ongoing scientific research, monitoring, and learning about the Delta as it changes over time.

A Delta Science Plan will guide efficient use of resources for balancing investments in addressing short-term science needs and those that build understanding over the long run. This plan will address effective governance for science in the Delta, strategies for addressing uncertainty and conflicting scientific information, the prioritization of research, near-term science needs, financial needs to support science, and more. Such a plan is essential to support the adaptive management of ecosystem restoration and water management decisions in the Delta.

Additional detail regarding the proposed Delta Science Plan is provided in recommendation G R1 in this chapter.

The Delta Plan

The Delta Reform Act established the Council and directed it to develop an overarching, long-term management plan for the Delta. Figure 2-1 shows the roles assigned to the Council under the Act. The Act specifically requires that this plan for the Delta include a science-based, formal adaptive management strategy for ongoing ecosystem restoration and water management decisions.

This section presents a three-phase adaptive management framework (Plan, Do, and Evaluate and Respond), describes specific considerations that went into the development of the Delta Plan, and provides the overarching framework for how the Council (in collaboration with others) will implement and continuously amend the Delta Plan to achieve the coequal goals.

Council Roles and the Delta Plan

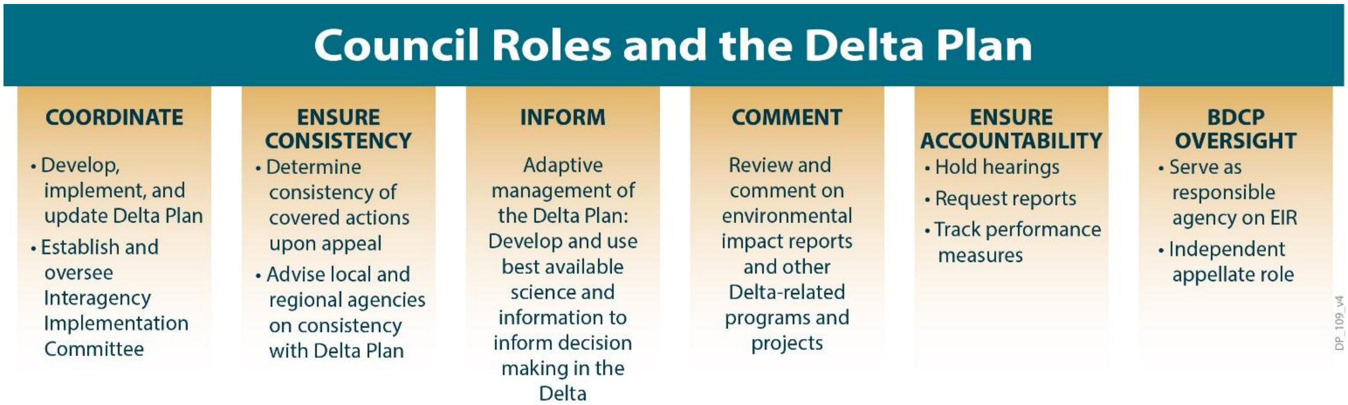

Figure 2-1

The Council's Three-phase Adaptive Management Framework

Several existing frameworks for adaptive management provide the basis for the Delta Plan's own adaptive management approach.[1] Although there are differences among various frameworks, they generally consist of three broad phases: Plan, Do, and Evaluate and Respond. Throughout all three phases of the adaptive management process, decisions are made by managers, policy makers, and/or technical experts. In developing an adaptive management plan, the best available science should be used to inform all phases of the adaptive management process.

In addition to requiring adaptive management for certain proposed covered actions, the Council, in coordination with others, will use adaptive management to develop, implement, and update the Delta Plan. The Council will rely in large part on the Delta Science Program to determine the relevance, value, and reliability of the best available science and to organize that information for its use in the Council's decisions. The Council has the final responsibility for determining the best available science used in support of its actions, including when a choice among competing interpretations of available science must be made.

The three phases of the Council's adaptive management framework (Plan, Do, and Evaluate and Respond) are shown on Figure 2-2, and are further broken down into nine steps, which are described in detail in Appendix C.

The Delta Stewardship Council's Three-phase Adaptive Management Framework

Figure 2-2

[1] Christensen et al. 1996, Stanford and Poole 1996, CALFED Bay-Delta Program 2000, Habron 2003, Abal et al. 2005, Healey et al. 2008, Kaplan and Norton 2008, Bay Delta Conservation Plan Independent Science Advisors on Adaptive Management 2009, Williams et al. 2009.

Plan: Development of the Delta Plan

The first phase of adaptive management is "Plan." The Plan phase requires clear definition of the problem, establishment of objectives, how to achieve those objectives, and actions for implementation. Performance measures are included to evaluate whether the actions are successfully meeting their intended objectives. As described in Chapter 1, the Council was established in response to an ongoing crisis in the Delta. Water supply reliability and the health of the Delta ecosystem are both at risk, and the status quo—including the patchwork governance of State, local, and federal agencies—is not making acceptable progress toward reversing disturbing trends in a balanced and sustainable manner.

The Delta Plan is intended to be foundational and adaptive. It is foundational in that the Council has built on previous efforts, including CALFED, the Delta Vision, the California Water Plan, planning efforts of the State Water Resources Control Board (SWRCB), the Delta Protection Commission (DPC), and others. The framework established in this Delta Plan is intended to advance the coequal goals of water supply reliability and ecosystem health, and to employ adaptive management to improve the Plan over time.

This Delta Plan officially supersedes and replaces the Interim Delta Plan adopted by the Council on August 27, 2010.

Structure of the Delta Plan

The Delta Plan contains five core policy chapters (Chapters 3 through 7) and a chapter on Funding Principles to Support the Coequal Goals (Chapter 8). The narrative sections of each policy chapter provide subject matter context and rationale for the selection and implementation of core strategies. These core strategies are then broken down into actions: the policies and recommendations. The policies in the Delta Plan are regulatory in nature, and compliance is required for those who propose covered actions. In each policy chapter, the Policies and Recommendations section is followed by a section identifying both science needs and key issues for future evaluation by the Council.

Finally, each policy chapter concludes with a set of performance measures. The Delta Reform Act requires that the Delta Plan include performance measures to evaluate whether it is achieving its objectives over time. Information learned from performance measures will be an important part of how the Council determines when and how to update the Delta Plan as part of the Evaluate and Respond phase of the adaptive management process. See the sidebar, Performance Measures in the Delta Plan, later in this chapter.

Considerations in the Development of the Delta Plan

The Delta Reform Act set forth certain requirements and guidance for the development of the Delta Plan. The Act required the development of several State agency plans to inform the Delta Plan planning process and set forth statutory guidelines for the consideration or inclusion of certain plans, some of which were not yet completed at the date of Delta Plan publication and will be considered in future plan updates.

- **Delta Reform Act objectives.** The Act lists numerous objectives and, in some sections, provides detailed guidance for what the Delta Plan shall include (see Table 2-2).
- **State agency proposals.** Specific agencies are named in the Delta Reform Act as being responsible for submitting reports or recommendations to the Council for consideration for inclusion in the Delta Plan. The DPC, California State Parks, and the California Department of Food and Agriculture (CDFA) all submitted proposals that were considered in the development of this Delta Plan.
- **Consistency with federal law.** The Delta Reform Act requires that the Delta Plan be developed consistent with the federal Clean Water Act, Section 8 of the federal Reclamation Act of 1902, and the federal Coastal Zone Management Act of 1972 (CZMA), or an equivalent compliance mechanism. See sidebar, Federal Participation in Implementing the Delta Plan, for more information.

Delta Plan Requirements by Water Code Section

TABLE 2-2

Water Code Section	Requirement
85211	The Delta Plan shall include performance measurements that will enable the council to track progress in meeting the objectives of the Delta Plan. The performance measurements shall include, but need not be limited to, quantitative or otherwise measurable assessments of the status and trends in all of the following:
85211(a)	– The health of the Delta's estuary and wetland ecosystem for supporting viable populations of aquatic and terrestrial species, habitats, and processes, including viable populations of Delta fisheries and other aquatic organisms.
85211(b)	– The reliability of California water supply imported from the Sacramento River or the San Joaquin River watershed.
85300(a)	The Delta Plan shall include subgoals and strategies to assist in guiding state and local agency actions related to the Delta.
85302(e)	The following subgoals and strategies for restoring a healthy ecosystem shall be included in the Delta Plan:
85302(e)(1)	– Restore large areas of interconnected habitats within the Delta and its watershed by 2100.
85302(e)(2)	– Establish migratory corridors for fish, birds, and other animals along selected Delta river channels.
85302(e)(3)	– Promote self-sustaining, diverse populations of native and valued species by reducing the risk of take and harm from invasive species.
85302(e)(4)	– Restore Delta flows and channels to support a healthy estuary and other ecosystems.
85302(e)(5)	– Improve water quality to meet drinking water, agriculture, and ecosystem long-term goals.
85302(e)(6)	– Restore habitat necessary to avoid a net loss of migratory bird habitat and, where feasible, increase migratory bird habitat to promote viable populations of migratory birds.
85300(a)	The Delta Plan may also identify specific actions that state or local agencies may take to implement the subgoals and strategies.
85302(a)	Implementation of the Delta Plan shall further the restoration of the Delta ecosystem and a reliable water supply.
85302(b)	The Delta Plan may include recommended ecosystem projects outside the Delta that will contribute to achievement of the coequal goals.
85302(c)	The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem:
85302(c)(1)	– Viable populations of native resident and migratory species.
85302(c)(2)	– Functional corridors for migratory species.
85302(c)(3)	– Diverse and biologically appropriate habitats and ecosystem processes.
85302(c)(4)	– Reduced threats and stresses on the Delta ecosystem.
85302(c)(5)	– Conditions conducive to meeting or exceeding the goals in existing species recovery plans and state and federal goals with respect to doubling salmon populations.
85302(d)	The Delta Plan shall include measures to promote a more reliable water supply that address all of the following:
85302(d)(1)	– Meeting the needs for reasonable and beneficial uses of water.
85302(d)(2)	– Sustaining the economic vitality of the state.
85302(d)(3)	– Improving water quality to protect human health and the environment.
85302(h)	The Delta Plan shall include recommendations regarding state agency management of lands in the Delta.

Delta Plan Requirements by Water Code Section

TABLE 2-2

Water Code Section	Requirement
85303	The Delta Plan shall promote statewide water conservation, water use efficiency, and sustainable use of water.
85304	The Delta Plan shall promote options for new and improved infrastructure relating to the water conveyance in the Delta, storage systems, and for the operation of both to achieve the coequal goals.
85305(a)	The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting effective emergency preparedness, appropriate land uses, and strategic levee investments.
85305(b)	The council may incorporate into the Delta Plan the emergency preparedness and response strategies for the Delta developed by the California Emergency Management Agency pursuant to Section 12994.5.
85306	The council, in consultation with the Central Valley Flood Protection Board, shall recommend in the Delta Plan priorities for state investments in levee operation, maintenance, and improvements in the Delta, including both levees that are a part of the State Plan of Flood Control and nonproject levees.
85307(a)	The Delta Plan may identify actions to be taken outside of the Delta, if those actions are determined to significantly reduce flood risks in the Delta.
85307(b)	The Delta Plan may include local plans of flood protection.
85307(c)	The council, in consultation with the Department of Transportation, may address in the Delta Plan the effects of climate change and sea level rise on the three state highways that cross the Delta.
85307(d)	The council, in consultation with the State Energy Resources Conservation and Development Commission and the Public Utilities Commission, may incorporate into the Delta Plan additional actions to address the needs of Delta energy development, energy storage, and energy distribution.
85308	The Delta Plan shall meet all of the following requirements:
85308(a)	– Be based on the best available scientific information and the independent science advice provided by the Delta Independent Science Board.
85308(b)	– Include quantified or otherwise measurable targets associated with achieving the objectives of the Delta Plan.
85308(c)	– Where appropriate, utilize monitoring, data collection, and analysis of actions sufficient to determine progress toward meeting the quantified targets.
85308(d)	– Describe the methods by which the council shall measure progress toward achieving the coequal goals.
85308(e)	– Where appropriate, recommend integration of scientific and monitoring results into ongoing Delta water management.
85308(f)	– Include a science-based, transparent, and formal adaptive management strategy for ongoing ecosystem restoration and water management decisions.

- **Incorporation of the Bay Delta Conservation Plan into the Delta Plan.** The Bay Delta Conservation Plan (BDCP) is a major project considering large-scale improvements in water conveyance and large-scale ecosystem restoration in the Delta. When completed, it must be incorporated into the Delta Plan if it meets certain statutory requirements. Completion of the BDCP process and the number of projects now under consideration in that process would have large impacts on the Delta and would affect the coequal goals. (More detailed discussions of the BDCP are provided in Chapters 3 and 4.) The Delta Reform Act describes a separate, explicit process for incorporating the BDCP into the Delta Plan (Water Code section 85320), and the

Council has adopted administrative procedures governing appeals to the Council related to BDCP incorporation (see Appendix D). If the BDCP is incorporated into the Delta Plan, it becomes part of the Delta Plan and, therefore, part of the basis for future consistency determinations.

- **Incorporation of other plans into the Delta Plan.** The Council may incorporate other plans or programs in whole or in part into the Delta Plan to the extent that they promote the coequal goals.

Do: Implementation and Oversight of the Delta Plan

The second phase of adaptive management is "Do." The "doing," or implementation, of the Delta Plan will occur over time (through 2100) through the coordinated efforts of many State, local, and federal agencies, in cooperation with nongovernmental organizations and private parties, and Council oversight and exercise of appellate authorities.

Federal participation in implementing the Delta Plan and the coequal goals is described in detail in the sidebar, Federal Participation in Implementing the Delta Plan.

The Council is responsible for overseeing the Delta Plan's implementation. Given the numerous government agencies that frequently have conflicting or overlapping jurisdictional and programmatic interest in Delta matters (see Table 2-1), there is a compelling need for the Council to fulfill the role as integrator of Delta policy and coordinator of actions. This integration and coordination will occur through convening a formal Interagency Implementation Committee, providing ongoing informal staff-to-staff agency coordination, providing comments and advice from the Council to other agencies on proposed or ongoing plans and programs, holding public hearings, developing science to support the Delta Plan, and using the Council's appellate authority over consistency of significant actions in the Delta with the Delta Plan.

Delta Plan Interagency Implementation Committee

Perhaps the most significant tool the Council will have for implementing the Delta Plan and ensuring accountability is a formal method for active agency coordination. The Delta Reform Act directs the Council to establish and oversee a committee of agencies responsible for implementing the Delta Plan. Notably, the law states that "each agency shall coordinate its actions pursuant to the Delta Plan with the Council and other relevant agencies" (Water Code section 85204). Governance challenges have long plagued management of the Delta and California's ability to achieve stated objectives for water supply and the Delta ecosystem. Ambiguous and sometimes conflicting authorities and responsibilities among agencies thwart real progress (NRC 2012).

The Council, therefore, will coordinate implementation of the Delta Plan through the establishment and leadership of an Interagency Implementation Committee to do the following:

- Monitor progress of priority actions and agency activities to implement the Delta Plan;
- Report regularly on implementation plans and actions;
- Identify opportunities for integration and leveraging of funding;
- Identify funding needs and support development of a finance plan to implement the Delta Plan;
- Assist in the ongoing development and tracking of Delta Plan performance measures;
- Coordinate regulatory actions on significant projects to implement the Delta Plan, as appropriate; and
- Discuss common issues and resolve interagency conflicts.

The Interagency Implementation Committee, which shall convene at least twice each year and more often as needed, will be overseen by the Council and will be organized around the implementation of the Delta Plan. The Interagency Implementation Committee will include federal, local, and State agency representatives as dictated by the specific matter or subject area in the Delta Plan. At a minimum, the Interagency Implementation Committee will consist of the Council's Executive Officer, the Delta Science Program lead

FEDERAL PARTICIPATION IN IMPLEMENTING THE DELTA PLAN

The Delta Reform Act recognizes the federal government's critical role in achieving the coequal goals through the Delta Plan's comprehensive, Delta-wide planning and implementation effort. This effort goes beyond federal participation in the more narrowly focused BDCP. This recognition builds upon the history of federal-State cooperative governance efforts in the Delta made necessary by the multitude of federal and State agencies working on interconnected, cross-jurisdictional issues in and related to the Delta, including water project operations, water quality regulation, levee maintenance, habitat restoration, and endangered species regulation.

Federal Law Now Incorporates the Coequal Goals

The federal Energy and Water Development Appropriations Act of 2012 (Title II of the Consolidated Appropriations Act of 2012 (PL 112-074)) contains, in pertinent part, the following:

> *The Federal policy for addressing California's water supply and environmental issues related to the Bay-Delta shall be consistent with State law, including the coequal goals of providing a more reliable water supply for the State of California and protecting, restoring, and enhancing the Delta ecosystem…Nothing herein modifies existing requirements of Federal law. (Section 205)*

The Council's staff will work with federal agency representatives to explore opportunities for federal participation in Delta Plan implementation efforts to help those agencies comply with this new Congressional policy directive.

The current regulatory provisions of the Delta Plan, including the consistency review and appeals process, apply to only covered actions of State and local agencies. However, once the Delta Plan is adopted, the Delta Reform Act requires the Council to pursue a compliance mechanism that requires consistency of federal actions. The Delta Reform Act identifies the CZMA, or "an equivalent compliance mechanism," as the preferred means to accomplish this objective. Under the CZMA, states are authorized to review certain activities of federal agencies, including activities directly conducted by federal agencies and activities permitted or licensed by these agencies, for consistency with a state's federally approved coastal management program. This review authority applies to any activity that affects any land or water use or natural resource of the state coastal zone.

In this regard, the Council staff has met, and will continue to meet, with federal agency representatives to identify the appropriate process to submit the Delta Plan to the Secretary of Commerce for approval under the CZMA (and with representatives of the California Coastal Commission and the San Francisco Bay Conservation and Development Commission, which administer California's coastal management program).

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scientist, and executive officers or directors from the California Department of Water Resources (DWR); California Department of Fish and Wildlife (DFW); SWRCB and regional water quality control boards; the San Francisco Bay Conservation and Development Commission; the California Water Commission; the Sacramento-San Joaquin Delta Conservancy; the DPC; the Delta Watermaster; the CDFA; the Natural Resources Agency; the Business, Transportation and Housing Agency; and the California Environmental Protection Agency. Federal agencies such as National Oceanic and Atmospheric Administration Fisheries, U.S. Fish and Wildlife Service, Bureau of Reclamation, Natural Resources Conservation Service, U.S. Geological Survey, U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, and others, as appropriate, will be invited to participate and provide status reports on various projects and programs related to Delta Plan implementation.

The meetings of the Interagency Implementation Committee will be open to the public, and the agenda will be noticed in advance. The committee will create ad hoc workgroups as appropriate to facilitate focus on specific issues. Stakeholder representatives will be encouraged to participate in the various workgroups. The work of both the formal Interagency Implementation Committee and the workgroups may be supplemented with meetings or hearings conducted by the Council.

The Delta Protection Commission's Role in Delta Plan Implementation

The Delta Protection Act states that the DPC is the appropriate agency to identify and provide recommendations to the Council on methods of preserving the Delta as an evolving place. The DPC developed and submitted a set of recommendations to the Council, many of which were incorporated in this Delta Plan (DPC 2012). The Delta Protection Act outlines a process for the DPC to review and provide comments and recommendations to the Council on any significant project or proposed project within the scope of the Delta Plan that may affect the unique values of the Delta (Public Resources Code section 29773(a)). The Council's adopted procedures include a process whereby the Council will notify the DPC of covered action appeals.

Other Delta Plan Implementation Actions

In addition to convening the Interagency Implementation Committee and carrying out the other responsibilities assigned to it by the Delta Reform Act, the Delta Plan assigns other tasks that will further refine the Delta Plan to the Council. These tasks are described in the following recommendations: G R1 (Chapter 2), WR R5 (Chapter 3), WR R15 (Chapter 3), DP R7 (Chapter 5), DP R19 (Chapter 5), RR R4 (Chapter 7), and FP R1 through R3 (Chapter 8).

Additional Council Authorities in Implementing the Delta Plan

The Delta Reform Act enumerated a range of specific authorities for the Council related to the implementation of the Delta Plan (as shown on Figure 2-1). A full list of authorities can be found in Water Code section 85210 and in various sections of the Delta Reform Act. In implementing the Delta Plan, the Council has the authority to:

- **Comment on environmental impact reports.** The Council has a role in commenting on any State agency environmental impact reports (EIRs) as appropriate to the mission of the Council.
- **Comment on policies related to the coequal goals and implementation of the Delta Plan.** As appropriate, the Council may comment formally on any proposed policies or regulations that will impact the achievement of the coequal goals and the implementation of the Delta Plan.
- **Advise local governments.** The Council has a role in advising local and regional planning agencies regarding the consistency of their planning documents with the Delta Plan. As described in Chapter 5, the Council will review sustainable community strategies and regional transportation plans to prevent conflicts with the Delta Plan and to coordinate metropolitan development with actions in the Delta.
- **Request reports from State, federal, and local agencies.** The Council has the authority to request reports from agencies on issues related to the implementation of the Delta Plan.
- **Hold hearings.** The Council has the authority to hold hearings in all parts of the state and to subpoena witnesses.
- **Develop, coordinate, and promote the use of science through the Delta Science Program.** The Council has a role in providing the best available unbiased scientific information to inform water and environmental decision making in the Delta by funding research, synthesizing and communicating scientific information to policy makers and decision makers, promoting independent peer review, and coordinating with Delta agencies to promote science-based adaptive management.
- **Make consistency determinations upon appeal.** The Legislature intended that State and local actions that would have a significant impact on the coequal goals or a government-sponsored flood control program be consistent with the Delta Plan. The Council has the authority to implement the Delta Plan in part through the enforcement of consistency of covered actions with the Delta Plan upon appeal. The Delta Reform Act also gave the Council a specific appellate role with respect to the BDCP and its future incorporation into the Delta Plan. The Council's appellate roles, the definition of a covered action, and the consistency determination process and appeals process are described in detail in the Covered Actions and Delta Plan Consistency section later in this chapter.

Monitoring Progress toward Achieving the Coequal Goals

The Council will use existing monitoring efforts (such as the efforts of the Interagency Ecological Program, California Water Quality Monitoring Council, and California Statewide Groundwater Elevation Monitoring) and new monitoring efforts to inform progress toward achieving the performance measures in the Delta Plan. The Council will monitor the progress of programs and projects toward achieving the administrative, output, and outcome performance measures in the current Delta Plan and those developed in the future. Working with others, in particular the Interagency Implementation Committee, the Council will use coordinated information about relevant status and trends and progress toward meeting the coequal goals to inform revisions to the Delta Plan. The Council's monitoring activities will be reported on the Council website.

Evaluate and Respond: Updating and Amending the Delta Plan

The third phase of Delta Plan adaptive management is "Evaluate and Respond." According to the Delta Reform Act, the Council must review the Delta Plan at least once every 5 years and can revise it as the Council deems appropriate. This authority is consistent with the Council's obligation to base the Delta Plan on the best available scientific information and to use an adaptive management approach in updating the Plan as new information becomes available.

When updating the Delta Plan, the Council will consider information from other adaptive management activities in the Delta; evaluation of Delta Plan policies and recommendations; performance measures; other completed plans related to the Delta; and coordination, hearings, and oversight. The Council will rely in large part on the Delta Science Program for determining the relevance, value, and reliability of the best available science, and organizing that information for its use in the Council's decisions. The Council has the final responsibility for determining the best available science used in support of its actions, including when a choice among competing interpretations of available science must be made.

Reporting on Delta Plan Performance Measures

This Delta Plan contains preliminary performance measures developed to monitor performance of Delta Plan policies and recommendations. (See sidebar, Performance Measures in the Delta Plan, for more detailed information.) Upon adoption of the Delta Plan, staff will take the lead, working with scientific, agency, and stakeholder experts to continue to refine the Delta Plan's performance measures. Delta Plan performance measures will be periodically reviewed by independent expert review panels and will be sent to the Delta ISB for further review and comment. The resulting updated performance measures will be developed no later than December 31, 2014, for consideration by the Council for incorporation into the Delta Plan. The Council will issue periodic public reports on the status of performance measures.

Data collection related to the Delta and water management in California is already occurring, although more is needed. The Council, through the Interagency Implementation Committee and working with stakeholders, will report regularly on Delta Plan performance measures and the Delta Plan's progress in advancing the coequal goals. These reports will be made available to the public.

PERFORMANCE MEASURES IN THE DELTA PLAN

The performance measures included in this Delta Plan are primarily administrative measures focused on implementation of near-term actions (generally, actions contained within policies and recommendations of the Delta Plan) that support the coequal goals. This initial set of performance measures will be expanded and refined after adoption of the Delta Plan and will be considered for inclusion in subsequent updates of the Delta Plan.

Delta Plan performance measures have been placed into three general classes:

- Administrative performance measures describe decisions made by policy makers and managers to finalize plans or approve resources (funds, personnel, projects) for implementation of a program or group of related programs.
- Output (also known as "driver") performance measures evaluate the factors that may be influencing outcomes and include on-the-ground implementation of management actions, such as acres of habitat restored or acre-feet of water released, as well as natural phenomena outside of management control (such as a flood, earthquake, or ocean conditions).
- Outcome performance measures evaluate responses to management actions or natural outputs.

Administrative performance measures are included in Appendix E. Output and outcome performance measures, where appropriate, are included at the end of individual chapters.

Development of informative and meaningful performance measures is a challenging task that will continue after the adoption of the Delta Plan. Performance measures need to be designed to capture important trends and to address whether specific actions are producing expected results. Efforts to develop performance measures in complex and large-scale systems like the Delta are commonly multiyear endeavors. The Council will improve all performance measures, but will focus on outcome measures through a multiyear effort, using successful approaches for developing performance measures employed by similar efforts elsewhere (such as the Kissimmee River Restoration, The State of San Francisco Bay, and Healthy Waterways Southeast Queensland, Australia) as positive examples (see Appendix C for more information).

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Communication and the Delta Plan

Keeping the public and decision makers informed as future Delta Plan changes are proposed and considered is a vital step. The Council is committed to open communication of current understanding gained through the evaluation of performance measures, monitoring, science, and adaptive management. This communication will be continuous as the Council receives and produces information that will be used to adapt its strategy toward meeting the coequal goals and updating the Delta Plan.

The Council's website and meetings will remain the central hub for communicating information about progress toward meeting the coequal goals and the objectives of the Delta Plan. Information learned from the analysis, synthesis, and evaluation of how well the policies and recommendations in the Delta Plan are meeting their intended goals will be gathered and communicated through a number of media and forums that may include:

- The Council's meetings and workshops, website, social media, and newsletter
- Staff reports on the status and trends of the Delta Plan performance measures
- Reports, presentations, and correspondence presented to the Council
- Interagency Implementation Committee meetings and products
- The Delta Science Program website, *Science News*; the online journal, *San Francisco Estuary & Watershed Science*; brown bag seminars; and Biennial Bay-Delta Science Conference
- Delta ISB meetings and products

Covered Actions and Delta Plan Consistency

The Delta Reform Act directs the Council to develop a legally enforceable long-term management plan for the Delta (this Delta Plan) and includes a mechanism for enforcement of Delta Plan policies over State and local actions identified as covered actions (Water Code sections 85001(c) and 85022). The Council has taken a hybrid approach to developing the Delta Plan by including both regulatory policies and nonregulatory recommendations. This section presents a discussion of the process and general requirements for certifying consistency with the Delta Plan through compliance with its regulatory policies, and includes examples of covered actions and exemptions.

Delta Plan regulatory policies are not intended and shall not be construed as authorizing the Council or any entity acting pursuant to this section to exercise their power in a manner that will take or damage private property for public use without the payment of just compensation. These policies are not intended to affect the rights of any owner of property under the Constitution of the State of California or the United States. None of the Delta Plan policies increases the State's flood liability.

Covered Actions Must Comply with Delta Plan Policies

The Delta Reform Act requires State and local actions that fit the legal definition of a covered action to be consistent with the policies included in the Delta Plan. The mechanism for determining consistency is the filing of a certification of consistency. Not all actions that occur in whole or in part in the Delta are covered actions. Only certain activities qualify as covered actions, and the Delta Reform Act establishes specific criteria and exclusions, discussed in this chapter. Furthermore:

- The State or local agency that carries out, approves, or funds a proposed action determines whether that proposed plan, program, or project is a covered action (subject to judicial review of whether the determination was reasonable and consistent with the law).
- The State or local agency that carries out, approves, or funds a covered action ("proponents") needs to certify consistency with the policies included in the Delta Plan.
- In the case of all other actions (those that do not meet the criteria of being a covered action or are otherwise explicitly excluded), the Delta Plan's policies, where applicable, are recommendations.

What Is a Covered Action?

For a State or local agency to determine whether its proposed plans, programs, or projects are covered actions under the Delta Plan and, therefore, subject to the regulatory provisions in the plan, it must start with the Delta Reform Act, which defines a covered action as (Water Code section 85057.5(a)):

> *…a plan, program, or project as defined pursuant to Section 21065 of the Public Resources Code that meets all of the following conditions:*
>
> 1. *Will occur, in whole or in part, within the boundaries of the Delta or Suisun Marsh;*
> 2. *Will be carried out, approved, or funded by the state or a local public agency;*
> 3. *Is covered by one or more provisions of the Delta Plan;*
> 4. *Will have a significant impact on the achievement of one or both of the coequal goals or the implementation of government-sponsored flood control programs to reduce risks to people, property, and state interests in the Delta.*

Figure 2-3 shows the steps to follow for identifying whether a proposed plan, project, or program is a covered action.

Screening Criteria for Covered Actions

As used in this Delta Plan, the statutory criteria for covered actions under the Delta Plan are collectively referred to as "screening criteria." Before using the screening criteria, a project proponent should first determine whether its proposed plan, program, or project is exempt from covered action status under either the Council's administrative exemptions or the Delta Reform Act's statutory exemptions, discussed below. Early consultation with Council staff is encouraged and can assist in this determination.

1. **Is a "Project," as defined by section 21065 of the Public Resources Code.** A proponent's first step in determining whether a plan, program, or project is a covered action is to identify whether it meets the definition of a project as defined in Public Resources Code section 21065. That particular provision is the section of the California Environmental Quality Act (CEQA) that defines the term "project" for purposes of potential review under CEQA.[2] If the plan, program, or project does indeed meet the definition of a project under CEQA, the next step in determining a covered action is to review the four additional screening criteria in the definition of covered action, *all* of which must be met by a proposed plan, program, or project for it to qualify as a covered action (see sidebar, What Does CEQA Consider a "Project"?).

2. **Will occur in whole, or in part, within the boundaries of the Delta or Suisun Marsh.** To qualify as a covered action, a project must include one or more activities that take place at least partly within the Delta or Suisun Marsh. This means, for example, that the diversion and use of water in the Delta watershed that is entirely upstream of the statutory Delta or Suisun Marsh would not satisfy this criterion. By contrast, this criterion *would* be met if water intended for use upstream were transferred through the statutory Delta or Suisun Marsh (pursuant, for example, to a water transfer longer than 1 year in duration).

Decision Tree for State and Local Agencies on Possible Covered Actions

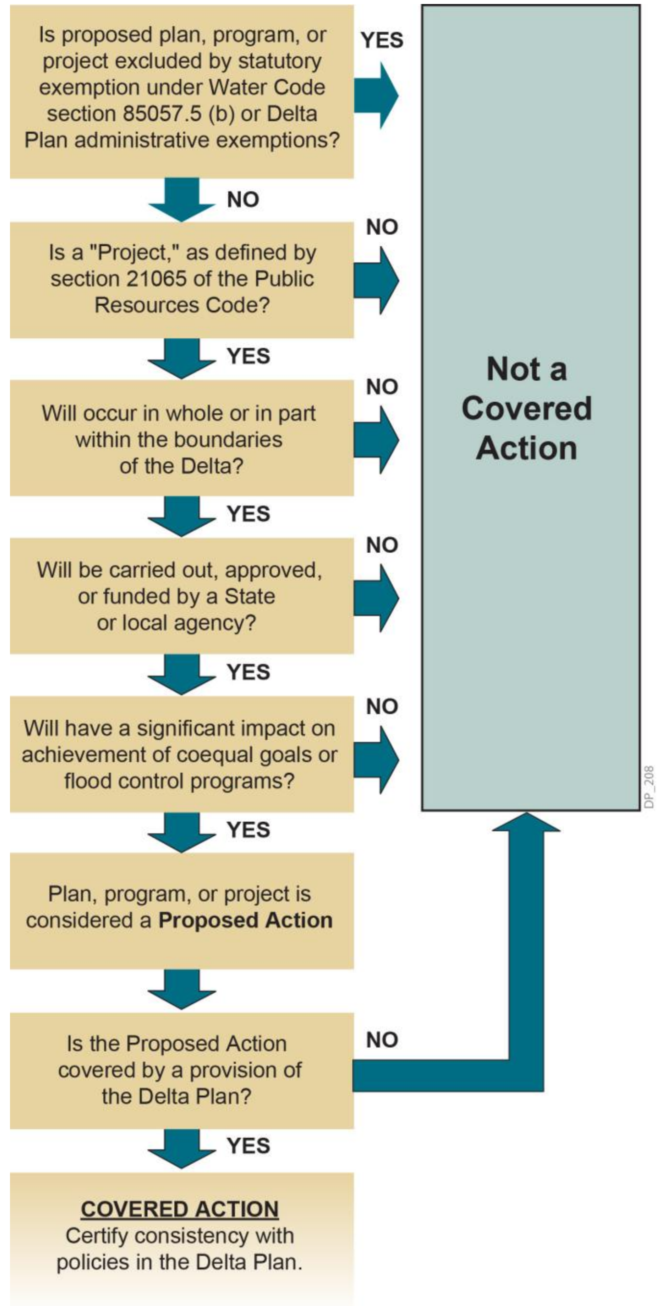

Figure 2-3

[2] It is important to note that CEQA's various statutory and categorical exemptions—which are considered only after the threshold determination of a CEQA "project" is made—are not similarly incorporated by cross-reference in the definition of covered action. Therefore, the Delta Plan must expressly incorporate a CEQA exemption for it to apply to the Delta Plan.

3. **Will be carried out, approved, or funded by the State or a local public agency.** If these screening criteria are met, it is recommended that the "significant impact" criteria be analyzed next.

4. **Will have a significant impact on the achievement of one or both of the coequal goals or the implementation of a government-sponsored flood control program to reduce risks to people, property, and State interests in the Delta.** In addition, a proposed project must have a "significant impact" as defined under Water Code section 85057.5(a)(4) to qualify as a covered action. For this purpose, significant impact means a substantial positive or negative impact on the achievement of one or both of the coequal goals or the implementation of a government-sponsored flood control program to reduce risks to people, property, and State interests in the Delta, that is directly or indirectly caused by a project on its own or when the project's incremental effect is considered together with the impacts of other closely related past, present, or reasonably foreseeable future projects. The coequal goals and government-sponsored flood control programs are further defined in Chapters 3, 4, and 7.

The following categories of projects will not have a significant impact for this purpose:

- "Ministerial" projects exempted from CEQA, pursuant to Public Resources Code section 21080(b)(1);
- "Emergency" projects exempted from CEQA, pursuant to Public Resources Code section 21080(b)(2) through (4);
- Temporary water transfers of up to 1 year in duration. This provision shall remain in effect only through December 31, 2016, and as of January 1, 2017, is repealed, unless the Council acts to extend the provision prior to that date. The Council contemplates that any extension would be based upon DWR and the SWRCB's participation with stakeholders to identify and implement transfer measures, as recommended in WR R15;
- Other projects exempted from CEQA, unless there are unusual circumstances indicating a reasonable possibility that the project will have a significant impact under Water Code section 85057.5(a)(4). Examples of unusual circumstances could arise in connection with, among other things:
  - Local government general plan amendments for the purpose of achieving consistency with the DPC's Land Use and Resource Management Plan; and
  - Small-scale habitat restoration projects, as referred to in CEQA Guidelines, section 15333 of Title 14 of the California Administrative Code, proposed in important restoration areas, but which are inconsistent with the Delta Plan's policy related to appropriate habitat restoration for a given land elevation.

WHAT DOES CEQA CONSIDER A "PROJECT"?

Public Resources Code section 21065 (which is incorporated by reference in the Delta Reform Act) defines the term "project" in the following manner:

> *21065. "Project" means an activity which may cause either a direct physical change in the environment, or a reasonably foreseeable indirect physical change in the environment, and which is any of the following:*
>
> *(a) An activity directly undertaken by any public agency.*
>
> *(b) An activity undertaken by a person which is supported, in whole or in part, through contracts, grants, subsidies, loans, or other forms of assistance from one or more public agencies.*
>
> *(c) An activity that involves the issuance to a person of a lease, permit, license, certificate, or other entitlement for use by one or more public agencies.*

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The Council will consider, as part of its ongoing adaptive management of the Delta Plan, whether these exemptions remain appropriate and/or whether the Delta Plan should be amended to include other types of projects.

If the above four screening criteria are met, then for purposes of the Delta Plan, the plan, program, or project is referred to as a "proposed action." Although a proposed action meets the first four screening criteria, the action has not yet been reviewed by the State or local agency to determine whether it meets the fifth screening criterion: is the proposed action covered by one or more Delta Plan policies? If the proposed action is covered by at least one Delta Plan regulatory policy, then the proposed action is a "covered action." If the proposed action is not covered by any Delta Plan regulatory policy, it is not a covered action.

5. **Is covered by one or more provisions of the Delta Plan.** This means that the proposed action must be covered by one or more regulatory policies contained in Chapters 3 through 7 of the Delta Plan. Each of those regulatory policies specifies the types of proposed actions that they cover. If the proposed action is covered by one or more provisions of the Delta Plan—the final criteria—the proposed action is, therefore, a covered action.

Statutory Exemptions

Certain actions are statutorily excluded from the definition of covered action and are exempt from the Council's regulatory authority (Water Code section 85057.5(b)). A complete list is included in Appendix F. These exemptions include:

- A regulatory action of a State agency (such as the adoption of a water quality control plan by the SWRCB, or the issuance of a California Endangered Species Act take permit by DFW)
- Routine maintenance and operation of the State Water Project or the Central Valley Project
- Routine maintenance and operation of any facility located, in whole or in part, in the Delta, that is owned or operated by a local public agency (such as routine maintenance of levees by a reclamation district)

Although a regulatory action by another State agency is not a covered action, the underlying action regulated by that agency can be a covered action (provided it otherwise meets the definition). The Council has concurrent jurisdiction over covered actions when that action is also regulated by another State agency. For example, the issuance of a California Endangered Species Act take permit by DFW is a regulatory action of a State agency and, therefore, is not a covered action. However, the underlying action requiring the take permit could be a covered action, and, if it is, it must be consistent with the Delta Plan's policies. Therefore, even when a covered action is regulated by another agency (or agencies), the covered action still must be consistent with the Delta Plan. In the situation where a covered action is governed by multiple agencies and laws, the action must comply with all relevant legal requirements.

Who Determines Whether a Proposed Plan, Program, or Project Is a Covered Action?

A State or local agency that proposes to carry out, approve, or fund a plan, program, or project is the entity that must determine whether that plan, program, or project is a covered action. That determination must be reasonable, made in good faith, and consistent with the Delta Reform Act and relevant provisions of this Plan. If requested, Council staff will meet with an agency's staff during early consultation to review consistency with the Delta Plan and to offer advice as to whether the proposed plan, program, or project appears to be a covered action, provided that the ultimate determination in this regard must be made by the agency. If an agency determines that a proposed plan, program, or project is not a covered action, that determination is not subject to Council regulatory review, but is subject to judicial review as to whether it was reasonable, made in good faith, and is consistent with the Delta Reform Act and relevant provisions of this Plan.

Mitigation of Significant Adverse Impacts on the Environment

Public Resources Code section 21081.6 requires a public agency to adopt a mitigation monitoring or reporting program (MMRP) to ensure compliance with the mitigation measures adopted by the agency at the time of project approval. The MMRP is a working implementation document to ensure that mitigation measures are implemented. The MMRP for the *Delta Plan Program Environmental Impact Report* (PEIR) ensures compliance with the Delta Plan mitigation measures. The Delta Plan MMRP lists the mitigation measures incorporated into the Delta Plan, when they need to be implemented, who is responsible for implementing them, and who reports on compliance. As specified in policy G P1 of the Delta Plan, any covered action that is not exempt must include either the mitigation measures identified in the Delta Plan's PEIR, if applicable and feasible; substitute mitigation measures that the proposing agency finds to be equally or more effective than those identified in the Delta Plan PEIR; or an explanation of why such mitigation is not feasible. Monitoring and/or reporting on implementation of the adopted Delta Plan mitigation measures will be accomplished through the certification of consistency process as part of the certification forms. The MMRP can be found on the DSC's website at http://deltacouncil.ca.gov/.

Certifications of Consistency

Once a State or local agency has determined that their plan, program, or project is a covered action under the Delta Plan, they are required to submit a written certification to the Council, with detailed findings, demonstrating that the covered action is consistent with the Delta Plan (Water Code section 85225 et seq.). Furthermore:

- The first policy in the Delta Plan, G P1, describes requirements to be included in the certification of consistency for all covered actions and is included in this chapter.
- The certification of consistency must be submitted to the Council prior to initiating implementation of the covered action.
- The certification of consistency should not be submitted to the Council until the covered action has been fully described and the impacts associated with the covered action have been identified; this coincides with the completion of the CEQA process.
- Should the covered action project change substantially, the agency will be required to submit a new certification of consistency to the Council.

The Council has developed a discretionary checklist that agencies may use to facilitate the process, as well as certification forms and related materials, available on the Council website.

Bay Delta Conservation Plan Covered Activity Consistency Certification

The Delta Reform Act describes a specific process for the potential incorporation of BDCP into the Delta Plan. If BDCP is incorporated, an agency proposing a qualifying "covered activity" under BDCP that also meets the statutory definition of a covered action must file a short form certification of consistency with findings indicating only that the covered action is consistent with the BDCP. Consistency for these purposes shall be presumed if the certification filed by the agency includes a statement to that effect from DFW.

Covered Action Consistency Appeals

In contrast to how many other governmental plans are implemented, the Council does *not* exercise direct review and approval authority over covered actions to determine their consistency with the regulatory policies in the Delta Plan. Instead, State or local agencies self-certify Delta Plan consistency, and the Council serves as an appellate body for those determinations.

Any person, including any member of the Council or its Executive Officer, who claims that a covered action is inconsistent with the Delta Plan and, as a result of that inconsistency, will have a significant adverse impact on the achievement of one or both of the coequal goals or implementation of government-sponsored flood control program, may file an appeal with regard to a certification of consistency submitted to Council.

The Council has appellate authority to determine the consistency of covered actions with the Delta Plan if they are challenged. The Council is required to apply the standard of substantial evidence when reviewing covered action appeals. State or local agencies are required to submit detailed findings upon filing their consistency determination, described previously. These findings and the record will provide the basis for the Council's decision making.

Per statute, an appeal must be filed within 30 days; if a valid appeal is filed, the Council is responsible for subsequent evaluation and determination—as provided in statute and the Council's Administrative Procedures Governing Appeals—of whether the covered action is consistent with the Delta Plan's policies. More than one policy in the Delta Plan may apply to a covered action. If no person appeals the certification of consistency, the State or local public agency may proceed to implement the covered action.

In the event of an appeal of a covered action, the Council may consult with the DPC consistent with Public Resources Code section 29773.

Upon receiving an appeal, the Council has 60 days to hear the appeal and an additional 60 days to make its decision and issue specific written findings. If the covered action is found to be inconsistent, the project may not proceed until it is revised so that it is consistent with the Delta Plan.

The appeals process is described in statute and further defined in the appeals procedures adopted by the Council; it is attached for reference purposes as Appendix D.

POLICIES AND RECOMMENDATIONS

State and local agencies approve many important plans, programs, and projects annually that are in or otherwise affect the Delta. Interagency coordination is often limited and, despite the Delta's special status, there are no overarching guidelines or coordinated best management practices to ensure that all significant actions use best available science or adaptive management in particular. The Delta Reform Act, in describing a process for coordinating actions under the Delta Plan, requires that State or local government actions are consistent with the Delta Plan and supported by detailed findings. Policy G P1 describes compliance requirements for covered actions that are to be included in the project proponent's written findings.

Problem Statement

Independent and disparate actions by individual agencies can lead to conflict and reduce successful achievement of the coequal goals. Lack of uniform use of best available science and adaptive management for water supply and ecosystem projects can lead to unintended consequences, reduced likelihood of project success, and increased likelihood of adverse environmental impacts. In addition, management actions can be delayed when uncertainty exists, while adaptive management allows for flexible decision making despite uncertainty.

In some cases, project proponents do not carefully plan for the resources and costs of monitoring and tracking, and full adaptive management does not occur. Failure of significant Delta-related actions to comply with existing law can thwart the successful achievement of the coequal goals.

Policies

The appendices referred to in the policy language below are included in Appendix B of the Delta Plan.

G P1. Detailed Findings to Establish Consistency with the Delta Plan

(a) This policy specifies what must be addressed in a certification of consistency filed by a State or local public agency with regard to a covered action. This policy only applies after a "proposed action" has been determined by a State or local public agency to be a covered action because it is covered by one or more of the policies contained in Article 3. Inconsistency with this policy may be the basis for an appeal.

(b) Certifications of consistency must include detailed findings that address each of the following requirements:

(1) Covered actions, in order to be consistent with the Delta Plan, must be consistent with this regulatory policy and with each of the regulatory policies contained in Article 3 implicated by the covered action. The Delta Stewardship Council acknowledges that in some cases, based upon the nature of the covered action, full consistency with all relevant regulatory policies may not be feasible. In those cases, the agency that files the certification of consistency may nevertheless determine that the covered action is consistent with the Delta Plan because, on whole, that action is consistent with the coequal goals. That determination must include a clear identification of areas where consistency with relevant regulatory policies is not feasible, an explanation of the reasons why it is not feasible, and an explanation of how the covered action nevertheless, on whole, is consistent with the coequal goals. That determination is subject to review by the Delta Stewardship Council on appeal;

(2) Covered actions not exempt from CEQA must include applicable feasible mitigation measures identified in the Delta Plan's Program EIR (unless the measure(s) are within the exclusive jurisdiction of an agency other than the agency that files the certification of consistency), or substitute mitigation measures that the agency that files the certification of consistency finds are equally or more effective;

(3) As relevant to the purpose and nature of the project, all covered actions must document use of best available science;

(4) Ecosystem restoration and water management covered actions must include adequate provisions, appropriate to the scope of the covered action, to assure continued implementation of adaptive management. This requirement shall be satisfied through both of the following:

(A) An adaptive management plan that describes the approach to be taken consistent with the adaptive management framework in Appendix 1B, and

(B) Documentation of access to adequate resources and delineated authority by the entity responsible for the implementation of the proposed adaptive management process.

(c) A conservation measure proposed to be implemented pursuant to a natural community conservation plan or a habitat conservation plan that was:

(1) Developed by a local government in the Delta; and

(2) Approved and permitted by the California Department of Fish and Wildlife prior to May 16, 2013

is deemed to be consistent with sections 5005 through 5009 of this Chapter if the certification of consistency filed with regard to the conservation measure includes a statement confirming the nature of the conservation measure from the California Department of Fish and Wildlife.

23 CCR Section 5002
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85225, 85225.10, 85020, 85054, 85302(g), and 85308, Water Code.

Problem Statement

Currently, science efforts related to the Delta are performed by multiple entities with multiple agendas and without an overarching plan for coordinating data management and information sharing among entities. Increasingly, resource management decisions are made in the courtroom as conflicting science thwarts decision making and delays action. Multiple frameworks for science in the Delta have been proposed, but a comprehensive science plan that organizes and integrates ongoing scientific research, monitoring, analysis, and data management among entities has yet to be fully formulated.

Recommendations

G R1. Development of a Delta Science Plan

The Delta Stewardship Council's Delta Science Program should develop a Delta Science Plan by December 31, 2013. The Delta Science Program should work with the Interagency Ecological Program, Bay Delta Conservation Plan, California Department of Fish and Wildlife, and other agencies to develop the Delta Science Plan. To ensure that best science is used to develop the Delta Science Plan, the Delta Independent Science Board should review the draft Delta Science Plan.

The Delta Science Plan should address the following:

- *A collaborative institutional and organizational structure for conducting science in the Delta*
- *Data management, synthesis, scientific exchange, and communication strategies to support adaptive management and improve the accessibility of information*
- *Strategies for addressing uncertainty and conflicting scientific information*
- *Prioritization of research and balancing of the short-term immediate science needs with science that enhances comprehensive understanding of the Delta system over the long term*
- *Identification of existing and future needs for refining and developing numerical and simulation models along with enhancing existing Delta conceptual models (e.g., the Interagency Ecological Program (IEP) Pelagic Organism Decline (POD) and the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) models)*
- *An integrated approach for monitoring that incorporates existing and future monitoring efforts*
- *An assessment of financial needs and funding sources to support science*

Timeline for Implementing Policies and Recommendations

Figure 2-4 lays out a timeline for implementing the policies and recommendations described in the previous section. The timeline emphasizes near-term and intermediate-term actions.

Timeline for Implementing Policies and Recommendations

TIMELINE | **CHAPTER 2: The Delta Plan**

	ACTION (REFERENCE #)	LEAD AGENCY(IES)	NEAR TERM 2012–2017	INTERMEDIATE TERM 2017–2025
POLICIES	Detailed findings to establish consistency with the Delta Plan (G P1)	Varies	●	●
RECOMMENDATIONS	Development of a Delta Science Plan (G R1)	Council	●	
COUNCIL ACTIONS	Establish Delta Plan Interagency Implementation Committee	Council	●	●

DP_341

Agency Key:
Council: Delta Stewardship Council

Figure 2-4

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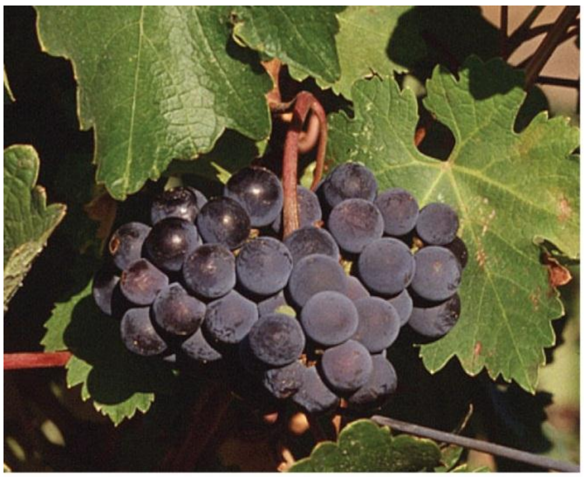
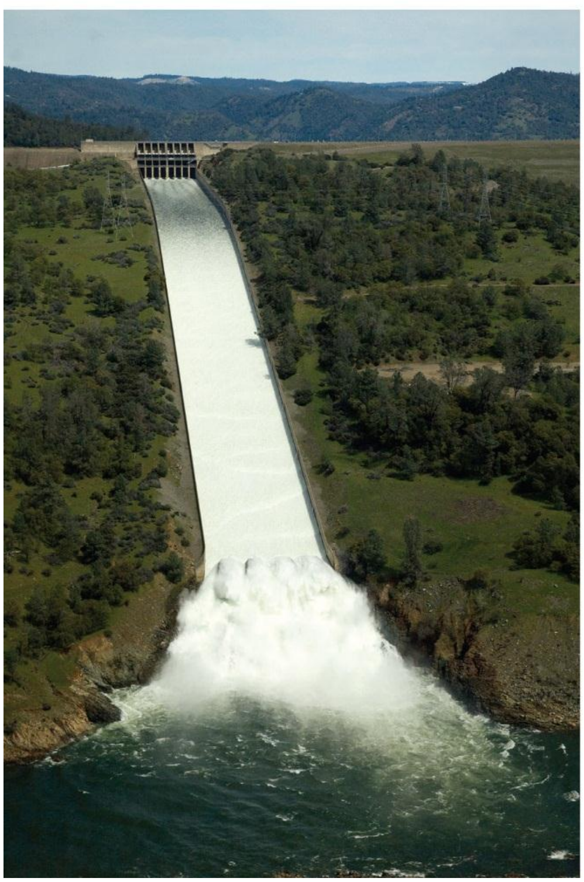
CHAPTER 3

A More Reliable Water Supply for California





ABOUT THIS CHAPTER

This chapter provides an overview of California's water supply, where it comes from, and how it is used. It also describes California's water policy foundations, including federal, State of California (State), and local policies, laws, and programs, and the need for continued improvements in local water planning, management, and information. It explains the special role of the Sacramento-San Joaquin Delta (Delta) in California's water, including its history, conflicts and challenges, and necessary investments and changes to achieve flexibility, improve resiliency, and increase water supply reliability.

As a starting point for this Delta Plan, four core water strategies must be implemented throughout the state to achieve the coequal goal of providing a more reliable water supply for California:

- Increase water conservation and expand local and regional supplies
- Improve groundwater management
- Improve conveyance and expand storage
- Improve water management information

These core strategies form the basis of the 2 policies and 19 recommendations found at the end of the chapter.

RELEVANT LEGISLATION

The Sacramento-San Joaquin Delta Reform Act of 2009 declares State policy for California's water resources and the Delta (Water Code section 85054):

> *"Coequal goals" means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.*

The Legislature declares the following objectives inherent in the coequal goals for management of the Delta (Water Code section 85020):

> *(a) Manage the Delta's water and environmental resources and the water resources of the State over the long term.*
>
> *(d) Promote statewide water conservation, water use efficiency, and sustainable water use.*
>
> *(f) Improve the water conveyance system and expand statewide water storage.*

The Legislature declared that:

> *85004(b) Providing a more reliable water supply for the state involves implementation of water use efficiency and conservation projects, wastewater reclamation projects, desalination, and new and improved infrastructure, including water storage and Delta conveyance facilities.*

Reduced reliance on the Delta for water supplies is established as State policy, along with an associated mandate for regional self-reliance (Water Code section 85021):

> *The policy of the State of California is to reduce reliance on the Delta in meeting California's future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency. Each region that depends on water from the Delta watershed shall improve its regional self-reliance for water through investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts.*

Water Code sections 85302, 85303, 85304, and 85211 provide direction on measures that must be included in the Delta Plan to meet the statewide water supply policy goals and objectives, and ultimately the coequal goal of increased water supply reliability:

> *85302(d) The Delta Plan shall include measures to promote a more reliable water supply that address all of the following:*
>
> > *(1) Meeting the needs for reasonable and beneficial uses of water.*
> >
> > *(2) Sustaining the economic vitality of the State.*
> >
> > *(3) Improving water quality to protect human health and the environment.*
>
> *85303 The Delta Plan shall promote statewide water conservation, water use efficiency, and sustainable use of water.*
>
> *85304 The Delta Plan shall promote options for new and improved infrastructure relating to the water conveyance in the Delta, storage systems, and for the operation of both to achieve the coequal goals.*
>
> *85211 The Delta Plan shall include performance measurements that will enable the council to track progress in meeting the objectives of the Delta Plan. The performance measurements shall include, but need not be limited to, quantitative or otherwise measurable assessments of the status and trends…*
>
> > *(b) The reliability of California water supply imported from the Sacramento River or the San Joaquin River watershed.*

The longstanding constitutional principle of reasonable use and the Public Trust Doctrine form the foundation of California's water management policy, and are particularly applicable to the Delta watershed and to the others areas that use Delta water as the basis for resolving water conflicts (Water Code section 85023). The constitutional principle is defined in Section 2 of Article X of the California Constitution as:

The right to water or to the use or flow of water in or from any natural stream or water course in this State is and shall be limited to such water as shall be reasonably required for the beneficial use to be served, and such right does not and shall not extend to the waste or unreasonable use or unreasonable method of use or unreasonable method of diversion of water.

Water Code sections 85031 and 85032 provide clarification that existing water rights, procedures, or laws are not affected:

85031(a) This division does not diminish, impair, or otherwise affect in any manner whatsoever any area of origin, watershed of origin, county of origin, or any other water rights protections, including, but not limited to, rights to water appropriated prior to December 19, 1914, provided under the law. This division does not limit or otherwise affect the application of Article 1.7 (commencing with Section 1215) of Chapter 1 of Part 2 of Division 2, Sections 10505, 10505.5, 11128, 11460, 11461, 11462, and 11463, and Sections 12200 to 12220, inclusive.

(b) For the purposes of this division, an area that utilizes water that has been diverted and conveyed from the Sacramento River hydrologic region, for use outside the Sacramento River hydrologic region or the Delta, shall not be deemed to be immediately adjacent thereto or capable of being conveniently supplied with water therefrom by virtue or on account of the diversion and conveyance of that water through facilities that may be constructed for that purpose after January 1, 2010.

(c) Nothing in this division supersedes, limits, or otherwise modifies the applicability of Chapter 10 (commencing with Section 1700) of Part 2 of Division 2, including petitions related to any new conveyance constructed or operated in accordance with Chapter 2 (commencing with Section 85320) of Part 4 of Division 35.

(d) Unless otherwise expressly provided, nothing in this division supersedes, reduces, or otherwise affects existing legal protections, both procedural and substantive, relating to the state board's regulation of diversion and use of water, including, but not limited to, water right priorities, the protection provided to municipal interests by Sections 106 and 106.5, and changes in water rights. Nothing in this division expands or otherwise alters the board's existing authority to regulate the diversion and use of water or the courts' existing concurrent jurisdiction over California water rights.

85032 This division does not affect any of the following:

(a) The Natural Community Conservation Planning Act (Chapter 10 (commencing with Section 2800) of Division 3 of the Fish and Game Code).

(b) The California Endangered Species Act (Chapter 1.5 (commencing with Section 2050) of Division 3 of the Fish and Game Code).

(c) The Fish and Game Code.

(d) The Porter-Cologne Water Quality Control Act (Division 7 (commencing with Section 13000).

(e) Chapter 8 (commencing with Section 12930) of Part 6 of Division 6.

(f) The California Environmental Quality Act (Division 13 (commencing with Section 21000) of the Public Resources Code).

(g) Section 1702.

(h) The application of the public trust doctrine.

(i) Any water right.

(j) The liability of the state for flood protection in the Delta or its watershed.

CHAPTER 3

A More Reliable Water Supply for California

In California, the conflicts over water are legendary. The connotations of wealth and power associated with control over water were captured in dramatic fashion in the 1974 film *Chinatown*. A decade later, Marc Reisner's bestselling nonfiction book, *Cadillac Desert*, described vast, arid California land tracts turned to lush, productive fields through the modern magic of water diversion and irrigation. California is known for many things: the urban, cultural giant that is Los Angeles; the great Central Valley, breadbasket to the world; cutting-edge technological advances hailing from Silicon Valley; and the fertile human-made islands of the Delta. The thread that ties these places together is a supply of fresh water from the Sacramento-San Joaquin watershed. Similarly, dozens of fish species—some of them threatened by extinction—and a diverse palette of flora and fauna also depend on this water. As described in Chapter 1, at the heart of California's water troubles are scarcity of supply and competing uses—in particular, conflict with the water needs of the ecosystem. This dynamic of conflict characterizes the essential debate over management of the Delta.

Building on the foundations of California water policy, the Delta Reform Act established the goal of providing "a more reliable water supply for California." This is coequal with the goal of "protecting, restoring, and enhancing the Delta ecosystem." Both must be accomplished while protecting and enhancing the unique values of the Delta as an evolving place. (See sidebar, What Does It Mean to Achieve the Goal of Providing a More Reliable Water Supply for California?)

The Delta Reform Act recognizes that the "Delta watershed and California's water infrastructure are in crisis and existing Delta policies are not sustainable" (Water Code section 85001(a)). The economies of major regions of the state are reliant upon the ability to use water within the Delta watershed or on water imported from the Delta watershed. Yet, the long-term impacts of these diversions, on the Delta and its watershed, in combination with many other factors, are causing native fisheries to decline. In recent years, the populations of salmon and several other fish species have reached their lowest numbers in recorded history, and many of California's salmon runs are now listed as endangered by the State or federal government. The courts have responded by imposing constraints, particularly in dry years, on water diversions through the Delta. As a result, water deliveries—particularly those that come from the State Water Project (SWP) and the federal Central Valley Project (CVP)—have become increasingly unpredictable.

The Delta Reform Act mandates many strategies that the Delta Plan must address to improve water supply reliability for California:[1]

- Promote, implement, and invest in water efficiency and conservation
- Implement and invest in wastewater reclamation and water recycling
- Increase and invest in desalination and advanced water treatment technologies
- Promote and implement options for improved water conveyance

[1] See Water Code sections 85004(b), 85020(d) and (f), 85021, 85023, 85302(d), 85303, and 85304.

- Expand and invest in storage
- Improve water quality to protect human health and the environment
- Invest in local and regional water supply projects and coordination
- Prohibit waste and unreasonable use, consistent with Article X, Section 2 of the California Constitution, and protect public trust resources consistent with the Public Trust Doctrine

California's precipitation is extremely variable, and both droughts and floods are not uncommon, even occurring in back-to-back years. Therefore, the State must adapt its water infrastructure and operations in the Delta to make better use of the greater volumes of water that are and, in the future, will continue to be available during wet years, and to take less water during dry years when conflicts with the Delta ecosystem and in-Delta water quality are at their greatest. Concurrently, the development and careful management of local water resources hold tremendous potential for improving water reliability and must be a priority for California.

Management of any natural resource is a continual balancing act. Establishment of the coequal goals provides policy priorities when it comes to managing water, but continuing disputes are inevitable. Given that water in California is scarce, actions that occur in one corner of the state can have ripple effects hundreds of miles away. Levee failures in the Delta may interrupt water supplies to industry in San Diego. Conversely, the way Southern California regions manage their water may affect California's water-dependent ecosystems. The management of a salinity regime to benefit the environment has implications for in-Delta water users. Upstream water use can affect the quality and quantity of water for all downstream users—urban, agricultural, or environmental. Decades-old decisions to drain swamps, build intrastate water projects, and mine gold have left legacy imprints on California's water and ecosystem management.

Although exports from the Delta account for only a fraction of California's water supplies, the Delta is of widespread importance given its geographic location and influential role in ecosystem dynamics. Those who live in the Delta watershed are concerned about how management actions in the Delta may affect them; those who live in the Delta are keenly aware of others' interest in their backyard; and those who rely fully or partially on Delta exports, in some cases located hundreds of miles from the Delta itself, fear the impacts of reduced water supply reliability on their local economies and standard of living.

The broad influence of the Delta is precisely why the Delta crisis cannot be resolved by taking actions in the Delta alone. The Delta Reform Act establishes a new policy for California of reducing "reliance on the Delta in meeting California's future water supply needs" (Water Code section 85021). Reduced reliance is to be achieved through a statewide strategy of investing in improved local and regional supplies, conservation, and water use efficiency so that "each region that depends on water from the Delta watershed shall improve its regional self-reliance." The State's water planning document, the *California Water Plan – Update 2009*, estimates that California could reduce water demand and increase water supply in the range of 5 to 10 million acre-feet (MAF) by 2030 just through the implementation of existing strategies and technology (DWR 2009). This amount of water is more than enough to meet the projected water demands of California's growing population through 2050. An integrated approach that includes increased water efficiency, local and regional diversification of water supplies, reduced reliance on water from the Delta, improved regional self-reliance, and concurrent improvements to storage and Delta infrastructure will build the resiliency and reliability of California's water supply.

WHAT DOES IT MEAN TO ACHIEVE THE GOAL OF PROVIDING A MORE RELIABLE WATER SUPPLY FOR CALIFORNIA?

Achieving the coequal goal of providing a more reliable water supply for California means better matching the state's demands for reasonable and beneficial uses of water to the available water supply.

- This will be done by promoting, improving, investing in, and implementing projects and programs that improve the resiliency of the state's water systems, increase water efficiency and conservation, increase water recycling and use of advanced water technologies, improve groundwater management, expand storage, and improve Delta conveyance and operations. The evaluation of progress toward improving reliability will take into account the inherent variability in water demands and supplies across California.

Regions that use water from the Delta watershed will reduce their reliance on this water for reasonable and beneficial uses, and improve regional self-reliance, consistent with existing water rights and the State's area of origin statutes and Reasonable Use and Public Trust Doctrines.

- This will be done by improving, investing in, and implementing local projects and programs that increase water conservation and efficiency, increase water recycling and use of advanced water technologies, expand storage, improve groundwater management, and enhance regional coordination of local and regional water supply development efforts.

Water exported from the Delta will more closely match water supplies available to be exported, based on water year type and consistent with the coequal goal of protecting, restoring, and enhancing the Delta ecosystem.

- This will be done by improving conveyance in the Delta and expanding groundwater and surface storage both north and south of the Delta to optimize diversions in wet years when more water is available and conflicts with the ecosystem less likely, and limit diversions in dry years when conflicts with the ecosystem are more likely. Delta water that is stored in wet years will be available for water users during dry years, when the limited amount of available water must remain in the Delta, making water deliveries more predictable and reliable. In addition, these improvements will decrease the vulnerability of Delta water supplies to disruption by natural disasters, such as earthquakes, floods, and levee failures.

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Accordingly, the Delta Stewardship Council (Council) envisions a future in which California has achieved the coequal goal of improved water supply reliability. In the future:

- California's water resources will be better managed, consistent with the State's Reasonable Use and Public Trust Doctrines.
- Improved efficiency and a greater diversity of sources will make more water available to meet the state's demands.
- Groundwater resources will be sustainably managed, and critical overdraft in groundwater basins will have been eliminated.
- Water suppliers in regions that use water from the Delta watershed will have reduced their reliance on this water and improved their regional self-reliance. California will be better prepared to meet the challenges of climate change and catastrophic events that may affect future water deliveries.

In the future, water exports from the Delta will more closely match water supplies available to be exported, consistent with California's variable hydrology and the coequal goal of protecting, restoring, and enhancing the Delta ecosystem. Conveyance facilities in the Delta will be improved, and additional groundwater and surface storage, both north and south of the Delta, will help optimize diversions in wet years when more water is available and conflicts with the ecosystem are less likely, and limit diversions in dry years when conflicts with the ecosystem are more likely. These patterns of Delta exports will be consistent with more natural flow patterns in the Delta, which will aid native species and reduce regulatory uncertainty. At the same time, deliveries of Delta water will be more predictable due to use of storage to deliver wet-year water that is exported and stored for future use. Flexibility of export operations will be enhanced through implementation of local and regional water efficiency, improved conveyance to reduce conflicts with the ecosystem, and water supply projects that reduce pressure on the Delta and reliance on these deliveries.

California's Water Supply Picture

California's water supply picture makes it unlike any other state in the nation. Geography, hydrology, circumstance, and governance have shaped the political landscape of California water in a manner that has both intrigued and frustrated people for decades. Engineering alterations have enabled urban metropolises to thrive—and sprawl—and expansive agricultural regions with global influence to flourish with supplemental water, imported in some cases from hundreds of miles away and across county and even state boundaries. A complex and sometimes conflicting system of laws and policies means that in dry years, frequent in California, a given water district might have surplus supplies with which to grow lettuce or alfalfa, while a district next door battles drought conditions and the associated economic and environmental impacts. A growing awareness of how past water management practices have led to current environmental conflicts and overall competition for water supplies, combined with the knowledge that past climate patterns are not necessarily indicative of the next century's hydrograph, are shaping how California plans for its water future (see Figure 3-1).

This section provides an overview of where California's water comes from and how it is used, the state's vast water supply infrastructure system, and the implications of climate change on California's water supplies.

Sources of California's Water Supply

Variability and uncertainty are the dominant characteristics of California's water resources. Precipitation is the primary source of California's water supply. However, this precipitation varies greatly from year to year, as well as by season and where it falls geographically in the state, which makes management of the state's water resources complex and challenging. Groundwater, which is often connected to surface supplies, contributes to a significant portion of California's water use, on average supplying 8 MAF (20 percent) of California's urban and agricultural uses; but in some areas, this figure is considerably higher and can be as much as 60 to 80 percent of a region's water supply (DWR 2009). Groundwater, and implications for its overuse, is discussed in greater detail later in this chapter.

The total amount of precipitation in an average year provides California with about 200 MAF of surface water falling as either rain or snow (DWR 2009).[2] The actual volume of water the state receives each year varies dramatically depending on whether the year is dry or wet. California may receive less than 100 MAF of water during a dry year and more than 300 MAF in a wet year (Western Regional Climate Center 2011a).

The term "average water year" in California is useful for explanatory purposes, but can be misleading as a measurement for planning. In fact, California experiences the most unpredictable pattern of precipitation in the nation, with the bulk of its annual water falling within just 5 to 15 days (Dettinger et al. 2011). This means that in years when fewer storms pass over California, the state faces the problem of too little water; conversely, a few extra storms may result in flooding. For example, between 2005 and 2008, Los Angeles experienced both its driest and wettest years on record (California Natural Resources Agency 2008). The historical record shows that California has frequently experienced long multiyear droughts, as well as extremely wet years that coincide with substantial flooding and consequent risk to people and property (Hanak et al. 2011).

[2] Includes up to 10 MAF of precipitation that occurs in Oregon, Mexico, and the Colorado River and is imported into California.

How California's Water Is Used

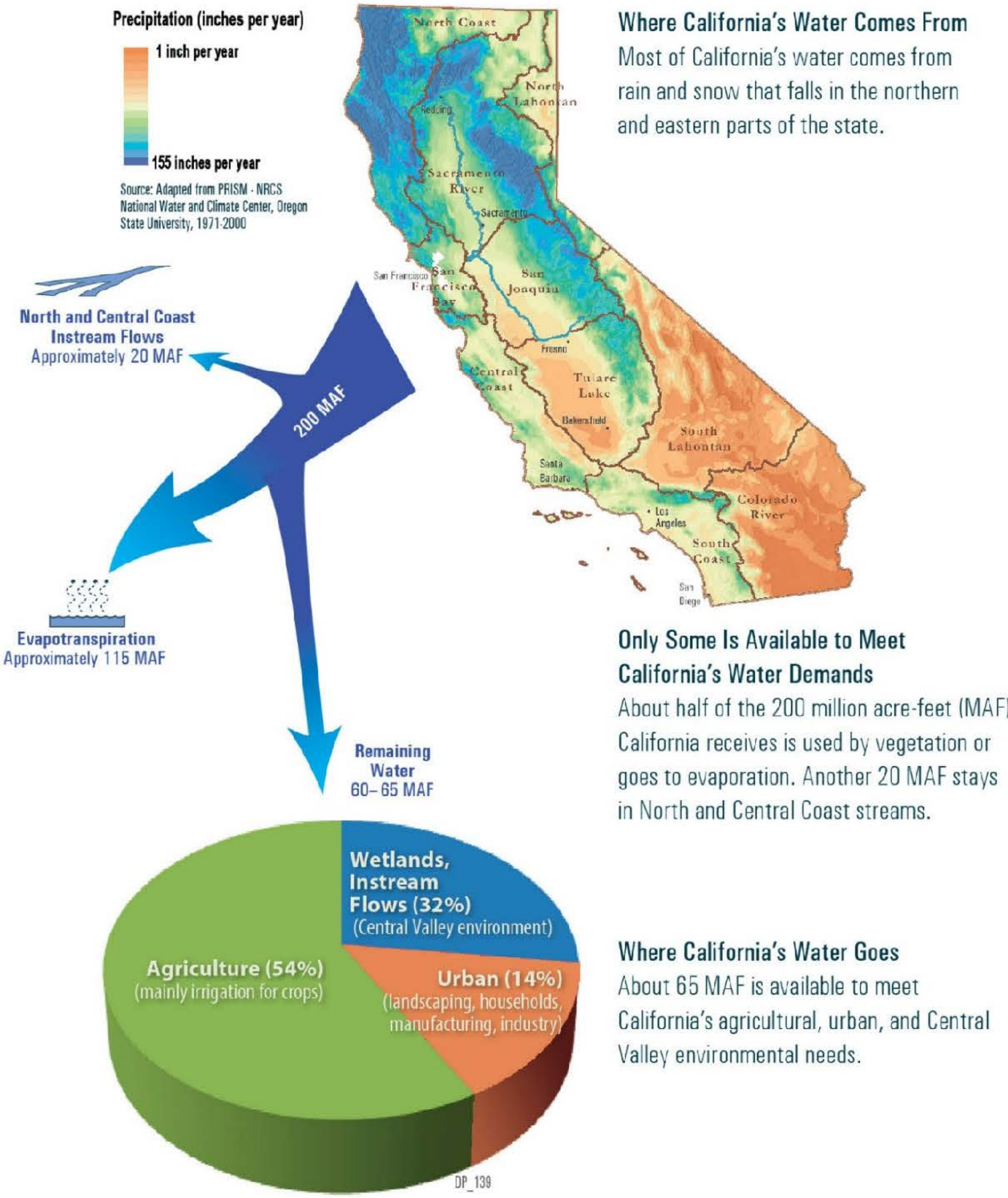

Figure 3-1 *Sources: Adapted from DWR 2009, USGS 2010*

Most of California's precipitation occurs between November and April, yet most of the state's agricultural and urban water demand is in the hot, dry months of summer and early fall, creating a management challenge. In addition, most of the precipitation falls in the mountains in the middle to northern half of the state, far from major population and agricultural centers. In some years, the far north of the state can receive 100 inches or more of precipitation while the southernmost regions receive only a few inches (Western Regional Climate Center 2011b). These basic characteristics of precipitation in California—seasonal timing and geography—and their fundamental disconnect with where and when Californians demand water provide the basic explanation for why water in California is such a complicated and controversial matter.

How California's Water Is Used

The amount of water available to meet agricultural, urban, and ecosystem water demands starts with the state's annual precipitation. On average, about half of this water evaporates; is used by surface vegetation for transpiration; or flows to deep subsurface areas, saline sinks, or the ocean (DWR 2009). The rest of this water—known as "dedicated water"[3]—is used to supply urban municipal and industrial uses, agricultural irrigation, water for ecosystem protection and restoration, and for storage in surface and groundwater reservoirs (DWR 2009).

Patterns of how and when water is used in the state vary with the type of water year. In fact, although best available estimates are included in this Delta Plan, state water managers often work with limited or incomplete information related to water use. The California Department of Water Resources (DWR) uses five water year–type classifications for planning and management purposes: wet, above normal, below normal, dry, and critically dry. In wet years, due to plentiful local rainfall, agricultural and urban landscape irrigation water demands are generally lower. Water demands are usually highest in years of reduced rainfall and because local supplies are low (DWR 2009). Ironically, agricultural and urban water demands may be lower during critically dry years because of short-term water use reduction actions, such as rationing or cropland fallowing to cope with water shortages.

In an average water year, this dedicated water totals approximately 80 to 85 MAF.[4] Again, the fluctuations between wet and dry years can be extreme, with wet years providing more than 95 MAF and critically dry years producing less than 65 MAF of available supply (LAO 2008, DWR 2009, USGS 2010).

However, not all of the 80 to 85 MAF is available to meet water demands within the Central Valley, Bay Area, and Southern California. In the late 1970s, the California Legislature secured State and federal protection of California's North Coast rivers and, in doing so, precluded major diversions from these rivers, including parts of the Trinity, Scott, Salmon, Eel, and Klamath rivers. Water from these rivers is now largely mandated to the environment by law, with the exception of diversions from the Trinity River to the Sacramento River for CVP supplies that are limited by federal law (Hanak et al. 2011). As a result, in an average year, approximately 20 MAF (out of the available supply of 80 to 85 MAF) are reserved for Wild and Scenic Rivers and other instream flow requirements in the North Coast and San Francisco Bay regions and some Central Coast and South Coast areas. Most of this water falls outside the Delta watershed. Although original State water plans and State and federal water contracts envisioned its capture and conveyance, permanent legal protections now prohibit it. (See the CVP and SWP Water Delivery Challenges section.)

[3] DWR uses the terms "dedicated" and "developed" interchangeably in their publications. DWR identifies California's average annual dedicated water supply as 85 MAF.

[4] All statewide average water use values were calculated using information in Volume 5 DWR Water Plan 2009 (including average values for years 1998 through 2005) and results from CALSIM II model runs prepared for DWR State Water Project Reliability Studies (DWR 2010b, DWR 2011c).

This means that the remaining water supply (of 60 to 65 MAF in an average year) goes to meet agricultural and urban demands and Central Valley environmental needs.[5,6] In an average year, irrigated agriculture uses approximately 34 MAF (54 percent) of this water, urban areas use about 9 MAF (14 percent), and 20 MAF (32 percent) is mandated to meet instream flow requirements, including State Water Resources Control Board (SWRCB) Delta water quality requirements and Central Valley wildlife refuge commitments (DWR 2009).

Accounting for how much water each sector actually uses is complicated because water may be reused several times for different purposes or it may be taken from surface or groundwater storage held from previous years.[7] The lack of consistent and accurate estimates of statewide water use is a significant challenge that has important implications for improved water management in California.

Future population and economic growth is expected to result in increased water demand. Today, California's water supply supports a population of 36.5 million people, an economy of $1.9 trillion, and diverse natural resources (LAO 2011). The largest economic sectors in the state are trade, transportation, and financial services, with agricultural services contributing about $38 billion (2 percent). Projections by the California Department of Finance in 2010 forecast that the population may grow to 60 million people by 2050, but the rate of growth is slowing and could be much lower.[8] As more development occurs, water use will continue to shift away from agricultural toward urban uses (DWR 2005, DWR 2009, LAO 2008, Hanak et al. 2011). At the same time, increasing water needs for ecosystem protection will likely exacerbate conflicts with agricultural and urban water demands.

California's Water Supply Infrastructure

To provide more reliable water supplies despite the state's hydrologic variability and diverse geography, and also to manage floods during wet years, State, federal, and local agencies have built a vast, interconnected infrastructure system throughout California (see Figure 3-2). The Delta, because of its geographic location and role in conveying water supplies, is often described as the "linchpin" of California's water infrastructure. Rivers and dredged channels act as conveyance canals, and pumping plants provide the momentum to move stored water to areas south. California's overall system includes a range of surface reservoirs, aqueducts, pumping plants, operable gates, groundwater wells, and water treatment facilities constructed over the last hundred plus years.

[5] Data are from 2000, which DWR categorized as an "average" rainfall year for the state.

[6] The "remaining water" of approximately 60 to 65 MAF, (62.4 MAF for purposes of percentage calculations) is referred to throughout this chapter as "total water use," unless otherwise specified. Total water use includes urban, agricultural, and Central Valley environmental uses such as instream flow requirements and non-CVP-managed wetlands.

[7] For example, water that is dedicated to instream flows often becomes available for downstream diversion to agricultural and urban uses. Some portion of the water that is used for agricultural irrigation or drinking water is returned to the ecosystem through agricultural tailwater releases, infiltration of irrigation water into groundwater, and discharges from sewage treatment plants. The State does not have a system for documenting these multiple uses.

[8] Growth projections by the California Department of Finance are regularly revised and over the past 2 decades reflect a trend toward slower expected growth for the state. Between 1993 and 2004, the California Department of Finance's population projections for 2040 declined by 12 million people, from 62 million to 50 million.

Moving and Storing California's Water

Figure 3-2

Large State, federal, and local dams and canal systems play an important role in storing and conveying water throughout California to meet a variety of urban and agricultural water demands.

Source: Adapted from DWR 2009

On average, local and regional water supplies account for 52 MAF (84 percent) of the state's total water use. Of the 52 MAF, about 44 MAF (84 percent) of the water supply comes from local surface water storage and deliveries, and includes sources such as the Santa Ana, Los Angeles, and Ventura river watersheds in Southern California; local diversions from the Sacramento and San Joaquin rivers; and stream drainages in the central coastal areas. In addition, groundwater supplies about 8 MAF (13 percent) of the state's total water use in average years (20 percent of urban and agricultural water use), and during droughts, can provide up to 60 percent or more for specific regions (DWR 2009). A small but rapidly growing percentage of local water comes from recycled water and water reuse projects.

Supplemental water supplies are conveyed from wetter regions of California, primarily through diversions of runoff from the great Sierra Nevada mountain range and some water from the Trinity River in the north state. In most regions, these imported water supplies augment local and regional sources, especially in dry years and dry seasons. On average, approximately 10.1 MAF (16 percent) of the state's total water use comes through a combination of major conveyance and storage facilities from water sources within California and from other states, with the SWP and CVP making up the majority of these imports (5.1 MAF, about 8 percent), and Hetch Hetchy (0.2 MAF), Mokelumne (0.3 MAF), and the Los Angeles Aqueduct (0.2 MAF) comprising the remaining in-state imports. A significant portion of the state's water supplies are imported from outside California, primarily from the Colorado River (4.3 MAF) through the Colorado River Aqueduct, which serves agricultural and urban demand in Southern California.

The network of infrastructure to store and convey water in California is impressive by modern standards and compared to other states. The state's single largest "reservoir" is the Sierra Nevada snowpack, which holds approximately 15 MAF per year on average (DWR 2009). However, for comparison, local, State, and federal agencies in California have constructed more than 1,200 major reservoirs with a combined storage capacity of 43 MAF, about half the average annual runoff for the entire state (Hanak et al. 2011, DWR 2011a).

Most of California's largest surface storage reservoirs are owned and operated by the federal government and total approximately 17 MAF of storage capacity. The largest federal facility, part of the CVP, is Shasta Lake, which holds 4.5 MAF. The State's single largest storage facility and keystone feature of the SWP, Lake Oroville Dam on the Feather River, has a capacity of 3.5 MAF (LAO 2008). Operating with other reservoirs as a system, these multibenefit facilities reduce the potential for floods at the same time that they make water available for seasonal water agricultural and urban demand, particularly in the summer and fall. They also generate clean electricity. Although these storage facilities provide many benefits, they have also significantly altered the natural ecology of these rivers. Dams and their associated facilities can present barriers to migrating fish and reduce or eliminate downstream gravel and sediment replenishment to the detriment of native species such as salmon. Moreover, reservoir operations have significantly modified the amount and timing of instream flows, as well as water temperature, further contributing to the decline of the state's native fish and ecological resources.

Looking to the future, fewer high-yielding surface storage sites are available in the state now because most of these areas have already been developed (NRC 2012). However, there are significant opportunities throughout California to expand groundwater storage and to reoperate surface storage in conjunction with groundwater storage (also known as conjunctive management or groundwater banking) and other programs to maximize the water supply and environmental benefits of these systems.

Climate Change Complicates Management of California's Water

With climate change, the state's water supply will become even more erratic. Weather patterns are expected to become more extreme with long, multiyear droughts becoming more frequent as well as extremely wet years. Since 1906, California has seen "dry or critically dry" years one-third of the time. This trend is increasing (California Data Exchange Center 2011).

By 2050, temperature increases of 1 to 3 degrees Celsius are expected to cause more winter precipitation to fall as rain, as opposed to snow, and to reduce the Sierra Nevada snowpack (the source of much of California's runoff) by 25 to 40 percent (DWR 2010d). Runoff patterns will shift, leading to greater cool-season runoff and decreased warm-season runoff (Reclamation 2011a). The pattern of spring runoff is also expected to change, with a more rapid spring snowmelt leading to a shorter, more intense spring period of river flow and freshwater discharge accompanied by higher flooding risks (Knowles and Cayan 2004, Knowles et al. 2006, Null et al. 2010, Willis et al. 2011). Because the Delta watershed provides a portion of the water supply for approximately 27 million Californians and irrigates millions of acres of farmland, rising sea levels leading to increased salinity intrusion, along with changes in the form of precipitation and timing of snowmelt, will profoundly alter the way water is managed in California.

Specifically, an anticipated shift in runoff patterns will present a management challenge to existing reservoir operations, with large runoff events increasingly putting pressure on reservoirs managed for multiple benefits, including flood control. Reduced natural water storage in the form of snowpack will diminish statewide carryover storage capacity, making the state increasingly vulnerable during prolonged dry periods and negatively affecting water supply reliability.

Sea level rise, as much as 55 inches by 2100 (OPC 2011), will result in high salinity levels in the Delta interior, which will impair water quality for agricultural and municipal uses, and change habitat for fish species. Maintaining freshwater conditions in the Delta could require unanticipated releases of water from storage, which will reduce available water supplies for fish. Rising seas also will dramatically increase the risk of catastrophic interruption of water exports as a result of levee failure and flood events, particularly in the interior Delta where substantial subsidence has already occurred. Warmer temperatures throughout the state will cause higher evaporation rates, particularly during the hot summer and early fall months, contributing to reduced streamflows, drier soils, reduced groundwater infiltration, higher losses of water from surface reservoirs, increased urban and agricultural demand for irrigation water, and more water needed for ecosystem protection (California Natural Resources Agency 2008).

The precise local impacts of climate change on regional water resources remain less certain. Many communities in the state already experience water shortages during droughts (California Environmental Protection Agency 2006, LAO 2009). Improved modeling, especially downscaling of global climate change information to regional and local levels, will help communities to evaluate the extent of their vulnerability and to develop water management strategies that will increase the resilience of their water supply systems (USEPA and DWR 2011).

Foundations of Water Policy in California

Over the past 160 years, the California water rights system has evolved into a complex mix of public and private rights and contractual obligations that were intended to create more certainty about how water is to be allocated among urban, agricultural, and environmental uses during droughts, catastrophic interruptions in water supplies, and other times of scarcity. (See sidebar, California's Complex Water Rights System.) Yet some of these rights and obligations conflict, and now, in many years, there is insufficient water in California to support them all.

California's legal system recognizes limitations on water rights based on the longstanding doctrines of Reasonable Use and Public Trust (NRC 2012). The Delta Reform Act reiterates that the principles of reasonable use and public trust "shall be the foundation of state water management policy" and that they are "particularly important and applicable to the Delta" (Water Code section 85023). The coequal goals of improving water supply reliability for the state and restoring the Delta cannot be achieved by actions in the Delta alone. Every region in California, along with the cities and farms that receive Delta water, will need to improve their management of the state's scarce water resources.

This section discusses the legal foundations for California water policy, explains the state's system of water rights, and describes new water policies and priorities, including reduced reliance on the Delta and improved regional self-reliance, established by the Delta Reform Act.

Reasonable Use and the Public Trust Doctrines

The Reasonable and Beneficial Use and Public Trust Doctrines, in combination with existing water rights and the State's area of origin statutes, have long been the legal and policy foundation for water management in California. The State's Reasonable and Beneficial Use Doctrine specifically limits all water rights and water use in California to "such water as shall be reasonably required for the beneficial use to be served, and such right does not and shall not extend to the waste or unreasonable use or unreasonable method of use or unreasonable method of diversion of water" (California Constitution, Article X, Section 2).

The SWRCB is the primary agency responsible for ensuring that water is not wasted and that the reasonable use standard is not violated. However, DWR also shares with them the duty to "take all appropriate proceedings and actions…to prevent waste, unreasonable use, unreasonable method of use, or unreasonable method of diversion in this state" (Water Code section 275). The SWRCB also is responsible for determining whether any water remains available in a stream or watershed for appropriation and whether the water is being fully used for "beneficial uses," consistent with State law that identifies the types of water uses that are permitted.[9] The State can review and modify existing water rights as well as consider approval of new permits and water rights to
reflect new conditions, including California statutes that require efficient water use and improved water management.

The Public Trust Doctrine provides the State with additional authority to reconsider past water allocation decisions in light of new information and changing water demands and social values, and to modify or revoke previously granted water rights if warranted. In a 1983 landmark legal decision, the California Supreme Court unanimously affirmed that the state's navigable lakes and streams are resources that are held in trust for the public and are to be protected for navigation, commerce, fishing, recreational, ecological, and other public values. The State "has an affirmative duty to take the public trust into account in the planning and allocation of water resources and to protect public trust uses whenever feasible" (*National Audubon Society v. Superior Court*, 33 Cal. 3d 419, 658 P.2d 709, 189 Cal. Rptr. 346, 1983 Cal.). This has significant implications for governance of water resources. In fact, both the Public Policy Institute of California and Appeals Court Associate Justice Ron Robie recently called for the establishment of a public trust advocate at the SWRCB to ensure that the State's duty to protect California's public trust resources is being performed adequately (Robie 2012, Hanak et al. 2011).

[9] Beneficial uses recognized in California include domestic, fire protection, fish and wildlife, industrial, irrigation, municipal, power production, recreation, and other uses (SWRCB 2010).

CALIFORNIA'S COMPLEX WATER RIGHTS SYSTEM

Whatever the type of water right that is held by an individual, business, or public agency, no one "owns" the water they use in California (Littleworth and Garner 2007). All water within the state is held in trust for the benefit of all the people of California (Water Code sections 102, 1201). Water rights holders have the right to "take and use water, but they do not own the water and cannot waste it" (*Central and West Basin Water Replenishment District v. Southern California Water Co.* (2003) 109 Cal. App. 4th 891, 905).

Riparian Rights – Landowners who own property that abuts a natural water course are entitled to make reasonable use of water on or flowing past their property. The water must be from a natural flow (not released stored water). Water cannot be stored under a riparian right and may only be used on property that is within the drainage of the water's source. If there is not enough water in a watershed to satisfy both riparian and appropriative rights, then riparian rights must be fulfilled first. In times of shortage, riparian right holders allocate the reduced water supply by sharing the shortage among the riparian users.

Appropriative Rights – An appropriative right is typically used when the prospective water user intends to use water on nonriparian land or the water user needs to store water for later use. Pre-1914, these rights were asserted in a manner similar to the filing of a mining claim; a water user filed a public notice of his or her intent to divert water and then diverted the water for a legally recognized beneficial use such as mining, irrigation, or drinking water. In times of shortage, appropriative right holders allocate the reduced water supply among themselves under a first in time, first in right priority system. Generally, water received through appropriative rights is more predictable than riparian rights, but appropriative rights can be lost through nonuse (because beneficial use is the basis for receiving the right), and shortages are allocated based on seniority (NRC 2012). California law recognizes water conservation as a "reasonable beneficial use" so that water efficiency improvements cannot be used as a reason to reduce appropriative rights held by a water user (Water Code section 1011(a)).

CVP and SWP Contractors – The Bureau of Reclamation and DWR hold appropriative water rights for the operation of the CVP and SWP, respectively. In many instances, these project rights are junior in priority to the rights held by water users in the Delta and within the Delta watershed. This means that during droughts and other periods of water shortages, the ability of the SWP and CVP to divert water from the Delta is limited by riparian owners and by more senior appropriative water rights.

Area of Origin Laws – Several statutes provide protections to areas within the Delta and the Delta watershed where the rivers originate (Littleworth and Garner 2007). Also known as "watershed protection" statutes, these laws provide the opportunity for water users in these areas to obtain water rights with a more senior priority than the SWP and CVP contractors so that local demands might be met before water becomes available for export.

Reasonable Use and Public Trust Doctrines – The SWRCB has the authority to review and modify existing water rights as well as approve new rights. This is an important principle because it enables the State to consider what is "reasonable" based on modern societal values, the need to protect other water users, protect the environment, and prevent the waste and unreasonable use of water. This authority derives in part, from the Public Trust Doctrine, under which the State has an ongoing duty to protect the navigable waters of the state for environmental protection, fishing, navigation, and commerce; and from the Reasonable Use Doctrine of the California Constitution, a provision mandating the reasonable and beneficial use of all waters in the state (Article X, Section 2).

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California's Water Rights System and Use Reporting

California's water rights system is of great legal significance. However, our water rights system does not and cannot guarantee a supply of water that exceeds what nature provides. Nor does any individual, business, industry, or agricultural enterprise "own" the water they use.

The amount of water used in California's stream systems is not fully known because water users under pre-1914 and riparian water rights have not been required, until recently, to submit annual reports accounting for their diversions. In 2009, the State adopted statewide water diversions reporting requirements (Water Code section 5100 et seq.); and in 2010, the SWRCB adopted regulations requiring online reporting of water use by all water rights holders, including all surface and groundwater users. In addition, there is limited information available to the State on consumptive use or the number of times that water is used within a stream system.

Discussed previously, the SWRCB has the authority to determine when a river or stream has been "over-appropriated," in other words, whether the amount of water available in a stream is less than the demands placed on that water. A right to use water represents potential diversions and uses. Actual water use in many rivers and streams is frequently far less than the total volume of asserted water rights. The difference between water rights and water received can be explained by restrictions or conditions in the permits/licenses, operation restrictions on the storage and transport facilities themselves, physical and economic limitations, non-consumptive uses such as hydroelectric power generation, and the use and reuse of water.

Understanding and reconciling the human demands for water to the supply available, while providing enough water to ensure desired and legally protected environmental and water quality goals, is a difficult process. This process is nonetheless essential to achievement of the coequal goals.

The Coequal Goals and Reducing Reliance on the Delta

In 2009, California further defined its water policy priorities as they relate to the Delta, including express recognition that the Delta crisis cannot be resolved by taking action in the Delta alone. Given the interconnected nature of the Delta with the water use patterns of large parts of Northern, Central, and Southern California, the new coequal goals of statewide water supply reliability and an improved, protected, and restored Delta ecosystem will fundamentally reshape California water management over the course of this century. Achieving these coequal goals is expected to be done, in significant part, through compliance with the Delta Reform Act's various mandates and goals relating to statewide water conservation, efficiency, and sustainable use, including the State's new policy to reduce reliance on the Delta and related mandate to improve regional self-reliance.

In particular, the Delta Reform Act mandates many statewide strategies that the Delta Plan must address to achieve the coequal goals, including water efficiency and conservation; wastewater reclamation and recycling; desalination and advanced water treatment technologies; improved water conveyance, surface, and groundwater storage; improved water quality; and implementation of local and regional water supply projects (Water Code sections 85004(b), 85020(d) and (f), 85021, 85023, 85303, and 85304).

These measures help achieve the requirements of Water Code section 85021, which declares that the State's policy is "to reduce reliance on the delta in meeting California's future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency." That section also mandates that "[e]ach region that depends on water from the delta watershed shall improve its regional self-reliance for water through investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts."

Consequently, to achieve the statewide water supply mandates and the coequal goal of statewide water supply reliability, regions located outside the Delta also must take actions outside the Delta to increase water efficiency and develop sustainable local and regional sources of water, which will contribute to improved water supply reliability.

Individual actions by water suppliers throughout the state will be vital to success in this regard. The implementation of programs and projects that result in a significant reduction in the amount of water used, or in the percentage of water used, from the Delta watershed (evaluated at the local, regional, and statewide levels) will be the foundational measures for assessing the State's progress in achieving these policies. The baseline for this evaluation will be existing water use and supplies, as documented in the most recently adopted urban and agricultural water management plans. (See Appendix G, Achieving Reduced Reliance on the Delta and Improved Regional Self-Reliance.)

It is important to recognize that reliance on water from the Delta and the Delta watershed varies throughout California, from region to region, and supplier to supplier. (See sidebar, Reliance on the Delta Varies by Region.) Some water suppliers have greater access to alternative water supplies or have a greater ability to implement a diverse range of water efficiency and water supply projects. Others, particularly in the upper watershed, may have a narrower range of options.

The key is that every supplier is doing its part and is taking appropriate action to contribute to the achievement of the coequal goals, including the State's policy of reduced reliance and associated mandate to improve regional self-reliance.

The Delta's Role in California's Water Supply

The Delta is the terminus for California's largest watershed, which encompasses the western slopes of the Sierra Nevada, the eastern slopes of the coastal range, and the valleys that lie between these ranges. Water in the Delta watershed starts as precipitation in the Sacramento River and San Joaquin River watersheds and, unless diverted or otherwise used, flushes San Francisco Bay and flows out to the ocean under the Golden Gate Bridge. Once again, this estuarine delta where California's two largest rivers meet is at the geographic and political center of water in California.

The CVP and the SWP rely on the Delta's artificial network of channels to convey water stored in upstream reservoirs to regions south of the Delta including the Bay Area, San Joaquin Valley, Tulare Lake Basin, Central Coast, and Southern California. (See sidebar, Reliance on the Delta Varies by Region, and Figure 3-3.)

Because of the Delta's central location, the water demands of many Californians are connected in some way to the Delta. Water diverted from the Delta watershed provides some portion of water supply for more than 27 million of the state's residents and approximately 3 million irrigated acres of farmland (DWR 2007a, DWR 2009, DWR 2011c, Reclamation 2011b). This water plays a critical role in helping to sustain a major portion of the state's $1.9 trillion economy.

This section provides an overview of water use and water infrastructure in the Delta watershed, followed by a description of water project operations in the Delta and the challenges and conflicts associated with these. The section concludes with a discussion of the importance of improving the flexibility of project operations, through improved conveyance, storage, and water management, in achieving the coequal goals.

Use of Water from the Delta Watershed

About half the state's runoff flows through the Delta watershed. Since the 1849 Gold Rush, communities throughout California have planned and constructed facilities to tap into this water to support economic development.

Many diversions in the Delta watershed occur in the upper watershed. On average, approximately 31 percent of the flow from the Delta watershed is diverted before it ever reaches the Delta (DWR 2011c). See Figure 4-5 in Chapter 4. These diversions are done through an extensive network of locally constructed dams, canals, and diversion structures that have been built over the past 160 years on nearly every stream and drainage within the Delta watershed (California Natural Resources Agency 2010). Some of the water diverted from Delta tributaries is returned to the tributaries through wastewater effluent and agricultural return flows, albeit at a degraded quality.

Water from these diversions sustains the economies of the residents, businesses, and growers who live in the areas where the water comes from—the "area of origin"—as well as the economies in the export areas. Some of these historical diversions occur through two large aqueduct and reservoir systems that were constructed early in the twentieth century to serve the growing water demands of San Francisco and East Bay Area communities. These facilities divert water before it reaches the Delta and convey it directly to reservoirs, treatment facilities, or customers in the Bay Area region. The Hetch Hetchy reservoir system on the Tuolumne River, and the Pardee and Camanche reservoirs system on the Mokelumne River account on average for approximately 0.5 MAF, or about 1.6 percent of the flow from the Delta watershed, of annual water deliveries from the Delta's upper watershed (DWR 2009).

RELIANCE ON THE DELTA VARIES BY REGION

Water exported from the Delta supplies about 8 percent of the state's total water use, and local and regional water supplies provide over 84 percent on average. However, reliance on water from the Delta watershed varies throughout California from region to region, supplier to supplier, and user to user.

For example, in the Sacramento and San Joaquin river watersheds, including water uses on the valley floor, foothills, mountain communities, and the Delta, the vast majority of the water supply comes from local sources: the rivers and reservoirs that flow into the Delta or from local groundwater resources that are replenished from runoff within the Delta watershed. Most of this water is used for irrigated agriculture, although increasing amounts are being shifted to drinking water and other municipal uses by the cities and towns that are growing in these regions. High-growth areas surrounding the Delta, including Fairfield, Sacramento, Stockton, and Tracy, are increasing urban water use and decreasing agricultural water use as the communities are developed.

Other regions, including the Tulare Lake region of the Central Valley, the San Francisco Bay Area, the South Coast, and the Central Coast, receive some portion of their water supply from diversions from the Delta's eastern tributaries or from water that is pumped from the Delta to supplement their limited local surface water and groundwater supplies. These exports vary by region and, for specific water users, the significance of these exports varies dramatically. For example:

- **Tulare Lake:** This region relies upon exports delivered through the Central Valley Project (CVP) and State Water Project (SWP) for 27 percent of its regional water supply, and most of this water use is for irrigated agriculture (on average 96 percent of CVP water deliveries and 89 percent of SWP deliveries). Kern County Water Agency, a water wholesaler, has the largest SWP import contract in the Tulare Lake Basin at nearly 1 million acre-feet (MAF) (DWR 2009).
- **San Francisco Bay Area:** This region's predominant water supply is from local sources (57 percent from surface and groundwater alone). However, diversions from the Delta's tributary streams provide up to 27 percent of this region's water, and CVP and SWP exports account for another 16 percent (DWR 2009). The reliance of the region's individual water suppliers on water from the Delta varies dramatically; the Marin Municipal Water District uses none (MMWD 2010), and the Zone 7 Water Agency in Alameda County receives as much as 82 percent of its water from SWP exports (Zone 7 2010).
- **Southern California:** This region is home to 50 percent of the state's population (with most in densely urbanized areas), and 80 percent of its water use is for drinking water, municipal, and industrial uses. SWP exports from the Delta account for roughly 25 percent of the region's water supplies, and local sources (groundwater, surface water, and increasingly recycled water) comprise another 50 percent, and imported water from the Colorado River about 25 percent (DWR 2009). Within the Metropolitan Water District of Southern California, the largest wholesaler in Southern California, the dependence of its member agencies on SWP imports can vary dramatically. Some agencies have few alternative water sources, while others have sufficient local supplies and are now planning to reduce their future reliance on imported water or to roll off the system completely (WBMWD 2010, City of Santa Monica 2012).

With increasing uncertainty over the reliability of Delta water exports, many communities have developed plans and projects to increase and diversify local water supplies and to increase water efficiency. Even with improvements in Delta operations that provide more reliable Delta water exports, regions will need to implement additional local and regional water management strategies to reliably meet their future water demands.

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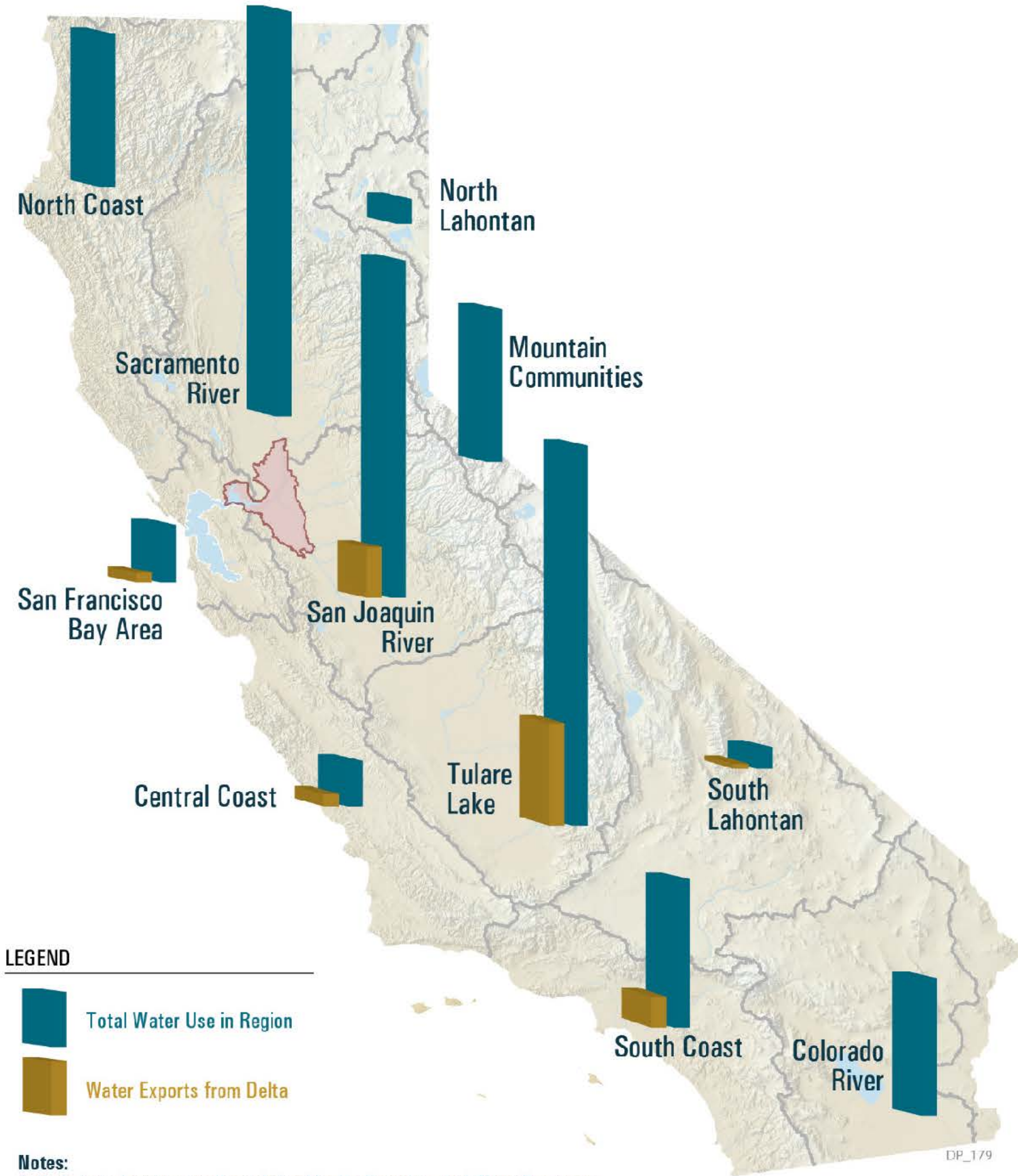
Local Water Sources Meet Most of California's Water Needs



Notes:
1. Hydrological regions are those defined by the Department of Water Resources
2. Delta water exports include contract amounts to maintain wetlands

Sources: DWR 2009, Reclamation 2011b, DWR 2011c

Figure 3-3 The vast majority of California's water comes from local sources. Exports from the Delta comprise 8 percent of California's water use. Yet, the Delta supply is important to many regions south of the Delta.

Within the Delta, growers and residents historically have relied on water from the Delta. In-Delta water use has remained relatively constant over the past 100 years (DWR 2007a) and averages about 4 percent (0.9 MAF) of inflows into the Delta. Most of this water is used for agricultural irrigation, and small and large communities throughout the Delta.

The CVP and SWP export systems became operational in the late 1940s after much of the local Delta development had occurred. Exports from the Delta now range from approximately 3 MAF in dry years to around 6.5 MAF in wet years (DWR 2009, Reclamation 2011b, Reclamation 2011c). In total, the SWP and CVP facilities export on average approximately 5.1 MAF per year from the Delta. These water diversions account for 24 percent of the inflows into the Delta (see Figures 3-4a and 3-4b).

Joint Federal and State Delta Operations

The federal CVP and California SWP were born out of long-range planning documents developed from the 1870s through the 1920s, including the 1919 Marshall Plan completed by U.S. Geological Survey and the 1930 Division of Water Resources Bulletin No. 25, "Report to the Legislature of 1931 on State Water Plan." These planning investigations developed and evaluated alternatives to provide:

- Fresh water to industries in Contra Costa and Alameda counties along Suisun and San Pablo bays
- Irrigation water to portions of the San Joaquin Valley that have substantial and increasing groundwater overdraft conditions, especially in the Tulare Lake region
- Supplemental water for Southern California urban development totaling 2 million acres in San Diego, Orange, and Ventura counties and the San Gabriel and San Bernardino valleys with water from Owens Valley, Mono Basin, and Colorado River

The California Legislature approved this plan in 1941 as the first State Water Plan (now the current California Water Plan), which included a description of facilities that would eventually be constructed as part of the CVP and SWP. Although design and construction of storage and conveyance facilities was done separately for CVP and SWP, both are operated in a coordinated manner for Delta operations.

Central Valley Project

Congress appropriated $20 million in Emergency Relief Appropriation Funds and authorized construction of the CVP by the U.S. Army Corps of Engineers (USACE) as part of the Rivers and Harbors Act of 1935. When the Rivers and Harbors Act was reauthorized in 1937, the construction and operation of the CVP was instead assigned to the Bureau of Reclamation (Reclamation).

Construction of the CVP by the federal government began in 1937. The first water was sold from the CVP to the City of Antioch from the initial reaches of the Contra Costa Canal in 1940, to support shoreline industries.

By the late 1940s, it had become apparent that California's rapid urban, agricultural, and industrial growth would quickly increase demands for water and power to levels that exceeded the initial CVP system capacity. In response, Congress authorized additional federal reservoirs and conveyance facilities over the next few decades, including Folsom Dam along the American River, Tehama-Colusa Canal along the west side of the Sacramento Valley, Trinity River Dam to provide additional water from the Trinity River into the Sacramento River for CVP operations, and New Melones Dam on the Stanislaus River. In 1960, the San Luis Unit, in the western San Joaquin Valley, was authorized by Congress to be constructed under a contract between the federal government and the State.

Where Delta Water Comes From and Goes

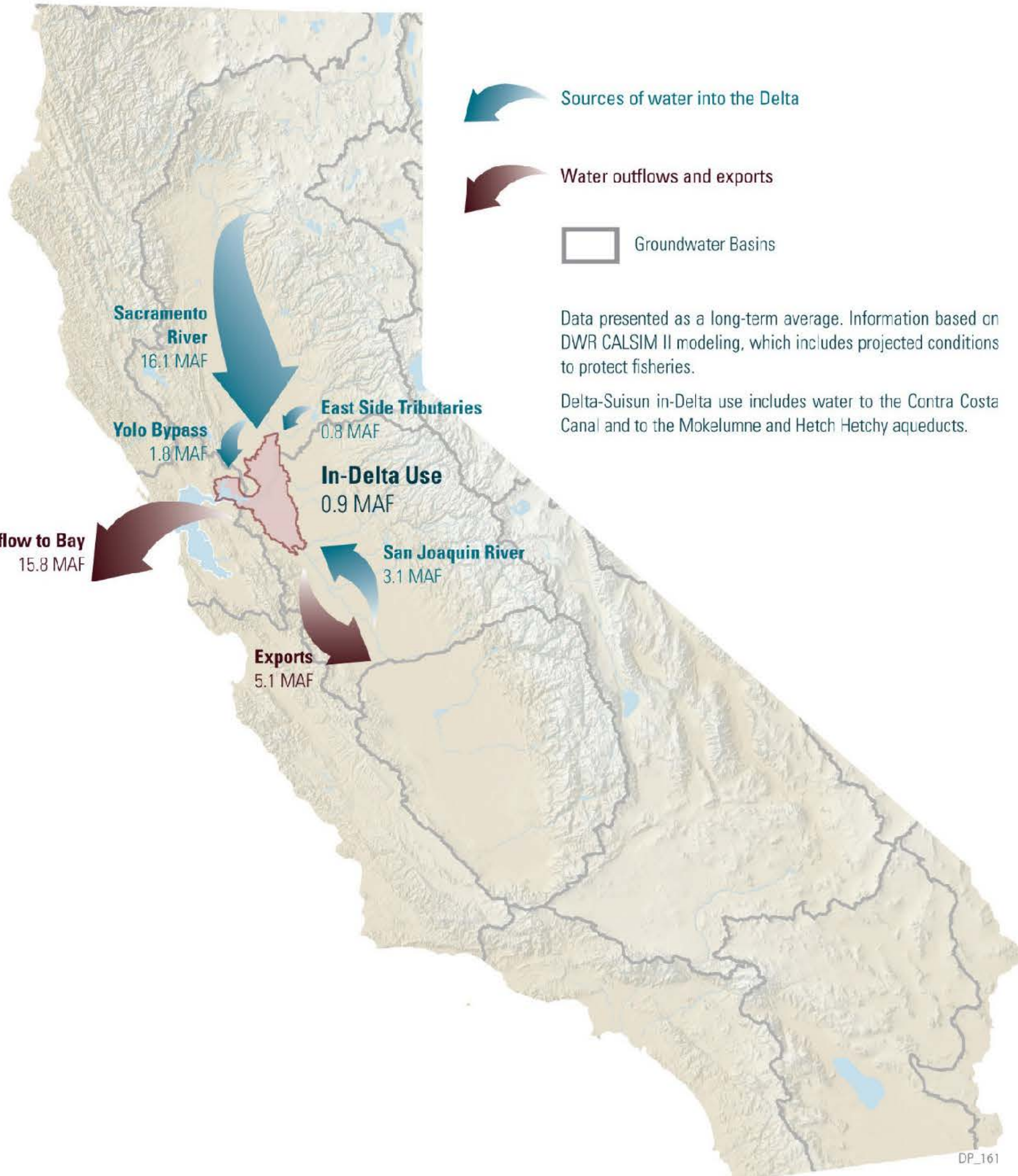


Figure 3-4a Over the past century, the combination of regional diversions from within the Delta watershed and water diverted directly from the Delta has transformed the Bay-Delta ecosystem, reducing historical outflows by an average of 50 percent.

Sources: LAO 2008, Reclamation 2011b, DWR 2011c

Delta Water Flows in Wet and Dry Years

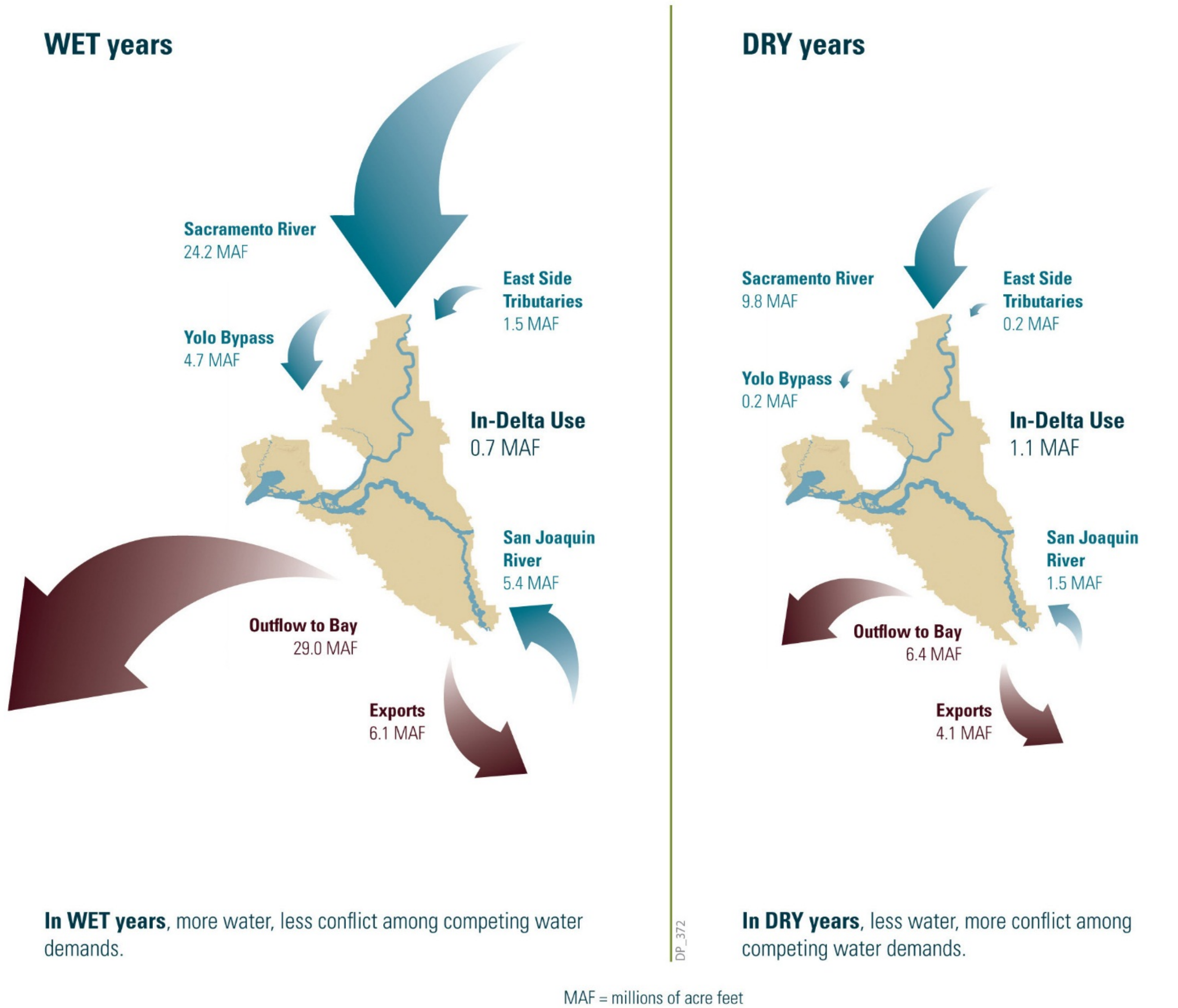


Figure 3-4b *Sources: LAO 2008, Reclamation 2011b, DWR 2011c*

The CVP is the largest surface water storage and delivery system in California, with a geographic scope covering 35 of the state's 58 counties. The project includes 20 reservoirs with a combined storage capacity of approximately 11 MAF, 8 power plants and 2 pumping-generating plants, 2 pumping plants, and approximately 500 miles of major canals and aqueducts. The CVP provides water through water service contracts and water rights agreements for a total of about 9.6 MAF per year (including water service contractors that use water from the Stanislaus River and San Joaquin River).

State Water Project

In 1947, the State began an investigation to consider the next phases of the State Water Plan to meet the state's anticipated supplemental water demands through development of the SWP and to control salinity intrusion in the Delta. In 1953, the State adopted the Abshire-Kelly Salinity Control Barrier Act to evaluate placement of a saltwater barrier near Suisun Bay to protect Delta water users and allow transfer of fresh water from the Sacramento Valley to the San Joaquin Valley. This plan was not implemented primarily due to costs and technical considerations, but alternatives continue to be evaluated today.

In 1957, Bulletin No. 3 was published, which described the need for SWP facilities to convey water from the Sacramento Valley to water-short areas of California. The report identified an urgency to expand statewide water facilities because of projected population growth and to support a balanced economy; major industrial growth; 6,875,000 acres of irrigated agriculture, or approximately 25 percent of all agricultural acreage in the United States; and flood control in Northern California. The study identified that there was a "seasonal deficiency" of 2,675,000 acre-feet of water in 1950 that had been met with groundwater pumping primarily from overdrafted aquifers. In 1960, California voters authorized the Burns-Porter Act to construct the initial projects of the SWP, including Oroville Dam and Lake Oroville on the Feather River, San Luis Dam and Reservoir to be jointly constructed and operated with Reclamation, the North and South Bay aqueducts, and the 444-mile California Aqueduct. Notably, DWR continues to project a 1- to 2-MAF deficit in average annual groundwater pumping from overdrafted aquifers (DWR 2009). A more detailed discussion of groundwater is provided later in this chapter.

Delta Operations

Prior to the 1960s, the CVP and SWP operated in the Delta unrestrained by environmental regulations. However, beginning in the 1970s, with the passage of environmental laws, including the federal Clean Water Act, Endangered Species Act, Central Valley Project Improvement Act, Porter-Cologne Water Quality Control Act, California Endangered Species Act, Wild and Scenic legislation, and many others, protection of the ecosystem became an explicit legal obligation for the SWP and CVP in addition to delivery of fresh water for agricultural and urban use.

In the modern context, CVP and SWP facilities operate according to a complex web of permits, licenses, and, in some cases, court orders that impose explicit conditions on how, when, and how much water can be exported from the Delta. Some of the entities that regulate water project operations in and upstream of the Delta include:

- The SWRCB and regional boards require the SWP and CVP to meet specific water quality criteria that result in operational standards within the Delta and the Delta watershed. The SWRCB also sets instream flow standards.
- USACE sets operational "rule curves" for reservoirs that provide flood protection upstream of the Delta. The Central Valley Flood Protection Board regulates encroachments on designated floodplains and floodways. (See Chapter 7.)
- The presence of threatened and endangered species in California's waterways and landscapes requires the California Department of Fish and Wildlife (DFW), U.S. Fish and Wildlife Service, and National Marine Fisheries Service to regulate water project operations in the Delta. Federal biological opinions that govern agency regulatory activities have been the subject of extensive recent litigation by water agencies and other interested parties.

To comply with these regulations and to optimize system efficiencies, DWR (for the SWP) and Reclamation (for the CVP) jointly coordinate their pumping operations in the Delta under the 1986 Coordinated Operating Agreement (COA). One of the benefits of the COA is that it resulted in improved reliability of deliveries for the SWP (DWR 2008). They also jointly manage portions of the water delivery facilities in the Central Valley. There are times when the CVP may use SWP export capacity or that the SWP may need to use CVP export capacity. This close coordination has resulted in flexible operation of the Delta facilities to improve reliability of Delta water deliveries as well as to reduce system vulnerability to disruption.

Additional operational changes are on the horizon for the CVP and SWP. The SWRCB has initiated a phased process to review and amend—or to adopt new—water quality and flow objectives for the Delta by 2014. Phase 1 of that review is focused on southern Delta water quality and San Joaquin River flows. Phase 2 is focused on other changes that may be needed to the remainder of the Bay-Delta Water Quality Plan to protect fish and wildlife beneficial uses. See Chapter 4 for more information on flow in the Delta and the relationship to ecosystem health, and Chapter 6 for more information on the Council's recommendations on the SWRCB process to update the Bay-Delta Water Quality Plan. Furthermore, conveyance alternatives under consideration by the Bay Delta Conservation Plan (BDCP) could mean large-scale changes to Delta infrastructure and operations.

Challenges and Conflicts in the Delta

Over time, the Delta has been transformed, mostly by human hands, to serve many purposes. As mentioned, the SWP and CVP were originally engineered to reliably deliver water to water service contractors and water rights holders without commensurate consideration for impacts on native species. The Delta is the only saltwater estuary in the world that is used as a conveyance system to deliver fresh water for export. This creates substantial water supply and ecosystem conflicts.

Legal changes in recent decades, combined with growing societal awareness and scientific understanding of water project operations on ecosystem health, had major implications for water operations in the Delta. The collision of changing societal values, growing demands for water deliveries from the Delta, and declining health of the Delta ecosystem have resulted in numerous complex and often bitter legal challenges that have increasingly shifted critical Delta water management decisions to the courts.

CVP and SWP Water Delivery Challenges

Overall, exports from the Delta have been rising over the past 4 decades (see Figure 3-5). Historically, the SWP and CVP have pumped more water from the Delta during dry years than wet years; but over time, exports have increased in all water year types, except in critically dry years. The SWP and CVP have each reached record exports in the past 10 years. In part, this is because recent increases in surface and groundwater storage south of the Delta have enabled more water to be taken during wet years. Increased south-of-Delta storage has also led to more agricultural-to-urban water transfers, which help improve the flexibility of operations in the Delta.

Yet, many factors threaten the ability of State and federal water managers to continue pumping water through the two projects at current export levels. Subsidence of the agricultural lands on the Delta islands, rising sea level, and earthquakes threaten the physical integrity of the Delta ecosystem and the levees that protect the export water quality. The location of the two pumping stations (one each for the CVP and SWP) in the south Delta is a problem for fisheries. Described previously, most of the water enters the Delta from the north through the Sacramento River. Pumping stations for the CVP and SWP are located in the south Delta and, when operating, frequently cause a net "flow reversal" in the central and south Delta channels. (See Chapter 4 for more details.) This reverse flow affects fish movement, including migration through the Delta, and often results in species that are free-floating or have weak swimming capability being drawn into the pumping facilities where they can be entrained (Grimaldo et al. 2009). Water quality is an issue too. A portion of the water flowing into the Delta is specifically allocated to Delta outflow to help repel salinity intrusion from the San Francisco Bay and to maintain low-salinity water near the western edge of the Delta. This means that water that might otherwise be used for exports must be released from upstream reservoirs to help control salinity (NRC 2012).

Historical Exports and In-Delta Use

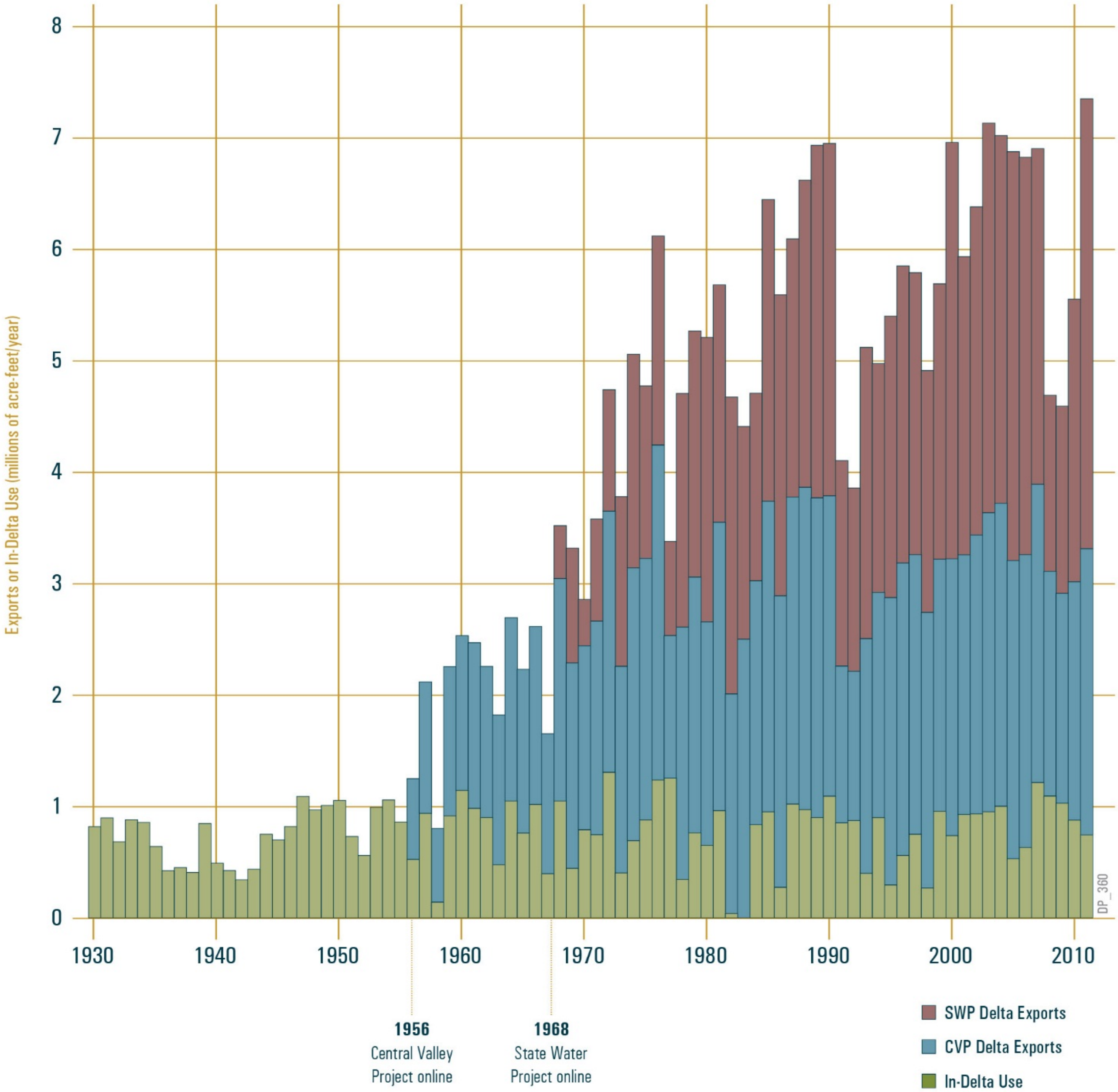


Figure 3-5 Overall exports from the Delta have been rising over the past 4 decades, while in-Delta uses have remained fairly constant. Exports by the CVP and SWP have reached record levels in the past 10 years.

Conflicts over water use are further complicated by original SWP and CVP contracts that assumed greater water export quantities than consistently can be delivered. Since 1990, the CVP has fulfilled 100 percent of its contract water allocations only three times, and the SWP has delivered 100 percent of its contract amounts only twice (Reclamation 2011c, DWR 2010b). The CVP's ability to meet maximum contracted amounts, particularly during dry years, has diminished since the addition of new municipal and industrial contractors who have priority over agricultural water deliveries.[10] Also, the 1992 passage of the Central Valley Project Improvement Act dedicated up to 800,000 acre-feet of CVP exports for wildlife refuges and environmental needs (Public Law 102-575, section 3406(b)(2)). The original SWP contract amounts were based on assumptions that additional major new dams and conveyance facilities would be constructed at a later date, which did not occur. As a result, even though the SWP had contracted to supply 4.2 MAF, average SWP exports between 1996 and 2006 were just 2.9 MAF (DWR 2008).

The reality is that the State and federal systems have never been able to reliably deliver the full contract amounts. Now, additional court-ordered and regulatory restrictions on State and federal pumping of export water, in combination with the 2007 through 2009 drought, further reduced the reliability of Delta water exports to SWP and CVP contractors. According to DWR, SWP deliveries are now expected to average 60 percent of maximum contract amounts in future years, down from 66 to 69 percent estimated in 2005 (DWR 2010b).

The process for allocating water shortages within the State and federal projects also impacts the extent to which various contractors experience different levels of Delta water supply reliability. Within the SWP, shortages are uniformly distributed across all water contractors. Within the CVP, municipal and industrial water users have a higher priority than agricultural water users. As a result, in dry years, CVP water rights contractors, such as the Sacramento River Settlement Contractors, may receive 100 percent of their water allocations while non-water rights contractors, including Westlands Water District, may receive as little as 10 percent.

North-to-south water transfers across the Delta can be an important tool for improving water supply reliability. However, transfers require the use of SWP or CVP facilities and, as such, are subject to the regulatory constraints on Delta exports. Because Delta pumping windows of opportunity are shorter and generally filled by contract deliveries, excess capacity for water transfers is increasingly hard to come by.

Although lesser known, an increasing challenge to Delta export reliability relates to the operations and maintenance of the large, complex facilities that make up the SWP. The SWP has experienced a significant and growing decline in operational reliability that has directly impacted DWR's ability to store and move water, produce electricity, and export water from the Delta when the appropriate hydrological conditions present themselves (DWR 2010b). These challenges include maintaining SWP delivery capabilities under continued manpower resource limitations, aging infrastructure, and constraints in providing competitive employee compensation despite adequate SWP funding. Further resource challenges are attributed to complex and cumbersome State contracting processes and State hiring freezes.

Improving Delta Water Supply Reliability through Investments in System Flexibility

Because California's annual precipitation is remarkably variable, the past expectation that each year—wet or dry—should yield the same quantity of water exported from the Delta watershed is unrealistic and can be an obstacle to necessary improvements in water supply reliability.

10 Additional municipal and industrial water contracts were implemented in the late 1980s for the CVP San Felipe Unit and in the last 10 years for the CVP American River Division.

The greatest conflicts between the water needs of people and fish within the Delta occur during dry years. That is when the least amount of water is flowing into the Delta and, historically, when exports have been a much larger percentage of Delta inflows than in wet years (see Figure 3-6). On average, exports have diverted about 17 percent of Delta inflows in wet years and about 36 percent during dry years (DWR 2011c). In past years, exports have exceeded 60 percent of Delta inflows in some dry months, but recent regulatory decisions now constrain such operations.

The recovery of the Delta ecosystem and listed species will help reduce regulatory restrictions on Delta exports and increase the long-term stability and predictability of rules governing Delta pumping.

More natural flow patterns in the Delta can be compatible with improving the reliability of water deliveries from the Delta. More water can be taken in wet years when more water is available, less water will be taken in dry years when it is needed for in-Delta water quality and environmental protections, and operations can be improved to increase seasonal flexibility to avoid impacts on Delta species and habitat. Many local water management actions that help reduce reliance on the Delta and improve regional self-reliance are also essential to improving overall flexibility of Delta operations and improving reliability of water supplies during periods when pumping is constrained.

Upstream, downstream, and in-Delta improvements can all add to export system flexibility, producing both water supply and ecosystem benefits. Storage capacity, however, is a current limitation to this scenario, and will worsen under anticipated climate change conditions. Were sufficient storage available, flows that exceed water needed to meet environmental and other requirements could be captured and stored. This stored water could then be released later in the year or carried over into subsequent years.

Fish predation and mortality at the export pumps could be reduced if the diversion points of the State and federal water projects in the Delta were moved or modified. Risks to a reliable source of fresh water conveyed through the Delta could be reduced through conveyance alternatives that could provide multiple diversion locations in the Delta (as those being analyzed in the BDCP process) and through strategic levee investments.

It is important to note that storage can increase the benefits of conveyance improvements, and conveyance improvements may be limited without the benefit of added storage. Improved operational flexibility, consistent with ecosystem restoration, can result in more reliable water supplies for all beneficial uses from year to year and, when managed for multiple benefits, can also ensure adequate flows to meet public trust needs, including the protection of the Delta ecosystem.

The Role of Storage in Increased Flexibility

Statewide water storage capacity, both above and below ground, is currently inadequate, especially south of the Delta, to facilitate export of water at times of surplus when the impacts on the Delta's ecosystem are reduced and the only impediment is lack of available storage capacity (DWR 2009). For example, in 2010, the SWP and CVP pump operations were slowed even though water was available to be pumped at a time when it would not have conflicted with endangered species or other water quality requirements. The SWP and CVP could not convey the surplus water through the Delta at that time because storage capacity south of the Delta was full.

Historical Delta Inflow and Delta Exports

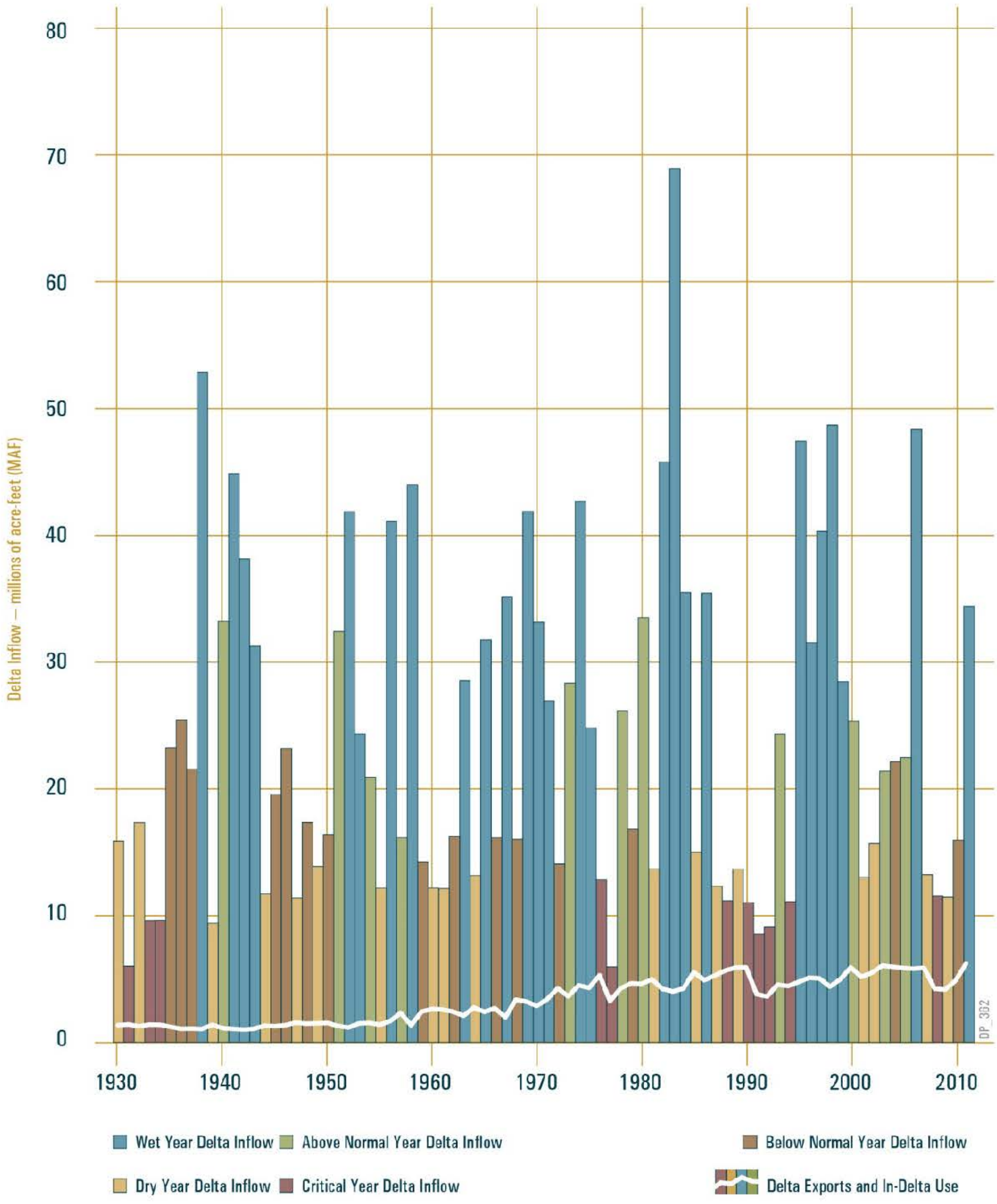


Figure 3-6

In many years, water flowing into the Delta greatly exceeds the amount of water that is exported from or used in the Delta. However, in dry years, total exports and in-Delta use have averaged as much as 36 percent of inflows.

Source: DWR 2012a

Applying Adaptive Management To Water Management Decisions			An adaptive management approach for water management decisions should be taken to plan for and assess the water supply outcomes of conveyance and storage improvement actions. The following is a hypothetical example of how the Council's three-phase and nine-step adaptive management framework (see Appendix C) could be applied to a water management decision.
		Adaptive Management Step	Hypothetical Water Supply Reliability Improvement Project
Plan	1	Define/redefine the problem	Current storage and conveyance configuration is not adequate for providing a more reliable water supply to south-of-Delta users under modern operating rules.
Plan	2	Establish goals and objectives	**Goal:** Improve water supply reliability for south-of-Delta water users. **Objective:** Optimize storage for south-of-Delta water users in wet years so that interruptions in deliveries are reduced and the amount of water delivered during wet years can be increased consistent with environmental regulations in the Delta.
Plan	3	Model linkages between objectives and proposed action(s)	There are inadequate options for south-of Delta water users to optimize storage in wet years, leading to vulnerability to interruptions and reduced capacity to divert water when it is available. The San Luis Reservoir is the only CVP water source for San Luis Unit, Cross-Valley Contractors, and San Felipe Division (SFD) water users. SFD serves water to Santa Clara and San Benito counties. As the San Luis Reservoir is drawn down during the summer and into the late fall (when predictable water supplies are needed most), a dense layer of algae develops near the surface. As the water level lowers, this algae gets captured by SFD intakes. The algae degrade water quality and make water more difficult to treat. As a result, SFD deliveries can be interrupted when the reservoir falls below 300,000 acre-feet. It is hypothesized that improving the San Luis Reservoir low-point intake would increase the predictability of water deliveries and make more water available to south-of-Delta water users during dry years. Alternatives to improving the low-point intake could include expanding the Pacheco Reservoir to provide storage for SFD water users. As a result of taking one or a combination of these actions, progress would be made toward improving water supply reliability for south-of-Delta water users by (1) reducing potential for interruptions, (2) diverting more water during wet years, and (3) making this water available during dry years when water from the Delta may not be available.
Plan	4	Select action(s) (research, pilot, or full-scale) and develop performance measures	**Selected Action:** Conduct feasibility analyses and modeling to determine which option would enable the highest increase in the reliability of water conveyance for south-of-Delta users in compliance with environmental requirements. **Performance Measures:** ▪ Administrative – Complete feasibility analyses and modeling. ▪ Output – Select and implement an improvement project (e.g., improve the low-point intake at San Luis Reservoir only). ▪ Outcome – Progress toward improving water supply reliability by (1) reducing potential for interruptions, (2) diverting more water during wet years, and (3) making this water available during dry years when water from the Delta may not be available.
Do	5	Design and implement action(s)	Design and implement the feasibility analyses and modeling.
Do	6	Design and implement monitoring plan	Design and implement the monitoring plan, including baseline monitoring, and measurement of (1) reduced interruptions of SFD deliveries when the reservoir falls below 300,000 acre-feet, (2) the amount of increased delivery of water during wet years, and (3) the amount of increased water deliveries from the reservoir during dry years to offset reduced Delta diversions.
Evaluate and Respond	7	Analyze, synthesize, and evaluate	Analyze, synthesize, and evaluate the feasibility analyses and model outputs, and make recommendations for selecting a project or adjusting the conceptual model.
Evaluate and Respond	8	Communicate current understanding	Provide project manager(s) and decision makers with synthesized information learned. For example, present information on the extent to which interruptions would be reduced, the value of the reduced interruptions, and the benefits of a specific operation scheme as part of a cost-benefit analysis.
Evaluate and Respond	9	Adapt	The DWR, Reclamation, and SFD contractors decide on a pilot- or full-scale improvement project.

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In the past decade, the State has spent tens of millions of dollars on integrated studies to evaluate how large surface storage and conveyance may be improved. DWR is now completing surface storage investigations that were initiated under CALFED more than 10 years ago (DWR 2010a). The three proposed new major surface storage reservoirs that are being evaluated are the North-of-the-Delta Offstream Storage (Sites Reservoir), Los Vaqueros Reservoir Expansion, and Upper San Joaquin River Basin Storage investigation (Temperance Flat Reservoir). DWR expects to make its decision on recommended projects by 2014.

In the meantime, smaller facility improvements, particularly for storage, are being implemented. Since 1995, more than 1.2 MAF of additional surface storage has been constructed at the regional level, including the Diamond Valley, Seven Oaks, and Olivenhain reservoirs in Southern California, and the Los Vaqueros Reservoir in Contra Costa County.[11] The sidebar, Applying Adaptive Management to Water Management Decisions, provides a hypothetical example of an approach to providing more reliable water supplies.

A legacy of both overdraft and water quality contamination has compromised groundwater storage in many regions of the state; however, important improvements are being made through expanded regional groundwater storage north and south of the Delta. Notably, an assessment of groundwater storage in 2000 identified more than 21 MAF of potential groundwater storage in Southern California and the southern portion of the San Joaquin groundwater basin (AGWA 2000). A more detailed discussion of groundwater management in California is included later in this chapter.

Significant opportunities are available to improve the operation of existing storage and conveyance facilities, build small-scale storage projects, or enhance opportunities for groundwater conjunctive management and water transfers in the next 5 to 10 years that are consistent with the coequal goals. DWR is leading a System Reoperation Task Force with Reclamation; USACE; and other State, federal, and local agencies to study and assess opportunities for reoperating existing reservoir and conveyance facilities to improve flood protection and capture of available water runoff, particularly in the context of climate change. Reservoir reoperation is also addressed in Chapter 7.

Many local storage and conjunctive management projects were identified through competitive State and federal grant funding application processes in the past decade. Most of these projects could not be funded because of limited funding and restrictions in some of the grant provisions. Later in this chapter, the New Water for California section provides further detail on the range of options and describes necessary steps that regions should take to improve regional self-reliance and reduce reliance on the Delta.

The Role of Conveyance in Increased Flexibility

Conveyance improvements can enhance the operational flexibility of the Delta system to divert and move water at times and from locations that are less harmful to fisheries, or to reliably transport environmental water supplies to specific locations at times when it can benefit fish and water quality (California Natural Resources Agency 2010). Existing configurations of Delta water conveyance and associated conveyance facilities do not provide adequate long-term reliability to meet current and projected water demands for SWP and CVP water exports from the Delta watershed (DWR 2009).

[11] Contra Costa Water District will complete a 160,000-acre-foot expansion of Los Vaqueros Reservoir in 2012. The feasibility of an additional 275,000-acre-foot expansion is still under consideration by State and federal agencies.

Conveyance improvements and associated ecosystem restoration actions are being evaluated as part of the multiagency BDCP effort. (See sidebar, Bay Delta Conservation Plan and Water Supply Reliability.) Once decisions are made regarding whether to build and, if so, in what manner to build conveyance improvements, construction of these facilities will likely take at least a decade or more and will not provide near-term reliability improvements. This means that Delta operations and deliveries of export supplies will continue to be constrained by existing infrastructure for at least the next 15 years.

During this time, steps must be taken to implement local water management programs and projects, described later in this chapter. Additionally, the State needs to address the continuing vulnerability of the Delta levee system and make improvements to protect the existing in-Delta conveyance system from catastrophic failure. (See Chapter 7 for a discussion of the benefits and vulnerabilities of Delta levees.) In particular, immediate improvements to the Delta levee system are critical because of the current instability and interdependence of the levees—the failure of one can affect the entire system (NRC 2012).

BAY DELTA CONSERVATION PLAN AND WATER SUPPLY RELIABILITY

The BDCP is a Habitat Conservation Plan (HCP) and Natural Community Conservation Plan (NCCP) that "proposes major physical changes to the Delta, including new diversion and conveyance facilities and their operational criteria, extensive new aquatic habitat, and other measures to help reverse the Delta's ecological decline and secure water supplies from the Delta for human use" (BDCP 2012c).

The BDCP is planned to be implemented over a 50-year timeframe using an adaptive management and monitoring program to adapt as conditions change and new information emerges. The parties seeking one of several permits pursuant to the BDCP include DWR, Reclamation, Metropolitan Water District of Southern California, Kern County Water Agency, Santa Clara Valley Water District, Zone 7 Water Agency, Westlands Water District, and the State and Federal Water Contractors Agency (BDCP 2012a). The goal of these parties, with the exception of Reclamation, is to formulate a plan that could ultimately be approved by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service as an HCP under the provisions of Endangered Species Act section 10(a)(1)(B) and as an NCCP by DFW under Fish and Game Code section 2800 et seq. and/or the California Endangered Species Act section 2050 et seq. Reclamation intends to use information developed as part of the BDCP process to help inform its Endangered Species Act Section 7 consultation on the coordinated long-term operation of the CVP and SWP with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. If the BDCP is successfully completed, and DFW determines that the BDCP meets the requirements in Water Code section 85320, it must be incorporated into the Delta Plan. That determination by DFW may be appealed to the Council (Water Code section 85320 (e)).

The BDCP is being developed to contribute to improving water supply reliability by modifying Delta conveyance facilities to create a more natural flow pattern in the Delta and allow for water exports when hydrologic conditions result in the availability of sufficient water, consistent with the requirements of State and federal law and the terms and conditions of SWP and CVP water delivery contracts, and other existing applicable agreements.

The BDCP process is considering a range of options for conveying water through or around the Delta:

- **Through-Delta Conveyance:** Continue to divert water in the southern Delta at existing or modified intakes/diversions for SWP and CVP operations.
- **Isolated Conveyance:** Divert water from the Sacramento River at new intakes/diversions and convey the water to the existing SWP and CVP pumping plants through a pipeline/tunnel.
- **Dual Conveyance:** Combine through-Delta conveyance and isolated conveyance to allow operational flexibility.

The BDCP process is ongoing. As of this publication, the public draft of the BDCP and the related environmental impact report/environmental impact statement are planned for release by late 2012, with final documents expected to be released in mid-2013 (BDCP 2012b). The Council is a Responsible Agency for California Environmental Quality Act purposes.

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New Water for California

The fact that water is a scarce resource does not mean that California is "running out of water" (NRC 2012). It does mean that California will need to develop plans, and implement programs and projects that can adapt to a highly variable and uncertain water future. The primary source of new water supplies for California in the future will come from local and regional sources.

This section discusses local water supply opportunities, the importance of local and regional water management planning, and the need for improved groundwater management and water data so that the state can better match its water demands to the available supplies.

California's Wealth of Water Opportunities

California has many new and underused water resources that can be developed to improve regional self-reliance. In 2009, DWR estimated that the state could further reduce water demand and increase water supplies in the range of 5 to 10 MAF by 2030 through the use of existing strategies and technologies (see Figure 3-7).[12] If the state developed only half this water (about 5 MAF) through water efficiency and new local supplies, it would be sufficient to support the addition of almost 30 million residents, more than the population growth that is expected to occur by 2050.[13]

Nearly all these potential supplies will come from a combination of improved conservation and water use efficiency in the urban and agricultural sectors, local groundwater and surface storage, conjunctive management, recycled water, drinking water treatment, groundwater remediation, and desalination. DWR has identified 27 "resource management strategies" that water suppliers should consider when expanding their water management programs throughout the diverse regions of the state (DWR 2009). Resource managers can combine these strategies into a response package, crafting them to provide multiple water resource benefits, diversify their water portfolio, and become more regionally self-reliant.

Often, the new local and regional water supplies have the additional advantage of being available even during extreme drought conditions, making them some of the most reliable sources of water for urban and agricultural uses. In particular, recycled water and the treatment and reuse of poor-quality groundwater are two of the most resilient water supplies under conditions of drought and climate change. The treatment of poor-quality groundwater also can significantly improve drinking water supplies, especially for rural and economically disadvantaged communities that have limited alternatives to secure clean water. In 2012, the California Legislature enacted Assembly Bill (AB) 685, declaring the established State policy that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes" (Water Code section 106.3 (a)). For more about drinking water quality, see Chapter 6.

For some local water resources, California has adopted specific targets, including:

- **Urban water conservation.** The State's goal is to achieve a reduction in statewide per capita urban water use of 20 percent, from a 2005 baseline of an estimated

[12] The range of 5 to 10 MAF is a conservative estimate and is consistent with recent studies that assess California's potential for increased water savings and water supplies. DWR provides a cautionary note that the water supply benefits summarized in the California Water Plan are not intended to be additive, recognizing the same resource management strategies may complement or compete with one another for funding, system capacity, or other elements that are necessary for implementation. In addition, unlike the 2005 version, DWR did not include in the 2009 California Water Plan an estimate for water supply benefits from improved conveyance. Instead, DWR states that the main benefits of conveyance improvements are increased water supply reliability, water quality protection, and operational flexibility (DWR 2009).

[13] Under California law, water conservation is considered a source of supply (Water Code section 1011(a)). A 2008 report from the Los Angeles Economic Development Corporation found that "using water more efficiently reduces demand, which has the same effect as adding water to the system." For Southern California, the report concludes that "urban water conservation could have an impact equivalent to adding more than 1 MAF of water to the regional supply (about 25 percent of current annual use)" (LAEDC 2008).

198 gallons per capita daily (GPCD) to 166 GPCD (DWR 2012b). This represents a potential annual water savings of approximately 1.8 MAF per year that will be accomplished by 2020. This is consistent with DWR's 2009 estimate that 2.1 MAF can be conserved in roughly the same period through increased use of water-efficient appliances, reduced water use for landscaping, and tiered rate structures, such as increasing block rates or budget-based rate structures.

- **Recycled water.** The State's goal is to increase the use of recycled water over 2002 levels by at least 1 MAF per year by 2020, and by at least 2 MAF per year by 2030 (DWR et al. 2010). DWR's 2009 estimate indicates that as much as 2.25 MAF could be recovered, about half of the amount of wastewater that is treated and released to flow to the ocean.
- **Stormwater runoff.** The State's goal is to increase capture and reuse of stormwater by at least 500,000 acre-feet per year by 2020, and at least 1 MAF per year by 2030 (DWR et al. 2010). The 2008 Scoping Plan for California's Global Warming Solutions Act of 2006 (AB 32) finds that up to 333,000 acre-feet of stormwater could be captured on an annual average for reuse in Southern California alone (CARB 2008).

California's Wealth of New Water Supplies

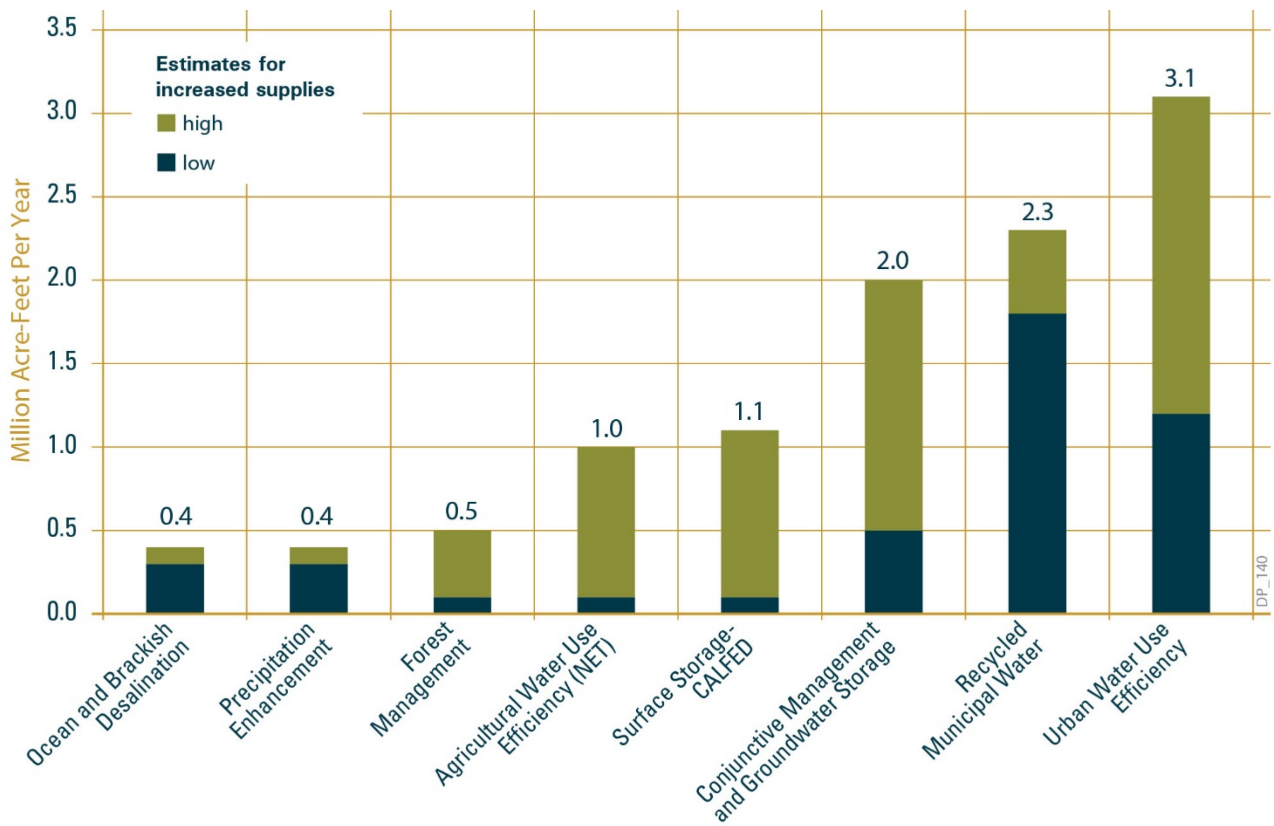

Figure 3-7 DWR estimates that California could further reduce its water demands and increase water supplies by 5 to 10 MAF per year over the next 30 years through the use of existing technologies.

Source: DWR 2009

The Importance of Local Water Management Planning

Over the past few decades, the State has built on successful local water management planning and, when possible, has provided funding for local districts to develop and implement water management plans. These plans are of benefit to all regions, not just those who rely on the Delta or Delta watershed.

These programs and projects increase the reliability of water supplies by increasing water efficiency and diversify the portfolio of water sources for urban and agricultural water suppliers that are more resilient under conditions of drought, emergency shortage, and climate change. Water developed through these activities can help reduce conflicts among urban, agricultural, and environmental uses, and can contribute to the ability of regions in California to reduce their reliance on water from the Delta watershed.[14]

The responsibility for implementing most of these water management strategies and achieving State objectives lies with over 600 local water agencies, including several privately owned and operated companies, plus wastewater districts, community service districts, and other special districts. The sheer number of local agencies engaged in water management makes it difficult to monitor and account for the significant new amounts of water supplies and increased water efficiency that is being implemented. Later in this chapter, the Informed Decision Making Requires Information section details this challenge and associated water management implications.

Since the mid-1980s, California has enacted progressively more stringent water conservation, efficiency, and water planning requirements for urban and agricultural water suppliers (see Appendix H). Beginning in 1983, wholesale and retail municipal water suppliers (those with at least 3,000 connections or delivering at least 3,000 acre-feet per year) have been required by the Urban Water Management Planning Act to prepare 20-year urban water management plans to guide investments in future water reliability. This law has been strengthened through several revisions to include specific water conservation goals (such as the 20 percent reduction in urban per capita water usage by 2020 adopted in 2009), compliance with demand management measures including adoption of rate structures that promote water conservation (AB 1420 in 2007), landscape conservation requirements (AB 1881 in 2006), and required installation of water meters (AB 2572 in 2004).

Existing law requires that urban water suppliers include a water supply reliability element and water shortage provisions in their urban water management plans, recognizing that suppliers need to prepare for extended droughts, the effects of climate change, and potential catastrophic interruption of deliveries caused by earthquakes or other events. Water suppliers must evaluate whether their water sources may be available at a consistent level of use and describe their plans for supplementing or replacing these sources, to the extent practicable with alternatives or water demand management measures (Water Code section 10631(c)(2)). Water suppliers must also describe the tools and options that will be used to maximize resources and minimize the need to

[14] As used in the Delta Plan, "regions" refer to the 10 hydrologic areas identified by DWR that correspond to the state's major water drainage basins, and included the two regional overlays for the Mountain Counties area and the Delta. The use of these regions as planning boundaries allows consistent tracking of their natural water runoff and accounting of surface and groundwater supplies.

import water from other regions (Water Code section 10620(f)).

Agricultural water suppliers (those that provide water to 25,000 or more irrigated acres, or 10,000 irrigated acres and who receive State funding to implement the plan provisions) have a requirement similar to urban suppliers and must prepare agricultural water management plans. The Agricultural Water Management Planning Act was adopted in 2009 (Senate Bill X7 7 [SBX7 7]). Requirements include reporting on farm gate water deliveries, adoption of rate structures that promote water conservation, and identification and implementation of locally cost-effective and technically feasible water efficiency measures.

Since 2000, the State has also promoted voluntary integrated regional water management plans (IRWMPs), recognizing that collaboration among multiple agencies, especially within watersheds, provides opportunities for better water management decisions and coordinated infrastructure investments. Significant bond funding has been made available to support implementation of projects identified through these IRWMPs. A 2006 report on the investments made for IRWMP projects identified over 1.2 MAF of water benefits in combined water supply and demand reductions that have been achieved through the expenditure of $1 billion in State bond funds in local and regional projects (DWR 2009). An additional $1 billion or more of local dollars were leveraged because of this State investment. Applicants for IRWMP funding must now demonstrate how their plans help reduce their region's dependence on water imported from outside their region (DWR 2010c).

As climate change begins to affect California's water supplies, the U.S. Environmental Protection Agency (Region 9) and DWR are encouraging water managers to plan for these impacts and to take steps to adapt to them. IRWMPs, and the agricultural and urban water management plans provide an excellent framework for addressing water-related climate change impacts (USEPA and DWR 2011). Because each region is unique, there is no single "correct" planning approach. Key concepts include risk assessment, such as the potential for interruption of water supplies for up to 36 months due to catastrophic events impacting the Delta, including earthquakes or floods. For example, DWR identified the potential for some portion of Delta deliveries to be interrupted for up to 36 months if a catastrophic earthquake occurred (DWR 2010b). Although this would have a primary impact on water suppliers that rely on water from the Delta, it might also affect upstream water suppliers that may be called upon to release more water into the Delta during the crisis.

Another useful tool is the regional water balance. According to DWR, the purpose of a regional water balance is to provide an accounting of all water that enters and leaves a specific hydrologic region, how it is used, and how it is exchanged between regions. A regional water balance can be used to compare how water supplies and uses in a region can vary between wet and critically dry hydrologic conditions, and how each region's water balance compares with other regions and with the state's overall water balance. This is important to all water planning activities and provides a basis for evaluating unsustainable water management practices and making appropriate improvements (DWR 2009).

Implementing a Path to Success in Local Water Management

Many agricultural and urban water suppliers are taking commendable action to improve water conservation and efficiency, and to expand their local and regional water supplies. (See sidebar, Regional Success Stories.) However, others are not.

For example, despite longstanding State laws that require preparation and implementation of urban water management plans, many water suppliers still regard these plans as voluntary because the only consequence of not completing them has been ineligibility to receive State grant and loan funding

REGIONAL SUCCESS STORIES

Significant improvements in water management are being implemented throughout California, especially in regions that rely upon water from the Delta and the Delta watershed. The 2010 urban water management plan updates and voluntary IRWMP grant applications filed in 2010 provide insight into what individual water agencies and regional planning efforts are doing to improve water efficiency and develop additional local water supplies. Examples of successful strategies to reduce reliance on the Delta and improve regional self-reliance follow.

In Southern California:

- **West Basin Municipal Water District.** Increased water efficiency and diversification of the district's water supplies between 2010 and 2035 will enable West Basin Municipal Water District to reduce its potable water demand despite expected future population growth. The total volume of imported water usage is projected to decline by 40,000 acre-feet over this period, and conservation, recycled water, and ocean desalination will expand the district's water resources by over 60,000 acre-feet (RMC Water and Environment 2011).
- **City of Los Angeles.** Today the City of Los Angeles uses less water than it did 30 years ago, despite population growth of more than 1 million residents. In 2011, per capita water usage was 123 gallons daily—the lowest in Los Angeles in more than 40 years and the lowest among any United States city with a population over 1 million (LADWP 2012). Through regional watershed planning efforts, the city is bringing together local and county public works departments, planning agencies, local and regional water supplies, and citizen groups to develop integrated multibenefit projects. In 2004, the city overwhelmingly approved Proposition O, which authorized $500 million in local bonds to fund water efficiency, stormwater capture, water treatment, recycled water, flood protection, open space, recreation, and other projects.

In the central San Joaquin Valley and Tulare Lake regions:

- **Poso Creek Regional Water Management Group.** The IRWMP focuses on more effective coordination of each participating irrigation district's water assets, recognizing that competition for the three sources of water that meet the region's demands (local supplies/Kern River, CVP, and SWP) is increasing. Proposed improvements include 400 acres of spreading ponds and additional conveyance (canals, pipelines, and pumping plants) between the Friant-Kern Canal and California Aqueduct and among irrigation districts, which will enable the region to take advantage of wet-year (unscheduled) water diversions from the Delta and reduce diversions in dry years (Semitropic Water Storage District 2011).

In the Delta:

- **East Contra Costa County.** Located entirely within the statutory Delta, all the water suppliers that participate in this IRWMP rely upon the Delta for more than 80 percent of average-year water demands, with three water suppliers receiving 100 percent. The IRWMP priorities for reducing reliance on the Delta include expanded use of recycled water, installation of water meters, increased water conservation, and new wellhead treatment for groundwater supplies (Contra Costa Water District 2011).

In the Bay Area:

- **City and County of San Francisco.** Increased water efficiency has resulted in general decline in total consumption and per capita water use since the mid-1970s to record low levels in the state despite growth in the county's population. Recognition of the vulnerability of the city's Hetch Hetchy Reservoir and aqueduct system to earthquakes and other emergencies, San Francisco is working to diversify its local water supplies, including increased conservation, new local groundwater wells, expansion of recycled water, use of gray water, rainwater harvesting, and participation in the Bay Area Regional Desalination Project with Contra Costa Water District, East Bay Municipal Utility District, Santa Clara Valley Water District, and Zone 7 Water Agency (San Francisco Public Utilities Commission 2011).

In the Delta upper watershed:

- **American River Basin.** The IRWMP features reduced reliance on water in the Delta's American River tributaries through expanded conjunctive use operations, development of recycled water, and increased water conservation. More water will be diverted during wetter periods and made available as groundwater in drier periods, which will help increase regional water supply reliability while improving flow and temperature conditions that benefit salmon and steelhead fisheries in the lower American River (Regional Water Authority 2011).

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to implement water projects. In the 2005 round of urban water management plan submittals, this incentive increased the number of plans submitted over previous years; however, only 75 percent of agencies that should submit plans actually did as of December 31, 2006, and more than 50 percent of these failed to include required conservation or drought contingency plans (DWR 2006). In the 2010 round of urban water management plan submittals, 66 percent of the agencies required to submit plans actually did by the August 2011 deadline. One year later, this percentage had increased to 85 percent, but no assessment for completeness has been performed (DWR 2012b).

Widespread compliance with existing water management laws alone would achieve great progress in improving water supply reliability for California. Compliance with all State water efficiency and management statutes and policies, at a minimum, should be the starting point for assessing a water supplier's reasonable use of California's water. In particular, water suppliers that do not engage in efficient use of water, particularly where the implementation of proven measures and technologies are economically justifiable, locally cost effective, and do not harm other water users, should be held accountable for wasting water. The SWRCB should be encouraged to use its authority to prevent waste and unreasonable use by seeking enforcement of these requirements. The potential for this type of action was anticipated in the Water Conservation Act of 2009 (SBX7 7), which explicitly recognized that the failure of urban water suppliers to reduce urban per capita water demand consistent with the State's 20 percent by 2020 conservation targets can be used after January 2021 to establish a violation of the law for the purposes of State administrative or judicial proceedings (Water Code section 10608.8(a)(2)).

Importantly, for those who prepare them, urban water management plans and integrated regional water management plans appear to be working. As a result of these efforts and increased irrigation efficiency, the amount of water needed to meet future urban and agricultural demands has changed. Since 1980, the total volume of water used in the urban and agricultural sectors has declined. Urban areas that have implemented the strongest water conservation programs show the greatest improvements in water efficiency and the largest reductions in water use (see Figure 3-8).

Groundwater Overdraft Is an Impediment to the Coequal Goals

Groundwater is a major source of water supply for nearly every region in California and a vital component of the state's water storage system, particularly during droughts (DWR 2009). More than 40 percent of Californians rely on groundwater for part of their water supply, and many small- to moderate-sized towns and cities are entirely dependent on groundwater for their drinking water systems (DWR 2003a). The state's most significant groundwater use occurs in regions that also rely on water from the Delta watershed, including the San Joaquin Valley, Tulare Lake, Sacramento Valley, Central Coast, and South Coast (see Figures 3-9 and 3-10). The Tulare Lake region alone accounts for more than one-third of the state's total groundwater pumping (DWR 2009). Because of historical groundwater overdraft and resulting land subsidence experienced in these regions, water users switched to using surface water from the CVP and SWP when the water projects were completed in the late 1960s. However, groundwater pumping and overdraft continued to become more severe as water demands continued to exceed available supplies. Recent satellite imaging revealed that the Central Valley lost approximately 25 MAF of stored groundwater during the period of October 2003 to March 2010 (Famiglietti et al. 2011).

As a result of use continually exceeding recharge, many of California's groundwater basins are in overdraft, and groundwater levels are declining over the long term (Faunt 2009). In some areas, overdraft can lead to a permanent loss of groundwater storage. According to DWR, a groundwater basin is in a state of "critical overdraft" when continuation of present water management practices would result in significant adverse overdraft-related environmental, social, or economic impacts. DWR estimates statewide average overdraft of about 1 to 2 MAF per year (DWR 2009). Groundwater use is also increasing, and is expected to grow at a faster rate in future decades as climate change reduces the reliability of surface water deliveries and increases the potential for extended droughts (DWR 2009). Without more efficient management, the state's groundwater resources will be significantly impacted, and in severe overdraft conditions, the aquifer's capacity to store groundwater may be irretrievably lost (DWR 2003a). Improved management is also needed to take advantage of opportunities to store water underground, particularly to aid flexibility when done in coordination with improved operations in the Delta.

California has established laws, regulations, and programs to protect the quality of its groundwater resources. Despite the major importance of this water supply to California, however, the quantity of groundwater used by agencies or individuals is largely unregulated at the State level. Except for Texas, California is the only state where use of its groundwater resources is managed at the local rather than State level. The lack of State oversight means that limited and often incomplete information is available to the public about how California's groundwater basins are being managed. So little is known, that in 2003, DWR was unable to revise the designation of critically overdrafted basins in its update on California's groundwater (DWR 2003a). Lacking current information and having limited resources to complete additional investigations, DWR simply republished the list of 11 basins identified in 1980.

Trends in California's Water Use

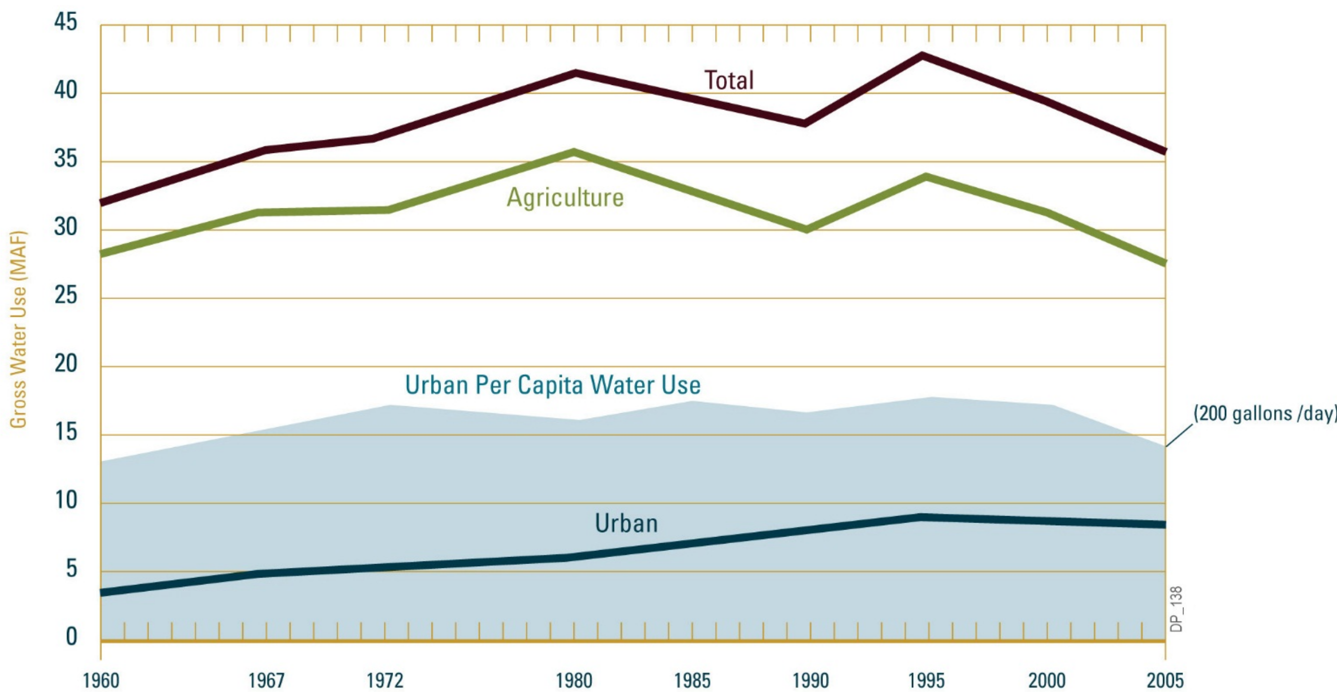

Figure 3-8 California's water use is declining, primarily due to increased water efficiency in both agricultural and urban areas. The City of Los Angeles, like many other cities, reports that it is using the same amount of water as it did over 30 years ago, even though its population has grown by more than 1 million people.

Sources: Hanak et al. 2011; adapted from DWR 2009

Critically Overdrafted Groundwater Basins

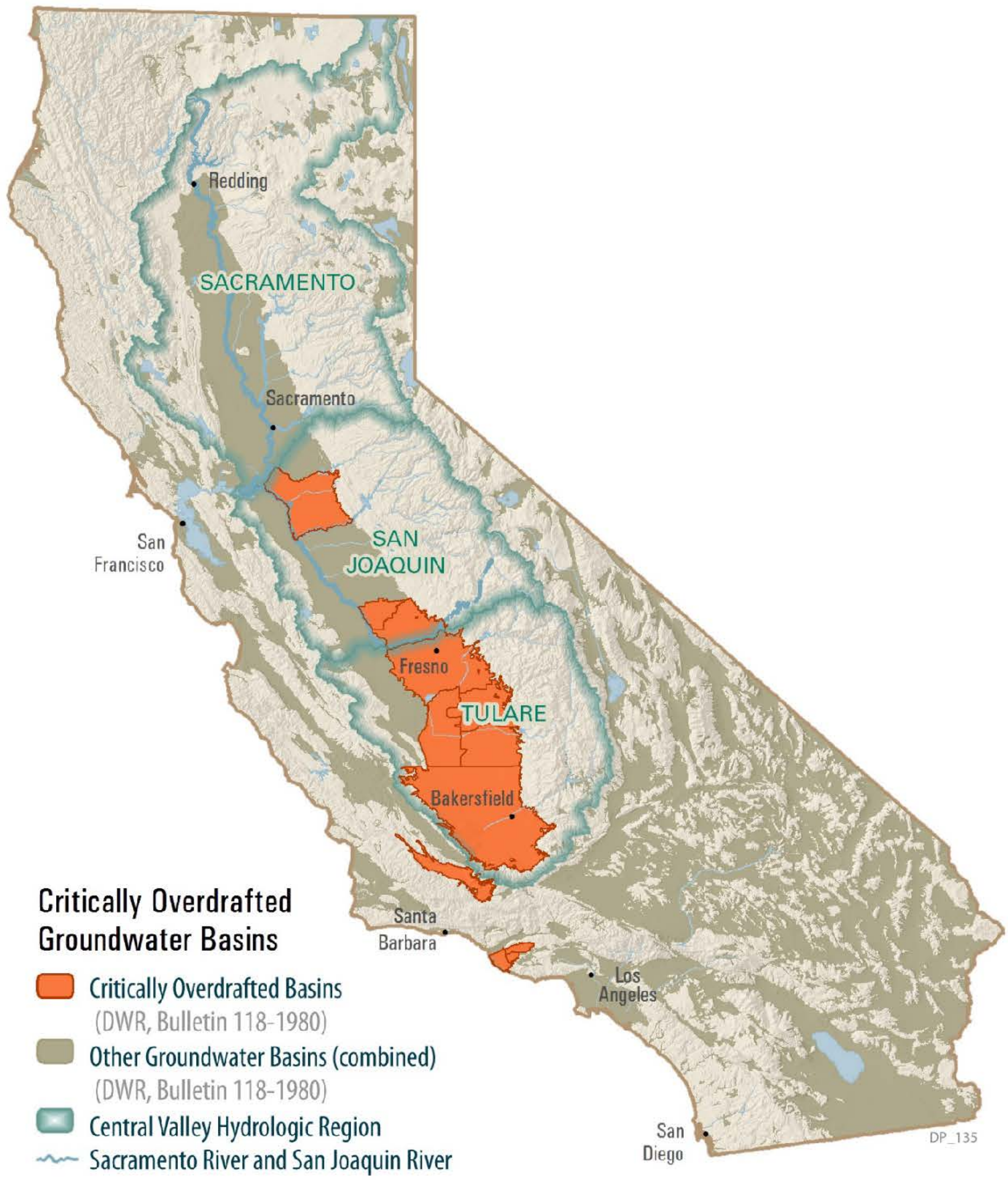

Figure 3-9

Groundwater overdraft is a critical water supply problem, especially in the Central Valley. More than 40 percent of Californians rely on groundwater for some portion of their supply, and many small- and moderate-sized communities are entirely dependent on groundwater for drinking water.

Sources: DWR 2003a; DWR 2009

San Joaquin Groundwater Pumping Is Unsustainable

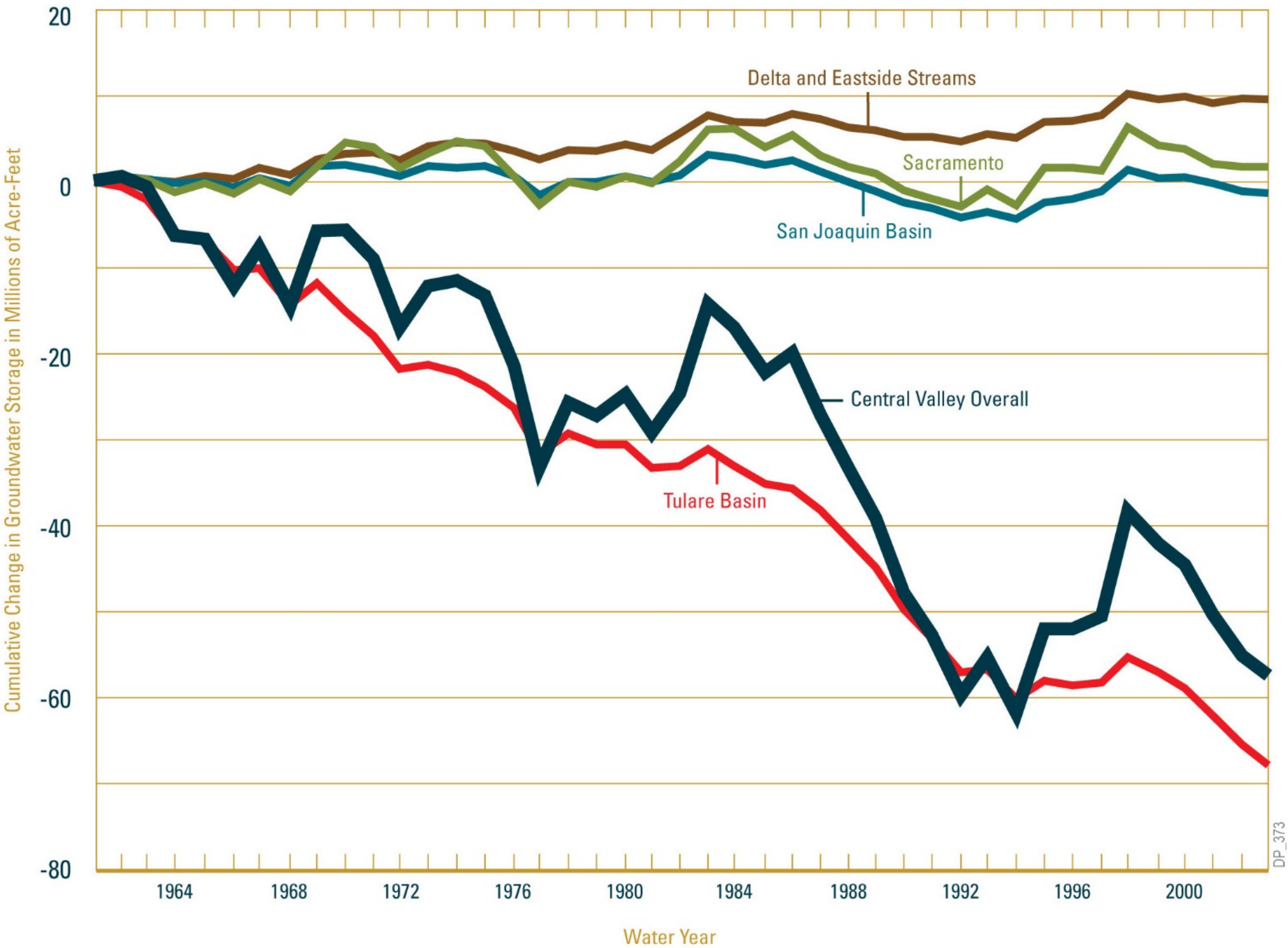

Figure 3-10

Estimated cumulative annual changes in groundwater storage in the Tulare Lake Basin due to over-pumping are more than 60 MAF since 1960. Serious land subsidence and loss of groundwater storage capacity impacts more than half of this region.

Source: Faunt 2009

Some regions appear to be making significant progress in developing sustainable groundwater management programs through regional water balances and voluntary groundwater management plans (known as AB 3030 plans), local ordinances, and court adjudications (Nelson 2011).[15] In 2009, the State created a mandatory statewide program for local reporting of groundwater elevation data, the California Statewide Groundwater Elevation Monitoring Program. This program will collect reported groundwater elevations and make the data available online.

Informed Decision Making Requires Information

One of the greatest challenges to California water management is the lack of consistent, comprehensive, and accurate estimates of actual water use by the type of use (agricultural, urban, and environmental) and by hydrologic region. The water use that is reported to the State is a combination of measured uses and estimated use that are not measured, with limited verification of actual water use. This means that California does not have a clear understanding of its water demands, the amount of water available to meet those demands, how water is being managed, and how that management can be improved to achieve the coequal goals for the Delta.

Key concerns include:

- Not all water uses are required to be monitored and measured. Many water rights were issued decades ago when water measurement was not required. Until reforms were approved by the California Legislature in 2009, water rights holders were not required to provide detailed information on water diversions and use. As a result, total diversion amounts are currently unknown and may be over-allocated in some locations or during dry periods (SWRCB 2008, SWRCB 2011, NRC 2012). Similarly, many groundwater withdrawals are not monitored or reported.
- Not all water users report data even when they are required to do so. A 2009 report prepared for the Legislature by the SWRCB on the development of a coordinated measurement database indicated that historically, about 67 percent of water permit and license holders actually report their water use information, and fewer than 35 percent of other water right claimants who are required to report actually do so (SWRCB 2009).
- SWP contractors are not required by DWR to provide data similar to that collected by Reclamation for CVP contractors. Reclamation has established best management practices for water efficiency, consistent with the federal Reclamation Reform Act and the Central Valley Project Improvement Act, and performs a "Water Needs Assessment" for each federal contractor with input from that contractor. Reclamation also requires contractors to submit an annual report that includes a full water balance (production from all sources, system losses, and changes in storage and water), and implement an effective water conservation and efficiency program based on the contractor's approved water conservation plan (Reclamation 2011b).
- SWP contract amendments in the past have not always been developed and approved in a transparent manner, and have resulted in litigation over implications for the management of the state's water supplies. In 2003, as part of a legal settlement, DWR adopted policies for how future contracts and contract amendments would be reviewed and adopted through an open and transparent process (DWR 2003b). Consistent application of this policy is important (see Appendix B).
- More detailed information on changes in groundwater levels, rates of groundwater extraction, and the location

[15] The State encourages additional voluntary development of locally controlled groundwater monitoring programs and related management plans through AB 3030 (1992), AB 303 (2000), AB 599 (2001), and SB 1938 (2002); through the IRWMP Program (through funding provided by Propositions 13, 50, and 84); and by limiting availability of State funding for water infrastructure to those agencies that have adequate groundwater management plans in place. The State also provides technical assistance to help local agencies more efficiently and sustainably manage groundwater resources, and has identified 14 required and recommended components for groundwater plans. Prior to 2002, there were no required elements for groundwater plans.

of basins with severe and chronic overdraft is needed as a baseline for the State's water resource management efforts. Basic groundwater management data (estimates of safe yield, monitoring of changes in storage in the aquifers and water quality conditions, and identification of replenishment sources and connections with surface water supplies) need to be quantified for many areas, but especially in those regions that rely upon water from the Delta watershed (DWR 2003a). The State's goal should be to sustainably maintain and maximize long-term reliability of these groundwater supplies, with a focus on preventing significant degradation of groundwater quality (DWR 2003a, ACWA 2011).

Recent legislation has resulted in significant improvements to the State's water monitoring and reporting requirements. However, time and resources will be necessary to assess the results from these improvements, which will also serve to inform future Delta Plan updates. For example, recently enacted provisions are now being implemented for:

- Groundwater monitoring (Water Code section 10920 et seq.)
- In-Delta and statewide water diversion reporting (Water Code section 5100 et seq.)
- In-Delta enforcement investigations under the authority of the Delta Watermaster (Water Code section 85230)
- Compliance with the State's goal of achieving a 20 percent reduction in statewide urban per capita water use by 2020 (Water Code section 10608 et seq.)
- Improved reporting on agricultural water use efficiency measures (Water Code section 10608 et seq. and 10800 et seq.)

In late 2010, the SWRCB also adopted regulations requiring online reporting of water use by all water rights holders, including appropriative, riparian, and pre-1914 surface water users, and groundwater users. Since 2008, DWR, SWRCB, and the California Department of Public Health have been working to develop a coordinated database to track the urban and agricultural water use data that are provided to each agency. This tool is central to the development of a statewide integrated system for streamlined data collection and analysis that will support improved water management in California.

POLICIES AND RECOMMENDATIONS

Policies and recommendations for providing a more reliable water supply for California are based on four core strategies:

- Increase water conservation and expand local and regional supplies
- Improve groundwater management
- Improve conveyance and expand storage
- Improve water management information

Increase Water Conservation and Expand Local and Regional Supplies

Approximately 84 percent of California's water supplies come from local and regional sources, including surface runoff, groundwater, recycled water, and water made available through advanced treatment. Improved management of these resources, including water conservation and efficiency, is central to the state's ability to better match its demands to the amount of supply that is available. Over the next 30 years, the *California Water Plan Update 2009* estimates that, with the use of existing technology, the state can reduce its demands and increase its water supplies in the range of 5 to 10 MAF. This is more than enough water to meet California's projected water demands beyond 2050 and to sustain its economic vitality.

The State's constitutional principle of reasonable use and the Public Trust Doctrine form the legal foundation for California's water management policies. Importantly, along with the coequal goals, the Delta Reform Act also established a new policy for California of reducing reliance on the Delta and improving regional self-reliance in meeting California's future water supply needs. The Delta Reform Act mandates many strategies that the Delta Plan must address to improve water supply reliability for California including water efficiency and conservation, wastewater reclamation and recycling, desalination and advanced water treatment technologies, improved water conveyance, surface and groundwater storage, improved water quality, and implementation of local and regional water supply projects and coordination (see Water Code sections 85004(b), 85020(d) and (f), 85201, 85023, 85303, and 85304).

An assessment of future water supply reliability is now required in urban water management and agricultural water management plans, as well as in voluntary regional water planning documents known as IRWMPs. In areas that rely upon water from the Delta watershed, water suppliers will need to identify, evaluate, and implement locally cost-effective and technologically feasible measures that reduce their reliance on the Delta and improve regional self-reliance.

Problem Statement

The lack of participation by some water suppliers throughout California to implement laws, programs, and projects that improve water efficiency, expand local and regional water supplies, and reduce reliance on the Delta and the Delta watershed contributes to higher water demands, less water supply to meet these demands, greater pressure on the Delta ecosystem for its water, and more vulnerability to the impacts of climate change and catastrophic events. Given the Delta Reform Act mandates to improve water supply reliability for California, reduce reliance on the Delta, and improve regional self-reliance, at a minimum, all water suppliers should demonstrate full compliance with State water efficiency and management laws, goals, and regulations to demonstrate reasonable and beneficial use of the state's water resources. California's success in achieving the policy of reduced reliance on the Delta and improving regional self-reliance will be demonstrated through a significant reduction in the amount of water used or in the percentage of water used from the Delta watershed. See Appendix G for additional information regarding how to achieve reduced reliance on the Delta and improved regional self-reliance.

Policies

WR P1. Reduce Reliance on the Delta through Improved Regional Water Self-Reliance

(a) Water shall not be exported from, transferred through, or used in the Delta if all of the following apply:

(1) One or more water suppliers that would receive water as a result of the export, transfer, or use have failed to adequately

contribute to reduced reliance on the Delta and improved regional self-reliance consistent with all of the requirements listed in paragraph (1) of subsection (c);

(2) That failure has significantly caused the need for the export, transfer, or use; and

(3) The export, transfer, or use would have a significant adverse environmental impact in the Delta.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action to export water from, transfer water through, or use water in the Delta, but does not cover any such action unless one or more water suppliers would receive water as a result of the proposed action.

(c) (1) Water suppliers that have done all of the following are contributing to reduced reliance on the Delta and improved regional self-reliance and are therefore consistent with this policy:

(A) Completed a current Urban or Agricultural Water Management Plan (Plan) which has been reviewed by the California Department of Water Resources for compliance with the applicable requirements of Water Code Division 6, Parts 2.55, 2.6, and 2.8;

(B) Identified, evaluated, and commenced implementation, consistent with the implementation schedule set forth in the Plan, of all programs and projects included in the Plan that are locally cost effective and technically feasible which reduce reliance on the Delta; and

(C) Included in the Plan, commencing in 2015, the expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance. The expected outcome for measurable reduction in Delta reliance and improvement in regional self-reliance shall be reported in the Plan as the reduction in the amount of water used, or in the percentage of water used, from the Delta watershed. For the purposes of reporting, water efficiency is considered a new source of water supply, consistent with Water Code section 1011(a).

(2) Programs and projects that reduce reliance could include, but are not limited to, improvements in water use efficiency, water recycling, stormwater capture and use, advanced water technologies, conjunctive use projects, local and regional water supply and storage projects, and improved regional coordination of local and regional water supply efforts.

23 CCR Section 5003
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 10608, 10610.2, 10610.4, 10801, 10802, 85001(c), 85004(b), 85020(a), 85020(d), 85020(h), 85021, 85022(d)(1), 85022(d)(5), 85023, 85054, 85300, 85302(d), 85303, and 85304, Water Code.

Recommendations

WR R1. Implement Water Efficiency and Water Management Planning Laws

All water suppliers should fully implement applicable water efficiency and water management laws, including urban water management plans (Water Code section 10610 et seq.); the 20 percent reduction in statewide urban per capita water usage by 2020 (Water Code section 10608 et seq.); agricultural water management plans (Water Code section 10608 et seq. and 10800 et seq.); and other applicable water laws, regulations, or rules.

WR R2. Require SWP Contractors to Implement Water Efficiency and Water Management Laws

The California Department of Water Resources should include a provision in all State Water Project contracts, contract amendments, contract renewals, and water transfer agreements that requires the implementation of all State water efficiency and water management laws, goals, and regulations, including compliance with Water Code section 85021.

WR R3. Compliance with Reasonable and Beneficial Use

The State Water Resources Control Board should evaluate all applications and petitions for a new water right or a new or changed point of diversion, place of use, or purpose of use that would result in new or increased long-term average use of water from the Delta watershed for consistency with the constitutional principle of reasonable and beneficial use. The State Water Resources Control Board should conduct its evaluation consistent with Water Code sections 85021, 85023, 85031, and other provisions of California law. An applicant or petitioner should submit to the State Water Resources Control Board sufficient information to support findings of consistency, including, as applicable, its urban water management plan, agricultural water management plan, and environmental documents prepared pursuant to the California Environmental Quality Act.

WR R4. Expanded Water Supply Reliability Element

Water suppliers that receive water from the Delta watershed should include an expanded water supply reliability element, starting in 2015, as part of the update of an urban water management plan, agricultural water management plan, integrated water management plan, or other plan that provides equivalent information about the supplier's planned investments in water conservation and water supply development. The expanded water supply reliability element should detail how water suppliers are reducing reliance on the Delta and improving regional self-reliance consistent with Water Code section 85201 through investments in local and regional programs and projects, and should document the expected outcome for a measurable reduction in reliance on the Delta and improvement in regional self-reliance. At a minimum, these plans should include a plan for possible interruption of water supplies for up to 36 months due to catastrophic events impacting the Delta, evaluation of the regional water balance, a climate change vulnerability assessment, and an evaluation of the extent to which the supplier's rate structure promotes and sustains efficient water use.

WR R5. Develop Water Supply Reliability Element Guidelines

The California Department of Water Resources, in consultation with the Delta Stewardship Council, the State Water Resources Control Board, and others, should develop and approve, by December 31, 2014, guidelines for the preparation of a water supply reliability element so that water suppliers can begin implementation of WR R4 by 2015.

WR R6. Update Water Efficiency Goals

The California Department of Water Resources and the State Water Resources Control Board should establish an advisory group with other State agencies and stakeholders to identify and implement measures to reduce impediments to achievement of statewide water conservation, recycled water, and stormwater goals by 2014. This group should evaluate and recommend updated goals for additional water efficiency and water resource development by 2018. Issues such as water distribution system leakage should be addressed. Evaluation should include an assessment of how regions are achieving their proportional share of these goals.

WR R7. Revise State Grant and Loan Priorities

The California Department of Water Resources, the State Water Resources Control Board, the California Department of Public Health, and other agencies, in consultation with the Delta Stewardship Council, should revise State grant and loan ranking criteria by December 31, 2013, to be consistent with Water Code section 85021 and to provide a priority for water suppliers that includes an expanded water supply reliability element in their adopted urban water management plans, agricultural water management plans, and/or integrated regional water management plans.

WR R8. Demonstrate State Leadership

All State agencies should take a leadership role in designing new and retrofitted State-owned and -leased facilities, including buildings and California Department of Transportation facilities, to increase water efficiency, use recycled water, and incorporate stormwater runoff capture and low-impact development strategies.

Improve Groundwater Management

Groundwater is the source, on average, of 20 percent of California's urban and agricultural water supplies. The state's most significant groundwater use occurs in regions that also rely upon water from the Delta watershed. In many of these groundwater basins, more water is pumped than is recharged, and groundwater levels are declining over the long term. The ***California Water Plan Update 2009*** estimates that the state, on average, overdrafts its groundwater basins by about 1 to 2 MAF per year and that the level of unsustainable groundwater pumping is increasing.

Problem Statement

The continued existence of major California groundwater basins in a chronic condition of overdraft combined with key regions of the state that depend on water from the Delta watershed and have poor groundwater practices, including unsustainable groundwater pumping, water quality contamination, irreversible loss of groundwater storage, and no groundwater plan for addressing these problems, is a major impediment to the achievement of the coequal goals.

Policies

No policies with regulatory effect are included in this section.

Recommendations

WR R9. Update Bulletin 118, California's Groundwater Plan

The California Department of Water Resources, in consultation with the Bureau of Reclamation, U.S. Geological Survey, the State Water Resources Control Board, and other agencies and stakeholders, should update Bulletin 118 information using field data, California Statewide Groundwater Elevation Monitoring (CASGEM), groundwater agency reports, satellite imagery, and other best available science by December 31, 2014, so that this information can be included in the next California Water Plan Update and be available for inclusion in 2015 urban water management plans and agricultural water management plans. The Bulletin 118 update should include a systematic evaluation of major groundwater basins to determine sustainable yield and overdraft status; a projection of California's groundwater resources in 20 years if current groundwater management trends remain unchanged; anticipated impacts of climate change on surface water and groundwater resources; and recommendations for State, federal, and local actions to improve groundwater management. In addition, the Bulletin 118 update should identify groundwater basins that are in a critical condition of overdraft.

WR R10. Implement Groundwater Management Plans in Areas that Receive Water from the Delta Watershed

Water suppliers that receive water from the Delta watershed and that obtain a significant percentage of their long-term average water supplies from groundwater sources should develop and implement sustainable groundwater management plans that are consistent with both the required and recommended components of local groundwater management plans identified by the California Department of Water Resources Bulletin 118 (Update 2003) by December 31, 2014.

WR R11. Recover and Manage Critically Overdrafted Groundwater Basins

Local and regional agencies in groundwater basins that have been identified by the California Department of Water Resources as being in a critical condition of overdraft should develop and implement a sustainable groundwater management plan, consistent with both the required and recommended components of local groundwater management plans identified by the California Department of Water Resources Bulletin 118 (Update 2003), by December 31, 2014. If local or regional agencies fail to develop and implement these plans, the State Water Resources Control Board should take action to determine if the continued overuse of a groundwater basin constitutes a violation of the State's Constitution Article X, Section 2, prohibition on unreasonable use of water and whether a groundwater adjudication is necessary to prevent the destruction of or irreparable injury to the quality of the groundwater, consistent with Water Code sections 2100 and 2101.

Improve Conveyance and Expand Storage

The greatest conflicts between the water needs of people and fish within the Delta occur during dry years. That is when the least amount of water is flowing into the Delta and, historically, when exports have been a much larger percentage of Delta inflows compared with wet years. The timing and pattern of Delta diversions must be shifted so that more water can be exported during wet years, when there is significantly more water available for diversion, and less is taken in dry years, when the water is needed for in-Delta water quality and ecosystem protections.

The ability to export larger amounts of water from the Delta during wet years will require improved conveyance to increase operational flexibility as well as more storage both north and south of the Delta so that this water can be captured, stored, and ultimately delivered to meet the water needs of both people and fish. With these improvements, Delta operations and, importantly, Delta export deliveries will become more predictable.

As an interim step toward increasing California's water supply reliability, the State should identify, prioritize, and implement smaller and more incremental operational, conveyance, and storage improvements (such as expanding existing facilities or constructing new ones) that can be accomplished quickly, preferably within the next 5 to 10 years.

Problem Statement

The state's interconnected network of surface and groundwater storage is insufficient in volume, conveyance capacity, and flexibility to achieve the coequal goals. The completion of the BDCP and the implementation of major new surface and groundwater storage facilities are needed but may take many years to implement, which will require more near-term actions to improve Delta operations and reduce the state's vulnerability to potential disruptions in water exports from the Delta due to floods and earthquakes or the need for additional regulatory protections for the environment.

Policies

No policies with regulatory effect are included in this section. See Appendix A, The Delta Stewardship Council's Role Regarding Conveyance.

Recommendations

WR R12. Complete Bay Delta Conservation Plan

The relevant federal, State, and local agencies should complete the Bay Delta Conservation Plan, consistent with the provisions of the Delta Reform Act, and receive required incidental take permits by December 31, 2014.

WR R13. Complete Surface Water Storage Studies

The California Department of Water Resources should complete surface water storage investigations of proposed off-stream surface storage projects by December 31, 2012, including an evaluation of potential additional benefits of integrating operations of new storage with proposed Delta conveyance improvements, and recommend the critical projects that need to be implemented to expand the state's surface storage.

WR R14. Identify Near-term Opportunities for Storage, Use, and Water Transfer Projects

The California Department of Water Resources, in coordination with the California Water Commission, Bureau of Reclamation, State Water Resources Control Board, California Department of Public Health, the Delta Stewardship Council, and other agencies and stakeholders, should conduct a survey to identify projects throughout California that could be implemented within the next 5 to 10 years to expand existing surface and groundwater storage facilities, create new storage, improve operation of existing Delta conveyance facilities, and enhance opportunities for conjunctive use programs and water transfers in furtherance of the coequal goals. The California Water Commission should hold hearings and provide recommendations to the California Department of Water Resources on priority projects and funding.

WR R15. Improve Water Transfer Procedures

The California Department of Water Resources and the State Water Resources Control Board should work with stakeholders to identify and recommend measures to reduce procedural and administrative impediments to water transfers and protect water rights and environmental resources by December 31, 2016. These recommendations should include measures to address potential issues with recurring transfers of up to 1 year in duration and improved public notification for proposed water transfers.

Improved Water Management Information

One of the greatest challenges to improved management of California's water supplies is the lack of consistent, comprehensive, and accurate estimates of actual water use in the state, both by sector of use (agricultural, urban, and environmental) and by regions within the state. The sheer number of water management agencies in California is a key logistical factor. Current data reported to various State agencies is a combination of measured uses and estimated uses, with limited verification of actual water use. This means that California does not have a clear understanding of its water demands, the amount of water available to meet those demands, how water is being managed, and how that management can be improved to achieve the coequal goals.

Problem Statement

Accurate, timely, consistent, and transparent information on the management of California water supplies and beneficial uses is an important tool used in the achievement of the coequal goals. The State needs sufficient information to assess the current reliability of its water supplies or to meaningfully measure progress toward achievement of more reliable water supplies for California.

Policies

The appendices referred to in the policy language below are included in Appendix B of the Delta Plan.

WR P2. Transparency in Water Contracting

(a) The contracting process for water from the State Water Project and/or the Central Valley Project must be done in a publicly transparent manner consistent with applicable policies of the California Department of Water Resources and the Bureau of Reclamation referenced below.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers the following:

(1) With regard to water from the State Water Project, a proposed action to enter into or amend a water supply

or water transfer contract subject to California Department of Water Resources Guidelines 03-09 and/or 03-10 (each dated July 3, 2003), which are attached as Appendix 2A; and

(2) With regard to water from the Central Valley Project, a proposed action to enter into or amend a water supply or water transfer contract subject to section 226 of P.L. 97-293, as amended or section 3405(a)(2)(B) of the Central Valley Project Improvement Act, Title XXXIV of Public Law 102-575, as amended, which are attached as Appendix 2B, and Rules and Regulations promulgated by the Secretary of the Interior to implement these laws.

23 CCR Section 5004
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85021, 85300, and 85302, Water Code.

Recommendations

WR R16. Supplemental Water Use Reporting

The State Water Resources Control Board should require water rights holders submitting supplemental statements of water diversion and use or progress reports under their permits or licenses to report on the development and implementation of all water efficiency and water supply projects and on their net (consumptive) use.

WR R17. Integrated Statewide System for Water Use Reporting

The California Department of Water Resources, in coordination with the State Water Resources Control Board, California Department of Public Health, California Public Utilities Commission, California Energy Commission, Bureau of Reclamation, California Urban Water Conservation Council, and other stakeholders, should develop a coordinated statewide system for water use reporting. This system should incorporate recommendations for inclusion of data needed to better manage California's water resources. The system should be designed to simplify reporting; reduce the number of required reports where possible; be made available to the public online; and be integrated with the reporting requirements for the urban water management plans, agricultural water management plans, and integrated regional water management plans. Water suppliers that export water from, transfer water through, or use water in the Delta watershed should be full participants in the database.

WR R18. California Water Plan

The California Department of Water Resources, in consultation with the State Water Resources Control Board and other agencies and stakeholders, should evaluate and include in the next and all future California Water Plan updates information needed to track water supply reliability performance measures identified in the Delta Plan, including an assessment of water efficiency and new water supply development, regional water balances, improvements in regional self-reliance, reduced regional reliance on the Delta, and reliability of Delta exports, and an overall assessment of progress in achieving the coequal goals.

WR R19. Financial Needs Assessment

As part of the California Water Plan Update, the California Department of Water Resources should prepare an assessment of the state's water infrastructure. This should include the costs of rehabilitating/replacing existing infrastructure, an assessment of the costs of new infrastructure, and an assessment of needed resources for monitoring and adaptive management for these projects. The California Department of Water Resources should also consider a survey of agencies that may be planning small-scale projects (such as storage or conveyance) that improve water supply reliability.

Timeline for Implementing Policies and Recommendations

Figure 3-11 lays out a timeline for implementing the policies and recommendations described in the previous section. The timeline emphasizes near-term and intermediate-term actions.

Timeline for Implementing Policies and Recommendations

TIMELINE CHAPTER 3: Reliable Water Supply

	ACTION (REFERENCE #)	LEAD AGENCY(IES)	NEAR TERM 2012–2017	INTERMEDIATE TERM 2017–2025
POLICIES	Reduce reliance on the Delta through improved regional water self-reliance (WR P1)	Water suppliers	●	●
	Transparency in water contracting (WR P2)		●	●
RECOMMENDATIONS	Implement water efficiency and water management planning laws (WR R1)	Water suppliers	●	●
	Require State Water Project contractors to implement water efficiency and water management laws (WR R2)	DWR	●	●
	Compliance with reasonable and beneficial use (WR R3)	SWRCB	●	●
	Expanded water supply reliability element (WR R4)	Water suppliers receiving Delta water	●	
	Develop water supply reliability element guidelines (WR R5)	DWR	●	
	Update water efficiency goals (WR R6)	DWR and SWRCB	●	●
	Revise State grant and loan priorities (WR R7)	DWR, SWRCB, and DPH	●	
	Demonstrate State leadership (WR R8)	State agencies	●	●
	Update Bulletin 118, California's Groundwater Plan (WR R9)	DWR	●	●
	Implement groundwater management plans in areas that receive water from the Delta watershed (WR R10)	Water suppliers receiving Delta water and uses groundwater	●	
	Recover and manage critically overdrafted groundwater basins (WR R11)	Local and regional agencies	●	●
	Complete Bay Delta Conservation Plan (WR R12)	Federal, State, and local agencies	●	●
	Complete surface water storage studies (WR R13)	DWR	●	
	Identify near-term opportunities for storage, use, and water transfer projects (WR R14)	DWR	●	
	Improve water transfer procedures (WR R15)	DWR	●	
	Supplemental water use reporting (WR R16)	SWRCB	●	
	Integrated statewide system for water use reporting (WR R17)	DWR	●	●
	California Water Plan (WR R18)	DWR	●	
	Financial needs assessment (WR R19)	DWR	●	●

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Agency Key:

Council: Delta Stewardship Council
DPH: California Department of Public Health
DWR: California Department of Water Resources
RWQCB: Regional Water Quality Control Board(s)
SWRCB: State Water Resources Control Board
Water suppliers: refers to both urban and agricultural water suppliers

Figure 3-11

Science and Information Needs

An improved understanding of the state's hydrologic systems, patterns of water use, and effects of climate change, especially within the Delta watershed and areas that receive water from the Delta, is essential to improving the management of California's water supplies to achieve the coequal goals. Key areas of needed research include:

- Improved projections for and measurement of surface water flows (amounts, timing, quality) and how they may be impacted by environmental regulations, changing land uses, and climate change
- Improved water supply and demand forecasting models that incorporate vulnerability to extreme events (droughts, floods, earthquakes) and account for the impacts of climate change
- Improved methods for downscaling climate change models (including dynamic downscaling) and improved models for water scenario planning that incorporates these data
- Improved information on effective watershed management actions to restore and enhance capacity of rural and urban landscapes to process stormwater for water quality and water supply benefits
- Improved models for assessing the interaction between water management scenarios in the Delta and ecosystem function, including implications of revised instream flow requirements on inflows to the Delta and revised wet year/dry year export scenarios
- Improved information on changing water use patterns in response to urban and agricultural water efficiency measures, including water pricing, and implications for future water demands
- Improved characterization of groundwater basins and subbasins, and improved estimates of groundwater supplies (amounts, quality)
- Improved models of aquifer and surface-groundwater relationships, which include the effects of climate change on evaporation, runoff, groundwater recharge, subsurface interactions, and the implications of these effects for safe yield and implementation of conjunctive use and water transfer programs

Issues for Future Evaluation and Coordination

Additional areas of interest and concern related to water supply and the Delta may deserve consideration in the development of future Delta Plan updates, including:

- **Delta water delivery predictability.** A Delta Delivery Predictability Index should be developed that depicts, by hydrologic year types, the estimated streamflows entering the Delta and suggested levels of water exports that would be consistent with in-Delta and ecosystem protections. As part of the index, a system for tracking the use of stored Delta water also should be developed. The index will lead to a better understanding of how water exported and stored during wet years would be available to urban and agricultural users during dry years to offset reduced exports. This information is key to better understanding how investments in new storage and improved conveyance contribute to improved reliability of California's water supplies.
- **Performance measures for reduced reliance on the Delta.** The Delta Plan identifies two core measures for assessing progress in reducing reliance on the Delta: (1) a significant reduction in the amount of water used from the Delta watershed, or (2) a significant reduction in the percentage of water used from the Delta watershed. The Council will collaborate with DWR, SWRCB, and stakeholders to develop a standardized method or methods by which progress to reduce reliance on the Delta and improve regional self-reliance should be reported (1) in the urban and agricultural water management plans; (2) in IRWMPs; and (3) in the California Water Plan. Potential additional measures should be identified and evaluated that will benefit the amount of water, quality of water, and timing of flows in and

through the Delta, and contribute to reduced reliance on the Delta and improving regional self-reliance consistent with Water Code section 85021.

- **Evaluation of urban and agricultural water management plans.** The Council will work with DWR and the State Legislature to identify resources and secure authority, if necessary, to conduct further evaluation of water management information contained in urban and agricultural water management plans. The goal of these actions is to improve knowledge about water management in California and, specifically, to facilitate the aggregation and evaluation of water management data over time to gauge success toward reducing reliance on the Delta, increasing regional self-reliance, and achieving the coequal goals.
- **Integrated water resource management.** The value of integrated regional water management planning is widely recognized, but information on how to implement effective integrated water management projects is not well understood. The number of conjunctive management programs that combine green urban design, flood control, stormwater infiltration, water conservation, recycled water, and groundwater elements are increasing. Information about the successful integration of water management infrastructure needs to be shared and consideration given as to how to effectively promote implementation of these integrated strategies.
- **Agricultural and urban water efficiency.** Improved demand management through urban and agricultural water conservation and efficiency is the fastest and least expensive strategy for making more water available to the Delta through inflows and reducing the pressure to export more water from the Delta. Additional best management practices should be identified and promoted, including evaluation of new water conservation-based rate structures and how they contribute to water savings while maintaining more stable revenue for water suppliers.
- **Delta Watermaster.** The Delta Watermaster is in the process of completing an assessment of potential illegal water diversions within the Delta. This assessment should be expanded to evaluate illegal water diversions throughout the Delta watershed.
- **Reoperation of upstream reservoirs.** DWR is working with USACE and other agencies to develop a coordinated proposal for the reoperation of reservoirs above the Delta to address the impacts of climate change on flood protection and water supply operations. This proposal should include consideration of improved watershed management actions that will also help attenuate flood flows as well as improve ecosystem functions and water supply availability.

Performance Measures

Development of informative and meaningful performance measures is a challenging task that will continue after adoption of the Delta Plan. Performance measures need to be designed to capture important trends and to address whether specific actions are producing expected results. Efforts to develop and track performance measures in complex and large-scale systems like the Delta are commonly multiple-year endeavors. The recommended output and outcome performance measures listed below are provided as examples and subject to refinement as time and resources allow. Final administrative performance measures are listed in Appendix E and will be tracked as soon as the Delta Plan is completed.

Output Performance Measures

- Water suppliers that receive water from the Delta watershed have documented the expected outcome for a measureable reduction in reliance on the Delta and improvement in regional self-reliance. (WR R1, WR R4)
- Progress made in achieving existing water conservation and water supply performance goals, and setting expanded future goals for local, regional, and statewide

water conservation, water use efficiency, and water supply development. (WR R6)

- Information in updated Bulletin 118 is included in the next (2013) California Water Plan Update and in the 2015 urban water management plans and agricultural water management plans. (WR R9)

Outcome Performance Measures

- Progress toward increasing local and regional water supplies, measured by the amount of additional supplies made available (reported in 5-year increments from 2000). (WR P1)
- Progress toward meeting California's conservation goal of achieving a 10 percent reduction in statewide urban per capita water usage by 2015 and a 20 percent reduction by 2020. (WR R1)
- Progress toward improved reliability of Delta water exports and reductions in the vulnerability of Delta exports to disruption. (WR R12, ER P1, RR P1)
- Progress toward increasing the predictability of water deliveries from the Delta in a variety of water year types. (WR R12, WR R14)
- Progress toward achieving California's goal for the increased use of stormwater runoff of at least 500,000 acre-feet per year by 2020 and by at least 1 MAF per year by 2030. (WR R6)

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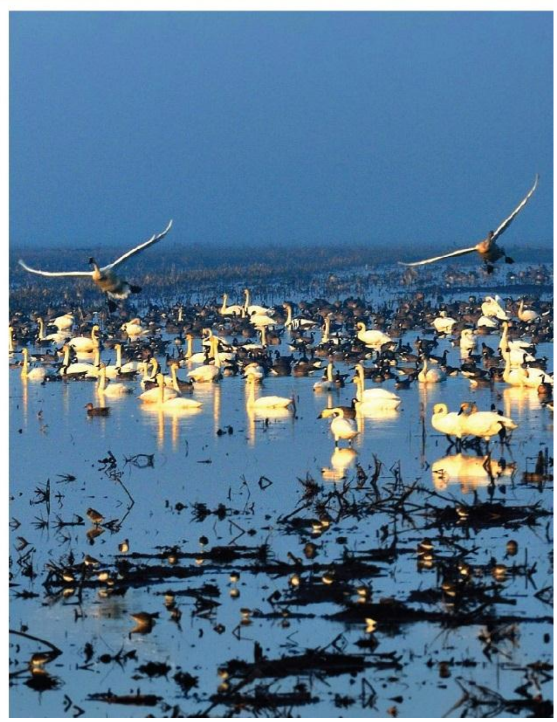
CHAPTER 4

Protect, Restore, and Enhance the Delta Ecosystem



ABOUT THIS CHAPTER

This chapter describes the Sacramento-San Joaquin Delta (Delta) ecosystem and the factors that affect and too often degrade it. It proposes policies and recommendations for restoring the Delta ecosystem organized into five core strategies to achieve the coequal goals of the Delta Reform Act:

- Create more natural functional flows
- Restore habitat
- Improve water quality to protect the ecosystem
- Prevent introduction of and manage nonnative species impacts
- Improve hatcheries and harvest management

These core strategies form the basis of the five policies and nine recommendations found at the end of the chapter.

RELEVANT LEGISLATION

The coequal goals for the Delta (Water Code section 85054) are relevant to ecosystem restoration:

> *"Coequal goals" means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.*

Eight objectives in Water Code section 85020 are inherent in the coequal goals. Section 85020(a), (c), and (e) are relevant to this chapter:

> *85020 The policy of the State of California is to achieve the following objectives that the Legislature declares are inherent in the coequal goals for management of the Delta:*
>
> > *(a) Manage the Delta's water and environmental resources and the water resources of the state over the long term.*
> >
> > *(c) Restore the Delta ecosystem, including its fisheries and wildlife, as the heart of a healthy estuary and wetland ecosystem.*
> >
> > *(e) Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.*

The coequal goals and inherent objectives seek broad protection of the Delta. Achievement of these broad goals and objectives requires implementation of specific strategies. Water Code sections 85022 and 85302 provide direction on the implementation of specific measures to promote the coequal goals and inherent objectives related to the Delta ecosystem restoration.

> *85022(d)(5) Develop new or improved aquatic and terrestrial habitat and protect existing habitats to advance the goal of restoring and enhancing the Delta ecosystem.*
>
> > *(6) Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.*

85302(c) The Delta Plan shall include measures that promote all of the following characteristics of a healthy Delta ecosystem.

> *(1) Viable populations of native resident and migratory species.*
>
> *(2) Functional corridors for migratory species.*
>
> *(3) Diverse and biologically appropriate habitats and ecosystem processes.*
>
> *(4) Reduced threats and stresses on the Delta ecosystem.*
>
> *(5) Conditions conducive to meeting or exceeding the goals in existing species recovery plans and state and federal goals with respect to doubling salmon populations.*

85302(d) The Delta Plan shall include measures to promote a more reliable water supply that address all of the following:

> *(1) Meeting the needs for reasonable and beneficial uses of water.*
>
> *(3) Improving water quality to protect human health and the environment.*

85302(e) The following subgoals and strategies for restoring a healthy ecosystem shall be included in the Delta Plan.

> *(1) Restore large areas of interconnected habitats within the Delta and its watershed by 2100.*
>
> *(2) Establish migratory corridors for fish, birds, and other animals along selected Delta river channels.*
>
> *(3) Promote self-sustaining, diverse populations of native and valued species by reducing the risk of take and harm from invasive species.*
>
> *(4) Restore Delta flows and channels to support a healthy estuary and other ecosystems.*
>
> *(5) Improve water quality to meet drinking water, agriculture, and ecosystem long-term goals.*
>
> *(6) Restore habitat necessary to avoid a net loss of migratory bird habitat and, where feasible, increase migratory bird habitat to promote viable populations of migratory birds.*

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CHAPTER 4

Protect, Restore, and Enhance the Delta Ecosystem

In the Delta Reform Act, the goal of protecting, restoring, and enhancing the Delta ecosystem is coequal to the goal of providing a more reliable water supply for California. Both must be accomplished while protecting and enhancing the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.

Some past land and water uses have put these goals in conflict. For example, reliable water supplies have been associated with artificially stabilized flows and a complex human-made system of infrastructure that includes dams, levees, and channelized rivers and sloughs. Yet healthy rivers and estuaries, and the native species that live in them depend on naturally variable water flows and a dynamic landscape. Many native species also depend on wetlands that have been drained for farming and other human uses.

Despite these conflicts, the Delta Stewardship Council (Council) must work to achieve the goal of protecting, restoring, and enhancing the Delta ecosystem. Inherent in that goal is the objective to "restore the Delta ecosystem, including its fisheries and wildlife, as the heart of a healthy estuary and wetland ecosystem" (Water Code section 85020(c)). (See sidebar, What Does It Mean to Achieve the Goal of Protecting, Restoring, and Enhancing the Delta Ecosystem?)

The Council envisions a future in which the Delta ecosystem has the following characteristics:

- Native species, including algae and other plants, invertebrates, fish, birds, and other wildlife, are self-sustaining and persistent.
- The tidal channels and bays in the Delta and Suisun Marsh connect with freshwater creeks, upland grasslands, and woodlands.
- The Sacramento and San Joaquin rivers and other Delta tributaries include reaches where streams are free to meander and connect seasonally to functional floodplains.
- Habitats for resident and rearing migratory fish, birds, and upland wildlife are connected by migratory corridors, including areas with high-quality cover and feeding opportunities.
- More natural variations in water flows and conditions make aquatic habitats, tidal marshes, and floodplains more dynamic, encourage survival of native species, and resist invasions by weeds and animal pests.
- The ecosystem is resilient enough to absorb and adapt to current and future effects of multiple stressors without significant declines in ecosystem services.
- The Delta will provide more reliable water supplies, in part because survival of its wildlife, fish, and plants do not require extraordinary regulatory protection.
- Californians recognize and celebrate the Delta's unique natural resource values through wildlife observation, angling, waterfowl hunting, and other outdoor recreation.

This future Delta will differ from the Delta that greeted the first Californians and will probably be different from the current ecosystem. Not every species or natural area now found in the Delta may persist through the changes ahead, including climate change, but Californians' use and management of the Delta will be directed and coordinated to sustain conditions that make species' survival more likely while maintaining the many other benefits provided by the Delta ecosystem.

WHAT DOES IT MEAN TO ACHIEVE THE GOAL OF PROTECTING, RESTORING, AND ENHANCING THE DELTA ECOSYSTEM?

Achieving the coequal goal of ecosystem protection, restoration, and enhancement means successfully establishing a resilient, functioning estuary and surrounding terrestrial landscape capable of supporting viable populations of native resident and migratory species with diverse and biologically appropriate habitats, functional corridors, and ecosystem processes.

For this purpose, the term "restoration" is defined in Water Code section 85066 as follows:

> *"the application of ecological principles to restore a degraded or fragmented ecosystem and return it to a condition in which its biological and structural components achieve a close approximation of its natural potential, taking into consideration the physical changes that have occurred in the past and the future impact of climate change and sea level rise."*

Restoration actions may include restoring interconnected habitats within the Delta and its watershed, restoring more natural Delta flows, or improving ecosystem water quality.

"Protection" means preventing harm to the ecosystem, which could include preventing the conversion of existing habitat, the degradation of water quality, irretrievable conversion of lands suitable for restoration, or the spread of invasive nonnative species.

"Enhancement" means improving existing desirable habitat and natural processes. Enhancement might include flooding the Yolo Bypass more often to support native species, or to expand or better connect existing habitat areas. Enhancement includes many fish and wildlife management practices, such as managing wetlands for waterfowl production or shorebird habitat, installing fish screens to reduce entrainment of fish at water diversions, or removing barriers that block migration of fish to upstream spawning habitats.

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A Restored Delta Ecosystem Is Key to a Reliable Water Supply

Delta water supplies can be more reliable only when the Delta ecosystem is restored. The water projects that rely on the Delta were developed without contemporary understanding of the Delta's ecology or anticipation of the value that Californians now place on a healthy environment. As the effects of the projects on the Delta ecosystem became apparent, a series of adjustments in their operation has been put in place. Each adjustment affected the water diversions, altering volume and timing to reduce damage, but without fully mitigating harm to the Delta ecosystem. The perilous condition of salmon, delta smelt, and other species remains a key limit on project operations. Only as these populations recover will water project operations become more flexible and reliable.

To restore the Delta ecosystem, Californians will need to use water management facilities in new ways. Reservoirs will need to hold and release water for ecosystem purposes as well as for water users. Storage and the development of alternative supplies will be needed to help reduce reliance on the Delta and improve regional self-reliance. Multipurpose bypasses and levees will need to provide habitat while also controlling flooding. Channels and water controls will need to be able to deliver water for habitats as well as for farms and cities. Modern water diversions will need to protect fish while providing reliable water supplies. For these reasons, restoring the Delta ecosystem will require new investment in water facilities and alternative supplies, not just regulation of water project operations or restoration of habitats for fish and wildlife. Other actions undertaken to protect the ecosystem can also benefit water users; for example, vigilance in preventing invasive species introduction can avoid future costs to manage mussel infestations in pipelines or other water structures. Tradeoffs may be necessary as we better match demands to the supply available, consistent with ecosystem protection, and match our expectations about the ecosystem to the changing climate.

A restored Delta ecosystem is also important to the Delta's future as an attractive place to live, work, and recreate. Water flows are important not just to water exporters, fish, and aquatic environments, but also to the Delta's municipal, industrial, and agricultural waters users, who will need consideration as system changes are planned and implemented. Restoration actions will require careful design so they are attuned to local needs: locating habitats to minimize conflicts with existing and planned uses; working with farmers by promoting wildlife-friendly farming; providing buffers between wildlife areas and farms; working with landowners regarding how to manage restored wildlife populations on or near their lands; and improving opportunities for outdoor recreation, including boating, angling, and hunting, that are enjoyed by residents and also attract visitors. Integrating habitat improvements when levees are rebuilt or flood channels are improved can draw new sources of funds to strengthen the Delta flood control system. In essence, a systems approach that recognizes tradeoffs and the value of balance will be necessary for California to achieve the coequal goals.

The Delta Ecosystem, Past and Present

In the Delta, the Central Valley's great rivers—the Sacramento from the north and San Joaquin from the south—join the Cosumnes, Mokelumne, and Calaveras here in a vast and complex estuary influenced by tides and river currents (see Figure 4-1).

Before the early 1800s, the rivers flowed through approximately 400,000 acres of tidal wetlands and other aquatic habitats that connected with several hundred thousand acres of nontidal wetlands and riparian forest. Flows of the Delta's rivers and tidal channels varied by season and year-to-year, sometimes pouring from the Sierra in great floods whose fresh waters overflowed wetlands and floodplains, and at other times declining as droughts shriveled rivers and brackish tidewaters pushed inland. To the west, the rivers joined to discharge through marsh-fringed Suisun Bay to the Carquinez Straight, San Francisco Bay, and the Pacific Ocean.

The Delta's historical landscape also varied from north to south (see Figure 4-2). In the north Delta, flood basins occurred where the Sacramento River intertwined with tidal channels. A vast area of freshwater wetlands dominated by tules transitioned into tidal wetlands. Shallow perennial ponds and lakes, broad riparian forests along natural levees, and seasonal wetlands at the upland edge were also common. The central Delta was characterized by large, tidal islands that flooded during spring tides (or more frequently) intersected by networks of branching tidal channels. Channel banks were low and covered by the willows, grasses, sedges, shrubs, and ferns that also grew in island interiors. The south Delta contained a complex network of channels formed predominantly by riverine processes. The floodplain comprised emergent wetlands, perennial and seasonal ponds, willow thickets, and seasonal wetlands. Driftwood and other woody debris filled some channels, likely from riparian forest along the San Joaquin River's natural levees.

Historical records show a rich and complex Delta with habitats supporting diverse and abundant native plants and animals (Grossinger et al. 2010, Whipple et al. 2010, Whipple 2011). Some fish, including smelt, schooled in the open waters of the western Delta's bays and channels, moving east when brackish water intruded from San Francisco Bay. Other resident wildlife and plants also prospered: rails in tidal and tule marshes, giant garter snakes in freshwater wetlands and ponds, and riparian brush rabbits and wood rats in willow thickets and riparian forests. Each fall, salmon and steelhead, drawn by the swelling Sacramento and San Joaquin rivers, migrated inland from the ocean and navigated upstream to spawning areas in their tributaries. As river flows receded, their young, emerging from these tributaries' spawning gravel, would return downstream and shelter in driftwood-lined eddies or undercut riverbanks and feed in Delta sloughs, marshes, and floodplains before returning to the sea. Waterfowl, cranes, and shorebirds migrated through the Delta along a north-south route that stretched from the Arctic to Mexico or beyond. Songbirds followed a similar path through riparian woodlands that connected from the Sacramento Valley through the Delta to the San Joaquin Valley.

To immigrants arriving in the nineteenth century, the Delta and Central Valley appeared a wild and dangerous place that had to be "reclaimed" to support the agricultural way of life they had inherited from their ancestors. The rapid transformation of the historical Delta over 160 years involved many changes. Over 1,000 miles of levees were constructed to drain wetlands and protect islands from damaging floods. Channels were cut between sloughs or through islands to ease navigation and encourage drainage without regard to effects on the estuary. Forests were cut and land leveled for farming (Hanak et al. 2011). This transformation produced the rich agricultural economy and rural culture of the Delta described in Chapter 5. But it came at a cost: loss of the original estuarine ecosystem and its species, and native people.

Comparison of Historical (early 1800s) and Modern Delta Waterways

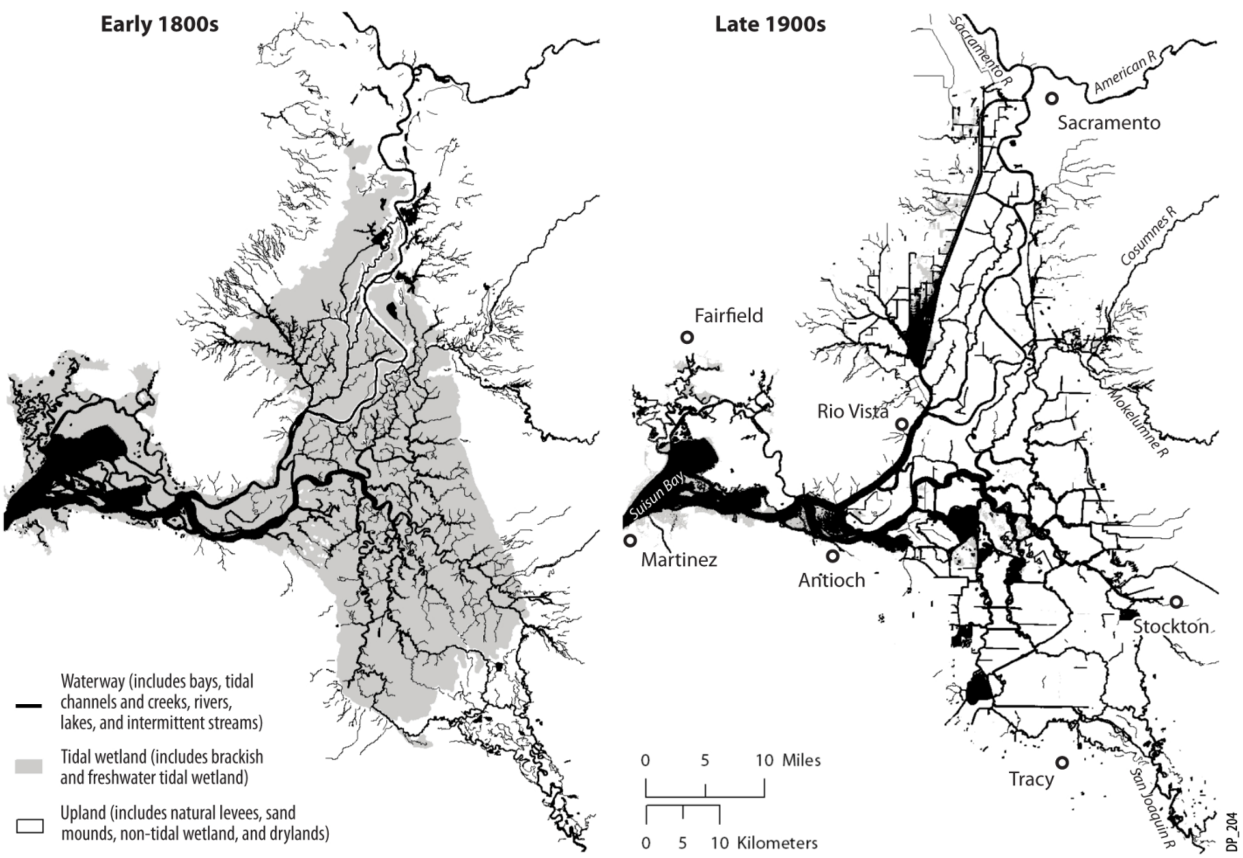

Figure 4-1 The map at left shows the complexity of early 1800s Delta hydrography (black) within tidal wetland (gray). The modern hydrography at right shows major differences such as channel widening, meander cuts, cross levees, and loss of within-island channel networks and tidal wetland.

Source: San Francisco Estuary Institute 2012

Primary Landscapes in the Historical Delta

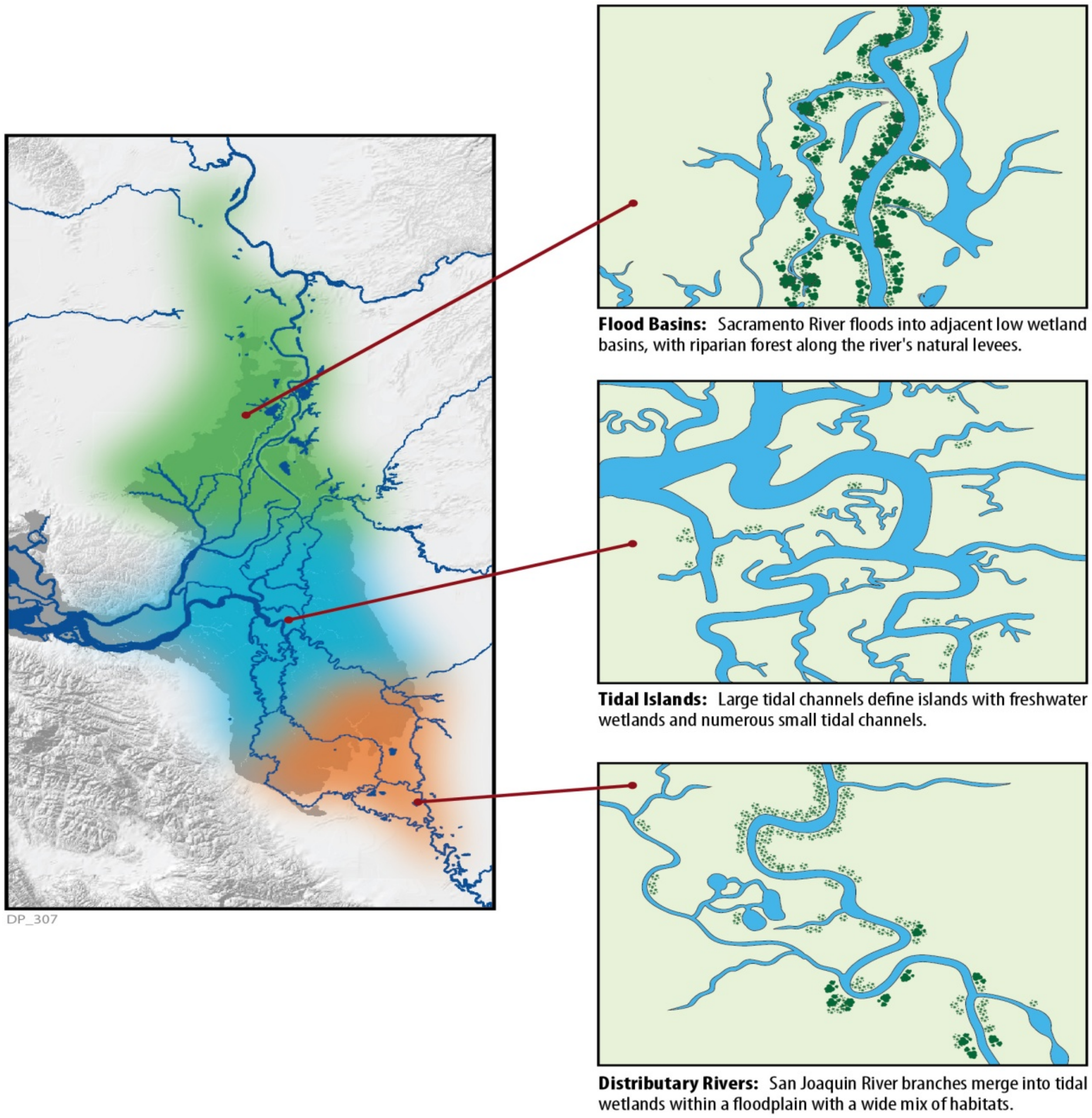

Figure 4-2 The historical Delta can be divided into three primary landscapes: flood basins in the north Delta, tidal islands in the central Delta, and distributary rivers (rivers with multiple branches flowing away from main channels) in the south Delta. Transitions between these landscapes occurred gradually, across broad areas. Though these landscapes held many habitat types in common, characteristics and spatial patterns varied greatly—these large-scale patterns are what helped define the landscapes, which in turn provided different functions for native species. Understanding these major landscape types is a valuable framework for evaluating current and future restoration strategies in the Delta, providing a baseline between the current landscapes and the long-established historical patterns.

Source: Whipple 2011

Nearly all the rivers historically flowing to the Delta were dammed, creating Shasta, Folsom, Millerton, and Oroville lakes and other impoundments described in Chapter 3. These dams, together with levees constructed to prevent flooding, blocked access to spawning areas and other habitats critical to salmon, splittail, and other fish. The once pronounced seasonal and year-to-year variability of river flows has given way to more stable, artificially regulated conditions. The formerly complex Delta sloughs have been replaced by a simplified grid of straightened channels, cuts, and often rock-lined rivers fixed in space and time, and used for water conveyance and shipping. Pumps to divert water for irrigation or municipal use south or west of the Delta further disrupted the estuary (see Figure 4-3).

Ecosystem restoration cannot restore the historical Delta. Its alteration is too complete to reverse and could not occur without damage to other beneficial uses of its water and land. The Delta Reform Act recognizes these limitations and defines restoration as a "...close approximation of its natural potential..." (Water Code section 85066).

Ecosystem Stressors

Many factors stress the Delta's ecosystem (Baxter et al. 2010). Stressors are actions or factors, whether caused by humans or nature, that negatively affect the ecosystem processes and functions. Stressors include altered flows, habitat loss, entrainment in Delta diversions, degraded water quality, harmful nonnative species, migration barriers, and impacts from hatcheries. Reducing one stressor, or even several stressors, is unlikely to solve all environmental problems in the Delta (Delta ISB 2011, see Appendix I). Many restoration projects fail because multiple stressors have been insufficiently considered (Palmer et al. 2005). Because of uncertainty over cause and effect, ecosystem restoration must address as many stressors as possible through adaptive management, as described in Chapter 2 and Appendix C.

Organizing stressors into categories, such as those developed by the Delta Independent Science Board (ISB), helps resource managers to think about, assess, and manage them. (See sidebar, Stressor Categories to Help with Management Options.) Ecosystem stressors and their effects can be categorized by what causes them (sources of stress) or by what can be done about them. The Delta Plan's ecosystem restoration strategies address the following current stressors:

- Delta flows
- Habitat
- Ecosystem water quality
- Nonnative species
- Hatcheries and harvest management

STRESSOR CATEGORIES TO HELP WITH MANAGEMENT OPTIONS

The Delta ISB developed categories that put Delta stressors into broad context to help assess management options (for example, what can be done about them) (Delta ISB 2011). Management options are stressor reduction, elimination, or mitigation. When this is not possible, adaptation to stressors must be promoted. The Delta ISB has proposed the following categories:

- **Current stressors** result from ongoing human activities that at least in some cases can be eliminated (for example, fish entrainment at water diversions and pollution from point sources).
- **Legacy stressors** result from past actions that cannot be undone, but their impact can sometimes be reduced or mitigated (for example, mercury pollution from historical gold mining and past introductions of nonnative species).
- **Globally determined stressors** result from large-scale human activities or natural processes that cannot be eliminated or mitigated within the purview of the Delta Plan and require larger-scale planning and adaptation (for example, global climate change and human population growth).
- **Anticipated future stressors** require preparation (for example, future land subsidence, urban expansion, and new invasions by nonnative species).

These categories have some overlap; for example, a globally determined stressor such as sea level rise also can be an anticipated future stressor.

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Changes in Historical Flows Challenge Delta Ecology

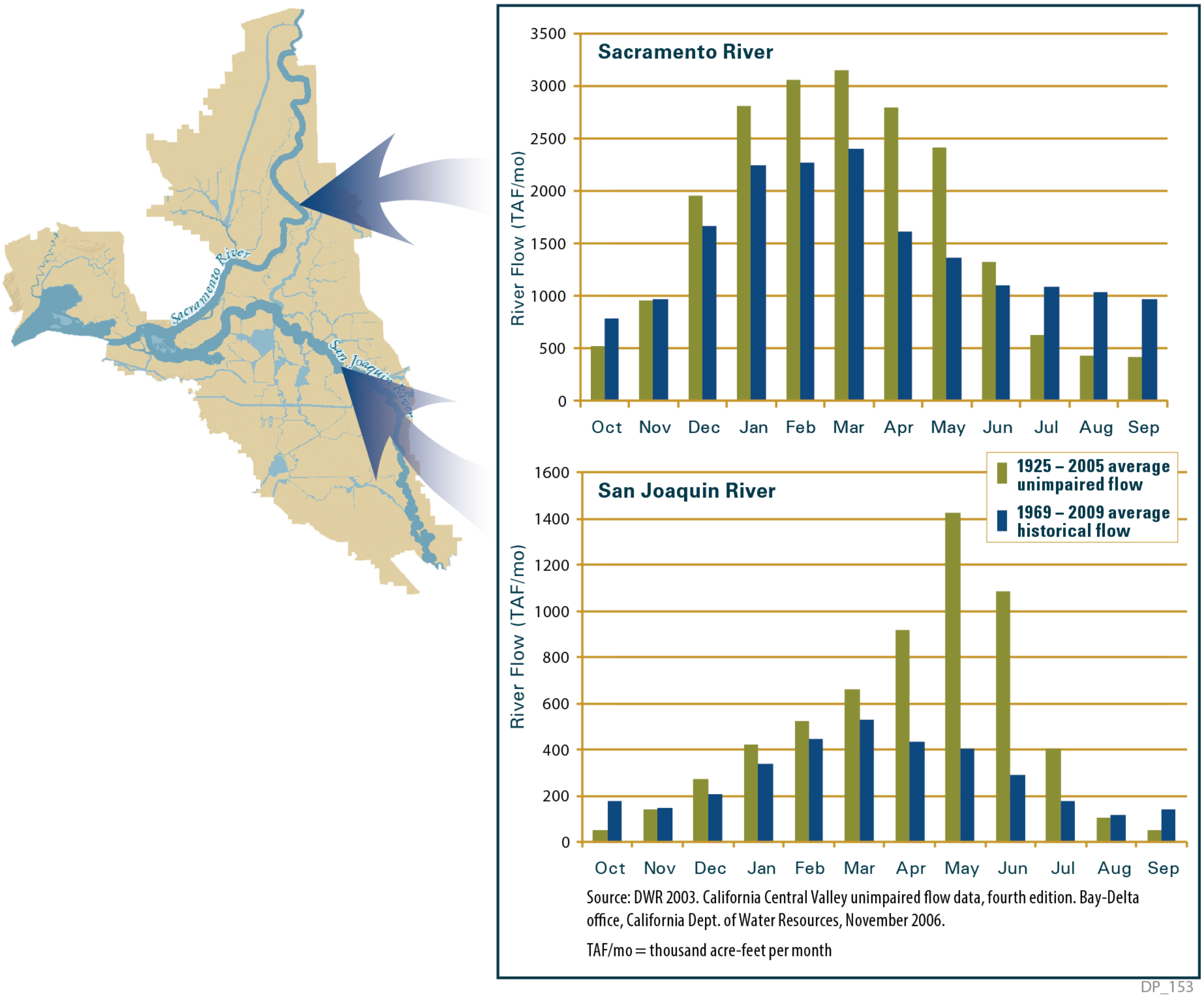

Figure 4-3

Habitat for native species has been shaped in the past by natural cycles of river flows.* Since the 1960s, our water system, with its upstream reservoirs, diversions, and other management facilities, has changed these patterns in two ways. First, seasonal flows are much less variable and encourage nonnative fish and vegetation, which can crowd out native species that thrive in a more varied environment. Second, peak flows now come at lower magnitudes and occur earlier on the San Joaquin; this shift affects water temperatures, salinity, and access to habitat, causing stress on native species.

** Natural flow is runoff that would have occurred had the landscape and waterways remained unaltered. Our best estimate of natural Delta inflow is "unimpaired flow," the flow that would be expected if reservoirs were removed but the contemporary watershed and valley land uses remained. However, natural and unimpaired Delta inflow are not the same, and the difference between them could be substantial at times.*

Climate Change

Climate change will cause major stresses on the Delta ecosystem. Rising sea level could inundate freshwater marshes and other freshwater aquatic habitats, potentially with brackish water, reducing habitat for native plants, fish, and wildlife. In addition to rising sea level, the amount of ideal low-salinity habitat for native fish such as the delta smelt will be affected by changes in runoff timing and intensity, which will also affect erosion and sedimentation patterns, again altering fish habitat. Increased water temperature will negatively affect smelt, salmon, and other coldwater-dependent fish, and will likely increase the range of invasive species (Healey et al. 2008, Villamanga and Murphy 2010). In terrestrial habitats, warming could create soil moisture deficits, change plant community composition, and even disrupt timing between pollinators and plants (California Natural Resource Agency 2009). Overall climate change will exacerbate current challenges to the protection and restoration of Delta ecosystems.

Ecosystem Restoration

Restoration of the Delta ecosystem does not mean a return to predevelopment conditions with only its native plants and animals. That is beyond human ability. Instead, restoration seeks to return areas to a close approximation of their natural potential, including re-establishing natural habitat and ecosystem functions, as feasible, within the context of the current configuration of the Delta, the current biological communities, and the permanent modifications to Delta land forms and hydrology. Successful ecosystem restoration rehabilitates key elements—the living and nonliving features such as soils, elevation, waterways, species, populations, and habitats—and the structure and processes that connect them. This section summarizes the principles of and considerations for ecosystem restoration in the Delta.

Much work has been done to develop ecological principles specific to the Delta. (See sidebar, Delta Ecological Principles.) Restoration projects that adhere to these principles are more likely to achieve their goals and objectives.

The Delta Reform Act's definition of restoration recognizes that the ecosystem will be dynamic, changing in response to restoration actions and future climate change (Healey et al. 2008, Delta ISB 2011). The desired future condition is an evolving ecosystem that supports communities of both native and nonnative species, and continues to provide value such as clean water, flood storage, or recreational fishing. A dynamic, restored Delta ecosystem can be a natural complement to the Delta as an "evolving place" described in Chapter 5.

To increase the likelihood of ecosystem restoration success, plans and actions must incorporate the principles of adaptive management (see Chapter 2 and Appendix C for a detailed discussion). This begins with a clear, practical vision of what will be achieved for the ecosystem, together with human need for water supply reliability and flood risk reduction. Additional examples are provided in the sidebar, Current Delta Ecosystem Restoration Efforts.

DELTA ECOLOGICAL PRINCIPLES

The following are ecological principles for the Delta adapted from those developed for the Delta Vision Blue Ribbon Task Force by former CALFED Lead Scientist Michael Healey (2007a, 2007b) and for the Bay Delta Conservation Plan (BDCP) Steering Committee by the BDCP Independent Science Advisors (2007).

Principle 1: Humans are part of the Delta ecosystem. Human activities over the past 160 years have produced a Delta ecosystem that is different from the historical ecosystem, and will remain so even as human-induced stressors are modified.

Management implications: Strategic management of human activities, and uses of the landscape and water in the Delta will be integral to the successful protection, restoration, and enhancement of the Delta ecosystem.

Principle 2: The Delta ecosystem is part of larger ecosystems. The Delta ecosystem affects and is affected by surrounding ecosystems. High year-to-year variability in precipitation and river flows are, in part, caused by climate patterns that span the entire Pacific Ocean. In addition, many animals that use the Delta do so for only part of their life cycles, spending other parts upstream in the rivers, in the ocean, or as far as away as South America and northern Canada.

Management implication: Management of the Delta cannot occur independently of structures and events upstream and in the ocean, in regional and state economies, or in the wider governance context.

Principle 3: The Delta ecosystem is a mosaic of smaller terrestrial and aquatic ecosystems. These ecosystems interact in important ways (for example, exchange of material, energy, and species). This landscape mosaic determines overall performance of the ecosystem. The size, shape, arrangement, and connections within the mosaic are critical to the way the Delta functions.

Management implication: Management plans and decisions need to be informed by a landscape perspective that recognizes interrelationships among patterns of land and water use, patch size, location and connectivity, and species success. The landscape perspective needs to be developed at several physical and temporal scales.

Principle 4: The Delta ecosystem is naturally dynamic. This includes disturbances and extreme events such as very wet and very dry years. Changes in one part of the Delta may have far-reaching effects in space and time.

Management implication: The Delta cannot be managed as a homogenous or static system.

Principle 5: Native Delta species are adapted to a naturally dynamic Delta ecosystem. The natural Delta is dynamic and variable, and the organisms living there are adapted to that variability.

Management implication: In order to successfully protect, restore, and enhance the Delta, management needs to include actions that mimic, to some extent, the historical natural variability.

Principle 6: Each native Delta species has particular tolerances for habitat variables such as temperature, dissolved oxygen, salinity, turbidity, and toxic substances. Species distributions may shift if conditions change and exceed these tolerances. Increase of air and water temperature by even 2 degrees may make the Delta uninhabitable for some local species and also make it potentially inhabitable for species from warmer regions.

Management implication: Loss of some species from the ecosystem may be inevitable. For local species, refugia may have to be located in cooler regions if extinction is to be prevented. Additional actions may be necessary to alleviate a potential increase in nonnative invasive species.

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CURRENT DELTA ECOSYSTEM RESTORATION EFFORTS

Several significant ecosystem restoration planning and implementation efforts are worth noting:

- The draft Ecosystem Restoration Program (ERP) Conservation Strategy was released by the California Department of Fish and Wildlife (DFW) in 2011 (DFG 2011) to update the CALFED ERP plans from 2000. DFW collaborates with its federal fish agency partners, the U.S. Fish and Wildlife Service and National Marine Fisheries Service, to implement the ERP, including providing grants for Delta and Suisun Marsh restoration research and implementation.
- DFW and the California Department of Water Resources (DWR) are continuing to implement and plan for ecosystem restoration projects begun under the CALFED Bay-Delta Program located in Suisun Marsh, at Dutch Slough, at Cache Slough, in the Yolo Bypass, and at the Cosumnes Preserve's North Delta project.
- The *Suisun Marsh Habitat Management, Preservation, and Restoration Plan* is a comprehensive approach to restoring 5,000 to 7,000 acres of tidal wetlands and maintaining managed wetlands and their functions consistent with the CALFED program, the Suisun Marsh Preservation Agreement, applicable species recovery plans, and other interagency goals.
- The Bay Delta Conservation Plan (BDCP) is an overarching approach to large-scale ecosystem restoration now in the planning process (see sidebar, Bay Delta Conservation Plan and Delta Ecosystem Restoration).
- Several Habitat Conservation Plans (HCP) and Natural Community Conservation Plans (NCCP) for parts of the Delta are in place or under development in the Delta. These plans' purpose is to minimize and mitigate the impact of authorized incidental take of the endangered or rare species and their habitats. Completed HCPs and NCCPs in the Delta include the San Joaquin HCP and East Contra Costa County HCP/NCCP. The BDCP, Yolo County HCP/NCCP, South Sacramento HCP, and Solano Multispecies HCP are under development.
- The State Water Resources Control Board (SWRCB) is updating its Bay-Delta Water Quality Control Plan (Bay-Delta Plan). The first phase focuses on objectives to protect water quality for south Delta agriculture and San Joaquin River flow objectives to protect fish and wildlife. The second phase focuses on other changes to its Bay-Delta Plan to protect fish and wildlife, including Delta outflow objectives, Sacramento River flow objectives, export/inflow objectives, Delta Cross Channel Gate closure objectives, Suisun Marsh objectives, potential new reverse flow objectives for Old and Middle rivers, potential new floodplain habitat flow objectives, potential changes to the monitoring and special studies program, other potential changes to the program of implementation, and issues identified through the BDCP process. As part of the SWRCB's review of its Bay-Delta Plan, it will consider information developed as part of its 2010 staff technical report *Development of Flow Criteria for the Sacramento–San Joaquin Delta Ecosystem* (SWRCB 2010) along with information about other factors, such as coldwater pool requirements and other water uses.
- In 2009, the Legislature established the Sacramento–San Joaquin Delta Conservancy (Delta Conservancy) as a primary State agency to implement ecosystem restoration in the Delta, along with supporting efforts that advance environmental protection and the economic well-being of Delta residents. The Delta Conservancy adopted a strategic plan to guide its planning and implementation efforts in March 2012.
- DWR's Delta Levees Special Flood Control Projects program provides funding to local agencies in the Delta for habitat projects linked to flood management improvements. Similarly, DWR's *2012 Central Valley Flood Protection Plan* proposes new or enhanced flood bypasses, levee setbacks, and fish passage improvements that provide both flood risk reduction and habitat. This effort is discussed in more detail in Chapter 7.

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Delta Flows

The Delta is the upstream portion of the San Francisco Estuary, where ecosystems dominated by the Central Valley's rivers transition to the more ocean-influenced ecosystem of the downstream portions of the estuary. Water flow is a "master variable," driving the ecological health of rivers and their ability to support valued environmental services (Poff et al. 1997, Postel and Richter 2003). In estuaries, the interaction of river flows and ocean tides produces a salinity gradient from fresh water to brackish and salty water. River flows and ocean tides also deposit and erode sediment to shape the estuarine landscape and its habitats. Estuarine species are adapted to the complex natural flow, salinity, and sediment dynamics in their native estuaries.

Delta flows can be divided into three categories: (1) river and floodplain flows, (2) in-Delta net channel flows, and (3) net Delta outflows (SWRCB 2010). Each category has different ecological effects. (See sidebar, Flow Is More than Just Volume.)

BAY DELTA CONSERVATION PLAN AND DELTA ECOSYSTEM RESTORATION

The parties seeking permits pursuant to the Bay Delta Conservation Plan (BDCP) are attempting to formulate a 50-year plan that, if successful, would ultimately contribute to the recovery of priority species, restoration of a more naturally functioning Delta ecosystem, and establishment of a secure and reliable water supply from the Delta for human use.

As discussed in the Chapter 3 sidebar, BDCP and Water Supply Reliability, the BDCP is a planning process intended to result in the issuance of permits from the California Department of Fish and Wildlife (DFW) under the Natural Community Conservation Planning Act and from the U.S. Fish and Wildlife Service and the National Marine Fisheries Service pursuant to Section 10 of the federal Endangered Species Act (ESA). In addition, the Bureau of Reclamation will use the information developed from this process to obtain incidental take authorization through an ESA Section 7 process. The BDCP proposes to contribute to the restoration of the health of the Delta's ecological systems by contributing to a more natural flow pattern than existing conditions within the Delta and by implementing a comprehensive restoration program.

As currently proposed, the BDCP takes an approach to supporting landscape-level processes by creating a reserve system consisting of a mosaic of natural communities that would be adaptable to changing conditions (including sea level rise) to sustain populations of covered species and maintain or increase native biodiversity (BDCP 2012). The proposal considers protection of at least 31,000 acres of existing natural communities, and restoration or creation of at least 72,809 acres of natural communities, including at least 65,000 acres of tidally influenced natural communities. In addition, the BDCP is intended to improve the Delta ecosystem by taking actions such as:

- Protecting and improving habitat linkages to promote the movement of native species
- Accommodating future sea level rise by providing transitional areas that allow future upslope establishment of tidal wetlands
- Allowing natural flooding to promote the regeneration of vegetation and related ecosystem processes
- Connecting rivers and their floodplains to recharge groundwater, provide fish spawning and rearing habitat, and increase food supply
- Managing the distribution and abundance of nonnative predators to reduce predation on native special-status species

Examples of elements of the BDCP strategy to support natural communities include:

- Controlling invasive nonnative plant species
- Restoring or creating 5,000 acres of riparian forest
- Restoring corridors of riparian vegetation along 20 miles of channel margin
- Restoring 2,000 acres of grassland
- Protecting at least 20,000 acres of cultivated land to support suitable habitat for native species

The BDCP also plans to propose comprehensive programs for monitoring, research, and adaptive management.

If the process is successful and DFW approves the BDCP as a natural community conservation plan pursuant to Chapter 10 (commencing with Section 2800) of Division 3 of the Fish and Game Code, and determines that the BDCP meets the requirements of this section, and the BDCP has been approved as a habitat conservation plan pursuant to the federal ESA (16 United States Code section 1531 et seq.), the Council shall incorporate the BDCP into the Delta Plan (Water Code section 85320(e)). The Council has a potential appellate role regarding the inclusion of the BDCP in the Delta Plan.

As of this publication, the final public draft of the BDCP and the related environmental impact report/environment impact statement are expected to be released in late 2013. The Council is a Responsible Agency for California Environmental Quality Act purposes.

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1. **River and floodplain flows.** The Sacramento and San Joaquin rivers and their tributaries provide fresh water into the Delta. Along the margins of the Delta, these rivers seasonally inundate floodplains. Inundated floodplains stimulate the food web by enhancing plant growth, triggering aquatic invertebrate production, exporting food that becomes available to animals downstream, and providing spawning and rearing habitat on the floodplain for fish such as salmon and splittail. In recent decades, floodplains like the Yolo Bypass are flooded primarily by very high flows that flood the Yolo Basin about one year in three. Floodplain restoration could re-establish topographic connections that flood the bypass more often and at lower flows.

2. **In-Delta net channel flows.** Delta flows are primarily driven by tides affected by the moon's cycles, river inflows, in-Delta agricultural diversions, and water exports through the Central Valley Project (CVP) and the State Water Project (SWP). Averaging these influences in any Delta channel over about 1 day gives the "net flow." Locations near the CVP and SWP export pumps, such as parts of Old River and Middle River in the south Delta, experience net "reverse" flows when export pumping by the water projects exceeds these channels' normal downstream flows. The average flow in these channels actually runs backward at times, which affects the Delta's aquatic ecosystems both directly and indirectly (see Figure 4-4). Reverse flow in the southern Delta is associated with increased entrainment of some fish species (Grimaldo et al. 2009) and disruption of migration cues for migratory fish (see the Migratory Corridors for Native Species section for more detail). Reverse and otherwise altered flows caused by upstream reservoir operations, the constraints of artificially connected Delta channels, plus water exports affect Delta habitat largely through effects on water residence time, water temperature, and the transport of sediment, nutrients, organic matter, and salinity (Monsen et al. 2007). These reverse flows could, in turn, affect the behavior of migrating fish, and habitat suitability for resident and migratory fish and other species. Finally, aquatic organisms often get drawn (entrained) into water pumping facilities, as described later in this chapter.

3. **Net Delta outflows.** Net Delta outflow is the sum of all inflows to, and diversions from, the Delta. It is the flow out of the Delta that would occur in the absence of tides (Oltmann 1988). During dry periods, outflow is a low percentage of the instantaneous tidal flow in the western Delta. Nevertheless, over periods longer than 2 weeks, Delta outflow transports river-derived organic matter to Suisun Bay (Jassby and Cloern 2000) and controls the location of the salinity gradient (Jassby et al. 1995). Delta outflow objectives are based on the monthly average location of the low-salinity zone in the western Delta. Outflow variability is recognized as a key factor promoting diverse native fish communities (Moyle and Mount 2007, Moyle et al. 2010).

FLOW IS MORE THAN JUST VOLUME

Flow is not simply the volume of water, but also the direction of flow, the timing of flow, the frequency of specific flow conditions, the duration of various flows, and the rate of change in flows.

Bunn and Arthington (2002) present four key principles underlying the links between hydrology and aquatic biodiversity and the impacts of altered flow regimes: (1) flow determines physical habitat, (2) aquatic species have evolved life history strategies based on natural flow regimes, (3) upstream-downstream and lateral connectivity are essential to organism viability, and (4) invasion and success of nonnative species is facilitated by flow alterations. Altered flow regimes have been shown to be a major source of degradation to aquatic ecosystems worldwide (Petts 2009).

DP-169

Flow Direction in South Delta

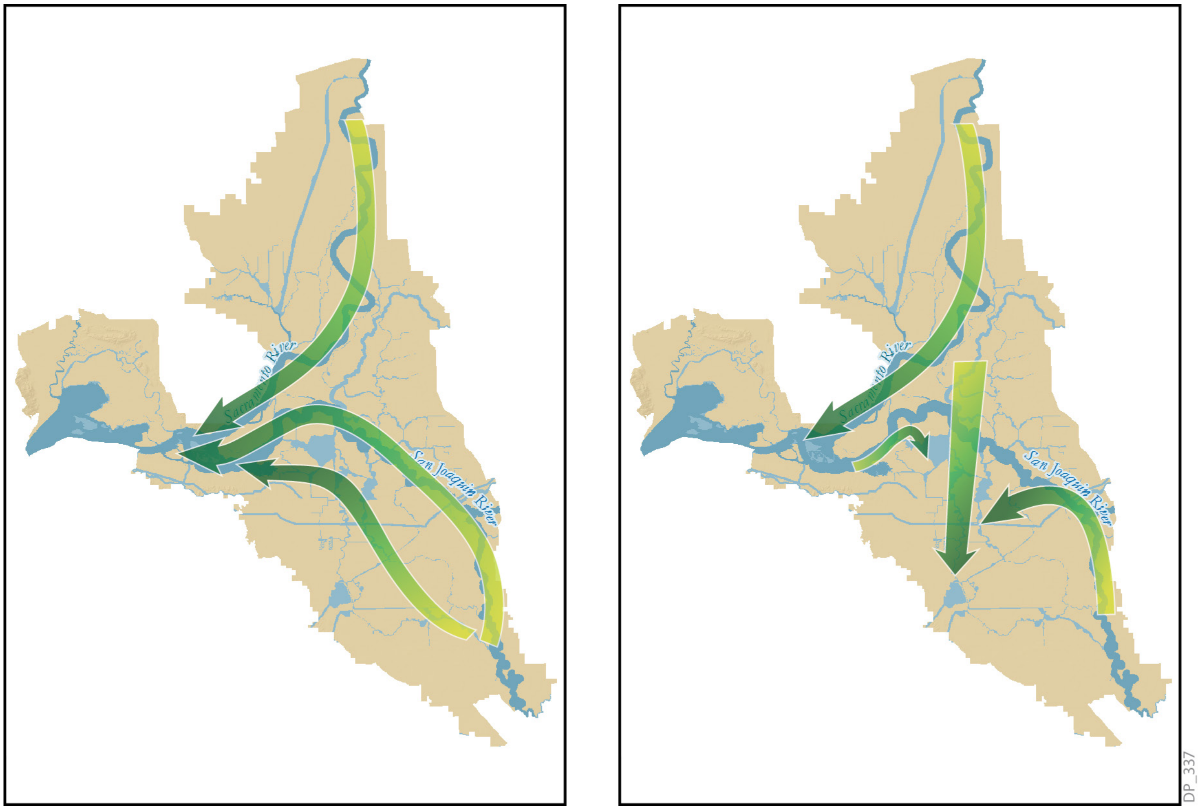
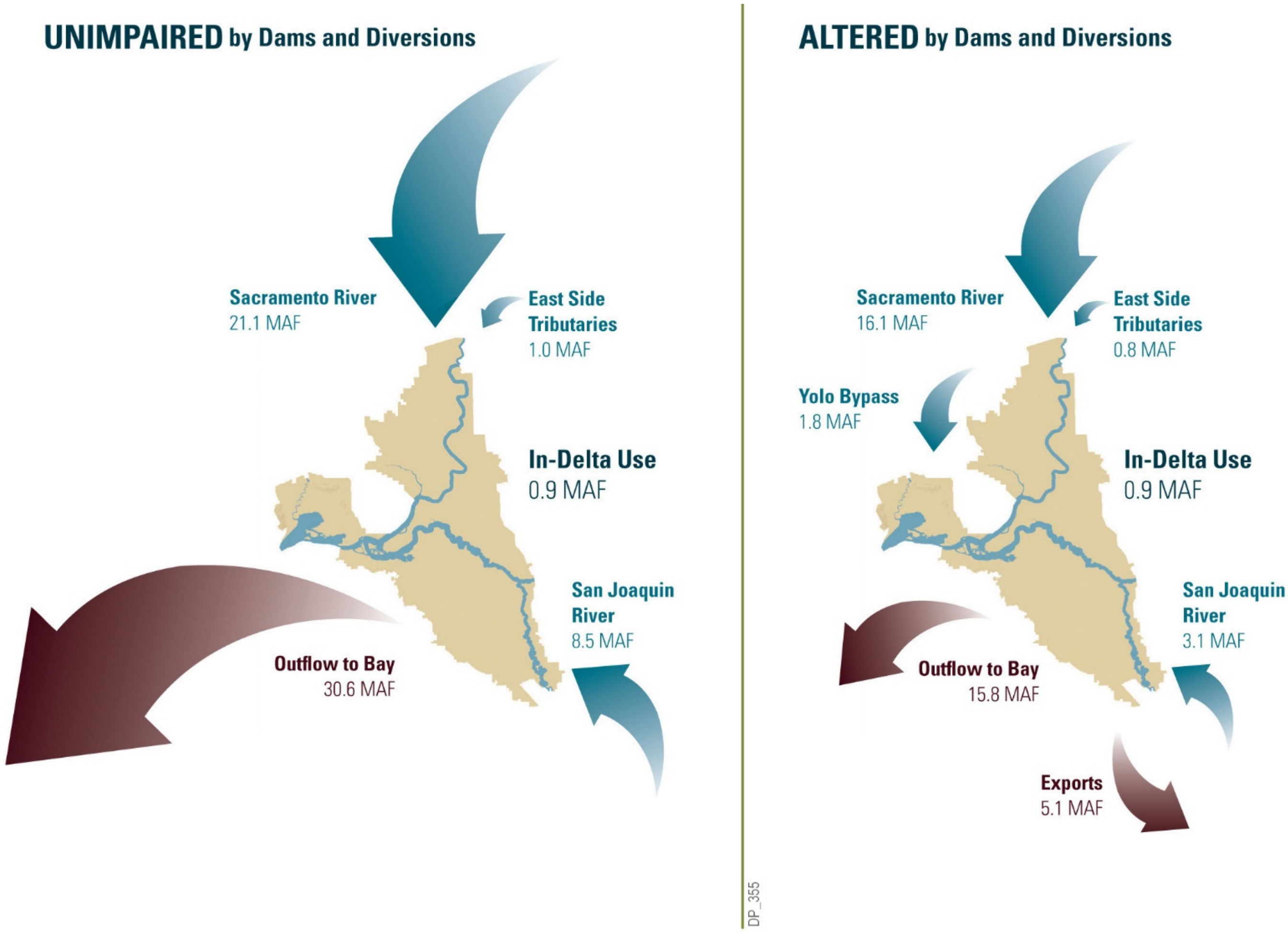


Figure 4-4 The left panel depicts the tidally averaged flow direction in the absence of export pumping. The right panel depicts reversal of tidally averaged flows that occurs during times of high exports (pumping) and low inflows to the Delta.

Present-day Delta flows are very different from historical, natural flows. Water flows have been altered by water supply and flood control infrastructure, including dams on the Sacramento and San Joaquin rivers and their tributaries; levees along these rivers and the Delta's channels; and draining of floodplains, wetlands, and groundwater basins (see Figure 4-5). Flows sometimes have not reflected the Fish and Game Code section 5937 requirement that dam owners should allow sufficient water at all times to pass through a fishway, or in the absence of a fishway, to pass over, around, or through the dam, to keep in good condition any fish that may have been planted or that exist below the dam (DFG 2012). Flows are now closely managed by releases from reservoirs to supply water for agricultural and urban uses, control salinity, and reduce floods. In the Delta, flows have also been rerouted through artificial channels. Flow management and modified Delta channel geometry have altered the salinity and sediment regimes in the Delta (Enright and Culberson 2010, Wright and Schoellhamer 2004), managing salinity for human uses rather than for fish and wildlife. Low winter-spring flows disrupt turbidity and salinity cues for migrating fish (Grimaldo et al. 2009), reduce access to spawning and rearing habits in tributaries and floodplains (Sommer et al. 1997, Feyrer 2004, Feyrer et al. 2007), and limit success for young fish trying to follow natural migration patterns (Feyrer and Healy 2003). Current flow management regulations provide some protection for ecological functions and native species, but the current Delta flow regime is generally harmful to many native aquatic species while encouraging nonnative aquatic species (SWRCB 2010).

Effects of Dams and Diversions on Delta Inflows and Outflows



Data presented as a long-term average. Information based on DWR CALSIM II modeling, which includes projected conditions to protect fisheries.

Delta-Suisun in-Delta use includes water to the Contra Costa Canal and to the Mokelumne and Hetch Hetchy aqueducts.

MAF = millions of acre-feet

Figure 4-5

Water flows more closely approximating the timing, frequency, duration, volume, and rate of change of flow produced naturally by a region's climate are best for native aquatic communities (Poff et al. 1997, Bunn and Arthington 2002, Carlisle et al. 2010). Flow is a major environmental input that shapes ecological processes, habitat, and biotic composition in riverine and estuarine ecosystems such as the Delta. Returning to a more naturally variable hydrograph is a key component of ecosystem restoration because the hydrograph works hand-in-hand with habitat restoration to produce diverse and interconnected food webs, refuge options, spawning habitat, and regional food supplies (Carlisle et al. 2010). Flows should provide species benefits and water supply reliability in the context of current hydrological conditions and degraded habitat. In some cases, flows to benefit the ecosystem will deviate from historical "natural" flows, because the channel geometry, land-water connectivity, and infrastructure limits our ability to mimic historical conditions. Flows will also need to be modified as habitat areas are restored. The Delta Plan, therefore, calls for "more natural functional flows" in the Delta as an important aspect of ecosystem restoration. (See sidebar, More Natural Functional Flow, for a description.)

Flow-related stressors can be reduced or mitigated through improved flow management and concurrent reduction of other stressors. Improved flow management comes from better use of current or improved water infrastructure. The challenge in managing flows is to both restore the Delta ecosystem and improve water supply reliability. Flow-related stressors are likely to increase as population grows and the climate changes. Preparation for these changes must start now.

The State Water Resource Control Board's (SWRCB's) Bay-Delta Water Quality Control Plan (Bay-Delta Plan) identifies water quality objectives to protect beneficial uses of the Bay and Delta, and an implementation program including control of salinity (caused by saltwater intrusion, municipal discharges, and agricultural drainage) through water projects operations. This is a contentious issue of public policy, and the Delta Reform Act directed the SWRCB to develop its new flow criteria using the best available science (Water Code section 85086).

The SWRCB is updating the 2006 Bay-Delta Plan with these steps: (1) review and update water quality objectives, including flow objectives, and the program of implementation in the 2006 Bay-Delta Plan, and (2) make any needed changes to water rights and water quality regulation consistent with the program of implementation. Updating the water quality objectives for the Delta, including an update of flow objectives, is important to protect the Delta ecosystem and the reliability of the Delta's water supplies. The sooner these objectives are set, the earlier the ecosystem can be protected and restored, the greater the possibility that a successful Bay Delta Conservation Plan (BDCP) will be approved, the earlier a more reliable water supply can be improved, and, therefore, the earlier the coequal goals can be achieved. That is why the Delta Plan calls upon the SWRCB to complete its work by specified deadlines. A more detailed explanation of the SWRCB's development of water quality objectives, including flow objectives, is included in Chapter 6.

Entrainment Is One Effect of Altered Flows

Entrainment occurs when fish and other aquatic life are drawn into a water diversion intake and are unable to escape. In the Delta, entrainment occurs primarily at the CVP facilities (Tracy Fish Facility and the nearby Delta-Mendota Canal) and the SWP facilities (including Clifton Court Forebay and the Skinner Fish Facility), as well as other smaller Delta intakes.

Much of the time, net channel flows in most of the south Delta are toward the pumps. This increases the probability that small, weak-swimming young smelt or salmon will be entrained. Depending on the type and size of the fish, the closer a fish is to the pumps, the more likely it is to be entrained. Greater reverse flows caused by pumping in the south Delta increase the numbers of fish entrained.

Some of the entrained fish are "salvaged," meaning they are caught in facilities at the pumps and then trucked and released to an area beyond the pumps' influence. The salvage process decreases the mortality of entrained fish (including salmon). Unfortunately, however, many fish, including delta smelt, are not able to survive the collection, handling, transport, and release.

MORE NATURAL FUNCTIONAL FLOW

What is natural Delta flow? Natural Delta flow is the historical (before 1849) pattern of watershed flows that eventually arrived in the Delta. Historical Delta flows resulted from rainfall in the watershed and the pattern of water storage and release from mountain snowpack, forest and valley soil and vegetation, and the natural topography of creeks, rivers, natural levees, and valley floodplains. These landscape patterns have been modified since 1849, and will largely not be returned to their former state.

Why is natural flow important? Native species are adapted (by natural selection) to the seasonal, interannual, and spatial variability of the historical flow pattern and the functions that come with it. Flows interact with land to create physical habitats and connections where species find food, refuge, and reproduction space. Through a variety of mechanisms, native species can survive, grow, and reproduce better when flows occur in more natural historical patterns.

What does natural flow look like? There were no measurements of natural Delta flow before the watershed was modified by gold mining, agriculture, and water storage. In general, natural flows rise in concert with precipitation patterns and fall slowly as the natural water storage capacity of the watershed is released. Natural flows are not simply water volumes but also include the seasonal timing, magnitude, frequency, duration, and rate-of-change in flows. It is often asserted that "unimpaired Delta inflow" is a good approximation of natural flow. For the Delta, unimpaired flow is the inflow that would be expected if reservoirs were removed but contemporary watershed and valley land uses remained. Unimpaired Delta inflow may overestimate the magnitude of natural Delta inflow and abridge the timing of seasonal peaks.

Will more natural flow work to meet ecosystem goals? Not by itself. Natural flows exist only in the context of natural landscape patterns. The pattern of historical natural flow reflected seasonal and interannual interaction with the historical landscape. For example, historical high flows in winter and spring were intercepted and stored by natural floodplains and then released slowly to the Delta through the summer. Much of the ecosystem functional value of natural flows occurs in these seasonal land and water interactions.

We do not have natural landscapes, so now what? Until large-scale restoration is in place, we can meet ecosystem goals in the interim by using the best available scientific understanding of the *functions* that flows provide to native species. For example, winter-run salmon historically survived low summer flows by finding cold-spring creeks in the watershed for spawning. These creeks are now blocked by dams, but cold water can be released from reservoirs to improve spawning habitat farther down. Another example is using Delta outflow to position the low salinity zone ("X2") in Suisun Bay at key times of the year when the salinity, refuge, and food resources there can benefit native fish. More natural flow is therefore understood to emphasize more natural *functions* rather than the shape of the hydrograph. More natural functional flows could include diverting more flow in wet years and less flow in dry years, as described in Chapter 3. With landscape restoration over time, managing water for functional natural flows should be adaptively managed as ecosystem conditions change. The Delta Plan call for "more natural functional flow" suggests that we can adaptively manage the *functions* that flows provide to the life history needs of native species. Therefore, managing for more natural functional flows protects, restores, and enhances the Delta ecosystem.

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Alteration of water flows also leads to losses of fish from predation. High rates of predation occur at the pumps, and the sloughs and channels near the pumps. Small fish drawn into this part of the Delta have a very low chance of survival. Juvenile salmon drawn into the central Delta through the Delta Cross Channel or Georgiana Slough also have a lower chance of survival than fish staying in the Sacramento River's mainstem. Whether the effects of flow on fish are direct through entrainment or indirect through increased mortality caused by altered flows and predation, the results are the same: fish lost as a result of Delta diversions.

Because of all these factors, managing flows within the Delta is a difficult but important tool for protecting fish. For example, the SWRCB requires reductions in diversions and increases in San Joaquin River inflows during springtime to increase the survival of outmigrating juvenile salmon. The biological opinions for salmon and smelt include measures to reduce entrainment and indirect loss of fish due to altered flows caused by the SWP and CVP diversions. These actions include restrictions on reverse flows in the Old River and Middle River channels in the south Delta and requirements for closing the Delta Cross Channel gates.

Entrainment does not just occur at the Delta pumps. It also can occur at other diversions upstream from the Delta. Larger diversions upstream and in the Delta are screened, but many smaller diversions are not. In-Delta unscreened diversions do not currently appear to entrain substantial numbers of salmon or smelt.

Habitat

Appropriate habitat is required for any organism to survive and reproduce (Hall et al. 1997). Because no two species have exactly the same requirements, habitats are species-specific components of ecosystems.

Expanding habitats for native species is an essential part of restoring the Delta's ecosystem. Recent biological opinions controlling long-term operations of the CVP and SWP require restoration of at least 8,000 acres of intertidal and associated subtidal habitats in the Delta, including Suisun Marsh (USFWS 2008). They also require restoration of 17,000 to 20,000 acres of floodplain rearing habitat for salmon in the Yolo Bypass and lower Sacramento River, including side channels and re-created floodplain terrace areas (NMFS 2009). Some of the tidal marsh acreage may also fulfill requirements for restored floodplains, depending on its location.

Habitat restoration, like water flow, is not just about quantity (or extent), but also about quality, connectivity, and diversity. Land cover types, such as open-water and riparian vegetation, vary greatly and are only one element of habitat (Lindenmayer et al. 2008); an organism's habitat is much more than just land cover. For example, the area of the Delta covered by open water has not changed substantially during the last few decades, but several open-water fish have declined steeply (Sommer et al. 2007, Baxter et al. 2010). This suggests that some of the Delta's open waters have become inhospitable to these certain fish species. The functional habitat available to these open-water fish has shrunk even though the area covered by open water has remained fairly stable. This means that simply changing land cover (for example, increasing riparian habitat) does not automatically increase target species. Other stressors such as poor water quality, predation, or entrainment may make these areas unsuitable.

Habitat loss and fragmentation resulting from human land use causes species loss worldwide (Foley et al. 2005). In estuaries and coastal areas, habitat destruction, coupled with exploitation such as overfishing, are the leading causes of species declines and extinctions (Lotze et al. 2006). Habitat restoration can help recover native species, particularly when other stressors such as altered flows, degraded water quality, or predation by introduced species are also reduced (Carlisle et al. 2010, Lotze et al. 2006).

Taking a large view of an ecosystem, habitats are species-specific "patches" in spatially varied landscapes. The survival and success of organisms is closely associated with the total amount of usable habitat, as well as with habitat patch sizes, shapes, and arrangements (Hannon and Schmiegelow 2002). Habitats that are too small, fragmented, or isolated may not provide long-term support for specific organisms. In general, more, larger, and better-connected patches of a specific habitat create the conditions for persistence or recovery of the species associated with that habitat (Lindenmayer et al. 2008). (See sidebar, Landscape Ecology: A Fundamental Tool for Restoration Planning.)

Much of the original habitat for the Delta's native fish, wildlife, and plants has been urbanized or converted to agriculture over the past 160 years (Healey et al. 2008, Moyle et al. 2010, Baxter et al. 2010). This habitat loss is one of the largest legacy stressors to the Delta ecosystem. The current Delta ecosystem continues to be productive, but its habitat types and conditions support a much different mix of species than the historical Delta. Many of the thriving species are nonnative, such as largemouth bass and the Brazilian water weed *Egeria densa*. Some consider a few nonnative species, such as bass prized by anglers, to be desirable. But too many nonnative plants and animals can upset an ecosystem's balance, creating conditions unsuitable for native aquatic and terrestrial species (Sommer et al. 2007, Healey et al. 2008, Baxter et al. 2010). This conflict and the inadequate habitat for native species that reside in and migrate through the Delta is an important current ecosystem stressor that must be addressed.

LANDSCAPE ECOLOGY: A FUNDAMENTAL TOOL FOR RESTORATION PLANNING

Landscape ecology examines the influence of spatial patterns on ecological processes (Wiens 2002) and considers the ways that species use the landscape for finding food and refuge, and for adapting to change (Simenstad et al. 2000, Lindenmayer et al. 2008). The mosaic of landscape features—or "patches"—and the connections between patches affect species' locations, food and cover, the energy required to obtain those resources, and, ultimately, survival. The landscape perspective considers connections and exchanges between uplands; riversides and wetland edges; and the sloughs, channels, and bays that make up estuarine aquatic habitats. The food webs of these adjacent systems exchange organisms and energy that, in turn, can increase the productivity of each (Cloern 2007). Native estuarine species—terrestrial, semiaquatic, and aquatic—are adapted to the rhythms of the landscape's mosaic of connected habitats and its dynamic processes.

From a landscape perspective, "form begets function." Therefore, correct spatial structure and patterns are prerequisites for restoring and maintaining desired ecosystem processes and functions, and for providing appropriate habitat for native species. In the long term, restoring spatial patterns at ecologically appropriate scales can promote the "self-repair" of ecosystem processes and functions (Teal et al. 2009) and increase resilience to stressors. Consequently, this approach could reduce the operating and maintenance costs of restoration in an era of limited resources. Planning for ecosystem restoration should always consider appropriately large spatial scales (regional or larger), but restoration actions can proceed at smaller scales to optimize the benefits that can be achieved with the often limited opportunities and resources available for restoration (Hermoso et al. 2012).

Additionally, landscape ecology considers people's role in shaping landscape patterns and processes (Turner 1989). Restored landscapes often have agricultural and urban neighbors. Each land use affects the other because they are connected by air, land, and water. Yet humans often want conflicting things (nature areas nearby with abundant wildlife, but also with convenient recreation facilities, no mosquitoes, and no impacts on adjoining farms). A functioning ecosystem depends on many things, including understanding and dealing with its relationship to human activities. The current regulatory and political framework for restoration projects often puts short-term benefits, such as low acquisition cost or immediacy of land availability, before long-term benefits of connectivity and appropriateness of scale. Landscape ecology provides a set of tools for assessing and prioritizing limited restoration opportunities. For example, using the principles of landscape ecology, decisions about land acquisitions for restoration must address how small parcels that become available for restoration might be connected and combined to maximize ecological benefits over the long term.

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The Importance of Land Elevation in Habitat Restoration

Opportunities for habitat restoration in the Delta are constrained first and foremost by the elevation of land, which determines the potential of an area to be restored. As described in Chapter 5, much of the Delta has subsided too deeply to restore its original ecological functions (see Figure 4-6).

Deeply subsided Delta lands can provide terrestrial and wetland habitat for native species only at great cost and with intensive management. They offer few opportunities to recover native ecosystem forms and functions. However, deeply subsided islands could include seasonal wetlands for waterfowl and wildlife-friendly agriculture. Actions that promote carbon sequestration, subsidence reversal, and improved migratory bird habitat are especially valuable.

The most promising restoration opportunities are found in the less-subsided flood basins, river corridors, and brackish tidal marshes on the Delta's perimeter, leading the Council to recommended six priority habitat restoration areas:

- **Yolo Bypass, from the Fremont Weir south toward the Delta.** Winter and spring flooding of the Yolo Bypass provides substantial benefits for spawning and rearing of Sacramento splittail and rearing of salmon (Sommer et al. 2001, Moyle et al. 2007). Projects in the planning stage include fish passage improvements and various approaches, such as notching the Fremont Weir to increase the frequency and duration of inundation during times of the year critical for spawning and rearing of native fish. Restoration of the Yolo Bypass can create conditions that promote enhanced growth and survival of juvenile spring- and winter-run salmon, among other species, and can benefit other migrating salmon.

Habitat Types Based on Elevation, Shown with Developed Areas in the Delta and Suisun Marsh

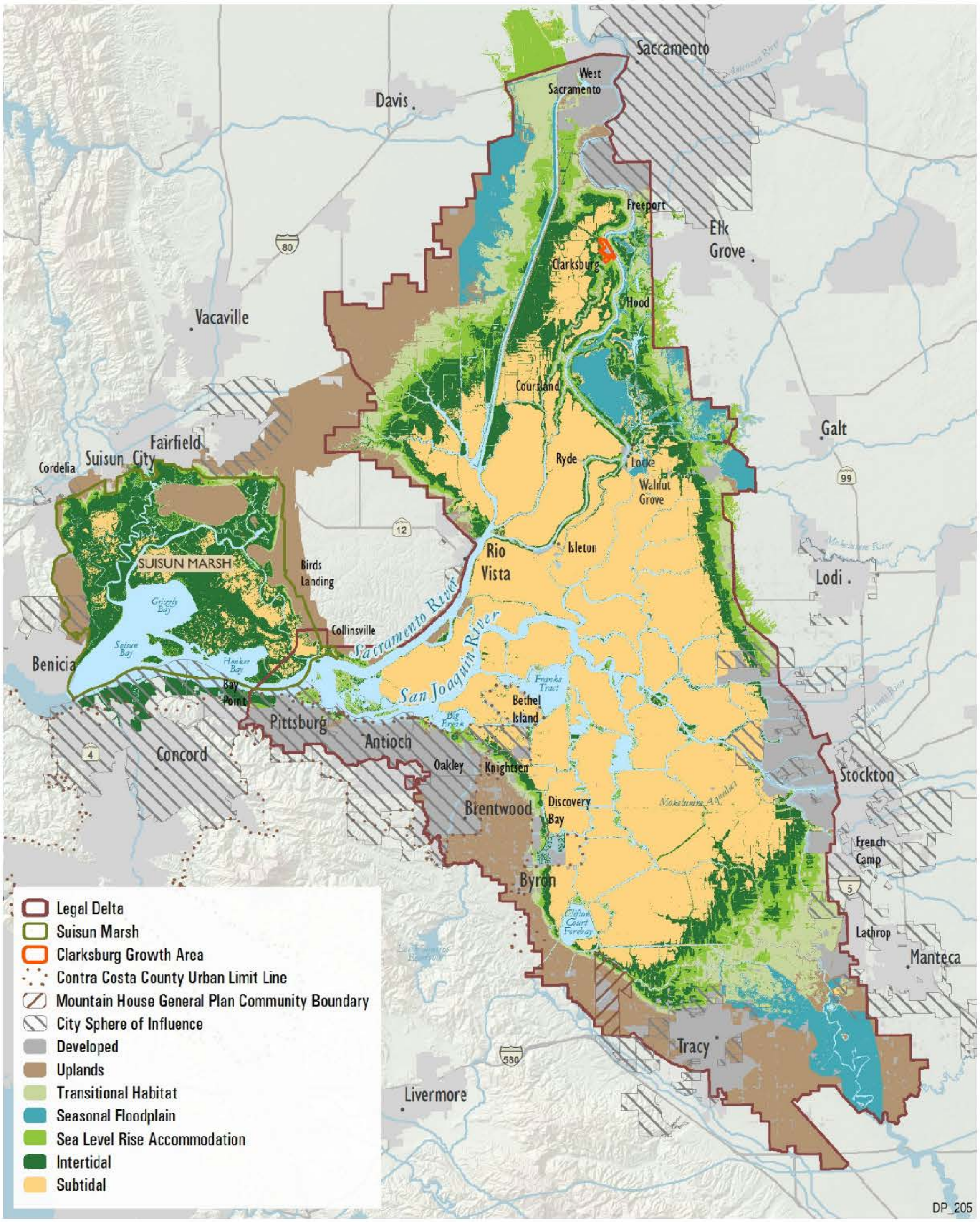

Figure 4-6 *Source: Adapted from DFG 2011*

- **Cache Slough Complex, southwest of the Yolo Bypass.** The flood basins entering the Cache Slough Complex are at the interface between river and tidally influenced portions of the Delta. A restoration project in this area is Liberty Island, which is being allowed to passively restore to marsh after floods breached the island's levees in 1997. Projects in the planning stage include California Department of Water Resource's (DWR's) Prospect Island restoration project. Habitat restoration at Cache Slough can create conditions that help recover delta smelt and that benefit migrating salmon. See the sidebar, Applying Adaptive Management to Ecosystem Restoration, for a hypothetical example implementing principles of adaptive management in projects such as these.
- **Cosumnes River–Mokelumne River confluence.** An existing restoration project is the Cosumnes River Preserve floodplain. Projects in the planning stage include DWR's North Delta Flood Control and Ecosystem Restoration Project on McCormack-Williamson Tract. Restoration here can benefit migrating salmon and contribute to the Delta's food webs.
- **Lower San Joaquin River floodplain between Stockton and Manteca.** Historically, the south Delta and its connection to the lower San Joaquin River contained a complex network of channels with low natural berms, large woody debris, willows, and other shrubs with upland areas supporting open oak woodlands. Projects in the planning stage include the Lower San Joaquin Flood Bypass proposed by the South Delta Levee Protection and Channel Maintenance Authority and its partners. Restoration to a mix of tidal marsh, riparian habitats, and wildlife-friendly agriculture could create conditions to recover riparian brush rabbits and Swainson's hawks, benefit migrating salmon, and serve to reduce the risks from flooding for urban areas.
- **Suisun Marsh.** This is the largest wetland area on the West Coast of the contiguous United States. Suisun Marsh is mostly managed for waterfowl, with levees that disconnect its wetlands from the estuary. An ongoing restoration project is DWR's Blacklock Restoration Project. Projects in the planning stage include California Department of Fish and Wildlife's (DFW's) Hill Slough Restoration Project. Restoration of tidal marsh and associated habitats here can create conditions that contribute to food webs in Suisun and Honker bays, and aid the recovery of longfin smelt and spring- and winter-run salmon.

  Unique local benefited species would also include Suisun song sparrows, saltmarsh harvest mice, and plants such as soft bird's-beak and Suisun thistle. Enhanced management of wetlands can reduce impacts on water quality while still maintaining or improving habitat for waterfowl of other wildlife.
- **Western Delta/Eastern Contra Costa County.** Some islands and tracts at appropriate elevations may be desirable sites for restoration of tidal marsh and channel margins to support food webs and provide habitat for native species. Decker Island is a recent restoration project in this area, and restoration at Dutch Slough is planned. Additional restoration of other islands or tracts may be considered in the BDCP or in local Natural Community Conservation Plans/Habitat Conservation Plans.

These six regions have been highly altered by more than a century of human use and exposure to multiple stressors. Returning a portion of these altered regions to habitat for native species requires a careful assessment of opportunities and challenges. Recommendations provided later in this chapter include actions to prevent or mitigate adverse impacts on opportunities for habitat restoration in these priority restoration areas.

Applying Adaptive Management To Ecosystem Restoration			An adaptive management approach to ecosystem restoration should be used to plan for and assess the ecological outcomes of the restoration action. The following is a hypothetical example of how the Council's three-phase and nine-step adaptive management frame-work (see Appendix C) could be applied to an ecosystem restoration project in the Cache Slough Complex.
Adaptive Management Step			**Hypothetical Cache Slough Ecosystem Restoration Project**
Plan	1	Define/redefine the problem	The Cache Slough Complex includes high biodiversity; however, ecological processes and habitat that benefit native species in the Cache Slough Complex are degraded.
Plan	2	Establish goals, objectives, and performance measures	**Goal:** Re-establish natural ecological processes and habitats to benefit native species in the Cache Slough Complex. **Objective:** Re-establish the hydrologic, geomorphic, and ecological processes necessary for the long-term sustainability of native habitats, and the plant and animal communities that depend upon them. Improve floodplain connectivity and aquatic habitat quality for native estuarine species, including delta smelt, longfin smelt, Sacramento splittail, and Chinook salmon, by offering a suite of natural habitats and improving the food web fish require.
Plan	3	Model linkages between objectives and proposed action(s)	The Cache Slough Complex provides high potential for restoration success because of its physical and biological attributes (such as tidal range, elevation, high amounts of suspended sediment, abundant zooplankton, and observed use by delta smelt). It is hypothesized that improved vernal pool and grassland habitats along with broad nontidal, freshwater, emergent-plant-dominated wetlands that grade into tidal freshwater wetland, shallow subtidal, and deep open-water habitat will increase the amount and quality of food for native species in the estuary. It is hypothesized that restoring tidal channel, wetland, and upland networks will improve conditions for native fishes. It is hypothesized that increases in the quality and quantity of food for native species will lead to increases in native species populations in the estuary. Native species expected to benefit from this restoration include delta smelt, juvenile Chinook salmon, Sacramento splittail, and longfin smelt.
Plan	4	Select action(s) (research, pilot, or full-scale) and develop performance measures	Pilot-scale restoration project in the Cache Slough Complex: restore a subset of the processes supporting the creation of tidal channel, wetland, and upland networks to support native fishes. Performance measures: ▪ Administrative – Properties are identified for the pilot study. Funding sources and budgets for the project and monitoring are in place. Properties are acquired. Restoration planning and design is completed. Environmental compliance permits are obtained. Restoration contractors are selected. ▪ Output – Pilot-scale Delta habitat restoration project is implemented. Progress toward restoring diverse and interconnected habitats for native resident and migratory species in the Cache Slough Complex. ▪ Outcome – Progress toward achieving viable populations of native resident and migratory species. Trends in native Delta species are upward over the next decade.
Do	5	Design and implement action(s)	Design and implement the pilot-study restoration project.
Do	6	Design and implement monitoring plan	Design and implement the monitoring plan, including baseline monitoring of food abundance for pelagic organisms. Monitor the extent and quality of targeted habitats, connectivity of habitats, and abundance and diversity of species.
Evaluate and Respond	7	Analyze, synthesize, and evaluate	Analyze, synthesize, and evaluate the status and trends of changes in habitats, connectivity of habitats, abundance, and species health and diversity.
Evaluate and Respond	8	Communicate current understanding	Provide project manager(s) and decision makers with annual reports of synthesized information learned. For example, provide a score card of the status and trends of species abundance and diversity, habitat connectivity, and so on.
Evaluate and Respond	9	Adapt	The managers and implementers of the restoration project reconsider their understanding of the problem statement and conceptual model, and decide whether or not to expand from a pilot-study project to a larger-scale restoration effort.

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Migratory Corridors for Native Species

Habitat restoration often targets resident species that use the restored habitat year-round. Successful restoration, however, must also consider species that only periodically use particular habitat patches and corridors. The historical Delta provided migration corridors and rearing habitat for many migratory bird and fish species, including the threatened greater sandhill crane, many species of ducks and geese, salmon, sturgeon, and the introduced striped bass.

In the past, the Delta was a migration route and also an important nursery area for young salmon (or "smolts"). Much of the Delta today presents real risks to migrating salmon; it is no longer a suitable nursery for salmon smolts (Williams 2006). Some Delta channels do provide a greater chance of fish survival than others. For example, salmon leaving the Sacramento River and entering the interior Delta through the Delta Cross Channel have significantly lower survival than fish that stay in the river (Newman 2008), demonstrating that the central Delta has become a gauntlet of risk instead of a viable migratory corridor.

Entrainment at the CVP and SWP southern Delta pumps and increased predation kill salmon smolts. Toxic contaminants and periods of low dissolved oxygen can be harmful. Important factors for route selection and survival of salmon smolts on their way to the ocean include differences in flows through different channels, feeding opportunities, growth rates, and vulnerability to predation (Perry et al. 2009).

On their way back from the ocean to spawn, adult salmon must navigate a maze of Delta waterways where water from many different sources is mixed in artificially connected channels, and where rivers sometimes flow backward (reverse net flows in Old and Middle rivers; see the Delta Flows section) (Monsen et al. 2007). A unique problem is presented by the San Joaquin River, whose polluted and reduced flows are often drawn to the SWP and CVP pumps as a result of reverse flows. During these times, almost no water from the San Joaquin River reaches the confluence with the Sacramento River. Instead, water from the Sacramento River and its tributaries fills most of the Delta, obscuring and confusing the chemical and flow cues that salmon and other migratory fish depend on to find their destinations.

In addition to altered water flow and chemical disruption, migratory fish encounter dams, reservoirs, and other physical barriers that hinder their historical migration. The most formidable barriers are upstream on the Sacramento and San Joaquin rivers and their tributaries, especially the many large and small dams associated with reservoirs, including Shasta, Folsom, and Millerton lakes and Lake Oroville. In the Central Valley, less than one-fifth of the historical spawning habitat is still accessible to Chinook salmon and steelhead (Reynolds et al. 1993, Yoshiyama et al. 1996).

Physical barriers in the Delta help maintain water supplies for agriculture but interrupt fish migration; structures with ledges and drops, such as bridge pilings, boat docks, narrow channels with riprapped edges, or the intakes of the SWP and CVP pumps, create attractive spots for predatory fish to feed on migrating species. The Delta Cross Channel is an example. Sometimes, a barrier can have positive effects. Federal, State, and local officials have recently tested novel bio-acoustic fish fences (BAFFs) at Old River and Georgiana Slough that use light, sound, and air bubbles to steer migrating fish into channels that are thought to provide better habitat and a greater chance of survival.

Some high-quality migratory fish rearing and migration habitat remains at the margins of the Delta, if not in its core. The Yolo Bypass and Cosumnes River floodplains provide good migratory and rearing habitat for salmon, and important habitat for other native fish, birds, and bats. DFW manages the Vic Fazio Yolo Wildlife Area, a 16,000-acre public-private restoration project in the Yolo Bypass, to promote waterfowl and other bird populations. The 46,000-acre Cosumnes River Preserve is jointly owned and operated by The Nature Conservancy, Ducks Unlimited, the Bureau of Land

Management, DFW, DWR, Sacramento County, and private owners to create, enhance, and protect a variety of habitats. These are good illustrations of ecosystem and flood risk reduction projects working together. Wildlife-friendly agriculture also occurs in these floodplain preserve areas and their surroundings. During winter and early spring floods, these floodplains provide plentiful food for migrating salmon and native fish such as splittail, prickly sculpin, and Sacramento sucker (Sommer et al. 2001, Crain et al. 2004). Salmon migrating through these floodplains grow faster and have greater survival. (See sidebar, Better Habitat Equals Greater Growth.) Native fish do particularly well when flows through these floodplains follow more natural patterns. Early February through April, strong flood flows with cool water temperatures benefit many young native fish. Nonnative fish benefit more from later and lower flows with higher temperatures. Floodplain restoration should thus focus on early flooding followed by careful draining. This provides important migration and nursery habitat for native species while keeping nonnative species, including predators, at bay.

BETTER HABITAT EQUALS GREATER GROWTH

This comparison illustrates faster growth in floodplain habitat compared to river habitat. Salmon on the left were reared within Cosumnes River channel habitat, and the salmon on the right were reared within Cosumnes River floodplain habitat. All salmon shown are the same age.

Source: Jeffres et al. 2008

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Actions above and below the Delta also complement actions in the Delta to restore migratory corridors for fish and wildlife. The Bureau of Reclamation, U.S. Fish and Wildlife Service, and DFW have modified Shasta Dam to release colder water for salmon and trout, removed barriers to fish migration such as the Red Bluff Diversion Dam, screened water diversions to reduce entrainment, restored riparian habitats at the Sacramento River National Wildlife Refuge (NWR) and San Joaquin River NWR, and improved habitats in Sacramento and San Joaquin river tributaries where salmon spawn. Efforts to restore flows in the San Joaquin River also can rebuild these migratory corridors.

For example, on Battle Creek, actions to remove multiple dams and fish ladders are being implemented through the Battle Creek Salmon and Steelhead Restoration Project. The primary objective of the restoration project is to restore the ecological processes that would allow the recovery of steelhead and Chinook salmon populations in Battle Creek while minimizing the loss of clean and renewable hydroelectric power through modifications to the hydroelectric project. This project is among the largest coldwater anadromous fish restoration efforts in North America and will restore approximately 42 miles of habitat in Battle Creek and an additional 6 miles of habitat in its tributaries. It will also help restore critically imperiled winter- and spring-run Chinook salmon and Central Valley steelhead. Additional restoration actions are planned for other Sacramento River tributaries including Clear Creek, Deer Creek, and Mill Creek.

On the mainstem of the San Joaquin River between Friant Dam and its confluence with the Merced River, the San Joaquin Settlement Agreement will increase flows, expand channel capacity, and remove barriers to migration to restore spring-run Chinook salmon runs. This long-term action is expected to occur in stages over 20 years. On the Tuolumne River, the largest tributary of the San Joaquin River, the Central Valley Project Improvement Act (CVPIA)

Restoration Plan actions focus on restoring spawning, rearing, and floodplain habitat. The Bobcat Flat Restoration Project includes excavation of 48,500 cubic yards of gravel and coarse material that will be used to restore 1.6 miles of fall-run Chinook salmon and Central Valley steelhead spawning and rearing habitat. Similar habitat restoration projects have been implemented or are planned on other tributaries of the San Joaquin River and the Delta, including the Merced, Stanislaus, Calaveras, and Mokelumne rivers. However, 16 years after the creation of the CVPIA restoration fund, a panel of independent scientists issued a report on the CVPIA Fisheries Program (Reclamation and USFWS 2008) concluding that more could be done to effectively address the most serious impediments to survival and recovery of salmonids.

Wetlands bordering San Pablo Bay downstream of the Delta are home to a host of native and nonnative fish, waterfowl, shorebirds, other wildlife, and endangered plants and important stopping points on the Pacific Flyway. Uncommon species found in and around San Pablo Bay wetlands include longfin smelt, delta smelt, salt marsh harvest mouse, California clapper rail, San Pablo song sparrow, and black rail. All Central Valley anadromous fish migrate through the bay and depend on its open water and marshes for some critical part of their life cycle. The bay and its adjacent marshes are also important nursery grounds for many marine, estuarine, and anadromous fish. More than 40,000 acres of diked baylands and wetlands bordering the San Pablo Bay have been protected and are being restored.

In the Sacramento and San Joaquin valleys, actions to protect, restore, and enhance wetlands carried out by the Central Valley Joint Venture have significantly increased wildlife habitat resources for migratory waterfowl, shorebirds, waterbirds, and riparian songbirds in accordance with conservation actions identified in the Joint Venture's Implementation Plan. The Joint Venture establishes population objectives for these migratory birds then determines the appropriate amount of food, habitat, and water supply necessary to meet the objectives. Wetland restoration becomes a priority when habitat and forage needs for population objectives are not being met.

Successful recovery of native species requires effective habitat restoration. In addition to restoring physical habitat and corridors for movement, reducing other stressors is important too. Together, they help in achieving the coequal goal of a healthier Delta ecosystem.

Riparian and Shaded Riverine Aquatic Habitat

Fish and birds migrating through the Delta need abundant floodplains and appropriate water flows; but they also need streamside trees and shrubs that shade and cool the rivers; undercut riverbanks where smolts and other small fish rest and hide; and trees that drop insects and leaves that contribute to the food web and provide cover, food, and nest sites for songbirds and other wildlife. Unfortunately, along most of the Sacramento and San Joaquin rivers, levees are near the water's edge, not set back from rivers, leaving little room for these habitat features, which often are provided only by trees growing immediately adjacent to or even on the levees themselves.

Because of the importance of these streamsides, water supply or flood risk policies and projects that affect the Delta's rivers and other channels should consider the impact on remaining riparian and shaded riverine habitat. Setting back levees can create additional area for habitat and increased capacity for flood flows. Setting back levees, however, can be expensive and difficult. At the same time, there is considerable controversy over the current policy of the U.S. Army Corps of Engineers (USACE) to require removal of trees and most shrubs from levees under their jurisdiction. A technical manual issued by the Federal Emergency Management Agency (FEMA) for earthen dams has been relied upon heavily to support this vegetation removal policy (FEMA 2005). There is little riverine habitat left. If implemented as proposed, the USACE's order would destroy much of what remains. The Delta Plan calls for the

USACE to reconsider and change its policy in order to protect riverine habitat.

Safe Harbor Agreements

Voluntary safe harbor agreements between wildlife agencies and landowners can contribute to the recovery of species protected by the State or federal Endangered Species Acts. These agreements assure the landowners that the presence of endangered species on their property will not result in restrictions on other activities undertaken on their land. Facilitating and creating standard rules for these agreements with Delta landowners may encourage more landowners to participate in conservation programs.

Suisun Marsh and the Bay Conservation and Development Commission

The Suisun Marsh is one of the Delta Plan's priority habitat restoration areas. It is one of the largest contiguous estuarine wetlands in North America; an important nursery for fish; a wintering and nesting area for waterfowl and waterbirds; and an essential habitat for plants, fish, and wildlife, including several scarce and sensitive species. Suisun Marsh offers unique restoration opportunities because of its position in the Delta ecosystem and the diversity of physical processes it hosts. Suisun Marsh harbors a greater percentage of native fish than the remainder of the Delta, in part because its brackish water limits nonnative species. Additionally, the marsh has many diverse tidal sloughs that provide options for food and refuge (Moyle et al., 2010).

Unlike the deeply subsided Delta, much of the Suisun Marsh is still at elevations suitable for restoration of intertidal habitat, including tidal marsh and shallow water habitat. This area provides the brackish portion of the estuary with the potential to support productive and complex food webs, and with space to adapt to sea level rise. State and local land use policies should reflect the unique role that Suisun Marsh can play.

The San Francisco Bay Conservation and Development Commission (BCDC) is responsible for protecting San Francisco Bay and its shoreline, including Suisun Marsh, through the San Francisco Bay Plan, as described in Chapter 5. It is developing regional strategies to address the impacts of sea level rise and climate change on the Bay. BCDC provides special protection of the Suisun Marsh under the Suisun Marsh Preservation Act through the Suisun Marsh Protection Plan (SMPP). BCDC recently amended the San Francisco Bay Plan to address climate change and sea level rise. The climate change policy, among other things, incorporates sea level rise projection ranges consistent with those developed by the California Ocean Protection Council (2011) and calls for development of a long-term regional strategy to address sea level rise and storm activity. The SMPP and the Suisun Marsh Local Protection Program should also be amended to address climate change and rising sea level.

Ecosystem Water Quality

Chapter 6 deals with water quality issues and contains many recommendations for action. Impaired water quality makes it much harder to restore a healthy Delta ecosystem. Recommendations in Chapter 6 regarding salinity and environmental water quality cover key linkages between ecosystem restoration and water quality.

Consistently good water quality is crucial for successful restoration of aquatic habitats, sustenance of native plants and animals, and other beneficial uses of Delta water. Salinity should be more consistent, with a naturally variable estuarine hydrograph with high-quality river inflows. Nutrient composition and concentrations should not cause excessive growth of nuisance aquatic plants or blooms of harmful algae, and should support diverse and productive aquatic food webs. Dissolved oxygen levels, water temperatures, turbidity, and other attributes should meet the needs of native species. At all times the Delta should be free of substances that exceed toxic concentrations. Discharge of treated wastewater, urban runoff, or agricultural return flows should not adversely affect the Delta.

Chapter 6 focuses on four key areas where the best available science shows the need to protect and improve water quality to achieve the coequal goals (see Chapter 6 for a complete discussion):

- Requiring Delta-specific water quality protection
- Protecting beneficial uses by managing salinity
- Improving drinking water quality
- Improving environmental water quality

Nonnative Species

Among the world's estuaries, the Delta and San Francisco Bay are among the most invaded by nonnative species (Cohen and Carlton 1998). Some nonnative species have been in the Delta for more than a century and seem to be a permanent feature of the Delta ecosystem. Because it is nearly impossible to eradicate nonnative species once they are established, many can be considered legacy stressors that can be managed but not eliminated.

However, the introduction of any new nonnative species has consequences, particularly for native species. Nonnatives can take over habitat space, compete for food and nutrients, alter food webs, modify the physical habitat structure, or prey upon native species (DFG 2011). In wetlands and riparian areas, nonnative vegetation often crowds out native plants and reduces diversity used by resident and migrating birds and other animals (PRBO CalPIF 2008). The result is that nonnative plants, invertebrates, and fish may replace native species, and that change on their native counterparts is often combined with the other stressors such as altered flow, impaired habitat, and poor water quality.

Significant nonnative species in the Delta include (DFG 2008):

- **Overbite clam.** The overbite clam, a bottom-dwelling filter feeder, entered the Delta in the late 1980s and adapted well to its brackish areas. Overbite clams contribute to the reduction of algae and some invertebrates in the Delta, especially in Suisun Bay (Kimmerer 2006), causing loss at the base of the food web, which contributes to the decline of delta smelt and other open-water fish (Sommer et al. 2007).
- **Asian clam.** The Asian clam was first found in the Delta in 1946 (USGS 2001). This clam does not tolerate saline water, but is abundant in freshwater parts of the Delta and in the mainstems of the Sacramento and San Joaquin rivers. Ecologically, this species can alter channel bottoms and competes with native freshwater mussels for food and space (Claudi and Leach 2000). Overbite and Asian clams cannot be effectively controlled, according to many experts (Healey et al. 2008), but they may be managed by manipulating environmental conditions such as flow or salinity to seasonally control their distribution.
- **Zooplankton.** Surveys of Delta waters reveal that introduced zooplankton, probably discharged in ocean ship ballast water in the San Francisco Bay and Delta, have almost completely replaced the original native zooplankton (Winder and Jassby 2011). The success of nonnative zooplankton species was accompanied by an overall decline in zooplankton biomass and size that suggests a decrease in their nutritional value for fish (Winder and Jassby 2011).
- **Nonnative invasive aquatic plants.** The floating water hyacinth, imported as a landscaping plant, proliferated in the Delta in the early 1980s. The Brazilian waterweed was introduced in the 1960s, probably from home aquariums, but did not reach nuisance levels until after the 1987-1992 drought (Jassby and Cloern 2000). These and other nonnative aquatic weeds in the Delta, including water pennywort, Eurasian water milfoil, and parrot feather, pose serious problems to native plants and animals, and hinder boating. The weeds flourish in a wide area where they act as powerful "ecosystem engineers" (Jones et al. 1994, Breitburg et al. 2010) through alteration of habitats, sometimes creating dense mats or thickets that displace native plants, reduce the food web

productivity, reduce turbidity, and interfere with water conveyance and flood control facilities. These invasive plants benefit nonnative predatory fish like largemouth bass. Areas of dense, submerged aquatic vegetation (SAV) may reduce the abundance of native fish larvae and adults (Grimaldo et al. 2004, Nobriga et al. 2005, Brown and Michniuk 2007). Restoration of aquatic habitats must be designed and managed to reduce nonnative SAV if conservation goals are to be met (Nobriga and Feyrer 2007).

- **Bass and sunfish.** Several species of nonnative fish have been introduced in the Delta. Largemouth and smallmouth bass, sunfish including bluegills and warmouth, crappies, and other fish in the centrarchid family are the best examples. They prey on salmon smolts, smelt, and other native fish. The increase in SAV, especially in and around "flooded islands" in the central Delta, enhances bass and bluegill populations (Brown and Michniuk 2007) and possibly populations of other nonnative predators (Grimaldo et al. 2009). Centrarchids harm native fish through predation and competition (Nobriga and Feyrer 2007, Brown and Michniuk 2007). The distribution of centrarchids may be modified by managing conditions such as water velocity, nutrients, salinity, and turbidity to reduce SAV.

The invasion of nonnative species is in the category of globally determined stressors because these species' arrival in the Delta is the result of large-scale natural processes and human activities that are beyond the purview of the Delta Plan. Nonnative species have persisted because they found favorable environments in which to live. Native species are adapted to the varied, complex floodplains, marshes, and other habitats of the historical Delta, with its tidal currents and river flows that constantly change physical, chemical, and biological conditions. In contrast, the stabilized flow pattern, altered habitats, and impaired water quality of the modern Delta often favor nonnative species. Reducing the impacts of nonnative species in the Delta will require addressing flow alterations, pollution (especially nutrients), and physical habitat characteristics.

Future invasions by zebra and quagga mussels are likely and will require considerable preparation, followed by interagency coordination and action. These mussels are an example of an "anticipated stressor" under the Delta ISB's classification of stressor types. Neither has been observed in the Delta yet, but they have proven to be highly invasive when conditions are right. They pose threats comparable to threats from the overbite and Asian clams. They can colonize hard and soft surfaces, often in large densities (greater than 2,800 individuals per square foot) that impede the flow of water through canals and pipes. These mussels also remove particulates in the water, unnaturally enhancing water clarity.

Once introduced, nonnative species are difficult and expensive to control, and often impossible to eradicate. The California Department of Boating and Waterways supports programs to control Brazilian waterweed and water hyacinths where they hinder boating, but only where conditions create the worst nuisances. The best way to prevent new infestations is to avoid the introduction of new species. Improvements in managing ballast water by shipping companies have been instituted recently, but likely more needs to be done.

There is no agreement about the value—or lack of value—of nonnative species. Opinions vary depending on the species and the interest of Delta users. Striped bass are nonnative but prized for their sport and economic value. Introduced to the Delta in the nineteenth century, they prey on native open-water fish such as delta smelt, longfin smelt, and juvenile salmon and steelhead. Striped bass are at the center of an ongoing debate about whether fishing regulations for introduced species should conserve the fish or should be less restrictive to reduce their abundance (DFG 2011).

The draft Ecosystem Restoration Program (ERP) Conservation Strategy acknowledges that many nonnative species will likely remain in the Delta, and emphasizes prevention and adaptation strategies such as public education, preventing establishment of additional nonnative species, and reducing the impacts of established nonnative species. DFW issued its *California Aquatic Invasive Species Management Plan* in 2008, which aims to coordinate the various State efforts to minimize harmful ecological, economic, and human health impacts from aquatic invasive species (DFG 2008).

Hatcheries and Harvest Management

In the Delta, people have harvested fish and shellfish for millennia. Today, fishing, crabbing, crawdadding, and clamming are important recreation activities. Central Valley salmon—most raised in hatcheries—migrate through the Delta and support an economically and culturally important coastal fishery. In the Delta and its tributary rivers, recreational fishing for salmon, sturgeon, striped bass, largemouth bass, shad, and other fish attracts anglers from throughout California and the world. Fishing in the Delta is a centerpiece of the unique cultural, recreational, and natural heritage that makes the Delta a special place (see Chapter 5).

The use of hatcheries to breed fish and regulations to limit overfishing have long been important tools for aquatic resource management. But they carry their own risk. Hatcheries can allow interbreeding, weakening the genetic fitness of a fish species (Israel et al. 2011). Harvest of hatchery-enhanced fish stocks can pose additional risks to native species. Overfishing itself reduces genetic diversity. Fishing regulations generally protect fish from overharvest, but regulations can also help or hurt other fish species. For example, DFW recently proposed changes to striped bass sport fishing regulations to allow greater harvest of striped bass in the hopes of reducing bass predation on native fish, especially salmon. These changes were rejected by the Fish and Game Commission, but it is likely other regulations will be recommended, particularly as the emphasis on saving native fish from nonnative invasives continues. Future proposals should be based on an improved understanding of anglers' behavior as well as a better understanding of the likely response in populations of striped bass and other predators. Harvest regulations and management practices must consider broader effects on nontarget species, including other predators, and the ecosystem.

Striped bass, for example, are not the only animals that prey on salmon. Predators are natural parts of any ecosystem, and predation is a basic ecosystem process. Fish predators in the Delta include many water birds, mammals, and fish such as native pikeminnows and introduced largemouth bass, smallmouth bass, striped bass, catfish, and other species. Nonnative fish consume salmon and other species of concern in the Delta and its tributaries (Lindley and Mohr 2003). Acoustic tagging studies in the San Joaquin River and southern Delta suggest significant predation on hatchery-reared salmon smolts. Survival of tagged salmon smolts released in the lower San Joaquin River was estimated to be only 5 percent in 2010, with much of the loss attributed to predation (San Joaquin River Group Authority 2010). However, despite the evidence of locally high predation, the overall contribution of predation to the decline of salmon, steelhead, and smelt populations is not clear, and the effect of predator controls will remain uncertain without additional study.

Hatchery Management

Another important tool for harvest management is raising fish in hatcheries, later to be released into natural waterways.

In California, hatcheries are particularly important to compensate for dams that block migration routes for salmon and steelhead (see previous Ecosystem Restoration section). The first salmon hatchery in the state was on the McCloud River. Today, California hosts two federal and twenty-one State hatcheries for salmon, steelhead, or trout. In recent years, "conservation hatcheries" for various threatened and endangered species were considered to prevent extinction of a species while restoration and stressor reduction activities are under way.

Hatcheries are important tools, but they involve genetic and ecological risks:

- **Genetic risks.** Human intervention in the rearing of wild animals has the potential to cause genetic change in fish such as salmon (Israel et al. 2011). These changes can impact fish diversity and the health of fish populations. Inbreeding in a fish hatchery can occur when a limited stock is used at the hatchery. Inbreeding can affect the survival, growth, and reproduction of fish. Ironically, conditions in the hatchery may favor fish that best survive in hatchery, not natural, environments. When released, hatchery-produced fish mix with naturally spawned fish, resulting in a lower survival rate once fish are released into rivers and streams. Finally, loss of genetic diversity is a documented effect of overfishing (Holmes 2011), which some have suggested is encouraged by the use of hatchery fish.

- **Ecological risks.** Wild and hatchery fish of the same species often compete in nature. For example, wild and hatchery-reared Chinook salmon share the same habitat and diet. Hatchery-released salmon are larger than wild salmon, resulting in possible predation on wild salmon of the same age. Hatchery production of salmon masks the decline of wild salmon, contributes to the genetic dilution and loss of wild salmon, and increases competition for limited freshwater and ocean resources on which wild salmon depend (McGinnis 1994). Throughout the world, overfishing has led to collapsing fish stocks and food web disruptions (Pauly et al. 1998). Hatchery and harvest effects often also interact. Harvest of salmon from waters where both hatchery and wild fish occur has put wild salmon and steelhead at risk (Lackey 2003). Wild salmon mortalities occur even with controlled fishing regulations. A portion of all fish released after being hooked and caught do not survive. Capture methods such as use of barbless hooks and use of landing nets can help reduce mortality of released fish.

Hatcheries and harvest are not the root problem of species declines in the Delta and Central Valley (DFG and NMFS 2001). Despite considerable fishing pressure in the first part of the twentieth century, striped bass, salmon, and steelhead remained abundant in California. Large declines followed the construction of dams on almost all Central Valley rivers, which greatly reduced access to spawning and rearing habitat. Once fish populations are low and habitat is damaged, their harvest can be an especially important control factor. Hatcheries were intended to substitute for lost spawning and rearing habitat, but nature cannot be so easily mimicked. Artificial propagation can provide abundant fish for restocking, but it cannot replace the abundance, productivity, life history diversity, and broad distribution of viable populations. Successful hatchery propagation will work best if it goes hand in hand with habitat restoration. Ultimately, fish produced in hatcheries must thrive and naturally reproduce once they have left the hatchery (Israel et al. 2011). Accordingly, close attention needs to be paid to genetic management to reduce genetic risks.

Hatchery and harvest regulations, and management practices related to those regulations must be based on the best available science and follow adaptive management protocols for monitoring and evaluating the results. Evaluations of hatchery fish impacts would be aided by better hatchery fish-marking techniques and more extensive marking.

POLICIES AND RECOMMENDATIONS

Policies and recommendations for restoring the Delta ecosystem include the following core strategies to reduce the impact of ecosystem stressors:

- Create more natural functional Delta flows
- Restore habitat
- Improve water quality to protect the ecosystem
- Prevent introduction of and manage nonnative species impacts
- Improve hatcheries and harvest management

Success of Delta ecosystem restoration depends on considering and addressing all stressor categories as well as completing and implementing the BDCP described in Chapter 3. Because reducing or eliminating some stressors, especially the globally determined and legacy stressors, will be difficult, adaptation to unmitigable stressors is also imperative.

Create More Natural Functional Flows

Water flow in the Delta is critically important because flow affects the reliability of water supplies and the health of the Delta ecosystem. The best available science demonstrates that flow management is essential to restoration of the Delta ecosystem. Several important ecosystem stressors, including entrainment, are linked to altered water flows. Greater reverse flows in the south Delta increase the numbers of fish entrained.

Problem Statement

Altered flows in the Sacramento and San Joaquin rivers and their tributaries change flows within and out of the Delta, and affect salinity and sediment in the Delta. Fish and other aquatic species native to the Delta are adapted to natural flow, salinity, and sediment regimes. Current flow, salinity, and sediment regimes harm native aquatic species and encourage nonnative species. The best available science suggests that currently required flow objectives within and out of the Delta are insufficient to protect the Delta ecosystem (SWRCB 2010). Additionally, uncertainty regarding future flow objectives for the Delta impairs the reliability of water supplies that depend on the Delta or its watershed. The predictability of water exports cannot be improved, and the BDCP cannot be implemented without timely SWRCB action to update flow objectives.

Policy

ER P1. Delta Flow Objectives

(a) The State Water Resources Control Board's Bay Delta Water Quality Control Plan flow objectives shall be used to determine consistency with the Delta Plan. If and when the flow objectives are revised by the State Water Resources Control Board, the revised flow objectives shall be used to determine consistency with the Delta Plan.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, the policy set forth in subsection (a) covers a proposed action that could significantly affect flow in the Delta.

23 CCR Section 5005
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85054, 85086, 85087, 85300, and 85302, Water Code.

Recommendations

ER R1. Update Delta Flow Objectives

Development, implementation, and enforcement of new and updated flow objectives for the Delta and high-priority tributaries are key to the achievement of the coequal goals. The State Water Resources Control Board should update the Bay Delta Water Quality Control Plan objectives as follows:

(a) By June 2, 2014, adopt and implement updated flow objectives for the Delta that are necessary to achieve the coequal goals.

(b) By June 2, 2018, adopt, and as soon as reasonably possible, implement flow objectives for high-priority tributaries in the Delta watershed that are necessary to achieve the coequal goals. [1]

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[1] SWRCB staff should work with the Council and DFW to determine priority streams. As an illustrative example, priority streams could include the Merced River, Tuolumne River, Stanislaus River, Lower San Joaquin River, Deer Creek (tributary

Flow objectives could be implemented through several mechanisms including negotiation and settlement, Federal Energy Regulatory Commission relicensing, or adjudicative proceeding. [2]

Prior to the establishment of revised flow objectives identified above, the existing Bay Delta Water Quality Control Plan objectives shall be used to determine consistency with the Delta Plan. After the flow objectives are revised, the revised objectives shall be used to determine consistency with the Delta Plan.

Restore Habitat

Loss of habitat is one of the largest stressors to the Delta ecosystem. The Delta Plan adopts the approach of the multiagency ERP Conservation Strategy (DFG 2011), which includes a map and accompanying text identifying appropriate habitat restoration types within the Delta and Suisun Marsh based on land elevation, included in the Delta Plan within Appendix B. Delta Plan Figure 4-6 is based on the ERP Conservation Strategy map. Policy ER P3 requires habitat restoration actions to use this figure and accompanying text (see Appendix B for additional information). For example, restoring tidal marsh habitat would generally not be appropriate outside the areas labeled "intertidal" on Figure 4-6 unless they connect other tidal marshes into large habitat areas or can recover elevation over time by natural processes.

An integrated, adaptive approach to restoring habitat must address several issues. Each problem statement below highlights one of these issues, followed by specific policies and recommendations intended to address it.

Problem Statement

Features of the Delta landscape, particularly the condition of its waterways, the elevation of its land, and other environmental conditions, have changed dramatically over the past 160 years. Damage to the habitats that support native species in the Delta has led to declines in native animal and plant populations, affecting both resident and migratory species.

to Sacramento River), Lower Butte Creek, Mill Creek (tributary to Sacramento River), Cosumnes River, and American River. Implementation through hearings is expected to take longer than the deadline shown here.

[2] Implementation through adjudicative proceedings or FERC relicensing is expected to take longer than the deadline shown here.

Policies

The appendices referred to in the policy language below are included in Appendix B of the Delta Plan.

ER P2. Restore Habitats at Appropriate Elevations

(a) *Habitat restoration must be carried out consistent with Appendix 3, which is Section II of the* Draft Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions *(California Department of Fish and Wildlife 2011). The elevation map attached as Appendix 4 should be used as a guide for determining appropriate habitat restoration actions based on an area's elevation. If a proposed habitat restoration action is not consistent with Appendix 4, the proposal shall provide rationale for the deviation based on best available science.*

(b) *For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that includes habitat restoration.*

23 CCR Section 5006
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85022, 85054, 85300, and 85302, Water Code.

ER P3. Protect Opportunities to Restore Habitat

(a) *Within the priority habitat restoration areas depicted in Appendix 5, significant adverse impacts to the opportunity to restore habitat as described in section 5006, must be avoided or mitigated.*

(b) *Impacts referenced in subsection (a) will be deemed to be avoided or mitigated if the project is designed and implemented so that it will not preclude or otherwise interfere with the ability to restore habitat as described in section 5006.*

(c) *Impacts referenced in subsection (a) shall be mitigated to a point where the impacts have no significant effect on the opportunity to restore habitat as described in section 5006. Mitigation shall be determined, in consultation with the California Department of Fish and Wildlife, considering the size of the area impacted by the covered action and the type and value of habitat that could be restored on that area, taking into account existing and proposed restoration plans, landscape attributes, the elevation map shown in Appendix 4, and other relevant information about habitat restoration opportunities of the area.*

(d) *For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers proposed actions in the priority habitat restoration areas depicted in Appendix 5. It does not cover proposed actions outside those areas.*

23 CCR Section 5007
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85022, 85054, 85300, 85302, and 85305, Water Code.

Figure 4-7 provides examples of ways a project can implement ER P3.

ER P4. Expand Floodplains and Riparian Habitats in Levee Projects

(a) *Levee projects must evaluate and where feasible incorporate alternatives, including the use of setback levees, to increase floodplains and riparian habitats. Evaluation of setback levees in the Delta shall be required only in the following areas (shown in Appendix 8): (1) The Sacramento River between Freeport and Walnut Grove, the San Joaquin River from the Delta boundary to Mossdale, Paradise Cut, Steamboat Slough, Sutter Slough; and the North and South Forks of the Mokelumne River, and (2) Urban levee improvement projects in the cities of West Sacramento and Sacramento.*

(b) *For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action to construct new levees or substantially rehabilitate or reconstruct existing levees.*

23 CCR Section 5008
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85022, 85054, 85300, 85302, and 85305, Water Code.

Recommendations

ER R2. Prioritize and Implement Projects that Restore Delta Habitat

Bay Delta Conservation Plan implementers, California Department of Fish and Wildlife, California Department of Water Resources, and the Delta Conservancy should prioritize and implement habitat restoration projects in the areas shown on Figure 4-8. Habitat restoration projects should ensure connections between areas being restored and existing habitat areas and other elements of the landscape needed for the full life cycle of the species that will benefit from the restoration project. Where possible, restoration projects should also emphasize the potential for improving water quality. Restoration project proponents should consult the California Department of Public Health's Best Management Practices for Mosquito Control in California.

How Projects Can Comply with ER P3

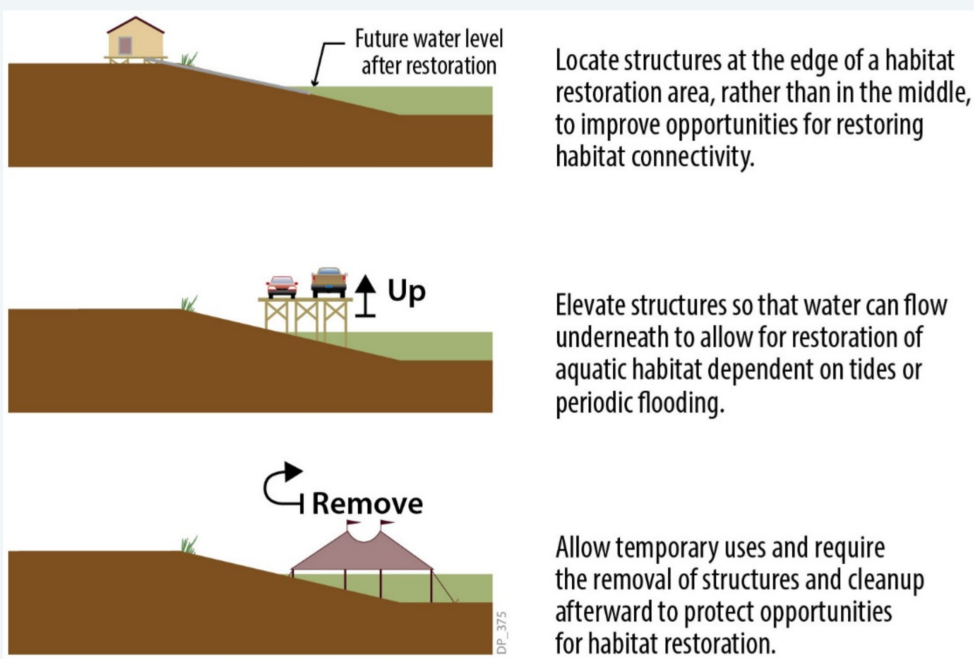

Figure 4-7 ER P3 requires projects located in the priority habitat restoration areas (shown on Figure 4-8) to protect opportunities to restore habitat. This figure shows conceptual examples of how to implement this policy.

Recommended Areas for Prioritization and Implementation of Habitat Restoration Projects

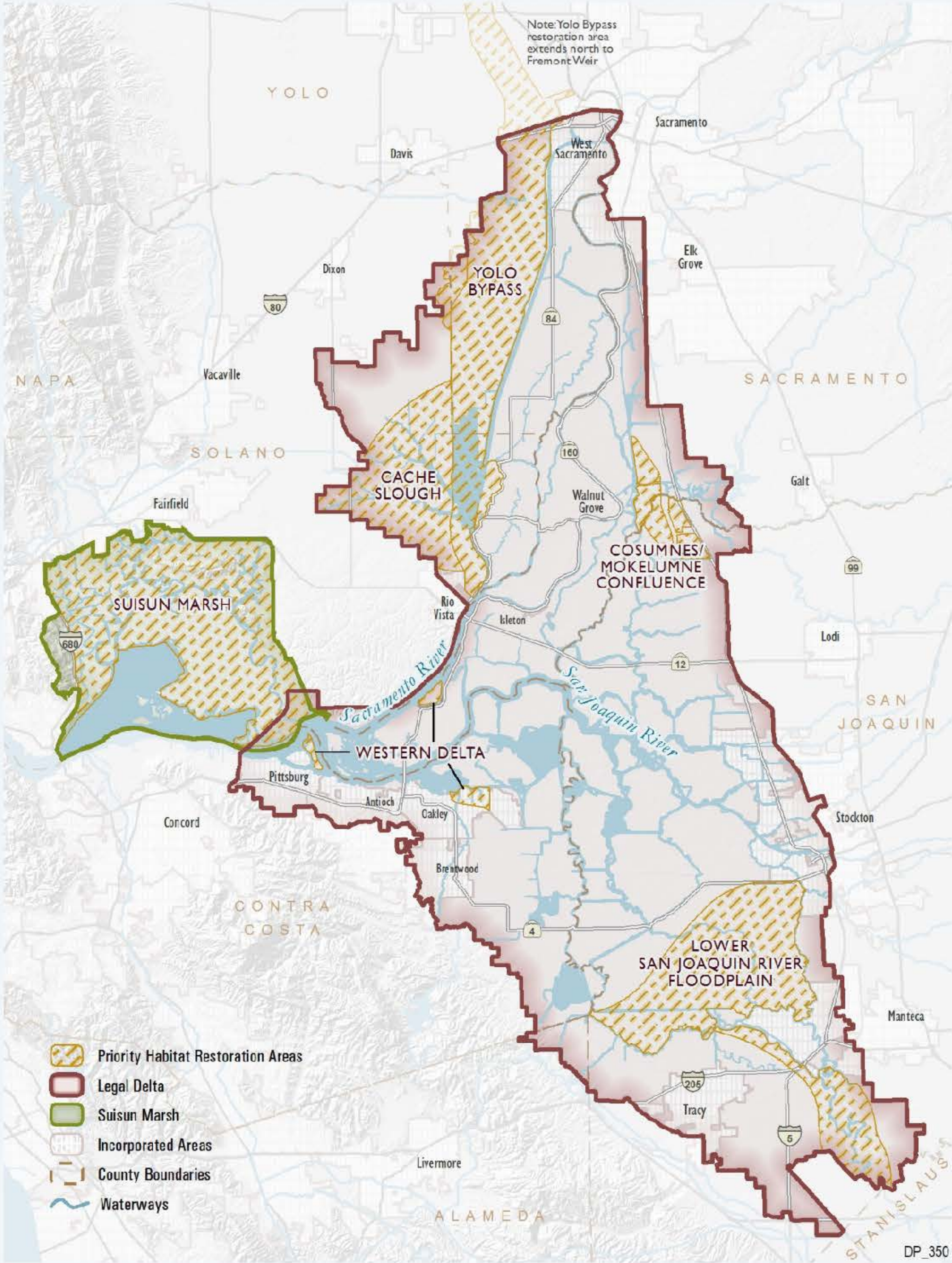

Figure 4-8

Priority habitat restoration areas are large areas within which specific sites may be identified for habitat restoration based on assessments of land use and other issues addressed through further feasibility analysis.

Source: DFG 2011

- ***Yolo Bypass.*** *Enhance the ability of the Yolo Bypass to flood more frequently to provide more opportunities for migrating fish, especially Chinook salmon, to use this system as a migration corridor that is rich in cover and food.*
- ***Cache Slough Complex.*** *Create broad nontidal, freshwater, emergent-plant-dominated wetlands that grade into tidal fresh-water wetlands, and shallow subtidal and deep open-water habitats. Also, return a significant portion of the region to uplands with vernal pools and grasslands.*
- ***Cosumnes River–Mokelumne River confluence.*** *Allow these unregulated and minimally regulated rivers to flood over their banks during winter and spring frequently and regularly to create seasonal floodplains and riparian habitats that grade into tidal marsh and shallow subtidal habitats.*
- ***Lower San Joaquin River floodplain.*** *Reconnect the floodplain and restore more natural flows to stimulate food webs that support native species. Integrate habitat restoration with flood management actions, when feasible.*
- ***Suisun Marsh.*** *Restore significant portions of Suisun Marsh to brackish marsh with land-water interactions to support productive, complex food webs to which native species are adapted and to provide space to adapt to rising sea level action. Use information from adaptive management processes during the* Suisun Marsh Habitat Management, Preservation, and Restoration Plan's *implementation to guide future habitat restoration projects and to inform future tidal marsh management.*
- ***Western Delta/Eastern Contra Costa County.*** *Restore tidal marsh and channel margin habitat at Dutch Slough and western islands to support food webs and provide habitat for native species.*

ER R3. Complete and Implement Delta Conservancy Strategic Plan

As part of its Strategic Plan and subsequent Implementation Plan or annual work plans, the Delta Conservancy should:

- *Develop and adopt criteria for prioritization and integration of large-scale ecosystem restoration in the Delta and Suisun Marsh, with sustainability and use of best available science as foundational principles.*
- *Develop and adopt processes for ownership and long-term operations and management of land in the Delta and Suisun Marsh acquired for conservation or restoration.*
- *Develop and adopt a formal mutual agreement with the California Department of Water Resources, California Department of Fish and Wildlife, federal interests, and other State and local agencies on implementation of ecosystem restoration in the Delta and Suisun Marsh.*
- *Develop, in conjunction with the Wildlife Conservation Board, the California Department of Water Resources, California Department of Fish and Wildlife, Bay Delta Conservation Plan implementers, and other State and local agencies, a plan and protocol for acquiring the land necessary to achieve ecosystem restoration consistent with the coequal goals and the Ecosystem Restoration Program Conservation Strategy.*
- *Lead an effort, working with State and federal fish agencies, to investigate how to better use habitat credit agreements to provide credit for each of these steps: (1) acquisition for future restoration; (2) preservation, management, and enhancement of existing habitat; (3) restoration of habitat; and (4) monitoring and evaluation of habitat restoration projects.*
- *Work with the California Department of Fish and Wildlife and the U.S. Fish and Wildlife Service to develop rules for voluntary safe harbor agreements with property owners in the Delta whose actions contribute to the recovery of listed threatened or endangered species.*

Problem Statement

Current USACE policy requires removal of vegetation from Delta levees, which would reduce already sparse riparian and shaded aquatic habitat along the channels.

Policies

No policies with regulatory effect are included in this section.

Recommendation

ER R4. Exempt Delta Levees from the U.S. Army Corps of Engineers' Vegetation Policy

Considering the ecosystem value of remaining riparian and shaded riverine aquatic habitat along Delta levees, the U.S. Army Corps of Engineers should agree with the California Department of Fish and Wildlife and the California Department of Water Resources on a variance that exempts Delta levees from the U.S. Army Corps of Engineers' levee vegetation policy where appropriate.

Problem Statement

The SMPP and the Local Protection Program components of the SMPP do not yet include climate change provisions. Without these amendments, it is unclear if and how Suisun Marsh will be managed to adapt to rising sea level.

Policies

No policies with regulatory effect are included in this section.

Recommendation

ER R5. Update the Suisun Marsh Protection Plan

The San Francisco Bay Conservation and Development Commission should update the Suisun Marsh Protection Plan *and relevant components of the Suisun Marsh Local Protection Program to adapt to sea level rise and ensure consistency with the Suisun Marsh Preservation Act, the Delta Reform Act, and the Delta Plan.*

Improve Water Quality to Protect the Ecosystem

Chapter 6 includes recommendations about salinity and ecosystem water quality. These recommendations support the protection of water quality for all beneficial uses of water and encourage the identification of water quality impacts of proposed actions. The recommendations also address acceleration of certain total maximum daily loads, low dissolved oxygen, implementation of a Delta Regional Monitoring Program, treatment of wastewater effluent and urban runoff, and Regional Water Quality Control Board engagement in Suisun Marsh.

Problem Statement

The Delta ecosystem is impaired by pollutants from municipal, industrial, agricultural, and other discharges and legacy pollutants flowing into the Delta and its tributaries, including pollutants that bioaccumulate and biomagnify in the food web.

Policies

No policies with regulatory effect are included in this section.

Recommendations

Recommendations for improving ecosystem water quality are included in Chapter 6.

Prevent Introduction of and Manage Nonnative Species Impacts

Problem Statement

Nonnative species are a major obstacle to successful restoration of the Delta ecosystem because they affect the survival, health, and distribution of native Delta wildlife and plants. There is little chance of eradicating most established nonnative species, but management can reduce the abundance of some. The resilience of native species is reduced by ongoing introductions of nonnative species and management actions that enhance conditions for nonnative species.

Policy

ER P5. Avoid Introductions of and Habitat Improvements for Invasive Nonnative Species

(a) The potential for new introductions of or improved habitat conditions for nonnative invasive species, striped bass, or bass must be fully considered and avoided or mitigated in a way that appropriately protects the ecosystem.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that has the reasonable probability of introducing or improving habitat conditions for nonnative invasive species.

23 CCR Section 5009
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85054, 85300, and 85302, Water Code.

Recommendations

ER R6. Regulate Angling for Nonnative Sport Fish to Protect Native Fish

The California Department of Fish and Wildlife should develop, for consideration by the Fish and Game Commission, proposals for new or revised fishing regulations designed to increase populations of listed fish species through reduced predation by introduced sport fish. The proposals should be based on sound science that demonstrates these *management actions are likely to achieve their intended outcome and include the development of performance measures and a monitoring plan to support adaptive management.*

ER R7. Prioritize and Implement Actions to Control Nonnative Invasive Species

The California Department of Fish and Wildlife and other appropriate agencies should prioritize and fully implement the list of "Stage 2 Actions for Nonnative Invasive Species" and accompanying text shown in Appendix J taken from the Conservation Strategy for Restoration of the Sacramento–San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions *(DFG 2011). Implementation of the Stage 2 actions should include the development of performance measures and monitoring plans to support adaptive management.*

Improve Hatcheries and Harvest Management

Problem Statement

Hatcheries and harvest regulation are important tools in fisheries management, but they also pose genetic and ecological risks to native species and the Delta ecosystem. These practices need to employ adaptive management strategies to predict and evaluate outcomes, and minimize risks.

Policies

No policies with regulatory effect are included in this section.

Recommendations

ER R8. Manage Hatcheries to Reduce Genetic Risk

As required by the National Marine Fisheries Service, all hatcheries providing listed fish for release into the wild should continue to develop and implement scientifically sound Hatchery and Genetic Management Plans (HGMPs) to reduce risks to those species. The California Department of Fish and Wildlife should provide annual updates to the Delta Stewardship Council on the status of HGMPs within its jurisdiction.

ER R9. Implement Marking and Tagging Program

By December 2014, the California Department of Fish and Wildlife, in cooperation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service, should revise and begin implementing its program for marking and tagging hatchery salmon and steelhead to improve management of hatchery and wild stocks based on recommendations of the California Hatchery Scientific Review Group, which considered mass marking, reducing hatchery programs, and mark selective fisheries in developing its recommendations.

Timeline for Implementing Policies and Recommendations

Figure 4-9 lays out a timeline for implementing the policies and recommendations described in the previous section. The timeline emphasizes near-term and intermediate-term actions.

Timeline for Implementing Policies and Recommendations

TIMELINE CHAPTER 4: Ecosystem Implementation

	ACTION (REFERENCE #)	LEAD AGENCY(IES)	NEAR TERM 2012–2017	INTERMEDIATE TERM 2017–2025
POLICIES	Delta flow objectives (ER P1)	SWRCB	●	●
	Restore habitats at appropriate elevations (ER P2)	DFW, DWR, Delta Conservancy	●	●
	Protect opportunities to restore habitat (ER P3)	DFW	●	●
	Expand floodplains and riparian habitats in levee projects (ER P4)	DWR, USACE	●	●
	Avoid introductions of and habitat improvements for invasive nonnative species (ER P5)	DFW, DWR, Delta Conservancy	●	●
RECOMMENDATIONS	Update Delta flow objectives (ER R1)	SWRCB	●	●
	Prioritize and implement projects that restore Delta habitat (ER R2)	DFW, DWR, and Delta Conservancy	●	●
	Complete and implement Delta Conservancy Strategic Plan (ER R3)	Delta Conservancy	●	
	Exempt Delta levees from U.S. Army Corps of Engineers' Vegetation Policy (ER R4)	USACE, DWR, DFW	●	●
	Update the Suisun Marsh Protection Plan (ER R5)	BCDC	●	
	Regulate angling for nonnative sport fish to protect native fish (ER R6)	DFW, CA Fish and Game Commission	●	
	Prioritize and implement actions to control nonnative invasive species (ER R7)	DFW	●	●
	Manage hatcheries to reduce genetic risk (ER R8)	DFW	●	●
	Implement marking and tagging program (ER R9)	DFW	●	●

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Agency Key:

BCDC: San Francisco Bay Conservation and Development Commission
BDCP: Bay Delta Conservation Plan
Delta Conservancy: Sacramento-San Joaquin Delta Conservancy
Council: Delta Stewardship Council
DFW: California Department of Fish and Wildlife
DWR: California Department of Water Resources
RWQCB: Regional Water Quality Control Board(s)
SWRCB: State Water Resources Control Board
USACE: U.S. Army Corps of Engineers

Figure 4-9

Issues for Future Evaluation and Coordination

Additional areas of interest and concern related to the Delta ecosystem may deserve consideration in the development of future Delta Plan updates:

- **Landscape-scale conceptual models.** The Delta Science Program will collaborate with other agencies, academic institutions, and stakeholders to develop landscape-scale conceptual models for the six priority restoration areas identified in ER R2.
- **Workshops to address stressor impacts.** The Delta Science Program, in collaboration with other agencies, academic institutions, and stakeholders, will hold workshops to develop additional recommendations to the Council for measures to reduce stressor impacts on the Delta ecosystem that would support and be consistent with the coequal goals. Recommended measures could be adopted as policies or recommendations by the Council into an amended Delta Plan.
- **Above-the-Delta migration corridors.** The Council will consult with fish and wildlife agencies and others as they complete or update plans to restore habitats for migratory species, such as anadromous fish or songbirds in the Sacramento and San Joaquin valleys above the Delta.

Science and Information Needs

The Delta ecosystem is not static; therefore, additional information is needed for decision making and adaptive management. Specifically, the following information is needed in the following areas:

- Landscape-scale conceptual models for Delta ecosystem restoration.
- Assessment of how flows benefit or harm native wildlife and plants.
- Effects of changing habitat quality and quantity on Delta fish and invertebrates. Examples might include (1) threadfin shad in the south and central Delta, (2) comparison of shallow shoal habitat and deep channel habitat to food resources of young striped bass, and (3) relationship between water turbidity and native fish migration, survival, growth, and/or reproduction.
- Hatchery, harvest, and/or predation impacts on natural fish populations.
- Tools to assess native fish response to restored habitats.
- Entrainment effects on fish populations.
- Tools to assess potential impacts of climate change and sea level rise to viability of species in intertidal habitats.

Performance Measures

Development of informative and meaningful performance measures is a challenging task that will continue after the adoption of the Delta Plan. Performance measures need to be designed to capture important trends and to address whether specific actions are producing expected results. Efforts to develop and track performance measures in complex and large-scale systems like the Delta are commonly multiyear endeavors. The recommended output and outcome performance measures listed below are provided as examples and subject to refinement as time and resources allow. Final administrative performance measures are listed in Appendix E and will be tracked as soon as the Delta Plan is completed.

The Delta Reform Act specifies some performance measures for large-scale ecosystem restoration within the Delta. Ecosystem performance measures should address progress in achieving the objectives set forth in Water Code sections 85302(c) and 85302(e).

Note that performance measures for ecosystem water quality are provided in Chapter 6.

Output Performance Measures

- The SWRCB adopts Delta flow objectives by June 2, 2014. (ER R1)
- The SWRCB adopts flow objectives for the major tributaries by 2018 (or soon as reasonably possible). (ER R1)
- Pilot-scale Delta habitat restoration projects are developed and initiated in the priority areas described in ER R2 by 2015. These projects include tidal brackish and freshwater marsh as well as floodplain restoration, and have clear adaptive management plans aimed at improving outcomes and providing lessons for the development of large-scale restoration projects. Metrics: acres restored by habitat type, and lessons learned. (ER R2)
- Progress, measured in acres of restored or enhanced habitat, is being made toward the biological opinions' targets of restoring 8,000 acres of tidal marsh and 17,000 to 20,000 acres of floodplain rearing habitat. (ER R2)
- The DFW and other appropriate agencies fully implement the list of "Stage 2 Actions for Nonnative Invasive Species." (ER R7)

Outcome Performance Measures

- Progress toward restoring in-Delta flows to more natural functional flow patterns to support a healthy estuary. Metrics: results from hydrological monitoring and hydrodynamic modeling. (ER R1)
- Progress toward decreasing annual trends in both the number of new and existing aquatic and terrestrial nonnative species, and the abundance and distribution of existing aquatic and terrestrial nonnative species in the Delta over the next decade. These trends will be derived from long-term animal and plant monitoring surveys conducted by the Interagency Ecological Program agencies, the California Department of Boating and Waterways, the U.S. Department of Agriculture, the San Francisco Estuary Institute, and others. (ER P5)
- Progress toward the documented occurrence and use of protected and restored habitats and migratory corridors by native resident and migratory Delta species. Trends in occurrence, use, and performance of native species in protected and restored habitats and corridors will be upward over the next decade. These trends will be derived from animal and plant monitoring surveys that are conducted as part of adaptive management strategies for the protection and restoration of these areas. (ER R2)
- Progress toward achieving the State and federal "doubling goal" for wild Central Valley salmonids relative to 1995 levels. Trends will be derived from long-term salmonid monitoring surveys conducted by the National Marine Fisheries Service, U.S. Fish and Wildlife Service, and others. (ER R2)

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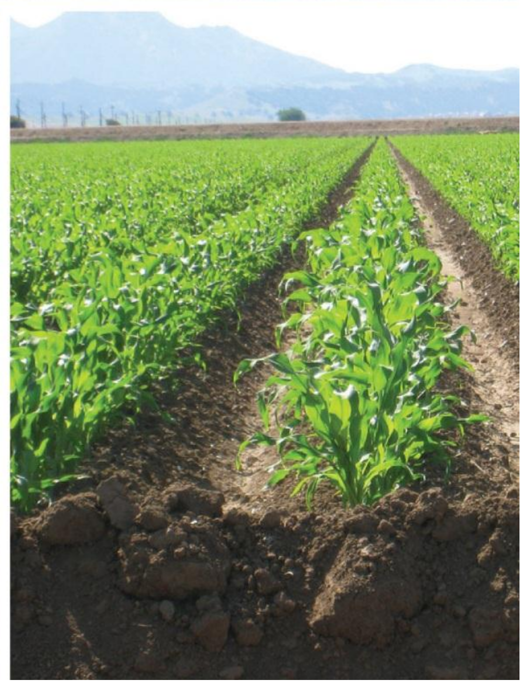
CHAPTER 5

Protect and Enhance the Unique Cultural, Recreational, Natural Resource, and Agricultural Values of the California Delta as an Evolving Place



ABOUT THIS CHAPTER

This chapter describes the unique values that distinguish the Sacramento-San Joaquin Delta (Delta) and make it a special region. It also outlines the Delta Stewardship Council's (Council) five core strategies for protecting and enhancing these values:

- Designate the Delta as a special place worthy of national and state attention
- Plan to protect the Delta's lands and communities
- Maintain Delta agriculture as a primary land use, a food source, a key economic sector, and a way of life
- Encourage recreation and tourism that allow visitors to enjoy and appreciate the Delta, and that contribute to its economy
- Sustain a vital Delta economy that includes a mix of agriculture, tourism, recreation, commercial and other industries, and vital components of state and regional infrastructure

The 2 policies and 19 recommendations to carry out these strategies are found at the end of the chapter. Protecting the Delta as a place also depends on the strategies to reduce flood and other risks to the Delta that are described in Chapter 7.

RELEVANT LEGISLATION

The Sacramento-San Joaquin Delta Reform Act of 2009 declared State policy for the resources and values of the Delta (Water Code section 85054):

> *"Coequal goals" means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.*

The Legislature declares the following objectives inherent in the coequal goals for management of the Delta (Water Code section 85020):

> *(a) Manage the Delta's water and environmental resources and the water resources of the state over the long term.*
>
> *(b) Protect and enhance the unique cultural, recreational, and agricultural values of the California Delta as an evolving place.*

Water Code section 85302(h) provides direction on the implementation of measures to promote the coequal goals and inherent objectives:

> *(h) The Delta Plan shall include recommendations regarding state agency management of lands in the Delta.*

The Delta Reform Act states (Water Code section 85022 (d)):

> *(d) The fundamental goals for managing land use in the Delta are to do all of the following:*
>
> > *(1) Protect, maintain, enhance, and, where feasible, restore the overall quality of the Delta environment and its natural and artificial resources.*
> >
> > *(2) Ensure the utilization and conservation of Delta resources, taking into account the social and economic needs of the people of the state.*
> >
> > *(3) Maximize public access to Delta resources and maximize public recreational opportunities in the Delta consistent with sound resources conservation principles and constitutionally protected rights of private property owners.*
> >
> > *(4) Encourage state and local initiatives and cooperation in preparing procedures to implement coordinated planning and development for mutually beneficial uses, including educational uses, in the Delta.*
> >
> > *(5) Develop new or improved aquatic and terrestrial habitat and protect existing habitats to advance the goal of restoring and enhancing the Delta ecosystem.*
> >
> > *(6) Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.*

Public Resources Code section 29703.5 describes the Delta Protection Commission's role in providing recommendations to the Delta Stewardship Council:

> *(a) The Delta Protection Commission created pursuant to Section 29735 provides an existing forum for Delta residents to engage in decisions regarding actions to recognize and enhance the unique cultural, recreational, and agricultural resources of the Delta. As such, the commission is the appropriate agency to identify and provide recommendations to the Delta Stewardship Council on methods of preserving the Delta as an evolving place as the Delta Stewardship Council develops and implements the Delta Plan.*
>
> *(b) There is a need for the five Delta counties to establish and implement a resources management plan for the Delta and for the Delta Stewardship Council to consider that plan and recommendations of the commission in the adoption of the Delta Plan.*

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CHAPTER 5

Protect and Enhance the Unique Cultural, Recreational, Natural Resource, and Agricultural Values of the California Delta as an Evolving Place

The Delta Reform Act provides that the coequal goals of providing a more reliable water supply and protecting, enhancing, and restoring the Delta ecosystem shall be achieved in a manner that protects the unique cultural, natural, recreational, resource, and agricultural values of the Delta as an evolving place. Achieving this objective begins with recognizing the values that make the Delta a distinctive and special place:

- The Delta's geography of low-lying islands and tracts, many below the water level and shaped by sloughs, shipping channels, and rivers; tidal influences; levees; and other water controls is unique among California landscapes.
- The Delta retains a rural heritage, characterized by farms and small towns linked by navigable waterways and winding country roads.
- The Delta's agricultural economy is vital to the region and contributes to California's important agricultural economy.
- The Delta is a region where maritime ports, commercial agriculture, and expanding cities coexist with a unique native ecosystem that is home to many species of wildlife and fish.
- The Delta is a place of multicultural tradition, legacy communities, and family farms.
- The Delta provides opportunities for recreation and tourism because of its unique geography, mix of activities, and rich natural resources.

The Delta's uniqueness, however, does not exempt it from change. Increasing pressures of growing populations, shifting commodity markets, climate changes, and rising sea level will require new ways of adaptation for this region. Some changes are driven by the Delta's location at the center of California's water systems and are required to meet statewide goals of restoring the Delta's ecosystem and improving water supply reliability. Other changes may be caused by floods, earthquakes, or other events that threaten the Delta's levees and islands. Some changes can be managed by policies that shape how the Delta's traditions are honored and its history preserved; guide new development; enhance recreation and tourism; and encourage agriculture, business expansion, and economic development.

Protecting the Delta as an evolving place means accepting that change will not stop, but that the fundamental characteristics and values that contribute to the Delta's special qualities and that distinguish it from other places can be preserved and enhanced while accommodating these changes (Delta Vision Blue Ribbon Task Force 2008). It does not mean that the Delta should be a fortress, a preserve, or a museum.

The Council envisions a future where the Delta's unique qualities are recognized and honored. Agriculture will continue to thrive on the Delta's rural lands; and its cities, ports, and rural villages will be desirable places to live, work, and do business. Visitors to the region will enjoy recreation on and in its waterways, marshes, resorts, parks, and historic legacy communities. The Delta's land uses and development will be resilient, protecting the rural character of the area, reducing risks to people and property, adjusting to changing conditions, and promoting the ability to recover readily from distress. The Delta's economic vitality will provide resources to respond to change and to support the families and businesses that make the Delta home. The vision of the Delta as an evolving place also acknowledges the role of Delta residents in shaping the future of the region through active and effective participation in Delta planning and management.

Creating a Common Vision of the Delta as a Place

The Delta Reform Act recognizes not only the uniqueness of the region, but also that it is managed and influenced by many State of California (State), federal, and local agencies, often with differing views about the Delta and with overlapping and sometimes conflicting jurisdictions. Through the Delta Plan, the Council intends to foster a common vision for the future of the Delta as a place and to promote more effective coordination among these agencies. (See sidebar, Looking at the Delta.)

Fashioning this common vision has begun by drawing much of the information and many of the strategies of this chapter from these agencies' reports and recommendations, including the following documents:

- The *Proposal to Protect, Enhance, and Sustain the Unique Cultural, Historical, Recreational, Agricultural, and Economic Values of the Sacramento-San Joaquin Delta as an Evolving Place* developed by the Delta Protection Commission (DPC) (DPC 2012a)
- The DPC's *Economic Sustainability Plan for the Sacramento-San Joaquin Delta* (ESP) (DPC 2012b)
- The *Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh* (Recreation Proposal) developed by California State Parks (California State Parks 2011)
- The Sacramento-San Joaquin Delta Conservancy's (Delta Conservancy) *Strategic Plan*

The Public Resources Code (section 29703.5(a)) names the DPC as "the appropriate agency to identify and provide recommendations to the Council on methods of preserving the Delta as an evolving place." The DPC is an agency created in 1992 by the Delta Protection Act to plan for and guide natural resource conservation and enhancement in the legal Delta while sustaining agriculture and meeting increased recreational demand.

LOOKING AT THE DELTA

The Delta presents itself from three vantages that display alternative aspects of its character.

From the water, the Delta is a thicket of sloughs, rock-lined channels, and open waterways where the land lies unseen behind tall levees and riparian vegetation. This is a Delta of recreational boating and oceangoing freighters, piers and lift bridges, diversions and water control structures, fish and diving ducks, resorts and marinas.

Another view of the Delta is a predominantly rural, agricultural landscape dotted with historic villages and where waterways are hidden on the other side of the levee, to be glimpsed only from bridges and levee-top roads. This is a Delta of vineyards, orchards, farm fields, ditches, and waterfowl hunting clubs; of historic farmsteads and one-of-a-kind shops and restaurants; and of farm machinery and bicyclists.

A third view of the Delta looks out from its metropolitan areas: Stockton, Manteca, Lathrop, Tracy, Contra Costa County's shoreline suburbs, Suisun City, Fairfield, Sacramento, and West Sacramento. This is a Delta of downtowns, neighborhoods, and new suburbs; cooling summer breezes and clammy winter fog; waterfront parks and a catch of striped bass in the freezer; and ports, warehouses, offices, and other job sites.

DP-188

As provided in Water Code section 85301, the DPC developed the *Proposal to Protect, Enhance, and Sustain the Unique Cultural, Historical, Recreational, Agricultural, and Economic Values of the Sacramento-San Joaquin Delta as an Evolving Place* (DPC 2012a). This proposal was submitted to the Council for incorporation into the Delta Plan. The proposal includes a plan to recognize the Delta as a place of special significance by applying for a federal designation of the Delta as a National Heritage Area (NHA). The NHA designation is granted by the U.S. Congress to places where natural, cultural, historic, and recreational resources combine to form a distinctive landscape and tell a nationally important story about the country and its experience.

The DPC also recommends strategies to support increased investment in agriculture, recreation, tourism, and other resilient land uses in the Delta. These strategies are derived from the ESP (DPC 2012b). Established in 2009, the Delta Conservancy is responsible for implementing ecosystem restoration projects protecting and preserving agriculture and working landscapes; increasing recreation and tourism opportunities; promoting legacy communities and economic vitality; and protecting, conserving, and restoring the region's physical, agricultural, cultural, historical, and living resources (Public Resources Code section 32322). Careful coordination between the DPC and Delta Conservancy can maximize the impact of both agencies' economic development activities.

Protecting the Delta as an Evolving Place Is Inherent in the Coequal Goals

Protecting the Delta as an evolving place is inherent in the coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. This is partly because attaining these two goals will necessitate a growing awareness among Californians of the Delta and its values, including its agriculture, recreation, natural resources, and unique culture. It is also because Delta residents benefit from the levees that help convey fresh water through the Delta; enjoy the wildlife, fish, and recreation that the Delta ecosystem produces; and work for its water management agencies and facilities. Changes required to provide a more reliable water supply or restore the ecosystem will influence the kind of place the Delta becomes, especially if structures to improve conveyance or areas of restored habitat significantly alter the Delta's familiar farming landscape. At the same time, the needs to protect the Delta's land uses and people will shape and constrain decisions about water supplies and ecosystem restoration, including allocation of water supplies, flow and salinity objectives, levee priorities, and how impacts to communities and land uses are mitigated.

Water for agricultural, municipal, and industrial uses is a key to the Delta as a place. Delta communities are the most dependent of all Californians on Delta water supplies, which support its residents, businesses, and farms. They, like other Californians, can often do more to use water more efficiently and to develop alternative supplies through recycling, conjunctive use of groundwater, or participation in regional water supply projects. Because the communities and economy of the Delta require water of reliable quality as well as amount, updates to the Bay-Delta Water Quality Control Plan have special influence on the region. The Delta is also influenced by other Central Valley water quality plans because they protect the quality of water for Delta consumers, farmers, and recreationists and the costs Delta residents and businesses pay to meet clean water standards.

A healthy ecosystem is also important to the Delta's communities. Residents find joy and relaxation in outdoor recreation and the connection with nature that the Delta ecosystem provides. Visitors drawn to its scenery, waterways, fish, and wildlife support tourism businesses. Protecting the ecosystem maintains these benefits and restoring it can expand them, especially when it can be accomplished in ways that enhance the Delta's working landscape. Coordinating restoration with planning for flood control can help control costs for levee improvement and management, draw on multiple sources of funds for multipurpose flood control investments, and provide alternate uses for areas that cannot be protected cost effectively. Restoring marshes, riverbanks, and riparian areas will alter how some land is used, but the impacts of these changes on the Delta's unique values can be managed through cooperation, careful design to lessen or avoid adverse effects, or reasonable mitigation of unavoidable impacts.

The Delta as a Place

The California Delta is a unique place distinguished by its geography, legacy communities, a rural and agricultural setting, vibrant natural resources, and a mix of economic activities. This section describes the features that make the Delta unique. Its 839,640 acres of land, sometimes centered on a wide river but laced with a network of narrow channels and sloughs, stretch to the horizon, bounded only by the levees that were built to drain the Delta's marshes and floodprone riversides. The Legislature has found that the Delta's uniqueness is particularly characterized by its hundreds of miles of meandering waterways and the many islands adjacent to them, and has described the Delta's highly productive agriculture, recreational assets, fisheries, and wildlife as invaluable resources (Water Code section 12981(b)). These natural assets, including the ecosystem and water resources as described in Chapters 3, 4, and 6, are among the Delta's important values.

The Delta is composed of three areas recognized in California law. The Primary Zone is the largest and includes 490,050 acres at the heart of the Delta (Public Resources Code section 29728). It is primarily rural farmland, but also includes several small towns established in the nineteenth and twentieth centuries. The Secondary Zone includes 247,320 acres surrounding the Primary Zone (Public Resources Code section 29731). It also includes farmland, but is increasingly dominated by the region's cities and suburbs. Suisun Marsh lies northwest of the Primary Zone, encompassing 106,570 acres (Public Resources Code section 29101) primarily of managed wetland. The Suisun Marsh overlaps the boundary of the Delta by about 4,300 acres (see Figure 5-1).

The Legislature has declared that the Delta is a natural resource of statewide, national, and international significance, and that the cities, towns, and settlements within the Delta are of significant historical, cultural, and economic value (Public Resources Code sections 29701 and 29708). However, not all Delta users, visitors, or residents recognize or appreciate the Delta's values. In a recent survey, 78 percent of Californians said they had not heard of or did not know about the Delta (Probolsky Research 2012). A survey in 2007 found that nearly half of Stockton residents had only a vague idea—or none at all—that they lived in or near the Delta (*Stockton Record* 2012).

This lack of a clearly recognized, widely communicated identity for the Delta is described as the lack of a "brand." Delivering a coordinated message about the Delta and its resources is difficult because responsibilities for the Delta are divided among so many agencies. Many visitors and even some residents of Delta cities and suburbs are unfamiliar with the region beyond their travel route or community, or know it only in name from news media reports about conflicts over its water and natural resources. To some, the Delta's flat agricultural landscape is dull and monotonous, and its resources are "out of sight and out of mind." Access into the Delta by first-time visitors can be difficult because of its winding roads and lack of amenities that signify a special region; simplify wayfinding; educate travelers about an area's history, culture, and natural resources; or encourage public access and recreation.

Delta Primary and Secondary Zones and Suisun Marsh

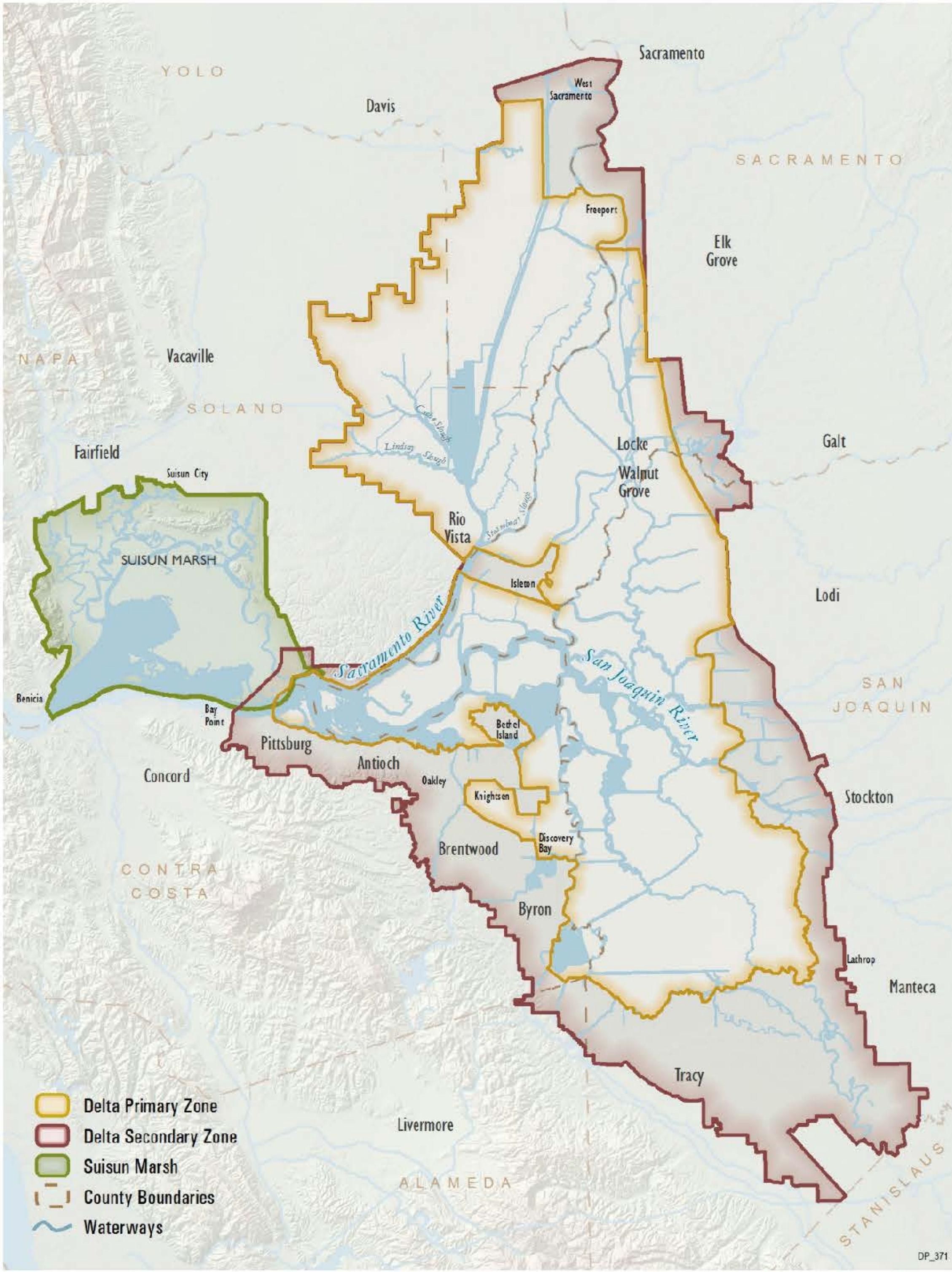

Figure 5-1

The Delta's People

About 570,000 people reside in the Delta, according to the 2010 Census. Ninety-eight percent of them live in the Delta's Secondary Zone, with the remainder in the Primary Zone. Prior to the recent recession, the population of the Delta's Secondary Zone had been growing rapidly, increasing almost 56 percent since the 1990 Census, a rate twice as fast as the state as a whole. Much of that increase occurred in new communities in previously unincorporated county areas, such as Discovery Bay; rapidly growing towns and communities such as Brentwood and Oakley on State Route 4; and cities such as Sacramento, West Sacramento, Stockton, and Lathrop. The age and household composition of the Delta's population is similar to California as a whole, but with slightly younger and larger families. About half the Delta's population is between the ages of 21 and 54, and about 29 percent are younger than 18 years old (DPC 2012b).

In contrast, the population of the Primary Zone has been essentially unchanged over those 20 years. The Primary Zone is also composed primarily of older people without children, living in smaller households.

Today, most Delta residents describe themselves as white or Hispanic, with the next largest groups being Asian, other races, and African-American or black. About one-third describe themselves as Hispanic. This diverse population reflects the many United States regions and foreign lands from which settlers emigrated to the Delta, including Mexico, China, Japan, Portugal, the Philippines, and other countries. These origins are reflected in communities and neighborhoods like Locke, an early twentieth century town built primarily by Chinese farmworkers. Cultural events honor many ethnic traditions in the Delta, including Chinese and Cambodian New Years, Portuguese festas, Greek holidays, Indian Diwali celebrations, Filipino fiestas, Cinco de Mayo events, and Juneteenth commemorations. Other festivals feature Delta agriculture, such as the Courtland Pear Fair and the Stockton Asparagus Festival (California State Parks 2011).

The Delta's Communities

The region's urban communities include the cities of Sacramento, West Sacramento, Stockton, Lathrop, Manteca, Tracy, Oakley, Brentwood, Antioch, Pittsburg, Benicia, Fairfield, Suisun City, Rio Vista, and Isleton, and the unincorporated communities of Freeport, Mountain House, Byron, Discovery Bay, Bethel Island, and Knightsen. They are located entirely or partially in the Delta's Secondary Zone or in the secondary management area of Suisun Marsh. Unincorporated communities in the Primary Zone include Clarksburg, Courtland, Hood, Locke, Walnut Grove, and Ryde. Appendix B includes maps of these unincorporated communities.

The general plans of Delta cities and counties describe where development of these communities may occur. These plans or actions by the local area formation commissions describe "spheres of influence" (SOIs) for each jurisdiction and often identify an urban limit line beyond which intense development cannot occur without amendment of the plan. About 26,000 acres of the Delta within these SOIs are expected to undergo urbanization (DPC 2012b) (see Figure 5-2). To encourage the location of new development within these SOIs rather than in rural areas, Chapter 7 policies exempt development in these areas from policies to increase flood protection standards. The Delta Plan includes no policies or recommendations to control land use or density in these communities.

Among the Delta's unincorporated communities, Bethel Island warrants a special note because of its flood risks, the development planned there, and its lack of public services. Its developed area occupies part of the 3,500-acre island, most of which is planned for rural agricultural or visitor-serving commercial uses. About 2,100 people reside on the island in about 1,300 residences concentrated on the island's south central shoreline, four mobile home parks, or 13 commercial marinas. Approximately 15 miles of levees surround the island, which is below sea level, limiting the drainage of floodwaters in the event of a levee breach.

A single road, Bethel Island Road, links the island to the mainland at the city of Oakley, complicating emergency response or evacuation in the event of flooding. Although the entire island is included in the urban limit line that Contra County's voters approved in 2006, development on the island clusters around Delta Coves, a 495-unit water-oriented residential development that was permitted in 1973, but that still remains unfinished, in part because of the bankruptcy of its developer. Other development includes mobile home parks and retail areas. Rural uses include single-family homes along the island's shoreline, marinas, resorts, a golf course, rural residential uses, and farmland. Contra Costa County's General Plan seeks to preserve and enhance the rural quality of Bethel Island and still allow for planned residential and commercial growth related to water-oriented recreation. The general plan notes that development other than a single home on existing parcels must await resolution of several issues, including improvement of the community's public services, levees, and emergency evacuation routes. Because of its flood risks and its rural character, Bethel Island is not excluded from the Delta Plan policy limiting new urban development. Restrictions on development on Bethel Island are consistent with the Contra Costa County General Plan.

As described in Chapter 2, covered actions subject to the Delta Reform Act do not include plans, programs, or projects within the Delta's Secondary Zone that a metropolitan planning agency has determined are consistent with a sustainable communities strategy adopted under California planning law. These sustainable communities strategies will, in part, accomplish the following:

- Identify the general location of uses, residential densities, and building intensities within the region.
- Identify areas within the region over their 20-plus-year planning period sufficient to house the population of the region.
- Identify areas within the region sufficient to house an 8-year projection of the regional housing need for the region.
- Identify a transportation network to serve the transportation needs of the region.
- Gather and consider information regarding resource areas and farmland in the region.
- Set forth a forecast development pattern, which, when integrated with the transportation network and other transportation measures and policies, will reduce greenhouse gas emissions from automobiles and light trucks. The sustainable community strategy development pattern will need to be based upon "current planning assumptions" that include the information in local general plans and SOI boundaries.

As provided in Water Code section 85212, the Council will cooperate with local and regional planning agencies to provide timely advice about sustainable community strategies and other local and regional plans for consistency with the Delta Plan. This will include reviewing their consistency with the ecosystem restoration needs of the Delta and whether these plans set aside sufficient lands for natural resource protection to meet the Delta's ecosystem needs. Through this coordination, decisions about locating and planning new urban development in the Secondary Zone can be coordinated to meet local communities' housing and other needs, as Water Code section 85022(d)(4) provides, while protecting and enhancing the Delta as an evolving place.

Delta Communities

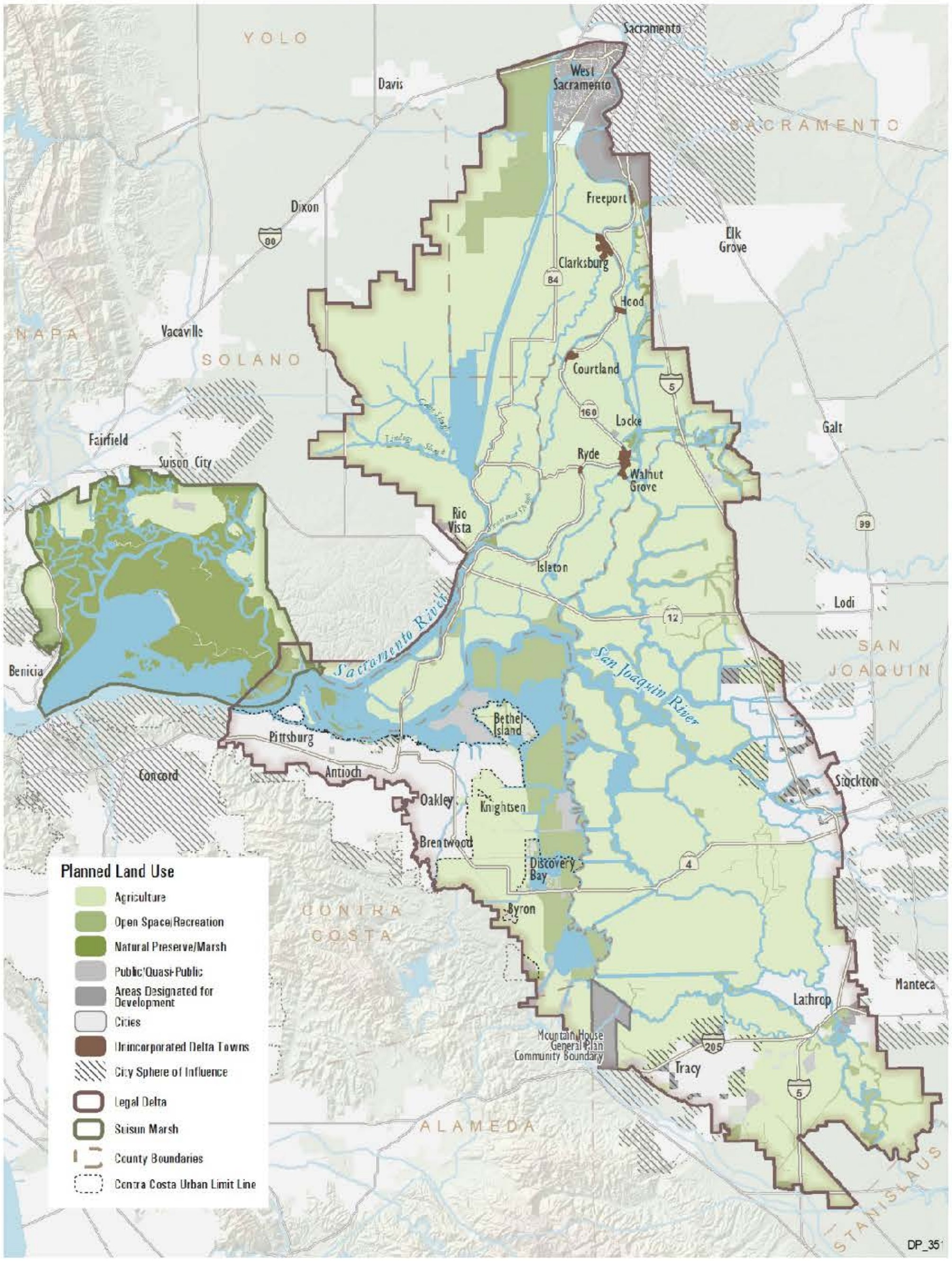

Figure 5-2 The map shows land uses designated by city and county general plans. Within cities' SOIs, the map shows land use designations proposed in city general plans, where available. In cases where cities have not proposed land uses within their SOIs, the map shows land uses designated by county general plans.

Sources: City of Benicia 2003, Contra Costa County 2008, Contra Costa County 2010, City of Fairfield 2008, City of Lathrop 2012, City of Manteca 2012, Mountain House Community Services District 2008, City of Rio Vista 2001, SACOG 2009, City of Sacramento 2008, Sacramento County 2011, Sacramento County 2012, Sacramento County 2013, San Joaquin County 2008a, San Joaquin County 2008b, Solano County 2008a, Solano County 2008b, City of Stockton 2011a, City of Stockton 2011b, City of Suisun City 2011, City of Tracy 2011a, City of Tracy 2011b, City of West Sacramento 2010, Yolo County 2010a, Yolo County 2010b.

The Delta's Legacy Communities

Bethel Island, Clarksburg, Courtland, Freeport, Hood, Isleton, Knightsen, Rio Vista, Ryde, Locke, and Walnut Grove are the Delta's legacy communities (Public Resources Code section 32301(f)). They are the residential, commercial, processing, and retail centers of the Delta, and resonate with its history and culture. Each community has its own character. Bethel Island is a recreation destination. Clarksburg and Courtland are centers for wine and pear production. Freeport and Hood were transportation centers, with river landings and rail spurs to move goods. Locke and Walnut Grove had large Asian populations who worked at packing sheds and surrounding local farms. Ryde is known for its landmark hotel, and Isleton is known for festivals and visitor-serving businesses. Rio Vista is the largest community, and Knightsen is a small community known for several nearby horse ranches. All legacy communities except Freeport, Isleton, and Bethel Island are in the Primary Zone. Rio Vista is partly in the Primary Zone and partly outside the Delta. The DPC ESP highlights the rich cultural histories of these distinctive communities and notes the importance of enhancing their legacy themes and creating better awareness of them. It highlights planning to strengthen these communities by building on the agricultural uses that surround them. It also recommends enhancing the Delta's recreation and tourism opportunities by improving these towns' lodging, entertainment, and retail options; encouraging agritourism; restoring historic buildings; and promoting context-sensitive infill development, including housing for the Delta's workforce.

Flood risks in these communities are higher than in the Delta's cities, as noted in Chapter 7, and they are too small to be capable of financing major levee improvements without significant assistance. According to the ESP, opportunities for residential or visitor-serving recreation developments in these communities may be impaired if flood risks are too high or development regulations are unpredictable or too burdensome. Although improvements to these communities' historic structures are exempt from Federal Emergency Management Agency (FEMA) floodproofing standards (FEMA 2008), flood risks, floodproofing standards for new development, and flood insurance costs can be barriers to business investment or development.

THE LEGACY OF THE DELTA'S NATIVE CALIFORNIA INDIANS

People have occupied the Delta for thousands of years. Early people gathered wild plants, including seeds, roots, greens, mushrooms, and nuts; hunted for rabbits, waterfowl, tule elk, or antelope; and speared or netted salmon, sturgeon, and other fish. Acorn processing allowed populations to grow. Permanent villages of 100 or more residents were established on sand mounds along major waterways, at the margins of tule marshes, and on the shores of Suisun Bay. Sandy uplands on Delta islands held smaller settlements. Boats of tule reeds were used to travel Delta waterways. Trade with neighbors brought obsidian and other tool stones, shell or bone ornaments, charm stones, and other goods from the coast and Sierra.

Four main groups resided in the Delta: Nisenan on the north, Miwok on the east, Yokuts in the south Delta and Contra Costa shoreline, and Patwin around Suisun Marsh and Putah Creek. Their presence is still acknowledged in place names (for example, Yolo, Suisun, and Mokelumne) and in artifacts such as stone pestles and bedrock mortars for grinding seeds and nuts; twined basketry of rushes and other plants; ancient habitations demarked by charcoal, shells, or other refuse; and cemeteries where loved ones were carefully buried, sometimes with ochre, beads, and other objects, or cremated. Today their descendants sustain a contemporary native California Indian community in the Delta.

Sources: Beals 1933, Bennyhoff and Fredrickson 1969, Fredrickson 1974, Johnson 1978, Kroeber 1925, Kroeber 1932, Levy 1978, Moratto 1984, University of California Archaeological Survey 1956, Wallace 1978, Wilson and Towne 1978

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Climate Change

Historical, cultural, and economic resources of the Delta are subject to the impacts of climate change. An increase in sea level of up to 55 inches is projected to occur by 2100. Along with increased flood risk associated with rising sea levels and changes in runoff timing and intensity, levees, highways, and other infrastructure that support the Delta's communities and economy will be threatened. In addition, land use planning is complicated by the prospect of rising sea levels and increased flooding that may accompany climate change. Rising water levels and more severe flooding will increase hazards to land uses and developments, and confound efforts to identify safe locations for new homes and businesses.

Impacts on agriculture, such as decreasing revenues, are also likely if Delta water supplies increase in salinity (Lund et al. 2007) and water demand increases. Impacts on agriculture from warming temperatures could reduce yields and increase vulnerability to weeds and pests (California Resources Agency 2008), as well as increase soil subsidence rates through increased rates of organic matter oxidation. In addition, Delta recreation and tourism could be affected by changes in Delta fisheries.

Land Use Planning in the Delta and Suisun Marsh

The land uses in the Delta are the result of myriad decisions made by residents, businesses, investors, and others since its settlement. These decisions are shaped today by local and State agencies that are responsible for planning or regulating land use or development. Primary authority for land use planning rests with the Delta's twelve cities and five counties, which are required to adopt comprehensive long-range general plans to guide development. In addition, the Legislature has authorized three State agencies to oversee land use planning by local governments or directly regulate land use actions in the Delta and the Suisun Marsh: the Council, the DPC, and the San Francisco Bay Conservation and Development Commission (BCDC). The Council and the DPC have concurrent jurisdiction in the Delta's Primary Zone, while the Council and BCDC have concurrent jurisdiction in the Suisun Marsh. The DPC and BCDC must ensure that local land use planning is consistent with their own laws and plans, and must also certify that any covered actions that they carry out or approve, such as updating their plans, are consistent with the Delta Plan (see Table 5-1).

The Council's Role

The Legislature has declared that existing developed uses and future developments that are carefully planned and developed consistent with Delta Reform Act policies are essential to Californians' economic and social well-being, especially those who live or work in the Delta. The Delta Reform Act includes six goals for managing land use (Water Code section 85022(d)):

> *(1) Protect, maintain, enhance, and, where feasible, restore the overall quality of the Delta environment and its natural and artificial resources.*
>
> *(2) Ensure the utilization and conservation of Delta resources, taking into account the social and economic needs of the people of the state.*

State Agencies with Land Use Jurisdiction in the Delta

TABLE 5-1

State Agency	Law	Plan
Delta Stewardship Council	Sacramento-San Joaquin Delta Reform Act of 2009	Delta Plan
Delta Protection Council	Delta Protection Act of 1992	Delta Land Use and Resource Management Plan for the Primary Zone of the Delta
San Francisco Bay Conservation and Development Commission	McAteer-Petris Act of 1965, Suisun Marsh Preservation Act of 1977	San Francisco Bay Plan, Suisun Marsh Protection Plan

(3) *Maximize public access to Delta resources and maximize public recreational opportunities in the Delta consistent with sound resources conservation principles and constitutionally protected rights of private property owners.*

(4) *Encourage state and local initiatives and cooperation in preparing procedures to implement coordinated planning and development for mutually beneficial uses, including educational uses, in the Delta.*

(5) *Develop new or improved aquatic and terrestrial habitat and protect existing habitats to advance the goal of restoring and enhancing the Delta ecosystem.*

(6) *Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.*

Goals 2, 3, and 4 are addressed in this chapter.

In addition, Water Code section 85305(a) provides, in part:

> *The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting…appropriate land uses.*

Water Code section 85022(a) directs "state and local land use actions identified as covered actions pursuant to section 85057.5 be consistent with the Delta Plan" and that the section's "findings, policies, and goals apply to Delta land use planning and development." Thus, the Council's role in reviewing land use actions is to consider the full range of State interests in the Delta, including the economic and social well-being of Californians, environmental protection, use and conservation of resources, public access and recreation, habitat restoration and enhancement, water quality, and flood protection.

The DPC's Role

The DPC *Land Use and Resource Management Plan for the Primary Zone of the Delta* (2010) guides land uses in the Primary Zone. Local government general plans must be consistent with the DPC's land use and resource management plan. Local government land use actions may be appealed to the DPC for review of consistency with the land use and resource management plan. Chapter 2 describes the special role that the Delta Reform Act gives to the DPC to review and comment on significant projects or programs, such as ecosystem restoration or flood control projects, under consideration by the Council. The referral of projects to DPC for its review and comment and the membership of the DPC chair on the Council assure that the Delta communities will have a voice concerning actions' effects on existing and planned uses of the Delta.

The DPC's management plan states these goals for land use in the Primary Zone (DPC 2010):

> *Protect the unique character and qualities of the Primary Zone by preserving the cultural heritage, strong agricultural/economic base, unique recreational resources, and biological diversity of the Primary Zone. Direct new non-agriculturally oriented non-farmworker residential development within the existing unincorporated towns (Walnut Grove, Clarksburg, Courtland, Hood, Locke, and Ryde).*

> *Encourage a critical mass of farms, agriculturally-related businesses and supporting infrastructure to ensure the economic vitality of agriculture within the Delta.*

DPC's management plan also acknowledges the importance of balancing urban development with the protection of agriculture and other rural lands (DPC 2010):

> *The periphery of the Delta is undergoing rapid urbanization associated with substantial population growth. Current and future population growth increases the demand for developable land, particularly in areas near the Bay area, Stockton, and Sacramento. This demand results in the conversion of open space, primarily agricultural land, to residential and commercial uses. Increasing concern exists regarding the potential for urbanization and projects in the Secondary Zone to impact the Primary Zone.*

Thus, the DPC's role in land use review is primarily to protect agricultural land, recreational uses, and biological diversity in the Delta's Primary Zone from urban development, direct most residential development within existing towns, and ensure the economic vitality of Delta agriculture.

BCDC's Role

The BCDC was established by the McAteer-Petris Act in 1965. The agency prepared the *San Francisco Bay Plan* to guide the conservation of the Bay's natural resources and development of its shoreline. In 1977, BCDC's authority was expanded to protect wildlife use and retain biological diversity of the Suisun Marsh under the Suisun Marsh Preservation Act. With respect to land use, the Suisun Marsh Preservation Act (Public Resources Code section 29003(e) and (f)) calls for:

- Development and implementation of plans and policies to protect the marsh from degradation by excessive human use
- Definition and establishment of a buffer area consisting of upland areas that have high wildlife values themselves and also contribute to the integrity and continued wildlife use of the wetlands within the marsh

BCDC's *Suisun Marsh Protection Plan* (SMPP) guides land use and development in the Marsh (BCDC 1976). The SMPP designates an 89,000-acre primary management area of waterways, including Suisun, Honker, and Grizzly bays, tidal marshes, and managed wetlands; and a buffer zone of upland grasslands and agricultural land composing a 22,500-acre secondary management area. Both the Bay Plan and the SMPP apply to Suisun Marsh, and the SMPP controls if there is a conflict. BCDC also is the federally designated State coastal management agency for the San Francisco Bay segment of the California coastal zone. The federal Coastal Zone Management Act (CZMA) empowers BCDC to ensure that federal projects and activities are consistent with BCDC's laws and policies. A marsh development permit from BCDC is required to place fill, dredge, construct a structure, substantially change land use, subdivide property, or grade land in the wetlands and waterways of the Suisun Marsh.

BCDC retains planning and permitting authority in the primary management area of the Marsh, but shares authority in the secondary management area with local government agencies and special districts. The Suisun Marsh Preservation Act authorizes BCDC to delegate authority to issue marsh development permits to local agencies and special districts with jurisdiction in the marsh after BCDC has certified that their components of the Suisun Marsh Local Protection Program (LPP) are consistent with the Suisun Marsh Preservation Act and the SMPP. BCDC first certified all the components of the LPP in the early 1980s. LPP components can be amended only after BCDC holds a public hearing and votes for recertification. Permits granted by local governments for projects in the secondary management area under the authority of their LPP component may be appealed to BCDC.

Thus, BCDC's role in the Suisun Marsh is to protect the unique natural resources of the Suisun Marsh from the potential adverse effects of development by directly regulating land use in the primary management area of the marsh and working with local government to regulate land use in the secondary management area.

Other Agency Jurisdictions

Land use and development in the Delta are also affected by other State and federal agencies. The State Lands Commission has jurisdiction over hundreds of miles of waterways in the Delta, and issues leases for in-stream structures and uses. The Central Valley Flood Protection Board issues permits to encroach in floodways and State flood management facilities. The State and regional water quality control boards control discharges from development to public waters. The California Department of Fish and Wildlife (DFW) regulates projects that affect waterways or habitats of State-listed endangered or rare species.

Among federal agencies, FEMA has a significant effect in the region by establishing floodproofing standards for new development in communities that participate in its National Flood Insurance Program. The U.S. Army Corps of Engineers oversees the filling of public waters and wetlands. The U.S. Fish and Wildlife Service and the National Marine Fisheries Service regulate development that affects essential fish habitat or federally listed endangered or rare species. Some Delta landowners see these complex rules as a barrier to the development and use of private land. As described in Chapter 2, the Delta Plan Interagency Implementation Committee will improve coordination among regulatory agencies to ease some of these barriers.

Minimizing Land Use Conflicts

Poorly sited or designed development can also encourage additional people to place their lives and property at risk as well as restrict ecosystem restoration opportunities (see Chapter 4 and Chapter 7). Many uses are already in hazardous locations. For example, about 116,000 residential structures are located in the 100-year floodplain of the Delta, mostly near Sacramento, West Sacramento, and Stockton. Almost 8,000 residences are below mean higher high water (DWR 2008). Land use planning is complicated by the prospect of rising sea levels and increased flooding that may accompany climate changes. Some necessary water facilities, ecosystem restoration projects, or flood management facilities may need to be located on farmlands or in other locations that are inconsistent with local land use plans. State and federal agency projects are not required to secure approvals from local governments or the DPC, but nevertheless should avoid conflicts with existing and planned land uses when feasible. These projects can alter scenic views, make noise, create conflicts with adjoining land uses, generate traffic, or disrupt transportation routes if not planned carefully. Fully considering local resident views and local government positions can minimize misunderstandings, reduce avoidable conflicts, and build trust and cooperation.

The Delta's Economy

This section provides an overview of the primary sectors that make up the Delta economy. The Delta's economy is primarily urban and service oriented. The Delta is a diverse, growing, and economically integrated region that in many respects is outperforming the state as a whole. Transportation, warehousing, and utilities are important sectors. Construction, housing, and real estate are also important, but have declined with the recent recession. Retail, education, health care, and accommodations are the top employment sectors. The Primary Zone is less diverse, and depends on agriculture and, to a lesser extent, recreation and tourism. Stockton, Sacramento, and other nearby urban areas provide employment for professionals who commute from the Primary Zone, and less-skilled workers commute into the Primary Zone to jobs in agriculture and food processing.

Agriculture and the Delta's Economy

The total value of Delta crops was approximately $702 million in 2009. Truck and vineyard crops account for 54 percent of crop revenues on 18 percent of acreage. The top five Delta crops in terms of value were (1) processing tomatoes, (2) wine grapes, (3) corn, (4) alfalfa, and

(5) asparagus. The highest per-acre values in the Delta come from truck crops mainly situated in the southern Delta and deciduous crops principally located in the northern Delta. Table 5-2 summarizes top crops by gross value and acreage.

Top Five Crops in the Delta

TABLE 5-2

Position (2009)	By Gross Value	By Acres Grown
1	Tomatoes	Corn
2	Wine Grapes	Alfalfa
3	Corn	Tomatoes
4	Alfalfa	Wheat
5	Asparagus	Wine Grapes

Source: DPC 2012b

When related value-added manufacturing such as wineries, canneries, and dairy products are included, the total economic impact of Delta agriculture is 13,179 jobs, $1.059 billion in value added, and nearly $2.647 billion in economic output in the five Delta counties. Including value-added manufacturing, the statewide impact of Delta agriculture is 25,125 jobs, $2.135 billion in value added, and $5.372 billion in economic output (DPC 2012b).

See the Agriculture in the Delta section for a more detailed description of agriculture and its contribution to the Delta's way of life and economy.

The Delta's Recreation and Tourism Economy

Recreation and tourism are important contributors to the Delta's economy. DPC's ESP estimates that Delta recreation and tourism support 3,000 jobs with $100 million in wages in the Delta counties; $312 million in direct expenditures in the Delta by anglers, hunters, boaters, picnickers, campers, hikers, bicyclists, visitors driving for pleasure, and others who recreate in parks, wildlife areas, trails, or roadways; and a total of $175 million in value added to the regional economy. Statewide, Delta recreation and tourism support 5,200 jobs and contribute $348 million in value added.

Despite these significant contributions, the Delta's recreation and tourism economy has been relatively flat since the 1990s. The recreation and tourism sectors suffer from limited recognition and understanding of the Delta, and the lack of an overall marketing strategy for the region. Brannan Island State Recreation Area, the best improved State park, is scheduled to close due to budget constraints. Many other public lands lack facilities for visitors. Motor boat registrations have declined in the region. Participation in fishing and hunting has declined also. Private-sector recreation and tourism businesses are stagnant, with employment unchanged over 2 decades and little investment in new facilities. Inadequate levees leave key visitor attractions, including the legacy communities, at risk, as described in Chapter 7. Flood risks, flood insurance, and difficulties in designing attractive but floodproof visitor facilities hinder new investment in recreation and tourism businesses.

Other Contributors to the Delta Economy

The Delta's infrastructure not only supports its residents and businesses, but also includes facilities that transport people and products through the Delta from the Sierra on the east to the Bay Area on the west, or from the Sacramento Valley on the north to the San Joaquin Valley on the south. The Delta's economy benefits from the surface transportation, utilities, and other infrastructure that crisscross the Delta to serve local needs, provide access to regional urban markets, and, in turn, link the Delta's economy to national and global markets.

The Delta's most recognizable infrastructure components are its levees, which are described in Chapter 7. Key transportation corridors include Interstates 80, 5, and 205; State Routes 4, 12, and 160; and railroads operated by Union Pacific, Burlington Northern Santa Fe, Amtrak, and the Altamont Commuter Express. County roads are important for transporting crops to market and for local circulation.

The ports at Stockton and West Sacramento are served by deep water shipping channels that the U.S. Army Corps of Engineers maintains along the San Joaquin and Sacramento rivers, and the Sacramento Deep Water Ship Channel. These ports connect to San Francisco Bay and ultimately to the Pacific Ocean, providing a valuable asset to Delta communities. Rice and other crops grown in the Central Valley and other products are exported across their docks, and fertilizer and other bulk commodities are imported. The Maritime Highway Corridor is a recent initiative to expand maritime traffic between the Delta ports and the Port of Oakland, in part to reduce truck travel and its air quality impacts. Areas for water-dependent industries are located in Collinsville, Rio Vista, Pittsburg, and Antioch, where they benefit from the Delta's abundant and high-quality water.

Other infrastructure in the Delta includes water, drainage, and wastewater treatment facilities. Stockton and Sacramento draw drinking water at least partly from the Delta and discharge wastewater there. The Delta is the site of forebays, pumps, and water control structures of the Central Valley Project and State Water Project, as described in Chapter 3. Aqueducts and other facilities serving the East Bay Municipal Utility District, the Contra Costa Water District, and other areas are located in the Delta. Natural gas wells in the Delta fuel power plants and other energy uses. Wind turbines and other renewable power sources also are located in the Delta. Electric transmission lines and fuel pipelines cross the Delta to carry energy to energy users. Communications towers support broadcasting and telecommunications. These facilities need to be planned carefully to avoid conflicts with water supply, ecosystem restoration, or flood management facilities, and existing and planned land uses.

Delta Investment Fund

In 2009, the Legislature established a Delta Investment Fund in the State Treasury (Public Resources Code section 29778.5). DPC's ESP recommends forming a regional agency to manage the fund, and to implement and facilitate economic development efforts, either through expansion of the DPC's authority or creation of a joint powers authority composed of local governments.

Agriculture in the Delta

Agriculture is among the qualities that define the Delta as a place. This section provides additional detail about the role of agriculture and discusses issues such as subsidence and water quality that must be considered in policy making. The Delta's initial reclamation created farmland, and ongoing maintenance of its levees and water controls allows for continued farming in the region. Agriculture dominates the Delta landscape, as shown on Figure 5-3, and provides the setting for Delta residents' communities, homes, and job sites. Agriculture benefits from the Delta's productive soils, special climate, and abundant water. Delta farms provide a local source of nutritious food and forage for nearby dairies. Farming, food processing, and related industries contribute significantly to the economy, particularly in the Delta's Primary Zone, where they predominate economic output, employment, and value-added activities. Characteristic local crops, such as pears, asparagus, and dried beans, are celebrated at annual festivals and county fairs.

Agriculture in the Delta depends on high-quality farmland. Prime farmlands with the best soils comprise about 400,600 acres, close to 85 percent of all farmland in the Delta. Another 101,760 acres are unique farmland, farmland of statewide or local importance, or farmland of potential local importance (DOC 2009). Because of the fertile peat soils and the moderating marine influence, Delta agriculture's per-acre yields are almost 50 percent higher than the state's average (Trott 2007). As described in Chapters 3 and 4, reliable, abundant fresh water is also an essential contributor to Delta agriculture.

Agricultural Land Use in the Delta

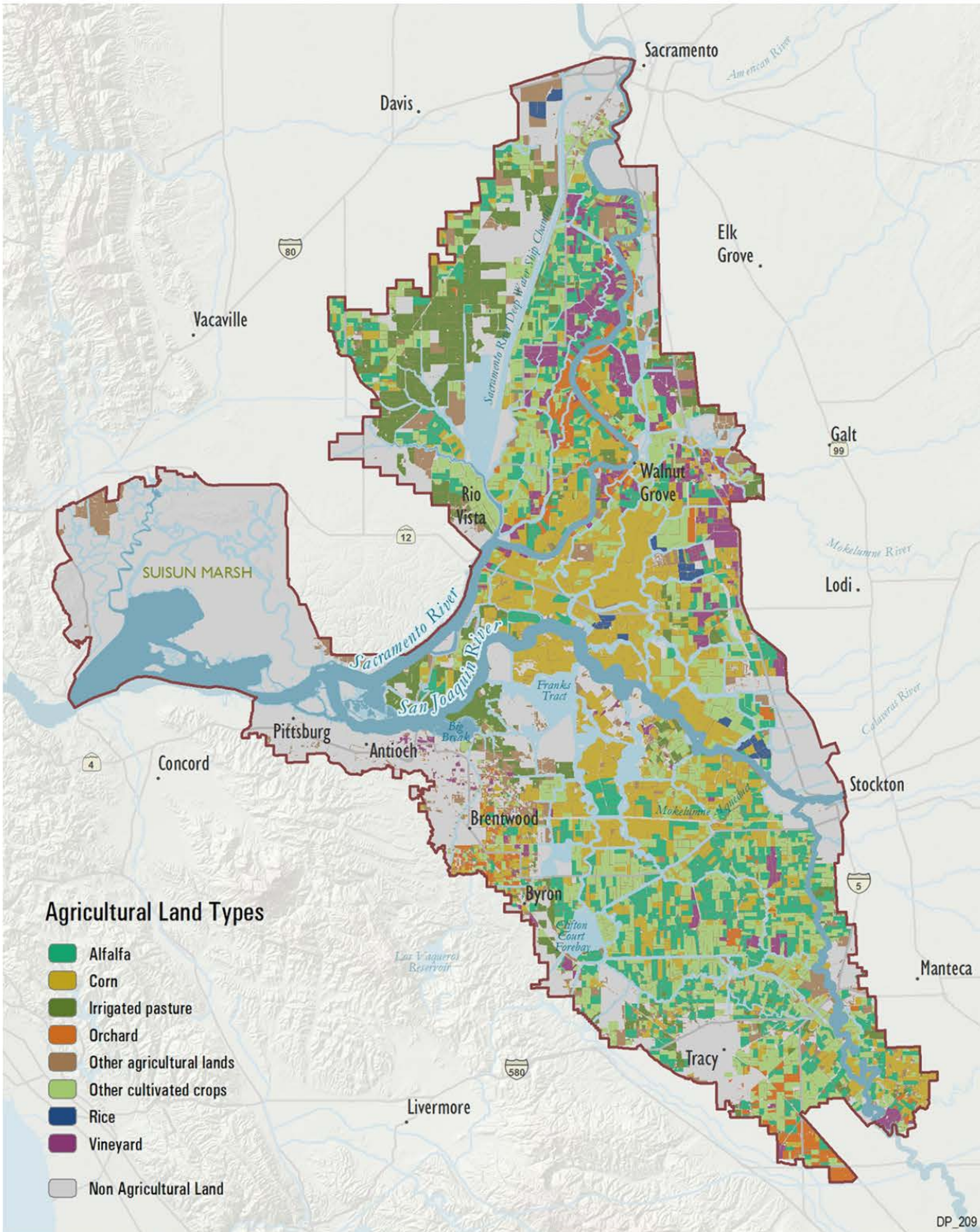


Figure 5-3 *Source: DOC 2008*

Field crops and pasture cover most of the Delta agricultural acreage. In 2010, about one-fourth of farmland in the Delta was corn, much of which is harvested as silage and used in the dairy industry. Alfalfa, the second most widely planted crop, covered about 20 percent of the Delta's farmland. Together, these croplands comprise about 10 percent of the irrigated acreage supporting California's dairy industry. Barley, wheat, and oats were planted on about 69,000 acres. About 41,000 acres of irrigated pasture are used by livestock. Truck crops, including processing tomatoes, asparagus, cucumbers, potatoes, pumpkins, and melons, covered nearly 52,500 acres. Almost 31,000 acres support vineyards. Orchards of pears, almonds, walnuts, and cherries grow on about 17,000 acres (DPC 2012b).

The DPC ESP forecasts that high-value crops, including truck, deciduous, and vineyard crops, are likely to increase in coming decades, potentially increasing farm incomes and economic output. Lower value crops, including field and grain crops, are likely to decline. Some traditional Delta crops are losing markets due to changing consumer preferences and competition from other regions. For example, the Bartlett pear market peaked around World War I, when 50 percent of all Bartletts were produced in California, mainly in the Delta. Until 1930, the Delta was also the world's asparagus capital, producing 90 percent of the globe's production (DPC 2011). Today, a mere 7,200 acres of asparagus fields remain. But growth of wine grapes and other crops, and expansion of local crop processing, particularly winemaking, could enhance agriculture's contribution to the Delta's economy (DPC 2012b). Urban development, ecosystem restoration, or flood control facilities that take farmland out of production could hasten the decline of agriculture.

Value is added to Delta crops when they are processed for ease of use or shipment. Examples include food and beverage manufacturing, such as the tomato canneries or sugar processors that were prominent twentieth century Delta businesses. Today's opportunities include winemaking or emerging sectors such as olive pressing. Special local markets that serve consumers in the Delta counties or Bay Area, such as farm-to-school programs or community-supported agriculture, also may provide new markets for some Delta crops. Facilities that improve the region's capacity to aggregate and distribute its crops to these local markets may enhance Delta agriculture (SACOG 2011). Consistent interpretation and application of regulations about food processing and distribution could help local producers and distributors establish facilities (Sumner and Rosen-Molina 2011).

Protecting Productive Farmlands

Although agriculture is the principal land use in the Delta, the total area of agricultural lands (including fallow lands) in the combined Delta and Suisun Marsh area has declined from about 549,420 acres in 1984[1] to 460,450 acres in 2008, and the percentage of agricultural land has decreased from about 65 percent of this combined area in 1984 to about 55 percent in 2008 (DOC 1984, DOC 1988, DOC 1990, DOC 2008). An additional 28,000 acres of farmland may be lost in the near future under current local government general plans. The Delta Plan acknowledges this loss since it focuses growth within existing city boundaries. However, any further loss of farms to urban development is unacceptable. The continued viability of agriculture in the Delta will require the protection of sufficient farmland and fresh water to support commercially viable operations and provide ways for agriculture to coexist with habitat restoration. Policies DP P1 and DP P2 acknowledge the importance of protecting these lands. The DPC and local governments play key roles in the protection of these lands.

The loss of some farmland to urbanization, habitat, and flooding is inevitable, the DPC ESP concludes; but continued shifts to higher-valued crops and value-added activities, as well as planning restoration in appropriate locations, may help compensate if land loss is not too great. As described in Chapter 4, elevations, locations, and other factors are key

[1] Data for Sacramento and San Joaquin counties were not available in the 1984 DOC report; thus, data for these counties were taken from the 1988 and 1990 reports, respectively.

determinants of the optimal sites for ecosystem restoration. When these restoration areas include farmlands, achieving the coequal goals of restoring the Delta ecosystem and improving water supply reliability may make some loss of productive agricultural lands unavoidable. Some conveyance alternatives could take farmland out of production, too. Improving flood control facilities may also unavoidably affect some farmland.

Subsidence

The reclamation of Delta islands and their cultivation for agriculture initiated a process of land subsidence, mostly due to oxidation of peat soils, but also from wind erosion. Drainage and cultivation dried the saturated peat, reducing its volume by approximately 50 percent. Early cultivation practices also included burning, which further reduced the volume of the soil and altered its structure. Over time, long-term oxidation reduced about 2.6 to 3.3 billion cubic yards of these peaty soils to small particles and gases. As a result, much of the central Delta today is below sea level, with some islands 12 to 15 feet below sea level. Many islands now more closely resemble bowls surrounded by water, with high sides defined by levees and deep, hollowed-out bases. Although subsidence has slowed in some areas, other regions of the Delta continue to lose soil to oxidation and wind erosion at a rate of 5 to 15 tons/acre/year. It is projected that some areas of the Delta could subside an additional 2 to 4 feet by 2050 (Deverel and Leighton 2010), resulting in the loss of up to 350 to 500 million cubic yards of soil at a rate of 5 to 15 tons/acre/year (see Figure 5-4).

Land subsidence impairs Delta agriculture, not only because of soil loss, but also by increasing the difficulty of maintaining drainage systems and levees. As described in Chapter 7, subsidence makes levees less stable and increases flood risks. The costs to recover a flooded island could be great. Some suggest that many islands would cost more to reclaim after flooding than the value of the land for agriculture. In 1998, 4,200 acres of farmland were lost when Liberty Island flooded and was not reclaimed (Reclamation District 2093 2009). Other once-farmed islands that were not reclaimed after flooding include Big Break, Franks Tract, and Mildred Island (Suddeth et al. 2010).

Oxidation of peat soils also liberates vast quantities of carbon dioxide (CO_2), contributing to global warming (Armentano 1980). Oxidation of the Delta's agricultural soils emits about 4.4 to 5.3 million tons of CO_2 annually (Delta Conservancy 2012). For comparison, a typical 500-megawatt coal-fired power plant emits 3 million tons of CO_2 per year.

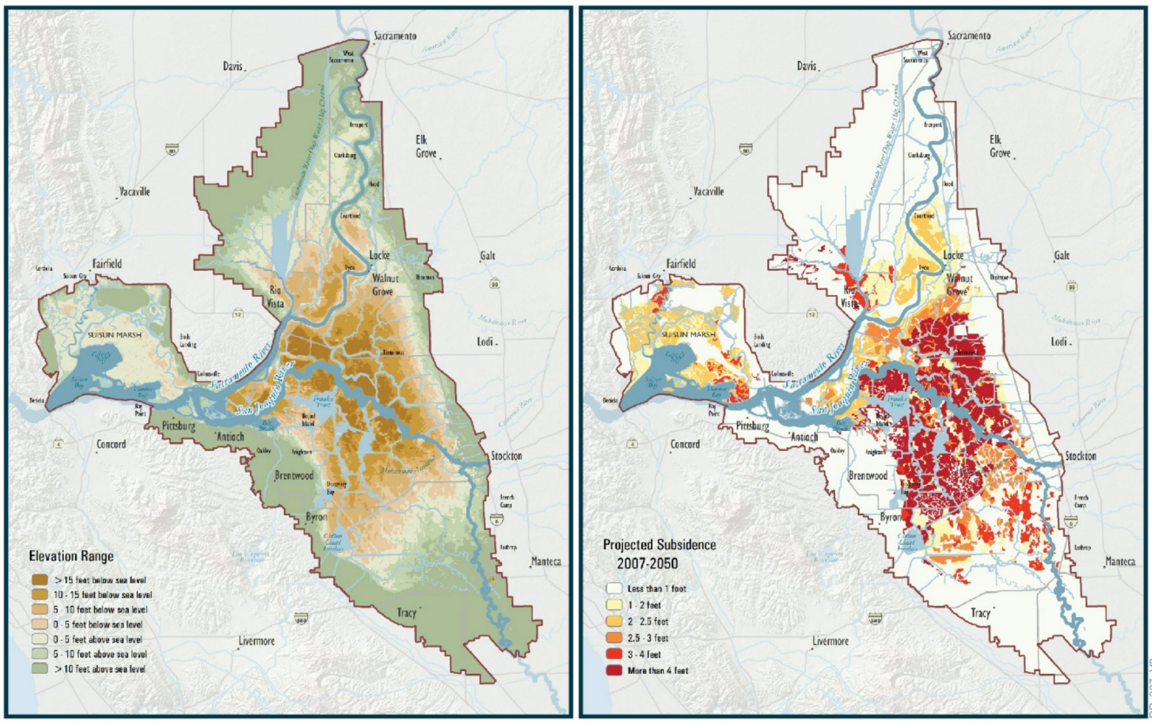
The potential to retire croplands on deeply subsided islands and manage them to rebuild peat and sequester carbon is sometimes pondered as an alternative to continued farming (Armentano 1980). State and federal agency investigations of alternative land management practices show that soils can be rebuilt, reversing subsidence and sequestering carbon, with some appropriately managed activities, such as tule farming (Miller 2008). Recent actions by the California Air Resources Board, under the California Global Warming Solutions Act of 2006 (Health and Safety Code section 38500 et seq.), provide for the development of a carbon market program, whereby certain activities may be considered acceptable for providing offset credits. Although this program is still in its initial stages, future opportunities may exist for Delta farmers to gain offset credits for growing plants that promote subsidence reversal and sequester carbon.

Agriculture and Water Quality

The DPC's ESP provides scenarios for how potential declines in water quality that could accompany some water conveyance, ecosystem restoration, or water quality actions could affect Delta agriculture. The potential for the agricultural economy to grow in the Delta will depend, in part, on the protection of the Delta's abundant fresh water and the policy response. Chapter 6 contains a detailed discussion of water quality and the Council's strategies for water quality.

Subsidence in the Delta

Current Delta Elevations | **Projected Subsidence, 2007–2050**



Source: DWR 2009 | Source: adapted from Deverel and Leighton 2010

Figure 5-4 Oxidation of peat soils through natural processes and human activities has caused the land elevation in the Delta to drop. Much of the central Delta is now at or below sea level. Future subsidence has been projected in these areas. As subsidence progresses, levees must be continually maintained, strengthened, and periodically raised to support increasing hydraulic stress.

Wildlife-friendly Agriculture

Agriculture has the potential to coexist with and even enhance restoration of the Delta ecosystem despite the conversion of some farmland to habitat. Techniques that integrate management of agriculture and wildlife habitat, often called "wildlife-friendly agriculture," include crop rotations that include soil-building crops or fallowing; integrated pest management to reduce pesticides; cover crops; the strategic use of permanent crops, such as pasture, to reduce soil disturbance and oxidation; and conservation tillage for field and row crops (Trott 2007). Some native species have adapted to using agricultural lands as habitat in place of tidal marshes, grasslands, and seasonal wetlands. Rice and other flood-irrigated crops support a range of wildlife, especially waterfowl, shorebirds, wading birds, and giant garter snakes. Swainson's hawk, other raptors, and coyote feed on small mammals and ground-nesting birds that inhabit alfalfa fields and other irrigated pastures. Waste grain also provides food for species such as ring-necked pheasant and greater sandhill crane (Trott 2007).

To support Delta agriculture and species recovery, farmers in the Delta are encouraged to implement management practices to maximize habitat values. Some U.S. Department of Agriculture (USDA) programs provide financial incentives for landowners to manage natural areas on their properties, including the Wildlife Habitat Incentives Program, the Environmental Quality Incentives Program, and the Conservation Reserve Program. The DFW, U.S. Fish and Wildlife Service, and Delta Conservancy also can assist landowners who want to enhance wildlife habitat.

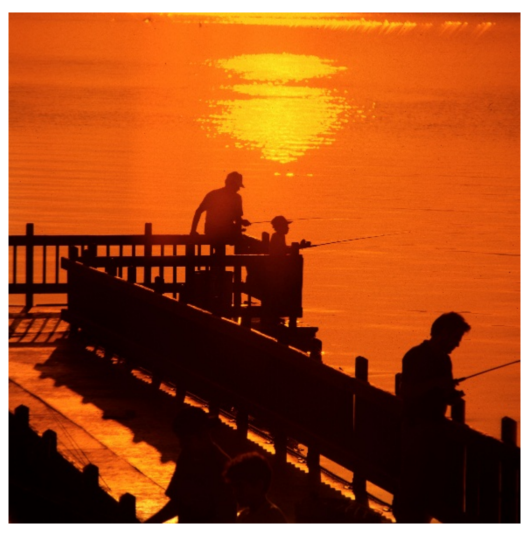
As described in Chapter 4, safe harbor agreements can assure these landowners that the presence of an endangered species on their property will not result in restrictions on activities on their land. Facilitating and creating standard rules for these agreements with Delta landowners may encourage more landowners to participate in conservation programs. Restoring wildlife and fish through wildlife-friendly agriculture can help achieve ecosystem restoration objectives while reducing the loss of farmland to habitat restoration.

Agritourism

Agritourism is another opportunity to add further value to the Delta economy from agricultural activities. Defined as recreational, educational, and other visits to working farms, agritourism is a small but fast-growing source of income for farms in the region and a growing segment of the Delta economy. In the Delta, agritourism destinations may include wineries, on-farm duck clubs, farm stands, and other places. Agritourism was estimated by USDA to generate $4 million in income for farms in the five Delta counties in 2007 (DPC 2012b). For farmers who choose to participate, agritourism can provide additional income, an opportunity to sell farm products directly to consumers, or alternative uses for unproductive lands or buildings. The Discover the Delta Foundation's Delta Discovery Center combines several agritourism functions, including a produce stand, wine sales, and interpretive features that teach people about the Delta's importance (Sumner and Rosen-Molina 2011).

Recreation and Tourism in the Delta

This section provides an overview of recreation and tourism in the Delta. DPC estimates that about 12 million activity days of recreation occur in the Delta annually (DPC 2012b). Recreational users originate from both within and outside the Delta. Visitors value the wide expanses of open land, interlaced waterways, historic towns, and the lifestyle offered by the Delta. The region's mix of land and water offers diverse recreation experiences and facilities, including fishing, boating, birdwatching, other nature activities, hunting, enjoying restaurants, campgrounds, picnic areas, and historic towns and buildings. Recreation also benefits from the Delta's open, agricultural landscape, with its scenic vineyards, orchards, and farmsteads. These are often backed by views of Mt. Diablo or the Montezuma Hills on the horizon, which provide a setting for outdoor photography, a scenic bike ride, or a drive along the Delta's roads. Special events draw visitors to taste local produce and wine, and learn about this unique place. These recreation opportunities are described in more detail in the DPC's ESP and in the Recreation Proposal that California State Parks submitted to the Council and DPC pursuant to Water Code section 85301(c)(1). Figure 5-5 shows the locations of State parks and other protected lands in the Delta. Figure 5-6 shows the variety and distribution of some of these opportunities in the Delta.



State Parks and Other Protected Lands

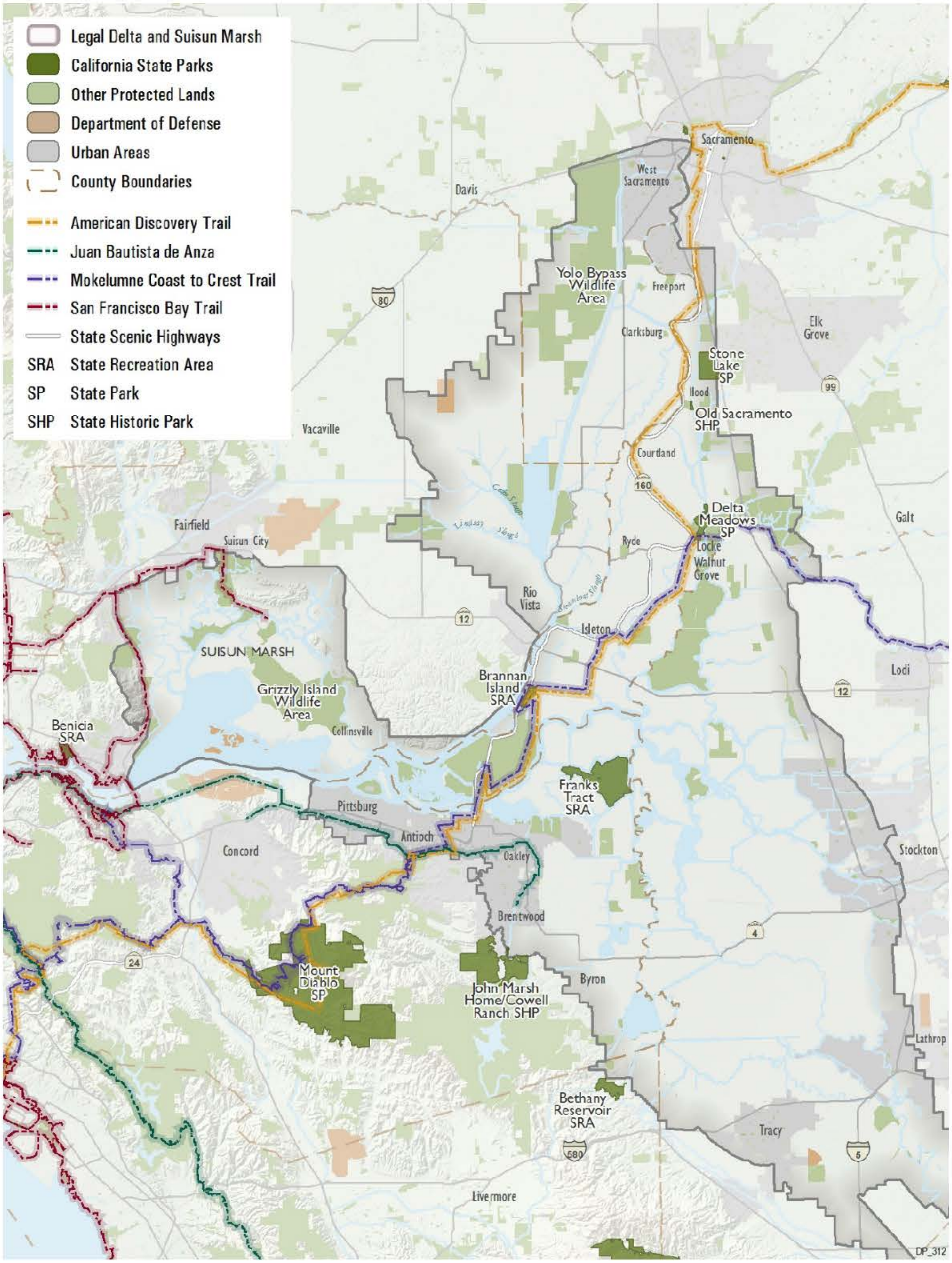


Figure 5-5 *Source: California State Parks 2011*

Major Delta Resources and Recreation

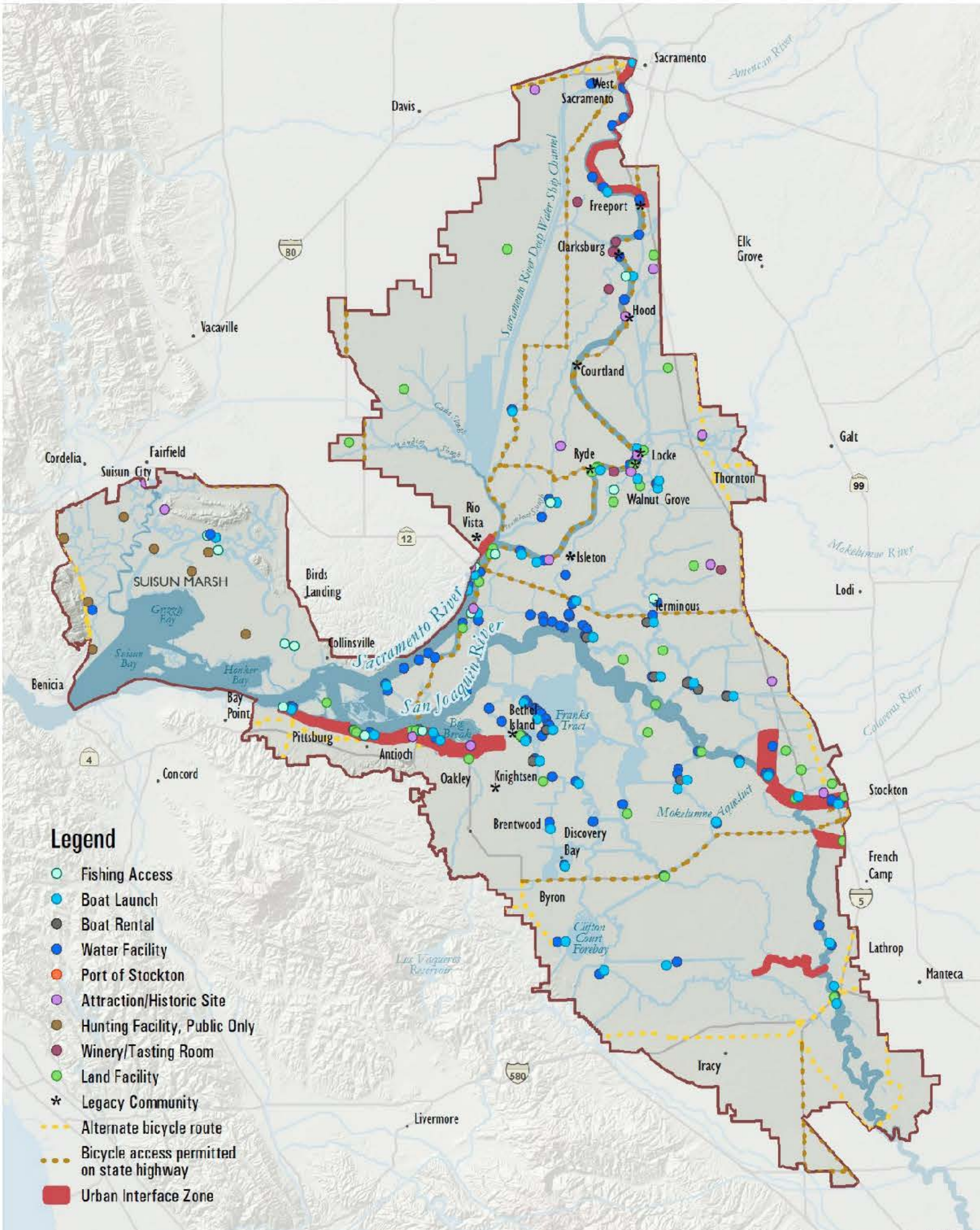


Figure 5-6

Sources: California Chambers and Visitors Bureau 2010, California Resources Agency 2007, DPC 2006, Discover the Delta Foundation 2010, California Department of Fish and Game 2009

The DPC ESP and the California State Parks Recreation Proposal both foresee opportunities to increase recreation and tourism in the Delta as the population of surrounding areas grows, especially with improved branding and marketing. Both reports emphasize improvements of "gateways" to the region on the Delta's urban edges and "base camps," focal points for visitors inside the Delta at destinations such as resorts, legacy communities, and parks. They also recommend diversifying dispersed outdoor recreation "adventures" at points of interest and activity areas for boaters, nature area visitors, and others. Ecosystem restoration, as described in Chapter 4, can enhance opportunities for nature-based recreation and boating, especially by nonmotorized boats, according to both reports.

The California State Parks Recreation Proposal recommends enhancing State parks and other State agencies' properties and programs to create a network of recreation areas in the Delta, and encourages improvement of public access along the shorelines of growing Delta communities, consistent with Water Code section 85022(d)(3). It recommends that recreation improvements be provided in new water management and habitat restoration projects unless they are inconsistent with the project purposes, in conformance with Water Code sections 11910–11915.5, or public safety. DPC's ESP also recommends that recreation facilities be included in ecosystem restoration projects when feasible. Additionally, the ESP emphasizes growing the tourism and recreation economy through private, visitor-serving businesses, and collaboration and partnerships between public- and private-sector recreation providers.

Future prospects for Delta recreation and tourism will be strongly influenced by decisions about the Delta ecosystem, water quality, levee improvements, and governance, including land use and environmental standards. The Bay Delta Conservation Plan (BDCP), Delta water quality plans, levee investments, and other decisions yet to be made can all significantly affect recreation and tourism.

Boating

Navigable waterways in the Delta and Suisun Marsh are available for public access and provide many recreational opportunities. Boating activities total more than 6.4 million visitor days annually, composed of 2.13 million annual boat trips with a projected growth to 8 million visitor days by 2020, according to the Department of Boating and Waterways. Almost 100 marinas, with more than 11,000 boat slips, and almost 60 launch ramp lanes support boating in the Delta and Suisun Marsh (DBW 2002). Popular activities include powerboating on the Sacramento and San Joaquin rivers, paddling sloughs and channels in canoes and kayaks, and sailing on the open water of Suisun and Honker bays. About 116,000 boats are registered in the five Delta counties, creating a large pool of potential recreationists (California State Parks 2011).

Public Recreation Lands

Public lands comprise about 10 percent of the Delta. State and local parks, State or national wildlife areas and refuges, ecological preserves, and other public lands provide important sites for relaxing outdoors, a family picnic, camping, and other outdoor recreation in the Delta. California State Parks owns three properties in the Delta: Brannan Island State Recreation Area and properties at Locke Boarding House-Delta Meadows and Stone Lakes. The DFW and the State Lands Commission also manage important State-owned recreation areas. The largest State ownerships are the California Department of Water Resources (DWR) lands on Sherman and Twitchell islands, which are available seasonally for hunting.

Table 5-3 summarizes the agency responsibilities, recreation-related opportunities, and examples of recreation facilities in the Delta managed by the State. City and county parks, including those of the East Bay Regional Park District, also provide important public recreation areas. These public lands are increasingly important for Delta recreation because privately owned riverbanks and levees, which comprise most of the Delta's shoreline, are increasingly posted to prevent trespass, reducing access to rivers and sloughs for bank fishing, nature observation, and outdoor relaxation.

State Agencies with Responsibility for Recreation in the Delta

TABLE 5-3

State Agency Name and Role	Recreation-related Facilities and Opportunities	Delta and Suisun Marsh Examples
California State Parks offers high-quality outdoor recreation and educational opportunities, protects natural and cultural resources, awards grants for local parks, and oversees the California Recreational Trails System.	Day-use picnic areas, campgrounds, marinas, trails, excursion railroads, interpretive services, heritage resource protection, restrooms	Brannan Island State Recreation Area, Old Sacramento State Historic Park, American Discovery Trail
California Department of Fish and Wildlife manages hunting and fishing; operates public lands for wildlife conservation, hunting, fishing, environmental education, and nature study; and encourages private conservation.	Ecological reserves, wildlife areas, boat launches, nature-based recreation and events, fish hatcheries	Woodbridge Ecological Reserve, Grizzly Island Wildlife Area, Clarksburg boat launch
California Department of Boating and Waterways provides public recreational boating facilities on public lands, marine patrol law enforcement, boating safety and clean and green education, and controls of aquatic invasive species.	Public boat launching facilities, public visitor docks, boat-in day use and overnight facilities, vessel pumpout facilities, floating restrooms, floating campsites	Antioch Marina, Brannan Island State Recreation Area, Sherman Island, Belden's Landing, Bethany Reservoir, and Rio Vista boat launch facilities
California Department of Transportation operates state highways, historic bridges, and ferries, and designates state scenic highways.	Scenic highways, ferries, historic bridges	State Highway 160, J-Mack Ferry, Steamboat Slough Bridge
California Department of Water Resources manages California's water resources, including State Water Project reservoirs, dams, land, and waterways available for recreation use.	Reservoirs, water conveyance infrastructure (canals, diversion sites, waterway flows), flood control projects, habitat management sites and facilities	Bethany Reservoir, Sacramento River flows, Fremont Weir, Suisun Marsh salinity control structure, Dutch Slough habitat restoration project
State Lands Commission has jurisdiction over hundreds of miles of waterways in the Delta and issues leases for instream recreation infrastructure.	Navigable waterways, submerged lands, dock and pier leases	Threemile Slough, Walnut Grove Public Dock

State Agencies with Responsibility for Recreation in the Delta

TABLE 5-3

State Agency Name and Role	Recreation-related Facilities and Opportunities	Delta and Suisun Marsh Examples
Sacramento-San Joaquin Delta Conservancy will implement ecosystem restoration, advance environmental protection, and support economic sustainability, including tourism and recreation.	Projects that enhance natural resources, cultural resources, or economic sustainability in a manner complementary to increased recreation, tourism, and environmental education	The Delta Plan, Bay Delta Conservation Plan, Economic Sustainability Plan, and Delta Conservancy Strategic Plan will guide projects
State Coastal Conservancy makes grants to purchase, protect, restore, and enhance coastal resources, including San Francisco Bay and Suisun Marsh, and to provide access to the shore.	Shoreline accessways, trails, habitat protection and restoration areas, farmland and open space protection	Rush Ranch protection, San Francisco Bay Area water trail, Marsh Creek stream restoration and trail
Delta Protection Commission adaptively manages the Delta's Primary Zone, including, but not limited to, agriculture, wildlife habitat, and recreation activities.	Heritage resource recognition and enhancement, agritourism program, regional trails	National Heritage Area feasibility study, Great California Delta Trail, Economic Sustainability Plan

Source: California State Parks 2011

Nature-based Recreation

Many recreation opportunities depend on the region's wildlife and fish, which support angling, nature observation, and hunting. Anglers pursue native fish, such as salmon and sturgeon, and introduced species such as striped bass, largemouth bass, and catfish. Some of the most visited public wildlife areas include the Yolo Bypass Wildlife Area, Lower Sherman Island, Calhoun and Acker Island, Stone Lakes National Wildlife Refuge, Cosumnes River Preserve, Solano County Land Trust's Jepson Prairie and Rush Ranch, and Suisun Marsh's wildlife management areas, including Grizzly Island and Joice Island. Hunting waterfowl is especially important in Suisun Marsh, most of which is managed by private duck clubs. Careful management of wildlife and fish is important to maintaining nature-based recreation, which can benefit from the restoration of fisheries and expansion of wildlife habitat.

Heritage Tourism

The Delta's legacy communities and other historic sites, from house museums to twentieth century industrial sites and weather-beaten marine facilities, attract history buffs and heritage tourists. Museums, nature centers, and interpretive programs draw visitors who want to learn about the Delta's natural and cultural resources. The region's productive farms and wineries, and its diverse ethnic heritage are attractions for food and wine tourism, and for community festivals and other special events. (Agritourism is discussed earlier in the Agriculture in the Delta section.)

Linking these areas and providing access to them are the Delta's waterways and roads. State Route 160 has a special role and provides visitors from metropolitan Sacramento and Contra Costa County with access to the Sacramento River, legacy communities, and the Delta's State parks. Its attractive rural landscape is reflected in its designation as a state scenic highway. California State Parks' Recreation Proposal recommends that the California Department of Transportation seek national scenic byway status for this route and prepare a scenic byway plan that would identify opportunities to improve signage, interpretation, and amenities for access, recreation, and nonautomobile circulation. A national scenic byway is a road recognized by the U.S. Department of Transportation for its archaeological, cultural, historic, natural, recreational, and/or scenic qualities. The program preserves and protects the nation's scenic but often less-traveled roads, and promotes tourism and economic development. Funding for byway-related projects is granted annually by the Federal Highway Administration. State Routes 4 and 12 are also important for recreational travel.

The American Discovery Trail, Mokelumne Coast-To-Crest Trail, and Great Delta Trail (Public Resources Code section 5852 et seq.) are State trails that can provide recreational access for bicyclists, hikers, and others. DPC's ESP and California State Parks' Recreation Proposal also recommend a system of water trails to guide boaters through the Delta's channels.

POLICIES AND RECOMMENDATIONS

The policies and recommendations presented in this section address the unique values that distinguish the Delta and make it a special region, and outline the Council's five core strategies for protecting and enhancing these values as follows:

- Designate the Delta as a special place worthy of national and state attention
- Plan to protect the Delta's lands and communities
- Maintain Delta agriculture as a primary land use, a food source, a key economic sector, and a way of life
- Encourage recreation and tourism that allow visitors to enjoy and appreciate the Delta and that contribute to its economy
- Sustain a vital Delta economy that includes a mix of agriculture, tourism, recreation, commercial and other industries, and vital components of state and regional infrastructure

Protecting the Delta also depends on the strategies to reduce flood and other risks, as detailed in Chapter 7.

Designate the Delta as a Special Place

Designating the Delta as a special place can build public recognition of the Delta and its unique resources. The DPC proposes to seek the Delta's designation as an NHA to recognize and promote "Delta-as-a-Place" and to cultivate appreciation and understanding of the Delta. The DPC recommends that the NHA include the legal Delta and Suisun Marsh, as well as adjoining areas in Rio Vista and the Carquinez Strait.

The proposed NHA's vision is "a regional network of partner sites, with interpretive/educational components, that will be linked where possible and serve as the primary attractions, on existing public properties or on private properties with the voluntary consent and involvement of the landowners." The NHA's goals are to "brand the Delta as a region of national significance to educate the public about 'Delta-as-a-Place,' and build more support for preserving, protecting, and enhancing the Delta." Other goals relate to economic development, public access, historic preservation, interpretation, and more.

Although State Route 160 is already recognized as a state scenic highway, national scenic byway status under the U.S. Department of Transportation and a scenic byway plan would provide opportunities to improve signage, interpretation, and amenities for access, recreation, and nonautomobile circulation. The byway program would qualify the route for special funding from the Federal Highway Administration.

Problem Statement

Because the Delta is different, it is sometimes unappreciated and misunderstood. Without a clear message about the Delta and its importance, the region and its resources can suffer from inattention or misuse. If the Delta's unique cultural, recreational, and agricultural values are not recognized, they are unlikely to be protected and enhanced.

Policies

No policies with regulatory effect are included in this section.

Recommendations

DP R1. Designate the Delta as a National Heritage Area

The Delta Protection Commission should complete its application for designation of the Delta and Suisun Marsh as a National Heritage Area, and the federal government should complete the process in a timely manner.

DP R2. Designate State Route 160 as a National Scenic Byway

The California Department of Transportation should seek designation of State Route 160 as a National Scenic Byway, and prepare and implement a scenic byway plan for it.

Plan to Protect the Delta's Lands and Communities

Protecting the Delta's lands and communities involves a multipronged policy approach. In the coming years and decades, the Delta will face increasing pressures from a growing population, changes in commodity markets, and changes in climate and sea level that will require flexibility and adaptation.

Some changes will be driven by the Delta's role in California's water systems, and they will be required to meet statewide goals of restoring the Delta's ecosystem and improving water supply reliability. These and other changes will shape how the Delta's communities and history are preserved, guide new development, affect recreation and tourism, and influence agriculture, business expansion, and economic development.

The policies and recommendations below reflect the Council's approach to fostering land uses and development that are resilient to these changes, reduce risks to people and property, adjust to changing conditions, and recover readily from distress. Protecting the Delta also depends on sustaining its economic vitality and maintaining the region as a desirable place to live, do business, and visit.

The maps that the following policies and recommendations reference are based on the best information available to the Council, but they may not precisely match either the built environment or local government land use plans. Where uncertainty exists with respect to the boundaries of areas referenced in these policies, the following rules should be considered in making determinations:

- The areas depicted should be assumed to generally follow parcel lines or other major landmarks, such as a road or highway, or river and stream.
- Local government general plans, including their land use diagrams, in effect at the time of the Delta Plan's adoption, may be consulted.

Problem Statement

Poorly sited or designed projects can detract from the values that contribute to the Delta's distinctive character, including its primarily rural, agricultural landscape; conflict with established uses, including farming and tourism; reduce opportunities for ecosystem restoration; or increase flood risks. By limiting significant new development to areas currently designated for development in cities, their SOIs, and unincorporated towns, the Council intends to foster a land use pattern that enhances the Delta's unique sense of place by protecting agriculture and the open, rural landscape while reducing risks to people and property. Outside the urban areas and towns mentioned above, in areas designated as agriculture, open space, recreation, natural preserve or marsh, or public/quasi-public, minor projects that are consistent with local land use designations, such as farmworker housing in areas designated as agriculture, are also appropriate. Similar limitations are already in place in the Primary Zone of the Delta, where the Delta Protection Act requires that new development must be consistent with the DPC's Land Use and Resource Management Plan. Additional protections for the Secondary Zone are needed. Diligent local *implementation of State law regarding flood protection in urban, urbanizing, and rural lands, and the National Flood Insurance Program will provide complementary flood protection benefits. New residential subdivisions, if any, in rural areas will also need to include adequate flood protection, as described in RR P2.*

Therefore, outside the urban areas and towns mentioned above, in areas that are designated as agriculture, open space, recreation, natural preserve or marsh, or public/quasi-public, the Council intends to enable counties to move forward with approval of minor projects that are consistent with these designations, such as farmworker housing in areas designated as agriculture. However, any proposals to site new residential development in rural areas will need to include adequate flood protection, as described in RR P2.

Careful planning for development in legacy communities is needed to protect their unique character and overcome barriers to investment. The Delta's urban areas will also continue to need sites for housing, employment, and businesses, supported by adequate roads and other infrastructure. Water management facilities, ecosystem restoration actions, and flood control projects will need to be accommodated in the Delta, too. Avoiding condemnation of property for water management, ecosystem restoration, and flood management facilities, when feasible, can promote better relations with Delta residents and local governments.

Policies

The appendices referred to in the policy language below are included in Appendix B of the Delta Plan.

DP P1. Locate New Urban Development Wisely

(a) New residential, commercial, and industrial development must be limited to the following areas, as shown in Appendix 6 and Appendix 7:

(1) Areas that city or county general plans as of May 16, 2013, designate for residential, commercial, and industrial development in cities or their spheres of influence;

(2) Areas within Contra Costa County's 2006 voter-approved urban limit line, except no new residential, commercial, and industrial development may occur on Bethel Island unless it is consistent with the Contra Costa County general plan effective as of May 16, 2013;

(3) Areas within the Mountain House General Plan Community Boundary in San Joaquin County; or

(4) The unincorporated Delta towns of Clarksburg, Courtland, Hood, Locke, Ryde, and Walnut Grove.

(b) Notwithstanding subsection (a), new residential, commercial, and industrial development is permitted outside the areas described in subsection (a) if it is consistent with the land uses designated in county general plans as of May 16, 2013, and is otherwise consistent with this Chapter.

(c) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers proposed actions that involve new residential, commercial, and industrial development that is not located within the areas described in subsection (a). In addition, this policy covers any such action on Bethel Island that is inconsistent with the Contra Costa County general plan effective as of May 16, 2013. This policy does not cover commercial recreational visitor-serving uses or facilities for processing of local crops or that provide essential services to local farms, which are otherwise consistent with this Chapter.

(d) This policy is not intended in any way to alter the concurrent authority of the Delta Protection Commission to separately regulate development in the Delta's Primary Zone.

23 CCR Section 5010
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85022, 85300, 85302, and 85305, Water Code.

DP P2. Respect Local Land Use When Siting Water or Flood Facilities or Restoring Habitats

(a) Water management facilities, ecosystem restoration, and flood management infrastructure must be sited to avoid or reduce conflicts with existing uses or those uses described or depicted in city and county general plans for their jurisdictions or spheres of influence when feasible, considering comments from local agencies and the Delta Protection Commission. Plans for ecosystem restoration must consider sites on existing public lands, when feasible and consistent with a project's purpose, before privately owned sites are purchased. Measures to mitigate conflicts with adjacent uses may include, but are not limited to, buffers to prevent adverse effects on adjacent farmland.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers proposed actions that involve the siting of water management facilities, ecosystem restoration, and flood management infrastructure.

23 CCR Section 5011
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85022, 85054, 85300, and 85305, Water Code.

Recommendations

DP R3. Plan for the Vitality and Preservation of Legacy Communities

Local governments, in cooperation with the Delta Protection Commission and Delta Conservancy, should prepare plans for each community that emphasize its distinctive character, encourage historic preservation, identify opportunities to encourage tourism, serve surrounding lands, or develop other appropriate uses, and reduce flood risks.

DP R4. Buy Rights of Way from Willing Sellers When Feasible

Agencies acquiring land for water management facilities, ecosystem restoration, and flood management infrastructure should purchase from willing sellers, when feasible, including consideration of whether lands suitable for proposed projects are available at fair prices.

DP R5. Provide Adequate Infrastructure

The California Department of Transportation, local agencies, and utilities should plan infrastructure, such as roads and highways, to meet needs of development consistent with sustainable community strategies, local plans, the Delta Protection Commission's Land Use and Resource Management Plan for the Primary Zone of the Delta*, and the Delta Plan.*

DP R6. Plan for State Highways

The Delta Stewardship Council, as part of the prioritization of State levee investments called for in Water Code section 85306, should consult with the California Department of Transportation as provided in Water Code section 85307(c) to consider the effects of flood hazards and sea level rise on State highways in the Delta.

DP R7. Subsidence Reduction and Reversal

The following actions should be considered by the appropriate State agencies to address subsidence reversal:

- *State agencies should not renew or enter into agricultural leases on Delta or Suisun Marsh islands if the actions of the lessee promote or contribute to subsidence on the leased land, unless the lessee participates in subsidence reversal or reduction programs.*
- *State agencies currently conducting subsidence reversal projects in the Delta on State-owned lands should investigate options for scaling up these projects if they have been deemed successful. The California Department of Water Resources should develop a plan, including funding needs, for increasing the extent of their subsidence reversal and carbon sequestration projects to 5,000 acres by January 1, 2017.*
- *The Delta Stewardship Council, in conjunction with the California Air Resources Board (CARB) and the Delta Conservancy, should investigate the opportunity for the development of a carbon market whereby Delta farmers could receive credit for carbon sequestration by reducing subsidence and growing native marsh and wetland plants. This investigation should include the potential for developing offset protocols applicable to these types of plants for subsequent adoption by the CARB.*

Maintain Delta Agriculture

Agriculture is the principal land use in the Delta; however, in recent decades, the total area of agricultural lands has declined, as has the overall percentage of lands in agricultural use. The continued viability of agriculture in the Delta will require the protection of sufficient farmland and fresh water to support commercially viable operations and provide ways for agriculture to coexist with habitat restoration. Policies DP P1 and DP P2 acknowledge the importance of protecting these lands. Farming in the Delta will have to respond to changing conditions and new challenges in the coming years. Among these challenges are shifting commodity markets and consumer demand, changes in climate and water supplies, and subsidence of reclaimed agricultural lands. To support both Delta agriculture and species recovery, farmers in the Delta are encouraged to implement "wildlife-friendly" management practices to maximize habitat values. Restoring wildlife and fish through wildlife-friendly agriculture can help achieve ecosystem restoration objectives while reducing the loss of farmland to habitat restoration. Agritourism is a small but fast-growing source of income for farms in the region. It is another opportunity to add further value to the Delta economy from agricultural activities.

Problem Statement

Agriculture in some parts of the Delta is threatened by urbanization, subsidence, and changing markets due to increased competition from other countries and regions, and shifting consumer preferences. The impacts from water conveyance facilities, ecosystem restoration, changing water quality, and flood management plans are yet to be determined, but rapid and significant changes could disrupt agriculture. Farmers are concerned that regulations and other barriers to conducting business and using their land also threaten the continued viability of agriculture.

Policies

No policies with regulatory effect are included in this section.

Recommendations

DP R8. Promote Value-added Crop Processing

Local governments and economic development organizations, in cooperation with the Delta Protection Commission and the Delta Conservancy, should encourage value-added processing of Delta crops in appropriate locations.

DP R9. Encourage Agritourism

Local governments and economic development organizations, in cooperation with the Delta Protection Commission and the Delta Conservancy, should support growth in agritourism, particularly in and around legacy communities. Local plans should support agritourism where appropriate.

DP R10. Encourage Wildlife-friendly Farming

The California Department of Fish and Wildlife, the Delta Conservancy, and other ecosystem restoration agencies should encourage habitat enhancement and wildlife-friendly farming systems on agricultural lands to benefit both the environment and agriculture.

Encourage Recreation and Tourism

The Delta region offers diverse recreation experiences and facilities such as fishing, boating, birdwatching, other nature activities, hunting, campgrounds, parks and picnic areas, and historic towns and buildings. DPC and California State Parks foresee opportunities to improve and increase recreation and tourism in the Delta. Both agencies recommend improvements of "gateways" to the region on the Delta's urban edges and "base camps" inside the Delta at destinations such as resorts, legacy communities, or parks that are focal points for visitors. Building on the reports of the DPC and California State Parks, the Council recommends protecting and improving existing recreation opportunities while seeking ways of providing new, and better coordinated, opportunities. Ecosystem restoration, as described in Chapter 4, can also enhance opportunities for nature-based recreation and boating. Future prospects for recreation and tourism will be influenced by decisions about the Delta ecosystem, water quality, levee improvements, and governance, including land use and environmental standards. The BDCP, Delta water quality plans, levee investments, and other decisions yet to be made can all significantly affect recreation and tourism.

Problem Statement

Recreation opportunities abound, but many have not been fully developed due to inadequate visitor information, aging and inadequate facilities, and restricted access to public lands. Limited cooperation in marketing, planning, and public-private partnerships between public recreation providers, other government land managers, businesses, and others hinders recreation and tourism, and impedes expansion of visitor-serving businesses.

Policies

No policies with regulatory effect are included in this section.

Recommendations

DP R11. Provide New and Protect Existing Recreation Opportunities

Water management and ecosystem restoration agencies should provide recreation opportunities, including visitor-serving business opportunities, at new facilities and habitat areas whenever feasible; and existing recreation facilities should be protected, using California State Parks' Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh *and Delta Protection Commission's* Economic Sustainability Plan for the Sacramento-San Joaquin Delta *as guides.*

DP R12. Encourage Partnerships to Support Recreation and Tourism

The Delta Protection Commission and Delta Conservancy should encourage partnerships between other State and local agencies, and local landowners and business people to expand recreation, including boating, promote tourism, and minimize adverse impacts to nonrecreational landowners.

DP R13. Expand State Recreation Areas

California State Parks should add or improve recreation facilities in the Delta in cooperation with other agencies. As funds become available, it should fully reopen Brannan Island State Recreation Area, complete the park at Delta Meadows-Locke Boarding House, and consider adding new State parks at Barker Slough, Elkhorn Basin, the Wright-Elmwood Tract, and south Delta.

DP R14. Enhance Nature-based Recreation

The California Department of Fish and Wildlife, in cooperation with other public agencies, should collaborate with nonprofits, private landowners, and business partners to expand wildlife viewing, angling, and hunting opportunities.

DP R15. Promote Boating Safety

The California Department of Boating and Waterways should coordinate with the U.S. Coast Guard and State and local agencies on an updated marine patrol strategy for the region.

DP R16. Encourage Recreation on Public Lands

Public agencies owning land should increase opportunities, where feasible, for bank fishing, hunting, levee-top trails, and environmental education.

DP R17. Enhance Opportunities for Visitor-serving Businesses

Cities, counties, and other local and State agencies should work together to protect and enhance visitor-serving businesses by planning for recreation uses and facilities in the Delta, providing infrastructure to support recreation and tourism, and identifying settings for private visitor-serving development and services.

Sustain a Vital Delta Economy

Many of the policies and recommendations in this chapter deal with aspects of the Delta's economy such as maintaining agriculture and encouraging recreation and tourism. The Delta's economy also benefits from the surface transportation, utilities, and other infrastructure that crisscross the Delta to serve local needs and link the Delta to regional, national, and global markets. Facilities such as natural gas wells, wind turbines, other renewable power sources, electric transmission lines, and fuel pipelines need to be planned carefully to avoid conflicts with water supply, ecosystem restoration, or flood management facilities and existing and planned land uses. The ports at Stockton and West Sacramento are valuable assets to Delta communities and the state. Areas for water-dependent industries are located in Collinsville, Rio Vista, Pittsburg, and Antioch.

Problem Statement

Other economic opportunities in the Delta, including port and energy uses, could suffer if unplanned development, flooding, or other land uses interfere with them.

Policies

No policies with regulatory effect are included in this section.

Recommendations

DP R18. Support the Ports of Stockton and West Sacramento

The ports of Stockton and West Sacramento should encourage maintenance and carefully designed and sited development of port facilities.

DP R19. Plan for Delta Energy Facilities

The California Energy Commission and California Public Utilities Commission should cooperate with the Delta Stewardship Council as described in Water Code section 85307(d) to identify actions that should be incorporated in the Delta Plan by 2017 to address the needs of Delta energy development, storage, and distribution.

Timeline for Implementing Policies and Recommendations

Figure 5-7 lays out a timeline for implementing the policies and recommendations described in the previous sections. The timeline emphasizes near-term and intermediate-term actions.

Timeline for Implementing Policies and Recommendations

TIMELINE **CHAPTER 5: Delta as an Evolving Place**

	ACTION (REFERENCE #)	LEAD AGENCY(IES)	NEAR TERM 2012–2017	INTERMEDIATE TERM 2017–2025
POLICIES	Locate new urban development wisely (DP P1)	Local governments	●	●
POLICIES	Respect local land use when siting water or flood facilities or restoring habitats (DP P2)	Local governments and State agencies	●	●
RECOMMENDATIONS	Designate the Delta as a National Heritage Area (DP R1)	DPC	●	
RECOMMENDATIONS	Designate State Route 160 as a National Scenic Byway (DP R2)	Caltrans	●	
RECOMMENDATIONS	Plan for the vitality and preservation of legacy communities (DP R3)	Local governments, DPC, Delta Conservancy	●	
RECOMMENDATIONS	Buy rights of way from willing sellers when feasible (DP R4)	Local, State, and federal agencies	●	●
RECOMMENDATIONS	Provide adequate infrastructure (DP R5)	Caltrans, local agencies, and utility providers	●	●
RECOMMENDATIONS	Plan for State highways (DP R6)	Council, Caltrans	●	
RECOMMENDATIONS	Subsidence reduction and reversal (DP R7)	State agencies	●	
RECOMMENDATIONS	Promote value-added crop processing (DP R8)	Local governments and economic development organizations	●	●
RECOMMENDATIONS	Encourage agritourism (DP R9)	Local governments and economic development organizations	●	●
RECOMMENDATIONS	Encourage wildlife-friendly farming (DP R10)	DFW, Delta Conservancy	●	●
RECOMMENDATIONS	Provide new and protect existing recreation opportunities (DP R11)	Water management and ecosystem restoration agencies	●	●
RECOMMENDATIONS	Encourage partnerships to support recreation and tourism (DP R12)	DPC, Delta Conservancy	●	●
RECOMMENDATIONS	Expand State Recreation Areas (DP R13)	Parks	●	●
RECOMMENDATIONS	Enhance nature-based recreation (DP R14)	DFW	●	●
RECOMMENDATIONS	Promote boating safety (DP R15)	Boating and Waterways	●	
RECOMMENDATIONS	Encourage recreation on public lands (DP R16)	DWR, DFW, Delta Conservancy, Parks	●	
RECOMMENDATIONS	Enhance opportunities for visitor-serving businesses (DP R17)	Local governments and State agencies	●	●
RECOMMENDATIONS	Support the Ports of Stockton and West Sacramento (DP R18)	Ports of Stockton and West Sacramento	●	●
RECOMMENDATIONS	Plan for Delta energy facilities (DP R19)	California Energy Commission and PUC	●	

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Agency Key:

Boating and Waterways: California Department of Boating and Waterways
Delta Conservancy: Sacramento-San Joaquin Delta Conservancy
Caltrans: California Department of Transportation
Council: Delta Stewardship Council
DFW: California Department of Fish and Wildlife
DPC: Delta Protection Commission
DWR: California Department of Water Resources
Parks: California State Parks
PUC: California Public Utilities Commission

Figure 5-7

Science and Information Needs

Better information about recreation and tourism in the Delta and additional research into best practices for managing farmlands in the Delta can contribute to efforts to protect the Delta's unique values. These needs include the following:

- Surveys of Delta recreation at regular intervals, such as every 5 years, to inform marketing and planning for recreation and tourism
- Assessments of opportunities to control or reverse subsidence of farmland
- Analysis of land and water use by agriculture, including land ownership (resident vs. absentee; age of owner; size of holding, etc.), cropping patterns, soil types, and other factors to identify the Delta's agricultural regions, their competitive advantages, threats and opportunities
- Analysis of farm labor housing needs.

Issues for Future Evaluation and Coordination

Many Delta agencies and residents are concerned that the region's economy may suffer if agriculture or other uses decline significantly due to habitat restoration or water conveyance projects, especially the BDCP described in Chapter 3, or changes in State priorities for levee investment resulting from the studies recommended in Chapter 7. DPC's ESP forecasts adverse economic impacts from farmland loss based on a scenario of how these decisions may affect the region. Its Proposal to Protect the Delta as a Place recommends that the Delta Investment Fund support protection of the Delta economy, and be administered by the DPC and guided by an investment committee appointed by the DPC's commissioners (DPC 2012a). The Delta Conservancy will also play a role in some economic development efforts, as provided in Public Resources Code section 32322(b).

Because BDCP and new levee investment priorities are not yet complete, the magnitude of any impacts to farmland, other uses, or the Delta's economy cannot reasonably be forecast. If significant adverse impacts to the Delta economy do result from farmland losses or other impacts due to habitat restoration, water conveyance, or revised levee investment priorities, then measures to compensate for these losses may warrant consideration. This consideration should include creation of a regional agency to implement and facilitate economic development efforts, guided by the DPC's ESP. The agency's responsibilities could include the following:

- Branding and marketing the Delta
- Coordinating with counties and cities to encourage planning and infrastructure development that is aligned with economic sustainability strategies
- Providing regulatory assistance to reduce impediments to priority activities, including visitor-serving developments, dredging, levee construction, and ecosystem restoration, to reduce impediments and lower costs of these activities
- Encouraging value-added processing of Delta crops, agritourism, visitor-serving commercial businesses, and preservation of the historic buildings in legacy communities
- Recommending and overseeing expenditures from the Delta Investment Fund

Performance Measures

Development of informative and meaningful performance measures is a challenging task that will continue after the adoption of the Delta Plan. Performance measures need to be designed to capture important trends and to address whether specific actions are producing expected results. Efforts to develop and track performance measures in complex and large-scale systems like the Delta are commonly multiyear endeavors. The recommended output and outcome performance measures listed below are provided as examples and subject to refinement as time and resources allow. Final administrative performance measures are listed in Appendix E and will be tracked as soon as the Delta Plan is completed.

Recommended performance measures for protection and enhancement of the unique cultural, recreational, natural resources, and agricultural values of the Delta as an evolving place are described below.

Output Performance Measures

- Congress designates the Delta and Suisun Marsh as an NHA by January 1, 2014. (DP R1)
- Water management, ecosystem restoration, and flood management projects minimize conflicts with adjoining uses by including adequate mitigation measures to avoid adverse effects. (DP P2)
- Recreation facilities are included in new ecosystem restoration projects. (DP R9)
- The DWR and others increase the extent of their subsidence reversal and carbon sequestration projects to 5,000 acres by January 1, 2017. (DP R7)

Outcome Performance Measures

- No further rural farmland in the Delta is lost to urban development. (DP P1)
- Progress toward protecting the Delta legacy communities, as indicated by renovation of historic structures, floodproofing, and other reductions in flood hazards, and maintenance or growth of small businesses and population. (DP R3)
- Increasing tonnage of cargo and the number of jobs at the ports of Stockton and West Sacramento. (DP R18)

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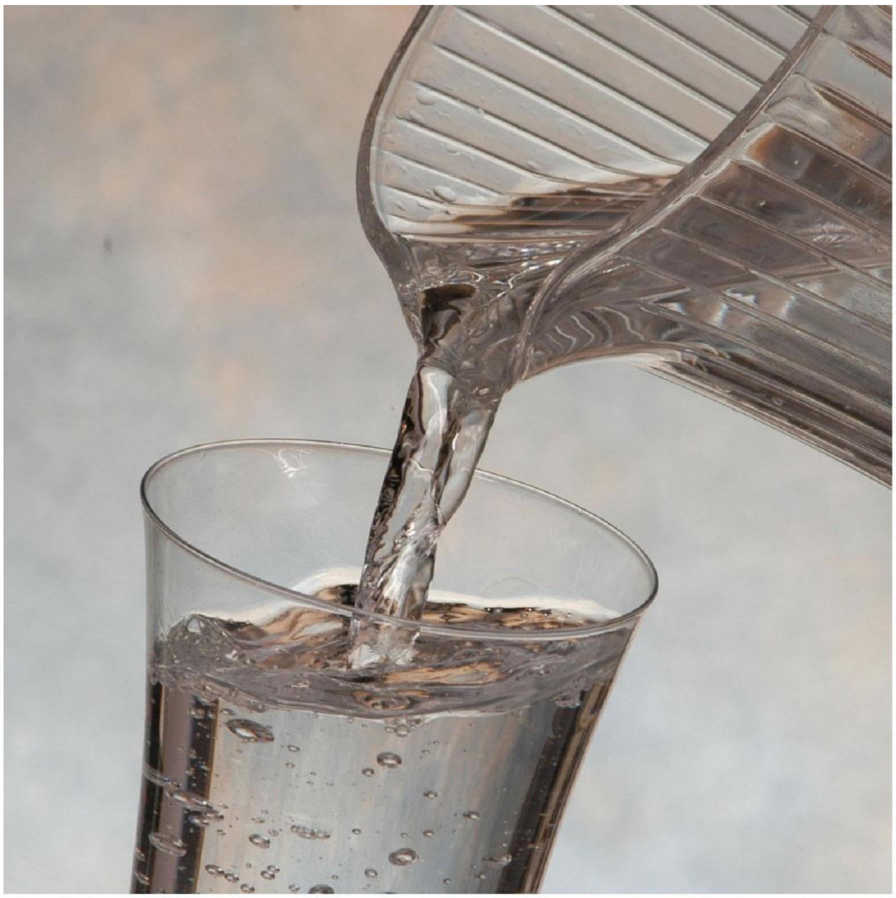
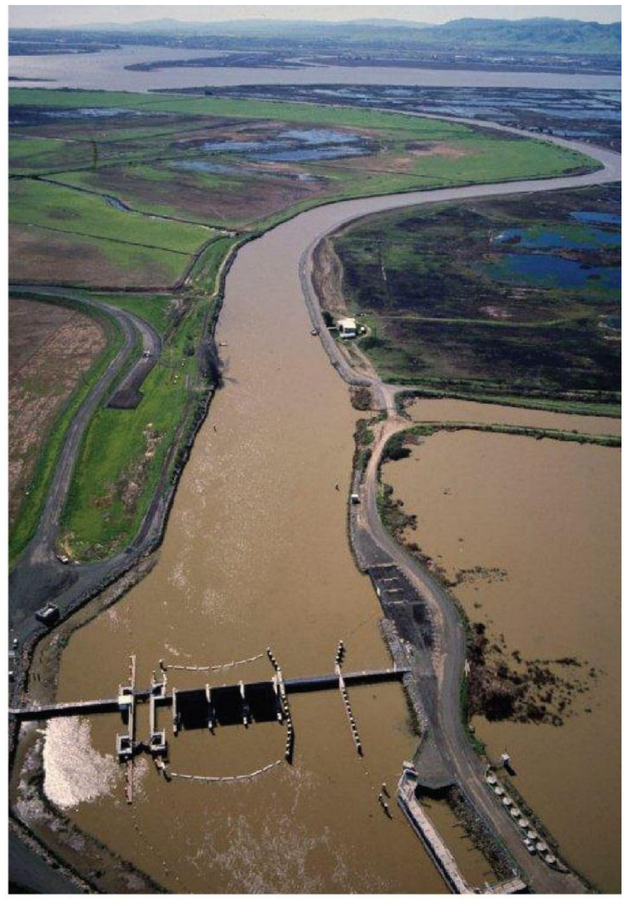
CHAPTER 6

Improve Water Quality to Protect Human Health and the Environment





ABOUT THIS CHAPTER

This chapter discusses the trade-offs and conflicts inherent in managing water quality for multiple objectives. It recommends strategies to make balanced improvements primarily through the prioritization of projects and programs. It also provides support to related information in Chapters 3, 4, and 5.

Other State of California (State) agencies have broad authority to protect and regulate water quality. This chapter sets forth priority Sacramento-San Joaquin Delta (Delta)-specific recommendations for those agencies and focuses on four core strategies where best available science shows the need for improved water quality to achieve the coequal goals:

- Require Delta-specific water quality protection
- Protect beneficial uses by managing salinity
- Improve drinking water quality
- Improve environmental water quality

These core strategies form the basis of the 12 recommendations found at the end of this chapter. These major aspects are critical to protecting human health and improving the environment. Salinity is discussed in a separate section because of its importance as a defining characteristic of the estuary and its implications to ecosystem health, its linkage to water project operations, and its historical importance in the Delta.

RELEVANT LEGISLATION

The protection and improvement of water quality is inherent to meeting the coequal goals of the State. Water quality plays a critical role in the achievement of a more reliable water supply and protection, restoration, and enhancement of the Delta ecosystem. Water quality also contributes to the values of the Delta as an evolving place. The Sacramento-San Joaquin Delta Reform Act of 2009 calls for improving water quality as follows:

> *85020 The policy of the State of California is to achieve the following objectives that the Legislature declares are inherent in the coequal goals for management of the Delta:…(e) Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.*

> *85022(d) The fundamental goals for managing land use in the Delta are to do all of the following: … (6) Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.*

> *85302(d) The Delta Plan shall include measures to promote a more reliable water supply that address all of the following: … (3) Improving water quality to protect human health and the environment.*

> *85302(e) The following subgoals and strategies for restoring a healthy ecosystem shall be included in the Delta Plan… (5) Improve water quality to meet drinking water, agriculture, and ecosystem long-term goals.*

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CHAPTER 6

Improve Water Quality to Protect Human Health and the Environment

The Delta Reform Act acknowledges water quality as an important element of a reliable water supply and directs the Delta Stewardship Council (Council) to improve water quality to protect human health and the environment. In general, water quality is an abstract concept unless it is discussed relative to protection of the beneficial uses of that water. The Delta Reform Act highlights drinking water, agriculture, and ecosystem goals as important beneficial uses for the purpose of the Delta Plan. The Council's role with respect to water quality is to ensure that the policies and recommendations in the Delta Plan balance the protection of myriad—and sometimes competing—beneficial uses of water.

In California, the entities primarily responsible for managing water quality in the state are the nine regional water quality control boards (RWQCBs) and the State Water Resources Control Board (SWRCB). The RWQCBs are responsible for water quality planning, permitting and enforcement, and financial assistance, when funds are available. The SWRCB is responsible for statewide plans, permits, and policies, and serves as a review body for RWQCB decisions. The SWRCB also has the important and challenging task of administering the State's complex water rights system of permits and licenses. As part of these duties, the SWRCB sets water quality objectives for major waterways, including the tributaries of the Delta, as described in Chapter 4. The Central Valley RWQCB is the regional board with primary jurisdiction in the Delta and Delta watershed.

Water quality in the Delta is influenced by many factors. Seasonal rainfall, snow runoff, and reservoir releases flow in from several rivers and streams, primarily the Sacramento and the San Joaquin rivers. During very high flows, some of this water flows across floodplains before it enters the Delta. Tides can bring saline waters into the Delta from the San Francisco Bay. There are also discharges from cities, industries, and agricultural lands. As all of these flows enter the Delta, they bring with them a variety of contaminants. Additionally, water is diverted from the Delta, either for use within the Delta or for use in Central and Southern California and other service areas. The timing and physical qualities of these flows into and out of the Delta affect the water quality needed to support the beneficial uses of Delta waters.

In achieving the coequal goals, the Council envisions a Delta where improved water quality supports a healthy ecosystem and the multiple beneficial uses of water, including municipal supply and recreational uses such as fishing and swimming. To support a more resilient and healthy Delta ecosystem, salinity patterns should be consistent with more natural flow patterns with inflows of high-quality water. Nutrient concentrations should support diverse and productive aquatic food webs, and should not cause excessive growth of nuisance aquatic plants or blooms of harmful algae. Physical attributes of the aquatic environment, such as dissolved oxygen (DO) concentrations, temperature ranges, and turbidity levels, should support the needs of native species. At all times, the Delta should be free of harmful concentrations of toxic substances. Discharges of treated wastewater, urban runoff, or agricultural return flows should be regulated so that they do not have a negative effect on the Delta. High water quality is imperative to the coequal goals and crucial for protecting the beneficial uses of Delta water, successful restoration of aquatic habitats, and sustenance of native plants and animals.

Beneficial uses of Delta waters involve trade-offs that are important to recognize and address when establishing water quality goals. These trade-offs emerge in cases where acceptable or even ideal water quality for one use may have unintended or adverse effects on another use. For example, variable salinity levels are beneficial for many native species in the Delta, but can be problematic for agricultural or municipal uses. Bromide salts, one component of salinity, can result in cancer-causing disinfection byproducts with some water treatment methodologies. Similarly, organic carbon in drinking water sources can contribute to harmful disinfection byproduct formation (Leenheer and Croue 2003). However, for ecosystem purposes, organic carbon is beneficial and is increased by wetland creation. Also, wetland creation can result in increased methylation of mercury, resulting in bioaccumulation of mercury in fish species, a threat to human health when these fish are consumed. Water quality is strongly connected to water supply, as reservoir releases to control salinity can reduce the availability of fresh water at times of the year when it is needed most. These and other issues affecting water quality policy are discussed in this chapter.

Beneficial Uses of Water in and from the Delta

A goal of the Delta Plan is to maintain water quality at a level that supports and enhances designated beneficial uses. Table 6-1 lists the beneficial uses for water in the Delta as specified in the SWRCB's 2006 *Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta Estuary* (Bay-Delta Plan).

The most important part of any water quality discussion is identifying the existing and potential uses of the water in question. These uses drive the level of water quality that must be attained, and what requirements and limitations must be placed on dischargers and diverters of that water to protect those uses. Specific discharge limitations are based on adopted science-based objectives necessary to protect associated beneficial uses. These limitations are then included in discharge permits.

Factors Influencing Water Quality in the Delta

This section provides an overview of factors that influence water quality in the Delta and existing water quality regulations. Water quality in the Delta is influenced by factors such as:

- Freshwater inflows and outflows
- In-Delta land use
- Dredging
- The Delta levee system
- Tides
- Point source inputs of pollutants
- Nonpoint source inputs of pollutants
- In-Delta water use
- Export diversions and operations

Delta Water Beneficial Uses

TABLE 6-1

Beneficial Use	Description
Municipal and Domestic Supply	Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.
Industrial Service Supply	Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining cooling water supply, hydraulic conveyance, gravel washing, fire protection, and oil well repressurization.
Industrial Process Supply	Uses of water for industrial activities that depend primarily on water quality.
Agricultural Supply	Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.
Groundwater Recharge	Uses of water for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers.
Navigation	Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.
Water Contact Recreation	Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These include, but are not limited to, swimming, wading, water skiing, skin and scuba diving, surfing, white-water activities, fishing, or use of natural hot springs.
Non-contact Water Recreation	Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion is reasonably possible. These include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.
Shellfish Harvesting	Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sports purposes.
Commercial and Sport Fishing	Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.
Warm Freshwater Habitat	Uses of water that support warmwater ecosystems including, but not limited to, preservation of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.
Cold Freshwater Habitat	Uses of water that support coldwater ecosystems including, but not limited to, preservation or enhancements of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.
Migration of Aquatic Organisms	Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.
Spawning, Reproduction, and/or Early Development	Uses of water that support high-quality aquatic habitats suitable for reproduction and early development of fish.
Estuarine Habitat	Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds).
Wildlife Habitat	Uses of water that support estuarine ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.
Rare, Threatened, or Endangered Species	Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under State or federal law as being rare, threatened, or endangered.

Source: SWRCB 2006

Generally, water quality is better in the northern Delta than in the central and southern Delta because higher-quality Sacramento River inflows are greater than inflows from the San Joaquin River, and the proportion of agricultural water use and drainage in the San Joaquin Valley is greater than in the Sacramento Valley. The SWRCB has listed Delta waterways (various streams, rivers, and sloughs in the Delta), the Carquinez Strait, and San Francisco Bay as having impaired water quality pursuant to the federal Clean Water Act (CWA) section 303(d) list[1] (SWRCB 2010). Pollutants of concern include insecticides, herbicides, mercury, selenium, nutrients, and legacy organic pollutants such as dichlorodiphenyltrichloroethane (DDT) and polychlorinated biphenyls (PCBs). Additional water quality issues in the Delta include temperature, salinity, turbidity, low DO, bromide, dissolved organic carbon, pathogens, and harmful algal blooms (HABs). Amounts of these constituents that are too high (or in some cases too low) can impair the ability of these waters to support beneficial uses, such as municipal water supply, recreational use, agricultural water supply, and habitat that supports healthy fish and wildlife populations. See Chapter 4 for additional discussion on how these water quality stressors can affect the Delta and its ecosystem.

Protecting Water Quality Is a Balancing Act

Water quality is central to the State's goals for the Delta – restoring the Delta ecosystem and providing for a more reliable water supply, while protecting and enhancing the Delta as a unique and evolving place. Conditions that affect water quality must be managed and balanced in a way that allows these goals to be met simultaneously. When one use is protected, steps must be taken to minimize impacts on other uses. The following examples of this interconnectedness illustrate the difficulty of the challenge at hand.

[1] The "303(d) list" is the list of impaired and threatened waters (stream/river segments, lakes) that states have identified as not meeting water quality standards and other requirements. Under section 303(d), the law requires that states establish priority rankings for waters on the list and develop total maximum daily loads (TMDLs) for these waters.

Water supply for agricultural, municipal, and industrial use requires control of chemical constituents such as salinity, and certain pollutants that could pose a threat to human health. Efforts to protect, enhance, and restore the Delta ecosystem, however, require the management of volume and timing of flows to provide beneficially variable salinity for certain species and sufficient fresh water for others. This management regime must also consider management of nutrients and suspended solids to ensure a viable food chain within the Delta.

Protecting the communities within the Delta and their water use involves many of these same salinity and pollutant controls that are important for any water supply, but water quality in the Delta must also support recreational uses such as swimming, fishing, and boating. Cumulative discharges of pollutants from Delta communities and from recreational craft can affect in-Delta uses. Sea level rise caused by climate change will affect in-Delta water use and the manner in which flows are managed to meet water quality demands. Levee construction and placement is important to guard against flooding that could threaten in-Delta and exported water supplies. In addition, levee construction can either disrupt ecosystem processes or help provide important habitat benefits, depending on the project's location and individual attributes.

Climate Change

Impacts on water quality from climate change are difficult to predict. However, a recent analysis by the U.S. Geological Survey (USGS) suggests that climate change poses a significant threat to water quality (Cloern et al. 2011). Increases in sea level would increase salinity intrusion into the Delta, threatening water quality for agricultural and municipal uses. Increased air and water temperatures would result in increased runoff amounts in winter, with less in spring and summer. Warmer water can directly affect the life cycle of many fish species and stimulate growth of nuisance aquatic plants or blooms of harmful algae, which can lead to decreases in DO and increases in organic carbon. Increased runoff in the winter could result in more erosion and greater pulses of pollutants.

Existing Water Quality Regulations

Many different agencies have a role in the regulation of water quality in the Delta. The SWRCB and the RWQCBs have primary responsibility over discharges affecting beneficial uses of water in California with the oversight of the U.S. Environmental Protection Agency (USEPA). Drinking water supply is regulated by the California Department of Public Health, also with oversight by USEPA. Additionally, the California Department of Pesticide Regulation regulates the sale and use of pesticides, which affect water quality. (See sidebar, A Water Quality Success Story.)

A WATER QUALITY SUCCESS STORY

Widespread use of the organophosphorus pesticide diazinon in the Central Valley and episodes of aquatic toxicity caused the Central Valley RWQCB to add the Sacramento and Feather rivers to its list of impaired water bodies in 1994. A total maximum daily load for diazinon was adopted in 2003. Stakeholders also took action to implement a diazinon control strategy, and the USEPA and California Department of Pesticide Regulation took steps to restrict approved uses of diazinon. Grants from the USEPA, the former CALFED Bay-Delta Program, and other agencies provided funding support for control program implementation and research throughout the Central Valley region, including the San Joaquin River.

These water quality control efforts have helped to reduce levels of diazinon to the point that violations of water quality standards in the Sacramento and San Joaquin rivers are rare. Although pesticide pollution is still a problem in parts of some Central Valley streams and rivers, the experience with diazinon shows that programs to address these and other water quality problems can be effective (USEPA 2010).

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The RWQCBs develop water quality control plans (known as Basin Plans) that establish water quality standards and implementation plans for achieving standards for all surface water and groundwater in their respective regions. Water quality standards include identification of beneficial uses, numeric and narrative water quality objectives to protect those uses, and water quality control policies. The RWQCBs issue discharge permits and requirements that specify the amounts of pollutants that may be discharged based on these objectives. Although these permits are intended to ensure protection of these beneficial uses, some water bodies continue to exceed standards, and beneficial uses are not being protected. These impaired water bodies are identified and listed pursuant to federal CWA section 303(d).

Placement of a water body on the CWA 303(d) list initiates a process to develop a pollution limit, or total maximum daily load (TMDL), to address each pollutant causing the impairment. A TMDL defines how much of a pollutant a water body can tolerate and still meet water quality standards. The TMDL must account for all sources of a pollutant, including point sources and nonpoint sources (discharges from wastewater treatment facilities; runoff from urban areas, agricultural inputs, and streets or highways; “toxic hot spots”; and aerial deposition). In addition to accounting for past and current activities, TMDLs may also consider projected future population growth that could increase pollutant levels. The TMDL identifies allocations for point sources and for nonpoint sources, and includes a margin of safety to account for uncertainty. An implementation plan is developed that specifies a set of actions that must be carried out to ensure that the TMDL results in achievement of water quality standards. TMDLs are usually implemented through amendments to the appropriate Basin Plan, which, in turn, will result in changes to discharge permits as they are reissued. Once a TMDL is approved, it may be some time before the necessary studies are completed to set and apportion specific discharge limitations among all dischargers and potential dischargers.

The 2008-2010 Integrated Report (SWRCB 2010), which includes the 303(d) list, prioritizes TMDLs to be developed for each water body-pollutant combination on the CWA section 303(d) list, and establishes schedules for completion of the TMDLs. Approved TMDLs and TMDLs under development are listed in Table 6-2.

On February 10, 2011, the USEPA issued an Advanced Notice of Proposed Rulemaking (USEPA 2011) as part of an effort to assess the effectiveness of current water quality programs designed to protect aquatic species in the San Francisco Bay and the Delta (referred to here as the Bay-Delta). The document identified key water quality issues affecting Bay-Delta aquatic resources and summarized current research for each of these issues, including total ammonia, selenium, pesticides, emerging contaminants, and other parameters affecting estuarine habitat and the migratory corridors of anadromous fish. The notice was intended to solicit public comment on possible USEPA actions to address water quality conditions affecting the Bay-Delta. USEPA may make changes to programs in the Bay-Delta through a formal rulemaking process as a result of further evaluation and consideration of public comment. These changes could affect federal water quality programs administered by the State.

Water quality in the Delta is also regulated by the San Francisco Bay Conservation and Development Commission (BCDC), which has jurisdiction on all tidal areas of the Bay, including Suisun Bay and Suisun Marsh. BCDC policies regarding water quality are intended to prevent the release of pollution into Bay waters to the greatest extent feasible. The BCDC makes decisions regarding water quality impacts based on evaluation by and the advice of the San Francisco Bay RWQCB. The BCDC reviews State and federal actions, permits, projects, licenses, and grants affecting the Bay, including Suisun Marsh, pursuant to the federal Coastal Zone Management Act.

In the Delta and the Suisun Marsh, the Bay-Delta Plan establishes water quality objectives for which implementation is achieved through assigning responsibilities to water right holders and water users (SWRCB 2006). (See sidebar, Water Board Regulation and the Bay-Delta Plan.) This is because the parameters to be controlled are significantly affected by flows and diversions; these responsibilities were established in Water Rights Decision 1641 in 1999. The Bay-Delta Plan also provides protection for beneficial uses that require control of salinity and operations of the various water projects in the Delta, including the State Water Project (SWP) and Central Valley Project (CVP) (SWRCB 2006).

TMDLs Approved and under Development in the Central Valley, Delta, and Suisun Bay

TABLE 6-2

Water Bodies	Pollutants	Status
American River	Mercury	Under Development
Cache Creek, Bear Creek, Harley Gulch	Mercury	Approved
Central Valley	Organochlorine Pesticides	Under Development
Central Valley	Pesticides	Under Development
Clear Lake	Mercury	Approved
Clear Lake	Nutrients	Approved
Grasslands	Selenium	Approved
North San Francisco Bay (includes Suisun Bay)	Selenium	Under Development
Sacramento and Feather Rivers	Diazinon	Approved
Sacramento County Urban Creeks	Diazinon and Chlorpyrifos	Approved
Sacramento-San Joaquin River Delta	Diazinon and Chlorpyrifos	Approved
Sacramento-San Joaquin River Delta	Mercury	Approved
Salt Slough	Selenium	Approved
San Francisco Bay (includes Suisun Bay)	Mercury	Approved
San Francisco Bay (includes Suisun Bay)	PCBs	Approved
San Francisco Bay Area Urban Creeks	Diazinon/Pesticide Toxicity	Approved
San Joaquin River	Salt and Boron	Approved
San Joaquin River	Diazinon and Chlorpyrifos	Approved
San Joaquin River	Selenium	Approved
Stockton Deep Water Ship Channel (Phase 1)	Dissolved Oxygen	Approved
Stockton Deep Water Ship Channel (Phase 2)	Dissolved Oxygen	Under Development
Stockton Urban Sloughs	Dissolved Oxygen	Under Development
Stockton Urban Water Bodies	Pathogens	Approved
Suisun Marsh	Dissolved Oxygen	Under Development
Suisun Marsh	Mercury	Under Development
Upper Sacramento River	Cadmium, Copper, and Zinc	Approved

Sources: Central Valley RWQCB 2011; San Francisco Bay RWQCB 2011a

The SWRCB and RWQCBs are the regulatory agencies with statutory authority to adopt water quality control plans, including regulating waters for which water quality standards are required by the federal CWA (Water Code sections 13170 and 13240). The Council recognizes the SWRCB's role and authority in regulating water quality, and supports and encourages the timely development and enforcement of programs (for example, water quality objectives and waste discharge requirements (WDRs), TMDLs, and National Pollutant Discharge Elimination System [NPDES] permits) to reduce pollutant loads that are causing water quality impairments in the Delta. The Council also supports and encourages the completion of the elements of the SWRCB's 2010 *Update to Strategic Plan 2008-2012* (June 2010) and the *Strategic Workplan for Activities in the San Francisco Bay/Sacramento–San Joaquin River Delta Estuary* (July 2008) prepared by the SWRCB, Central Valley RWQCB, and San Francisco Bay RWQCB.

WATER BOARD REGULATION AND THE BAY-DELTA PLAN

Water Quality Criteria, Objectives, and Standards. The SWRCB and RWQCBs have primary responsibility for the regulation of discharges and control of pollutants that affect California's surface and groundwater resources.

The water boards do this by using scientific studies and information to first determine the water quality *criteria* that are needed for specific beneficial uses of that water. Examples of beneficial uses include drinking water use, agricultural use, recreation, and others listed in the Bay-Delta Plan. The water quality criteria are then used to develop water quality objectives.

Water quality *objectives* account for additional information such as economic impacts, effects on other uses, available technology, and similar factors. Water quality objectives are considered equivalent to water quality *standards* required by the USEPA. The RWQCBs adopt water quality control plans that contain these objectives; they identify specific beneficial uses of each water body covered by that plan and specific water quality objectives to protect those uses. These plans are then used to issue general or site-specific discharge permits with specific pollutant discharge limitations.

Section 303(d) of the federal CWA requires that California create a listing of impaired water bodies that are not meeting water quality standards. Water bodies on this 303(d) list require development of a TMDL, which establishes a limitation on the amount of pollution that water body can be exposed to without adversely affecting its beneficial uses. This TMDL allocates proportions of the total limitation among dischargers to the impaired surface water. TMDLs typically result in changes to water quality control plans, so that existing and future permits contain pollutant limits or other provisions necessary to ensure that the water quality standards are met.

Flow Objectives. The SWRCB is responsible for administering and overseeing the right to take and use water in California. Where storage, transport, diversion, and use of water threaten to adversely affect water quality and beneficial uses, the SWRCB may adopt plans that set objectives for water quality and flow where necessary to protect beneficial uses. As a special kind of water quality objective, *flow objectives* are developed on the basis of scientifically developed information and account for other factors, such as economic impacts, physical constraints, and effects on other uses such as water supply and agricultural use.

The Bay-Delta Plan. In the case of the Delta, the SWRCB has adopted the Bay-Delta Plan. This plan contains water quality objectives, including flow objectives. The Delta Reform Act required that certain flow criteria be developed, which the SWRCB completed in 2010.

In early 2012, the SWRCB officially launched the comprehensive review of the Bay-Delta Plan. The water quality control planning phase of this review will include review of potential modifications to current objectives included in the Bay-Delta Plan, the potential establishment of new objectives, and modifications to the program of implementation for those objectives. It will also include potential changes to the monitoring and special studies program included in the Bay-Delta Plan. The water quality control planning process will not include amendments to water rights and other measures to implement a revised Bay-Delta Plan. A separate environmental impact report will be prepared for these actions. In addition, a separate substitute environmental document is being prepared to address updates to the water quality objectives for the protection of southern Delta agricultural beneficial uses, San Joaquin River flow objectives for the protection of fish and wildlife beneficial uses, and the program of implementation for those objectives.

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Salinity in the Delta

The Delta is an estuary, and like any estuary, fresh water from rivers and tributaries flows downstream where it mixes with salt water. The location, extent, and dynamics of the freshwater-saltwater interface are important drivers of many estuarine (ecological) processes and important considerations in water management for human uses. The geographic extent of water of the correct salinity is important to many estuarine species as it is an important characteristic of their habitat. Crops vary in their tolerance of salt content in water used for irrigation, and salinity can reduce yields of sensitive crops at relatively low levels. Salt in municipal water supplies increases corrosion of pipes and appliances, can affect taste, and can contribute to the formation of disinfection byproducts that are harmful to human health. The management-intensive regulation of salinity in the Delta for multiple benefits is another example of the highly altered system the Delta has become. This section provides a summary of the history of Delta salinity problems and the effects of salinity on agricultural, municipal, and industrial water use.

History and Causes of Delta Salinity Problems

The location of the freshwater-saltwater interface in the estuary shifts with the seasons and the tides and from year to year depending on the amount of precipitation, water diversions, and Delta outflow (Kimmerer 2004; Malamud-Roam et al. 2007; Stahle et al. 2011). The location, extent, and dynamics of this freshwater-saltwater gradient have changed over the past 150 years because of landscape modification, water management and flood management infrastructure such as dams and conveyance facilities, channel dredging, and climate change.

Figure 6-1 is a representation of salinity over a range of concentrations relevant to suitability for water supply. It shows the salinity gradient in the western Delta under high and low outflow conditions. Changes in seasonal inflow to the Delta caused by upstream diversions, storage of water behind the State and federal water project dams, and operation of the State and federal Delta pumps have generally shifted the salinity gradient upstream and have changed seasonal and interannual salinity patterns. Even with these measurable shifts in salinity caused by diversion, storage, and conveyance of water, a primary driver of seasonal and annual salinity variability in the western Delta and Suisun Marsh continues to be the amount of precipitation in the watershed (Enright and Culberson 2010).

The examination of tree rings throughout the mountains of California provides a good indicator of precipitation over the last 650 years, but tree rings alone cannot accurately reproduce the details of Delta salinity over this period (Stahle et al. 2011). However, strong evidence indicates that the western Delta was a freshwater ecosystem for 2,500 years before human modification in the nineteenth and twentieth centuries (Malamud-Roam and Ingram 2004). Channel dredging, significant reductions in tidal marsh area, and levee construction have changed Delta salinity by increasing the strength of tides in the Delta, increasing connections between channels, and reducing the moderating effects of wetlands and floodplains on outflow. Consequently, simply allowing more variability in Delta outflow will not produce the same salinity patterns that existed before development.

Although sea water is the primary source of salinity in the western Delta and Suisun Marsh, it is not the only source. Agricultural drainage is another significant source of salinity, particularly in the San Joaquin Valley. Municipal and industrial discharges also can locally increase salinity, although such salinity increases are generally small compared to increases from brackish water inputs. All surface waters and groundwaters contain some amount of salt, and this salt is concentrated with use through evaporation and transpiration of water by plants (Central Valley Drinking Water Policy Workgroup 2007). The remaining water in drainage, agricultural return flows, or percolated groundwater has a higher salt concentration than the supply water. This normal increase in salinity with water use is exacerbated in some parts

Salinity in the Delta Varies by Inflow Volumes

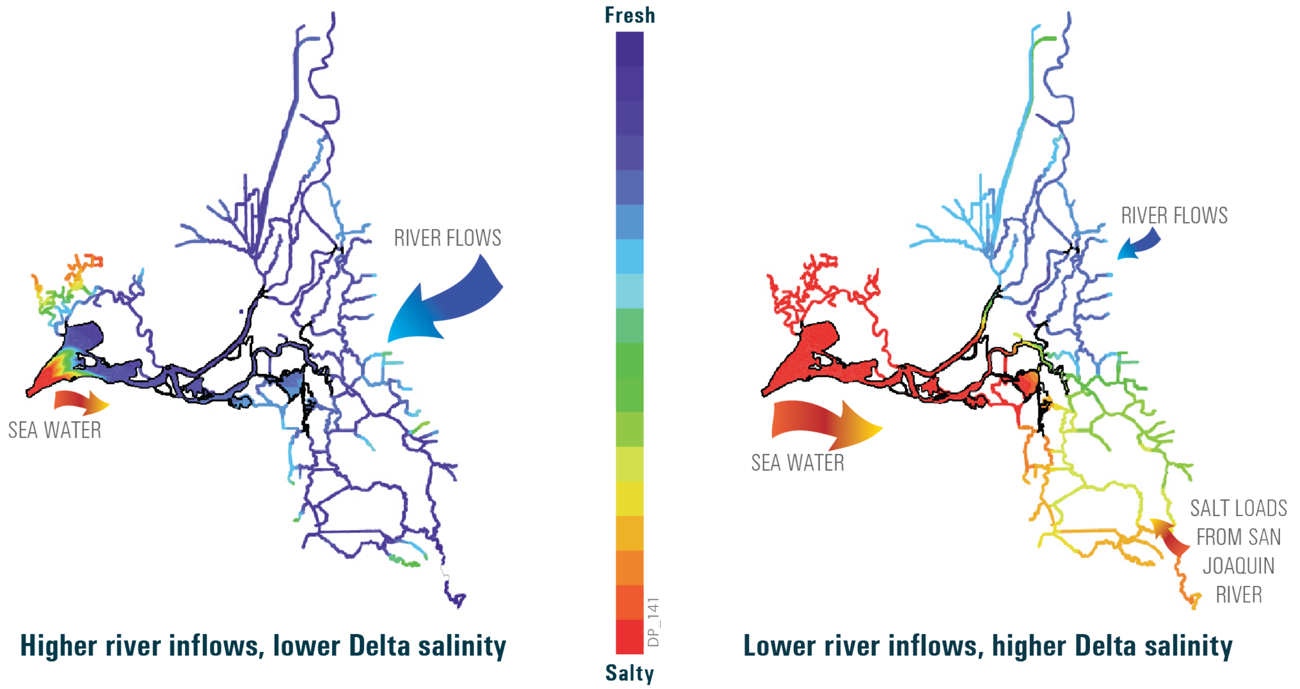

Figure 6-1

Delta salinity varies with inflow and outflow. Very high flows (left) push fresh water well into Suisun Bay and produce low-salinity conditions throughout the Delta. During very low flow periods (right), sea water can be seen pushing into the interior Delta from Suisun Bay with high salinity also entering from the San Joaquin River in the southeastern Delta.

Source: Central Valley Drinking Water Policy Workgroup 2007; images created by Resource Management Associates

of the San Joaquin Valley by naturally occurring salts in soils and a Delta water supply that already includes salt. Some of the salt load in the San Joaquin Valley accumulates in groundwater, affecting a variety of uses. Another manifestation of the salt problem is elevated salinity in the San Joaquin River at the point where it enters the Delta; this level is much higher than in the Sacramento River and marginally meets applicable water quality standards for much of the year. At times, salinity from sea water mixing into the western Delta and salinity from the San Joaquin River creates a Delta with a "freshwater corridor" leading from the Sacramento River to the State and federal water export pumps in the south Delta.

Salinity in the Delta Ecosystem

The role of water quality characteristics in ecosystem function, including salinity, temperature, turbidity, and DO, is discussed in detail in Chapter 4. Salinity is a defining characteristic of habitat for estuarine organisms and perhaps the most important water quality characteristic affecting municipal, industrial, and agricultural water use. However, salinity patterns that benefit native species are sometimes in conflict with human uses of water.

The salinity tolerances and preferences of fish vary by species. Delta smelt spawn in fresh water, but juveniles and adults generally show a preference for salinity in the range of 0.5 to 5 parts per thousand (ppt). Adult longfin smelt tolerate a much wider range of salinity and thrive in salinities greater than 5 ppt. Splittail do well in a wide range of salinities from fresh water up to 18 ppt (Moyle 2002). Largemouth bass and bluegill, introduced species, prefer fresh water and are rarely found at salinities greater than 1 to 2 ppt. The location, extent, and dynamics of the freshwater-saltwater interface in the Bay-Delta is an important factor in the distribution and abundance of many fish, invertebrate, and plant species, and is largely determined by the amount of fresh water flowing from the Delta west into Suisun Bay.

The interface between fresh water and salt water is a critical region of the estuary for many native fish and other organisms. Although there is no broadly accepted definition, the low salinity zone (LSZ) of the estuary is generally considered to be the region with salinity ranging from fresh water up to about 5 ppt, about one-seventh the salinity of sea water. The part of the salinity gradient centered on 2 ppt is considered to be of particular importance because it is hypothesized to be an area where suspended particulate matter and organisms accumulate. The location in the Bay-Delta where the tidally averaged salinity at 1 meter from the bottom is 2 ppt is known as X2 (measured as distance in kilometers from the Golden Gate Bridge) and serves as a water quality objective to regulate Delta outflow. The endangered Delta smelt show a preference for the LSZ. Their distribution during most of the year is centered near X2 (Nobriga et al. 2008). The position of X2 is also correlated with the abundance of several estuarine fish and invertebrates such as the bay shrimp and longfin smelt. That is, higher outflows (X2 located closer to the Golden Gate Bridge) are correlated with greater abundance of longfin smelt and bay shrimp (Kimmerer 2004). However, the processes linking greater Delta outflow with the abundance of estuarine species in the Bay-Delta system are not clearly understood, and continue to be studied and debated.

One proposed mechanism for the benefits of X2 as a regulatory marker for Delta smelt and other pelagic species is its relationship to the extent of low-salinity habitat. Lower values of X2 place it in the vicinity of Grizzly and Suisun bays, which results in a much larger area of low-salinity habitat than when X2 is located upstream of the confluence of the Sacramento and San Joaquin rivers. One of the potential negative effects of climate change will be a reduction in the availability of suitable low-salinity habitat for Delta smelt. The combined effects of sea level rise and changes in other aspects of estuarine habitat caused by climate change and increased water diversions are likely to pose a significant threat to the future survival of Delta smelt (Feyrer et al. 2011). Additional information on the relationship between flows in the Delta, the low-salinity zone, and implications for ecosystem health is included in Chapter 4.

Effects of Salinity on Agricultural Water Use

As noted in Chapter 5, agricultural use of water in the Delta is a significant factor in the health of the Delta's regional economy. The effect of salinity on agricultural water use varies by crop, soil type, and other factors (Hoffman 2010). The existing water quality objective, designed to protect the most sensitive crops, is set by the SWRCB at 700 microsiemens per centimeter (μS/cm) during the irrigation season and 1,000 μS/cm for the remainder of the year in southern Delta channels. At 700 μS/cm, water is relatively fresh, approximately equivalent to a salinity of 0.37 ppt (about 1 percent). The SWRCB is reviewing this objective based on the most recent information about the impacts of salinity on typical Delta crops. Salts from upstream and in-Delta agricultural drainage and from seawater intrusion from the Bay can affect agricultural water use in the Delta. Poor flow circulation in some parts of the Delta resulting from water diversions and historical channelization can exacerbate salinity problems.

Water quality to protect agricultural water use in the southern Delta is controlled through a combination of San Joaquin River inflow, export pumping, and Delta outflow changes. When salinity threatens to exceed water quality objectives for the San Joaquin River near Vernalis, additional high-quality water is released from New Melones Reservoir.

The effect of these releases is tempered by the installation and operation of flow barriers in the southern Delta to benefit agriculture. Salinity from seawater intrusion is reduced through a combination of reservoir releases, gate closures, and export pumping changes that, when necessary, control Delta outflow. Any significant changes to the way that water moves into or through the Delta, such as sea level rise, changed conveyance, changed inflow, or changed outflow, will change salinity patterns in the Delta.

Water quality at the SWP and CVP export pumps in the southern Delta, while usually meeting all applicable standards for municipal and agricultural use, is significantly higher in salinity than Sacramento River inflow to the Delta. Allowing salinity to vary in a way that might benefit native species could affect agricultural and municipal uses of Delta water.

Effects of Salinity on Municipal and Industrial Water Uses

Salinity contamination of municipal water supplies, as described in the following section on drinking water quality, can make water unpalatable, contributes to the formation of harmful disinfection byproducts, and increases corrosion of pipes and equipment. The existing objectives for protection of municipal and industrial beneficial uses in the southern Delta, expressed as limits on concentration of chloride, were developed to protect former industrial uses, but have been retained because they also protect drinking water quality. Secondary standards (standards that apply to aesthetic properties) for drinking water supplies also apply to water exported from the Delta by the CVP and SWP.

Under the current salinity regulations and operations practices for Delta water, municipal and industrial water supplies generally meet all salinity objectives. However, sea level rise, Delta levee failures, and increasing salt from upstream all threaten Delta municipal and industrial water supplies. Removing salts from water supplies is technically possible, although difficult and expensive; and disposing of the concentrated salt waste stream remains a key challenge.

Increased salinity further affects the reliability of municipal and industrial water supplies by reducing opportunities for water reuse and recycling (Healey et al. 2008), in turn potentially increasing reliance on imported surface water. Moving Delta intakes upstream, away from the influence of seawater intrusion and San Joaquin River inflow, could substantially reduce these water supply threats and is the subject of analysis under the current Bay Delta Conservation Plan process.

The salinity regime in the Delta is driven by natural flows, water management, and human land and water uses in the Delta and its watershed. Achieving the coequal goals will require updated comprehensive flow objectives and water quality control programs for salinity that balance ecosystem and water supply needs. The SWRCB must pay significant attention to the examination and resolution of these water quality issues in its development of new Delta flow requirements and as new plans for Delta conveyance are developed.

Drinking Water Quality

Water moving through the Delta contributes some part of the drinking water supplies for more than 25 million Californians. It is also used extensively for body-contact recreation such as swimming and water skiing. At the current locations where Delta water is diverted for municipal use, the water sometimes contains relatively high concentrations of bromide, organic carbon, nutrients, and dissolved solids (salinity). These drinking water constituents of concern are not directly harmful in drinking water, but they lead to formation of harmful chemicals during drinking water treatment, or contribute to taste, odor, or other municipal water supply problems. Sources of these drinking water constituents of concern include natural processes, such as tidal mixing of sea water into the Delta, and the flux of water and organic matter from wetlands, as well as urban runoff, agricultural runoff, and municipal wastewater discharge. Pathogenic (infectious) protozoa, bacteria, and viruses are also present in Delta waters and are a disease risk for both drinking water and body-contact recreation.

The future of water quality is a major concern for municipalities using Delta water. Current water quality regulations and policies for surface waters do not directly apply to many of the drinking water quality constituents of concern. Sea level rise, levee failure, salinity variability, agricultural water use, and increased urban runoff due to population growth in the watershed all pose a threat to drinking water quality. Clear policies regarding the protection of water quality relevant to the drinking water quality constituents of concern are needed to prevent such degradation. The Central Valley RWQCB is developing a drinking water policy that is, in part, intended to prevent the degradation of high-quality drinking water sources (Central Valley RWQCB 2010).

Disinfection Byproducts

Treatment of public water supplies is necessary to prevent disease caused by pathogenic organisms. However, bromide and organic carbon in municipal water supplies contribute to the formation of harmful disinfection byproducts when water is treated for domestic use (Healey et al. 2008, AWWA 2011). (See sidebar, Disinfection Byproducts.) The disinfection byproducts of primary concern in tap water, such as trihalomethanes (THMs), haloacetic acids, and bromates, are carcinogens subject to stringent public health standards. Treatment of water from the Delta is particularly challenging because it can contain elevated levels of both bromide and organic carbon (DWR 2007). Changes to drinking water treatment processes to reduce the amounts of disinfection byproducts in tap water are technologically challenging and can significantly increase the cost of drinking water treatment (Chen et al. 2010).

Organic carbon (total or dissolved) is an aggregate measure of the amount of a wide variety of organic compounds in water. In fresh water, these compounds typically come largely from decaying plant material. Along with bromide, elevated concentrations of organic carbon contribute to formation of disinfection byproducts. The amount of disinfection byproduct varies with the type and source of organic carbon, but total organic carbon concentration is nearly always correlated with disinfection byproduct formation. Large-scale restoration of wetlands could increase the amount of disinfection byproducts formed in Delta

DISINFECTION BYPRODUCTS

Disinfection byproducts are formed when disinfectants used in water treatment plants react with bromide and/or natural organic matter (decaying vegetation) present in the source water. Different disinfectants produce different types or amounts of disinfection byproducts. Disinfection byproducts identified in drinking water include THMs, haloacetic acids, and bromates. The USEPA has established regulations for these contaminants and set the maximum contaminant levels (MCLs) to prevent health effects (40 *Code of Federal Regulations* Part 141).

Trihalomethanes (THM) are a group of four chemicals formed along with other disinfection byproducts when chlorine or other disinfectants used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter in water. The THMs are chloroform, bromodichloromethane, dibromochloromethane, and bromoform. THM violations are the primary difficulty for drinking water systems that use water from the Delta, especially the smaller systems. Some people who drink water containing total THMs in excess of the MCL over many years could experience liver, kidney, or central nervous system problems and increased risk of cancer.

Haloacetic acids are a group of chemicals formed along with other disinfection byproducts when chlorine or other disinfectants used to control microbial contaminants in drinking water react with naturally occurring organic and inorganic matter in water. Haloacetic acids include monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid. Some people who drink water containing haloacetic acids in excess of the MCL over many years may have an increased risk of cancer.

Bromate is a chemical formed when ozone used to disinfect drinking water reacts with bromide in source water. Bromate formation is a problem for drinking water systems that use ozone as the primary disinfectant. Bromate violations are uncommon, but are a concern during low-flow years when seawater intrusion causes bromide concentrations in Delta water to increase. Some people who drink water containing bromate in excess of the MCL over many years may have an increased risk of cancer.

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water used for municipal supplies due to an increased amount of total organic carbon and the greater disinfection byproduct formation potential of wetland-derived organic carbon (Kraus et al. 2008).

Salinity

Salinity, frequently measured as electrical conductivity or total dissolved solids, has several significant effects on the use of water for domestic uses. Salts make water unpalatable at relatively low concentrations, with 500 parts per million total dissolved solids set as the recommended maximum level in the California secondary drinking water standards (California Code of Regulations, Title 22, section 64449). Salinity also increases the cost of treatment and costs to the consumer due to corrosion and other factors (Howitt et al. 2009). One common component of sea water, bromide, is a disinfection byproduct precursor that forms THMs and haloacetic acids with chlorine or chloramine disinfection, and forms bromate with ozone disinfection.

Pathogens

Pathogenic organisms and pathogen indicators are found in most surface waters. Two common protozoan pathogens that cause gastroenteritis, *Giardia lamblia* and *Cryptosporidium parvum*, have been found in Delta waters (at generally low levels) with respect to drinking water sources or body-contact recreation (Tetra Tech 2007). Source waters that exceed drinking water regulatory thresholds for *Cryptosporidium* trigger additional pathogen removal requirements (USEPA 2004). Although available data do not demonstrate that such conditions currently exist at Delta municipal water supply intakes, future plans that move or create new water intakes could result in increased treatment costs. Pathogen indicators such as fecal coliforms or *E. coli* are frequently at levels of concern in urban stormwater runoff. Several urban creeks and Delta water bodies that receive urban runoff are listed as impaired due to the presence of these indicator bacteria.

Nutrients

In the Delta, drinking water supplies with excessive levels of nutrients are primarily of concern because they, along with other factors such as residence time and temperature, can stimulate algae growth in the Delta and in reservoirs (Tetra Tech 2006a, Izaguirre and Taylor 2007). Algal blooms in storage reservoirs can disrupt treatment processes, and cause taste and odor problems. Taste and odor complaints associated with Delta water supplies have been attributed to algae growth in reservoirs or in the Delta itself (DWR 2007).

Drinking Water Intakes

The quality of Delta water with respect to drinking water use varies considerably both geographically and over time. Average organic carbon and bromide concentrations are very low in the Sacramento River where it enters the Delta. San Joaquin River water is moderately high in bromide, salinity, and nutrients, and moderately high in organic carbon. Intakes in the west Delta can be strongly influenced by the estuarine salinity gradient. An intake for the City of Antioch is frequently out of use because of salinity intrusions. The North Bay Aqueduct intake on Barker Slough in the northwest Delta is strongly affected by the local watershed and has the highest average organic carbon concentrations of any Delta municipal water supply intake (Tetra Tech 2006b). In addition to the drinking water quality problems at the current North Bay Aqueduct intake location, the intake may also have a negative effect on the ecosystem because it is located in an area that is otherwise high-quality habitat for listed native fish species.

Groundwater Quality Concerns

The drinking water supply from groundwater for many communities in the Delta and areas served by water exported from the Delta is contaminated by nitrates and other pollutants, particularly in the San Joaquin Valley. Survey findings show that a high financial burden is borne by low-income households when it comes to nitrate-contaminated water

(Pacific Institute 2011). The high cost of accessing water from alternative sources, coupled with the low earnings of these households, often makes safe drinking water in these communities unaffordable (Pacific Institute 2011). Small community and private water systems throughout the Central Valley and in the Delta rely on groundwater as their primary source of drinking water. They are affected by groundwater contamination to a greater degree than larger public water systems because many are in areas that are vulnerable to contamination (SWRCB 2011). Their wells are often shallower than larger community systems, and they have limited resources to treat or respond to contaminated groundwater problems. The California Legislature explicitly recognized these issues when, in 2012, it enacted Assembly Bill 685, declaring the established State policy that “every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes” (Water Code section 106.3(a)). More information on groundwater and how it relates to the Delta can be found in Chapter 3.

Environmental Water Quality

The Delta ecosystem is affected by a variety of pollutants discharged into Delta and tributary waters. Pollutants of concern affecting Delta biological species and ecosystem processes include nutrients, pesticides, mercury, selenium, and other persistent bioaccumulative toxic substances. Newly identified pollutants of potential concern (often referred to as emerging contaminants) also need to be investigated.

Nutrients

Nutrients, and their potential benefits and problems, have become an increasingly important component in the discussion of water quality issues in the Delta. The role of nutrients and nutrient loading for the Delta and Suisun Marsh is a subject of debate. Plant nutrients of concern in water are primarily nitrogen and phosphorus compounds including ammonia, ammonium, nitrite, nitrate, and phosphate. Excessive amounts (over fertilization) or altered proportions of these nutrients in streams, rivers, lakes, estuaries, or the coastal ocean can have detrimental effects on ecosystems. Die-offs of algae that deplete oxygen and cause fish kills are a well-known example, but even less obvious effects of nutrients can have important impacts on aquatic ecosystems. Changes in the types of algae that form the base of the aquatic food web, including growth of toxic algae, have been linked to excessive amounts or altered ratios of plant nutrients. Recent and current research is reconsidering the role of nutrients for aquatic ecosystems of the Delta, as follows:

- **Ammonium.** Ammonium in Delta waters has been shown to affect ecosystem water quality. Dugdale et al. (2007) has determined that ammonium concentrations may be having a significant impact on phytoplankton composition and open-water food webs because of suppression of diatom blooms in the Bay-Delta. Ammonium concentrations in Suisun Bay and the Delta have been increasing, primarily due to point source discharge loading from wastewater treatment facilities. It is not known, however, how much this inhibition extends to freshwater algae in the Delta.
- **Nutrient ratios.** Ratios of nutrients in Delta waters are thought to be a primary driver in the composition of aquatic food webs in the Bay-Delta (Glibert et al. 2011). The effect of ammonium on food webs in the Delta remains an open question, and much active research and healthy scientific debate continue.

- **Harmful algal blooms.** HABs create a toxic environment for aquatic organisms and the organisms that eat them. The emergence of HABs over the past decade threatens environmental water quality. The shift toward greater abundance of cyanobacteria in the Delta includes known HABs such as *Microcystis aeruginosa*. *Microcystis aeruginosa* has become a common bloom-forming component of the phytoplankton of the Delta during the warm summer and early fall months (Lehman et al. 2005, 2008). Interactions between nutrients and HABs in the Delta warrant additional study and are currently being investigated.
- **Nonnative aquatic plants.** Nutrients affect the productivity of aquatic macrophytes (plants visible to the naked eye) and the structure of the aquatic plant community (Wetzel 2001). Two nonnative aquatic plants, Brazilian waterweed and water hyacinth, have become particularly problematic in the Delta. Scientific studies have documented the distribution and spread of these invasive aquatic plants in the Delta (Underwood et al. 2006, Hestir et al. 2008, Khanna et al. 2011, Santos et al. 2011). The role of nutrient enrichment in the spread and productivity of these nonnative aquatic plants is unknown. Further research is required on the potential links between invasive aquatic plants in the Delta and nutrient inputs.

The effects of increased nutrient inputs also need to be considered in light of anticipated changes in the Delta with regard to lowered turbidity and warming temperatures. Figure 6-2 shows increasing nutrients in the Delta over time. As discussed in the following section, nutrients have been implicated in DO depletion in Delta channels due to the stimulation of plant growth with subsequent death and decay, and the microbial conversion of total ammonia to nitrate through the process of nitrification.

Dissolved Oxygen

DO in water is essential to the survival of most fish and many other aquatic organisms. Depletion of DO in a water body because of decaying organic matter is a classic water quality problem that can result in clear signs of pollution, including fish kills and foul odors. Low DO concentrations also can have less obvious effects. DO events occur regularly in the channels of Suisun Marsh and the Stockton Deep Water Ship Channel (SDWSC) and sporadically elsewhere in the Delta, with several waterways listed as impaired by the RWQCB.

One of the most significant water quality issues affecting the Delta in recent decades has been low DO episodes (DO concentrations less than regulatory objectives) in the SDWSC reach of the San Joaquin River in the Delta, which were thought to act as a barrier to salmon migration (Central Valley RWQCB 2005). Until the last few years, low DO events were a regular occurrence in this part of the Delta primarily during the summer and fall months.

The SDWSC DO problem has existed since at least the 1960s. The Central Valley RWQCB added this segment of the Delta to its list of impaired water bodies in 1998, and adopted a TMDL in 2005 that follows a phased approach requiring studies and initial actions followed by reconsideration of TMDL requirements in 2012. Extensive studies have identified several contributing factors, including inputs of algae from upstream (probably related to nutrient loads), discharges of total ammonia from the Stockton Regional Wastewater Control Facility (RWCF), increased channel depth due to dredging, and reduced net flows (Central Valley RWQCB 2005). See sidebar, Applying Adaptive Management in Water Quality Decisions, for more information about an adaptive management approach to DO in the SDWSC.

The improved wastewater treatment processes at the RWCF were fully operational starting in 2006. This, along with other discharge reductions upstream, appears to have greatly reduced the frequency and severity of low DO episodes in the SDWSC. The California Department of Water Resources (DWR) aeration facility also has been shown to be an effective remedy for the occasional DO depletion problem that might occur under current conditions. The actions taken to

Nutrients Create Delta Water Problems

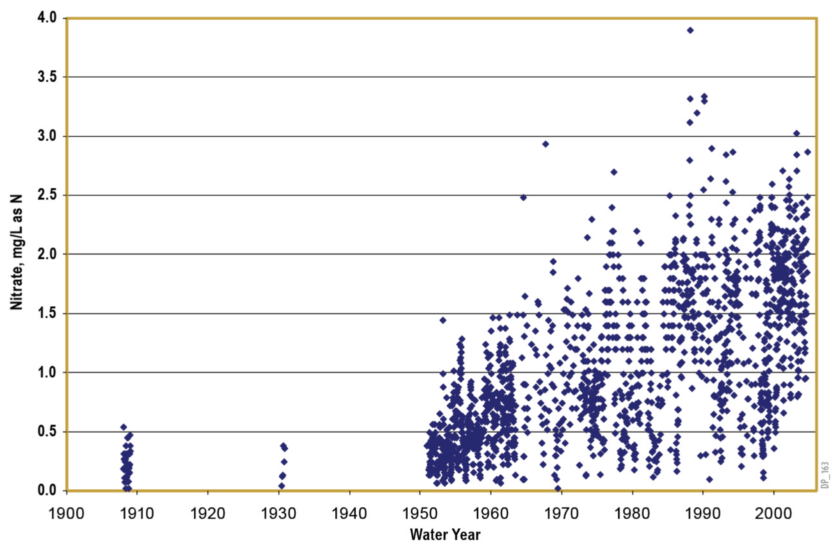

Figure 6-2 Nitrate concentrations at the point where the San Joaquin River enters the Delta dating back to 1908 show how much this important plant nutrient has increased. High nutrient concentrations are linked to a variety of problems including DO depletion, growth of nuisance aquatic plants, and taste and odor problems in drinking water.

Source: Adapted by the Delta Stewardship Council with data provided by USGS

comply with the current TMDL, along with improved flows and load reductions in the San Joaquin River watershed, appear to have provided a solution to this longstanding water quality problem. If continued, the actions taken to comply with the SDWSC TMDL should be sufficient to prevent future DO depletion problems.

The DO depletion problems in Suisun Marsh are caused by seasonal operations of ponds and wetlands managed for waterfowl hunting. For most of the year, duck club ponds are drained and occasionally flooded to promote the growth of plants that are the favored food of water fowl. When these ponds are flooded for hunting in the late summer and fall, the decay of accumulated plant matter followed by tidal exchanges of water with adjoining channels can cause severe DO depletion. Some of these low DO events have caused documented fish kills. The San Francisco Bay RWQCB has started the TMDL process to address DO depletion in Suisun Marsh.

The best pathways to address other Delta low DO problems will vary with local conditions and causes, but likely will be a combination of reduced loadings of oxygen-demanding substances and changes to flow conditions, under the framework of adaptive management. As TMDLs are developed to address low DO concentrations in the Delta, actions needed to improve DO conditions will be implemented through SWRCB and RWQCB programs, including NPDES permits, stormwater NPDES permits, WDRs, waivers of WDRs, and water rights. Low DO conditions in the Delta need to be addressed to prevent these conditions from increasing in extent and severity.

Applying Adaptive Management in Water Quality Decisions			An adaptive management approach to water quality control decisions should be taken to plan for and assess their outcomes. The following is an example of how the Council's three-stage, nine-step adaptive management framework (see Appendix C) was used for water quality decision making in the TMDL process to improve DO concentrations in the SDWSC.
Adaptive Management Step			**Improving DO Concentrations in the SDWSC**
Plan	1	Define/redefine the problem	Low concentrations of DO in the SDWSC periodically exceeded the Central Valley Basin Plan water quality objectives for DO for many years. Low DO acted as a barrier to migrating salmon.
	2	Establish goals, objectives, and performance measures	**Goal:** Meet the water quality objectives for DO in the SDWSC. **Objectives:** Maintain minimum DO concentrations of 5 milligrams per liter (mg/L) at all times and 6 mg/L September through November.
	3	Model linkages between objectives and proposed action(s)	Hydrodynamic and water quality models informed the development of a Physical and Chemical Processes Conceptual Model and a Biological and Ecological Effects Conceptual Model. The models identified at least four primary factors or processes influencing oxygen concentrations: (1) San Joaquin River flow through the SDWSC, (2) SDWSC volume, (3) algae and oxygen-demanding substances from the San Joaquin River upstream of the SDWSC, and (4) oxygen-demanding substances, including ammonia discharged from the RWCF. http://www.sjrdotmdl.org/concept_model/index.htm
	4	Select action(s) (research, pilot, or full-scale) and develop performance measures	**Selected Actions:** (1) Conduct studies to identify causes for the low DO levels and assign responsibility to correct the problem; (2) reduce RWCF ammonia discharges to the San Joaquin River; and (3) construct a Demonstration Dissolved Oxygen Aeration Facility (Aeration Facility). **Performance Measures:** ▪ Administrative – Implement Phase 1 TMDL actions. ▪ Output – Implement studies; select wastewater treatment improvements to reduce ammonia discharges including engineered wetlands and nitrifying bio-towers; develop pilot-scale aeration project. ▪ Outcome – DO concentrations are maintained at or above the water quality objectives for DO. Aquatic life, including resident and migratory fish, is not affected by low DO conditions.
Do	5	Design and implement action(s)	**Selected Actions:** (1) Conduct ongoing studies to improve the conceptual models; (2) add engineered wetlands and two nitrifying bio-towers to the RWCF; and (3) design, build, and operate the Aeration Facility at Rough and Ready Island to determine its applicability for increasing DO concentrations in the SDWSC.
	6	Design and implement monitoring plan	Collect baseline DO data prior to aerator operations. Conduct ongoing studies to test the understanding of linkages in the conceptual models. Conduct compliance monitoring at the RWCF as required by the permit. Conduct performance monitoring of the Aeration Facility to measure achievement of the target (increased DO concentrations in the SDWSC).
Evaluate and Respond	7	Analyze, synthesize, and evaluate	Technical Working Group will assess the study results and aeration pilot-study results.
	8	Communicate current understanding	Technical reports, study results, and web-based conceptual models were developed and maintained on a website. Pilot Report Aeration System and staff presentation to the Central Valley RWQCB (February 3, 2011).
	9	Adapt	Development of a revised control program (Phase 2 TMDL) including identification of additional or modified actions. Development of an aeration agreement with long-term funding for operation and maintenance of the Aeration Facility, including possible future modifications. Development of a system-level (long-term) monitoring plan for the Aeration Facility. Periodic review of control program actions and aerator operations.

Pesticides

Pesticides include insecticides, herbicides, fungicides, and various other substances used to control pests. In the Bay-Delta region, the primary pesticides of concern include the organophosphorus pesticides (for example, diazinon and chlorpyrifos), pyrethroid insecticides, and the legacy organochlorine pesticides (for example, DDT, chlordane, and dieldrin). These substances are known to have adverse impacts on aquatic organisms or, in some cases (as with the organochlorine pesticides), birds and mammals.

The Sacramento, San Joaquin, and Feather rivers; the Delta; and numerous agriculturally dominated streams in the Central Valley are either listed as impaired or are covered under an existing TMDL for pesticides (Central Valley RWQCB 1998, 2006). Delta waterways were placed on the CWA section 303(d) list for diazinon and chlorpyrifos due to aquatic toxicity (SWRCB 2010).

Smaller agriculturally dominated waterways and urban creeks are particularly vulnerable to toxicity from pesticides. Although agriculture is considered the primary source of pesticide impairment in the Central Valley and Delta, urban sources are also locally important (Kuivila and Hladik 2008). Some of the highest pesticide concentrations have been observed in residential area creeks and waters receiving urban runoff (Weston et al. 2005). Pyrethroid insecticides, which are common replacements for the organophosphorus pesticides, have been implicated as the principal pesticides causing toxicity in surface water samples collected from throughout California (Hunt et al. 2010).

Aquatic invertebrates in the water column are the organisms most affected by chlorpyrifos and diazinon exposure (Giddings et al. 2000); however, pyrethroids—because of their high potential to stick to organic matter—also can affect sediment-dwelling organisms (Werner and Oram 2008, Weston et al. 2004). Pyrethroid pesticides from multiple runoff sources have been found at levels toxic to aquatic invertebrates (Weston et al. 2005, Weston 2010).

Contaminants cannot be eliminated as a possible contributor to the declines in open-water fish populations in the Delta (known as pelagic organism decline [POD]). Johnson et al. (2010) reported that insufficient data are available to determine whether contaminants played an important role in the POD. Research on the role of contaminants in the POD continues with efforts under way to better define the presence of contaminants in the environment, the effects of contaminant mixtures, sublethal effects of contaminants on the POD species, and the effects of contaminants on prey organisms (Baxter et al. 2010). Synergistic effects of pesticide mixtures have been demonstrated for other species including juvenile salmon (Laetz et al. 2009).

Mercury

The Delta and many Delta tributaries are included in the SWRCB's section 303(d) list of impaired water bodies due to mercury contamination (Central Valley RWQCB 2009). Historical mercury mining in California's Coast Ranges and mercury use associated with gold mining in the Sierra Nevada over a century ago have left an environmental legacy of pervasive mercury contamination in many Northern California watersheds (Alpers and Hunerlach 2000). The current regulatory approach for mercury includes the mercury TMDL adopted by the San Francisco Bay RWQCB in 2006 and the Delta methylmercury TMDL adopted by the Central Valley RWQCB in 2010. Unfortunately, however, mercury is likely to persist in California's environment for many years to come.

Mercury is transformed into methylmercury by bacteria in the environment. Methylmercury, initially present at very low concentrations, enters the aquatic food web and can accumulate to levels of concern in long-lived fish at the top of the aquatic food chain, such as striped bass and largemouth bass. Methylmercury has been found in some types of Delta fish at concentrations that may be harmful to human health. The State has issued health advisories for fish consumption due to mercury contamination for a number of water bodies in the Delta and its watersheds. Mercury contamination of fish is of particular concern for people who are frequent consumers of Delta fish (Shilling 2009).

There is general concern that increased concentrations of methylmercury in water, sediment, and plants and animals might result from restoration of wetland and floodplain habitats in the Delta and, thus, must be carefully planned and monitored to minimize the production of methylmercury. For instance, the restoration of wetlands, particularly in areas where the abundance of mercury in soils or sediments is elevated, could accelerate the production of methylmercury and increase the contamination of aquatic plants and animals (Naimo et al. 2000, Wiener and Shields 2000). Additionally, flooding of wetlands or uplands, or fluctuating water levels during tidal cycles could stimulate methylmercury production and transport, thereby increasing concentrations of methylmercury in water and in plants and animals (Hecky et al. 1991, Hall et al. 1998, Paterson et al. 1998, Bodaly and Fudge 1999). Increased methylmercury production is a significant concern for planned wetland and floodplain ecosystem restoration projects, and should be monitored.

Further study is needed to determine the dominant processes affecting methylmercury concentrations in food webs in the Delta. The CALFED Ecosystem Restoration Program developed a framework (Mercury Strategy) for monitoring, research, risk communication, and adaptive management to address mercury problems in the Bay-Delta system (Wiener et al. 2003). The approach taken by the Central Valley RWQCB in its Delta Mercury Control Program, adopted April 22, 2010, is consistent with the Mercury Strategy (Central Valley RWQCB 2010).

Selenium

Selenium, a naturally occurring element, is an essential nutrient at low concentrations for humans and other organisms. However, higher concentrations can be toxic to fish and wildlife. Once selenium enters the aquatic environment, it has a high potential to bioaccumulate in zooplankton and benthic (bottom-dwelling) invertebrates and, subsequently, to biomagnify in the food web as it reaches top-level predators such as fish, birds, and mammals (Skorupa and Ohlendorf 1991, Fan et al. 2002, Hamilton 2004, Stewart et al. 2004, Paveglio and Kilbride 2007).

The major source of selenium loading to San Francisco Bay is the San Joaquin River, which receives selenium-laden agricultural drainage waters from the western San Joaquin Valley (Luoma and Presser 2000). Other sources of selenium loading include oil refineries, municipal and industrial wastewater, urban and nonurban runoff, atmospheric deposition, and erosion and sediment transport from within the north San Francisco Bay. Improved wastewater treatment at petroleum refineries discharging into San Francisco Bay has reduced the amount of selenium discharged, but these facilities are still the most significant point source of this pollutant (San Francisco Bay RWQCB 2011b).

Recent monitoring results indicate that selenium water column concentrations in the north San Francisco Bay are much lower than the current 5-parts per billion objective for chronic exposure (San Francisco Bay RWQCB 2011b). However, levels of selenium in aquatic organisms and fish show that the current regulatory criteria may not be sufficient. Despite progress to reduce selenium in the Bay-Delta system, levels in the food chain are still of concern. Selenium has been identified as a possible contributing factor to the observed decline of white sturgeon, Sacramento splittail, starry flounder, and diving ducks such as surf scoters. The focus of regulatory efforts at the State and national level is shifting from water-column concentrations to the concentration of selenium in the tissues of affected organisms (San Francisco Bay RWQCB 2011b).

Historically, portions of the San Joaquin River downstream of Grasslands, Salt Slough, and Mud Slough contained elevated levels of selenium from agricultural drainage (Saiki et al. 1993). The discharge of selenium from this area also has been significantly reduced from historical levels under a control program administered by Central Valley RWQCB, with plans for further reductions through 2019 (Reclamation 2009).

Contaminants of Emerging Concern

The term "contaminants of emerging concern" refers to a broad class of largely unregulated compounds for which there is concern that adverse effects might occur at environmentally significant concentrations. Examples of manufactured chemicals frequently found in water bodies and organisms include flame retardants, pesticides, human and veterinary pharmaceuticals, and ingredients in personal care products (Kolpin et al. 2002, Daughton 2004, Hoenicke et al. 2007).

Contaminants of emerging concern include many manufactured chemicals. These manufactured chemicals have the potential to alter water quality because of their widespread use, pathways to the environment, and potency. The primary sources for most contaminants of emerging concern include effluent from wastewater treatment plants, agricultural fields, and stormwater runoff. Many chemicals identified as contaminants of emerging concern have not been tested for their potential toxic effects on aquatic life. Most emerging pollutant maximum concentrations in the environment are well below established lethal concentration values for even the most sensitive aquatic species. Sublethal and chronic low-level exposures are of primary concern (Oros 2003, Brander et al. 2009, Ostrach 2009).

Regulatory and chemical monitoring programs should adapt to the quickly changing mix of contaminants of emerging concern identified through current studies and the peer-reviewed scientific literature (best available science). Effective management of contaminants of emerging concern in the Delta will require responsible agencies to perform appropriate scanning-level activities to prioritize a specific list of pollutants of highest concern and to develop or require work plans for special studies, and to conduct or require monitoring in accordance with the work plans. To this end, in 2011, the SWRCB established a Science Advisory Panel to address contaminants of emerging concern in aquatic ecosystems. The panel completed a report in April 2012 that included several recommendations for how the SWRCB should monitor and assess potential impacts of contaminants of emerging concern (Anderson et al. 2012).

POLICIES AND RECOMMENDATIONS

Policies and recommendations to address the water quality issues discussed in the preceding sections are based on the following strategies:

- Require Delta-specific water quality protection
- Protect beneficial uses by managing salinity
- Improve drinking water quality
- Improve environmental water quality

These major aspects of water quality are critical to achieving the coequal goals. The approach described here includes augmenting or accelerating existing programs where it is feasible to address an existing or anticipated water quality problem. The SWRCB and RWQCBs have broad authority to protect and regulate water quality; therefore, this chapter sets forth priority Delta-specific recommendations and does not contain regulatory policies at this time.

Require Delta-specific Water Quality Protection

Water flow, water quality, water supply, and habitat conditions in the Delta are distinctly different from other parts of the watershed and from San Francisco Bay downstream. The Delta is the most valuable estuary and wetland ecosystem on the West Coast of North and South America (Water Code section 85002), and is the primary habitat for a number of special-status species. Many communities in and around the Delta draw their drinking water directly from Delta waterways. Delta waterways also receive urban stormwater, treated wastewater, agricultural drainage, and drainage from managed wetlands. Studies have shown that such discharges can have significant impacts on water quality. These impacts are often more severe near the point of discharge. Stormwater, wastewater, and agricultural drainage discharges into the Delta should be managed so that they do not pose a significant risk to the beneficial uses of water in the Delta.

Problem Statement

Water quality management approaches developed for general application statewide or in other regions may not be sufficient for the unique and dynamic conditions of the Delta, its biological resources, and critical water supply services. Water supplies and habitats for special-status species require proactive and anticipatory measures for water quality protection consistent with their importance in achieving the coequal goals.

Policies

No policies with regulatory effect are included in this section.

Recommendations

WQ R1. Protect Beneficial Uses

Water quality in the Delta should be maintained at a level that supports, enhances, and protects beneficial uses identified in the applicable State Water Resources Control Board or regional water quality control board water quality control plans.

WQ R2. Identify Covered Action Impacts

Covered actions should identify any significant impacts to water quality.

WQ R3. Special Water Quality Protections for the Delta

The State Water Resources Control Board or regional water quality control board should evaluate and, if appropriate, propose special water quality protections for priority habitat restoration areas identified in recommendation ER R2 or other areas of the Delta where new or increased discharges of pollutants could adversely impact beneficial uses.

Protect Beneficial Uses by Managing Salinity

Beneficial uses within the Delta include drinking water, agriculture, and ecosystem protection. Salinity potentially affects these uses, but to varying degrees. The primary sources of salinity in the Delta are from tidal seawater intrusion from the Pacific Ocean through the San Francisco Bay, and to a lesser extent from agricultural and other discharges in the Central Valley. Historically, natural flows through the Delta regulated salinity in a way that favored the Delta ecosystem. Today, salinity in the Delta is dominated by the effects of upstream water diversions and use of the Delta to convey flows to Central and Southern California. The SWRCB is responsible for ensuring protection of beneficial uses through regulation of pollutant discharges, and regulation of water diversions and flows under their water rights authority.

Problem Statement

Salinity affects Delta agricultural, municipal, and environmental beneficial uses, but in different ways. Salinity and flow conditions in the Delta are affecting ecosystem, agricultural, and municipal uses. The timing and distribution of salinity is primarily affected by flow, which is largely determined by water management in the Delta and its watersheds as determined by applicable flow objectives. Delta conditions have changed since the current Delta flow objectives were adopted, and new scientific information about salinity, flow, and their effects on beneficial uses is available.

Policies

ER P1 in Chapter 4 on the SWRCB's Delta Flow Objectives addresses this issue.

Recommendations

ER R1 in Chapter 4 on the SWRCB's Update of Delta Flow Objectives addresses this issue.

Improve Drinking Water Quality

Millions of Californians entirely or partially rely on the Delta as a drinking water supply, and the future quality of that water supply is uncertain. Contamination of groundwater supplies places greater demand on surface waters that are tributary to the Delta for urban and agricultural users. Current water quality regulations and policies for surface waters do not apply directly to many of the drinking water quality constituents of concern. Sea level rise, levee failure, salinity variability, agricultural water use, and increased urban runoff from population growth in the watershed all pose a threat to drinking water quality. To prevent such degradation, we need clear policies regarding the protection of water quality relevant to the drinking water quality constituents of concern. The Central Valley RWQCB's anticipated drinking water policy is intended, in part, to prevent the degradation of high-quality drinking water sources (Central Valley RWQCB 2010).

In 2006, the SWRCB, the Central Valley RWQCB, and stakeholders began a joint effort to address salinity and nitrate problems in California's Central Valley and adopt long-term solutions that will lead to enhanced water quality and economic sustainability. Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) is a collaborative basin planning effort aimed at developing and implementing a comprehensive salinity and nitrate management program.

Problem Statement

Delta drinking water supplies are degraded by inputs from sea water, regional soils, and sediments; from agricultural, urban, and industrial sources from the watershed; and from in-Delta sources.

Policies

No policies with regulatory effect are included in this section.

Recommendations

WQ R4. Complete Central Valley Drinking Water Policy

The Central Valley Regional Water Quality Control Board should complete the Central Valley Drinking Water Policy by July 2013.

WQ R5. Complete North Bay Aqueduct Alternative Intake Project

The California Department of Water Resources should complete the North Bay Aqueduct Alternate Intake Project Environmental Impact Report by December 31, 2012, and begin construction as soon as possible thereafter.

WQ R6. Protect Groundwater Beneficial Uses

The State Water Resources Control Board should complete development of a Strategic Workplan for protection of groundwater beneficial uses, including groundwater use for drinking water, by December 31, 2012.

WQ R7. Participation in CV-SALTS

The State Water Resources Control Board and Central Valley Regional Water Quality Control Board should consider requiring participation by all relevant water users that are supplied water from the Delta or the Delta watershed or discharge wastewater to the Delta or the Delta watershed to participate in the Central Valley Salinity Alternatives for Long-Term Sustainability Program.

Improve Environmental Water Quality

A variety of pollutants are discharged into Delta and tributary waters. These pollutants affect Delta biological species and ecosystem processes. Pollutants of concern include nutrients, pesticides, mercury, selenium, and other persistent bioaccumulative toxic substances. Newly identified pollutants of potential concern (emerging contaminants) also need to be investigated.

Problem Statement

Pollutants contained in municipal, industrial, agricultural, other nonpoint source discharges, and legacy sources flowing into the Delta and its tributary waterways, including pollutants that bioaccumulate and biomagnify in the food web, impair the Delta ecosystem. Evidence from water quality and ecosystem monitoring continues to show that significant water pollution problems persist in the Bay-Delta system and the Central Valley. Insufficient funding and support could lead to slowing or even erminating the SWRCB and the San Francisco Bay and Central Valley RWQCBs' engagements in regulatory processes, research, and monitoring that are essential to improving water quality in the Delta.

Policies

No policies with regulatory effect are included in this section.

Recommendations

WQ R8. Completion of Regulatory Processes, Research, and Monitoring for Water Quality Improvement

The State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards are currently engaged in regulatory processes, research, and monitoring essential to improving water quality in the Delta. In order to achieve the coequal goals, it is essential that these ongoing efforts be completed and, if possible, accelerated, and that the Legislature and Governor devote sufficient funding to make this possible. The Delta Stewardship Council specifically recommends that:

- *The State Water Resources Control Board should complete development of the proposed policy for nutrients for inland surface waters of the State of California by January 1, 2014.*
- *The State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards should prepare and begin implementation of a study plan for the development of objectives for nutrients in the Delta and Suisun Marsh by January 1, 2014. Studies needed for development of Delta and Suisun Marsh nutrient objectives should be completed by January 1, 2016. The water boards should adopt and begin implementation of nutrient objectives, either narrative or numeric, where appropriate, for the Delta and Suisun Marsh by January 1, 2018.*
- *The State Water Resources Control Board and the Central Valley Regional Water Quality Control Board should complete the Central Valley Pesticide Total Maximum Daily Load and Basin Plan Amendment for diazinon and chlorpyrifos by January 1, 2013.*
- *The State Water Resources Control Board and the Central Valley Regional Water Quality Control Board should prioritize and accelerate the completion of the Central Valley Pesticide Total Maximum Daily Load and Basin Plan Amendment for pyrethroids by January 1, 2016.*
- *The State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards have completed Total Maximum Daily Load and Basin Plan Amendments for methylmercury, and efforts to support their implementation should be coordinated. Parties identified as responsible for current methylmercury loads or proponents of projects that may increase*

methylmercury loading in the Delta or Suisun Marsh should participate in control studies or implement site-specific study plans that evaluate practices to minimize methylmercury discharges. The Central Valley Regional Water Quality Control Board should review these control studies by December 31, 2018 and determine control measures for implementation starting in 2020.

WQ R9. Implement Delta Regional Monitoring Program

The State Water Resources Control Board and Regional Water Quality Control Boards should work collaboratively with the California Department of Water Resources, California Department of Fish and Wildlife, and other agencies and entities that monitor water quality in the Delta to develop and implement a Delta Regional Monitoring Program that will be responsible for coordinating monitoring efforts so Delta conditions can be efficiently assessed and reported on a regular basis.

WQ R10. Evaluate Wastewater Recycling, Reuse, or Treatment

The Central Valley Regional Water Quality Control Board, consistent with existing water quality control plan policies and water rights law, should require responsible entities that discharge wastewater treatment plant effluent or urban runoff to Delta waters to evaluate whether all or a portion of the discharge can be recycled, otherwise used, or treated in order to reduce contaminant loads to the Delta by January 1, 2014.

WQ R11. Manage Dissolved Oxygen in Stockton Ship Channel

The State Water Resources Control Board and the Central Valley Regional Water Quality Control Board should complete Phase 2 of the Total Maximum Daily Load and Basin Plan Amendment for dissolved oxygen in the Stockton Deep Water Ship Channel by January 1, 2015.

WQ R12. Manage Dissolved Oxygen in Suisun Marsh

The State Water Resources Control Board and the San Francisco Bay Regional Water Quality Control Board should complete the Total Maximum Daily Load and Basin Plan Amendment for dissolved oxygen in Suisun Marsh wetlands by January 1, 2014.

Timeline for Implementing Policies and Recommendations

Figure 6-3 lays out a timeline for implementing the policies and recommendations described in the previous section. The timeline emphasizes near-term and intermediate-term actions.

Timeline for Implementing Policies and Recommendations

TIMELINE CHAPTER 6: Improve Water Quality

	ACTION (REFERENCE #)	LEAD AGENCY(IES)	NEAR TERM 2012–2017	INTERMEDIATE TERM 2017–2025
RECOMMENDATIONS	Protect beneficial uses (WQ R1)	Varies	●	●
	Identify covered action impacts (WQ R2)	Varies	●	●
	Special water quality protections for the Delta (WQ R3)	SWRCB, RWQCB	●	
	Complete Central Valley drinking water policy (WQ R4)	Central Valley RWQCB	●	
	Complete North Bay Aqueduct Alternative Intake Project (WQ R5)	DWR	●	
	Protect groundwater beneficial uses (WQ R6)	SWRCB	●	
	Participation in CV-SALTS* (WQ R7)	SWRCB and Central Valley RWQCB	●	
	Completion of regulatory processes, research, and monitoring for water quality improvements (WQ R8)	SWRCB, San Francisco Bay and Central Valley RWQCBs	●	
	Implement Delta regional monitoring program (WQ R9)	SWRCB and RWQCBs	●	
	Evaluate wastewater recycling, reuse, or treatment (WQ R10)	Central Valley RWQCB	●	
	Manage dissolved oxygen in Stockton Ship Channel (WQ R11)	SWRCB and Central Valley RWQCB	●	
	Manage dissolved oxygen in Suisun Marsh (WQ R12)	SWRCB and San Francisco Bay RWQCB	●	

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*CV-SALTS: Central Valley Salinity Alternatives for Long-Term Sustainability Program

Agency Key: DWR: California Department of Water Resources RWQCB: Regional Water Quality Control Board(s) SWRCB: State Water Resources Control Board

Figure 6-3

Science and Information Needs

Successful management of water quality depends on a well-designed, comprehensive, and consistent system of water quality monitoring. Current Delta water quality monitoring is fragmented among several different agencies and programs. The Central Valley RWQCB has initiated an effort to develop a Delta Regional Monitoring Program that will consolidate and coordinate most of the current monitoring. Developing a coordinated and thorough regional monitoring program is essential to performance measurement and adaptive management in the Delta.

As identified above, a number of outstanding science questions need to be resolved with respect to water quality. Additional study is needed on the following:

- The effects of salinity on introduced and native plant and animal species
- Trends in concentrations of drinking water constituents of concern
- The effects of nutrients on the Delta ecosystem and municipal water supplies
    - The importance of phytoplankton bloom suppression from ammonium
    - The role of nutrient loading on HABs in the Delta
    - Possible linkages between nonnative aquatic plants and nutrient inputs
- Controlling DO depletion
- The effects of the simultaneous presence of multiple pesticides, even at low levels, on species of concern
- The processes contributing to mercury and selenium compounds in food webs and their effects on the ecosystem
- The impacts of pharmaceutical compounds, personal care products, and other emerging contaminants on the ecosystem
- The combined effects of multiple contaminants and water quality conditions on the ecosystem
- Sources and impacts of pathogens on drinking water sources and recreation in the Delta
- An analysis and evaluation of existing water quality models in the Delta
- Fate and transport of water quality contaminants in the Delta

Issues for Future Evaluation and Coordination

Additional areas of interest and concern related to water quality and the Delta may deserve consideration in the development of future Delta Plan updates, including the following:

- **Small and disadvantaged communities:** Ensuring a safe drinking water supply can have a disproportionate cost for small and disadvantaged communities. Delta communities that are small and disadvantaged include Bethel Island, Courtland, Freeport, Hood, Isleton, Locke, and Walnut Grove. There are also small and disadvantaged communities in areas served by water exported from the Delta that are disproportionately impacted by nitrate and other groundwater pollutants. Available options to correct unsafe drinking water conditions include shared services and facilities; consolidation of several small systems into a single, larger system; centralized treatment; interim point-of-use treatment or use of bottled water; replacement of a contaminated source with an uncontaminated source; and, in the case of chemical contamination, blending of contaminated sources with uncontaminated sources. Consideration also must be given to the new State policy that "every human being has the right to safe, clean, affordable and accessible water adequate for human consumption, cooking, and sanitary purposes" (Water Code section 106.3(a)). Availability and prioritization of funding, restructuring of regulatory requirements, and provision of technical assistance may all be part of the solution, but involve the authority of various agencies including the California Department of Public Health, SWRCB, DWR, U.S. Department of Agriculture, and local cities and counties. An integrated effort including the input and involvement of the regulatory and affected agencies will be needed to properly address these issues and to refine effective recommendations.

- **Coordinated and prioritized water quality monitoring and modeling:** Various water quality monitoring and modeling efforts are ongoing, but are not coordinated among affected agencies. Agencies involved in these efforts include the SWRCB, RWQCBs, DWR, the Interagency Ecological Program, California Department of Fish and Wildlife, and now, the Council. Collective discussion and evaluation by these and other entities will be needed in order to make recommendations regarding the need for and prioritization of water quality modeling in the Delta.
- **Contaminants of emerging concern:** The SWRCB and RWQCBs should continue ongoing efforts to address contaminants of emerging concern. This work should include development of a work plan for conducting or requiring special studies of pollutants, including emerging contaminants and causes of toxicity in Delta waters and sediments.
- **Water quality objectives for selenium:** The identified sources of selenium as a contaminant and its potential to bioaccumulate and biomagnify in the environment are ongoing concerns. The SWRCB and San Francisco Bay and Central Valley RWQCBs should continue efforts to revise water quality objectives for selenium.

Performance Measures

Development of informative and meaningful performance measures is a challenging task that will continue after the adoption of the Delta Plan. Performance measures need to be designed to capture important trends and to address whether specific actions are producing expected results.

Efforts to develop and track performance measures in complex and large-scale systems like the Delta are commonly multiyear endeavors. The recommended output and outcome performance measures listed below are provided as examples, and subject to refinement as time and resources allow. Final administrative performance measures are listed in Appendix E and will be tracked as soon as the Delta Plan is completed.

Output Performance Measures

- DWR begins constructing the North Bay Aqueduct Alternate Intake Project as soon as possible after the environmental impact report is completed. (WQ R5)
- Progress toward reducing concentrations of inorganic nutrients (ammonium, nitrate, and phosphate) in Delta waters over the next decade. (WQ R8)
- TMDLs for critical pesticides (for example, diazinon, chlorpyrifos, and pyrethroids) in the waters and sediments of the Delta are met by 2020. (WQ R8)
- A Delta regional water quality monitoring program is implemented within the first 5 years of the Delta Plan. (WQ R9)

Outcome Performance Measures

- Water quality in the Delta meets objectives established in the applicable water quality control plan. (WQ R1)
- Trends in measureable toxicity from pesticides and other pollutants in Delta waters will be downward over the next decade. (WQ R8)
- Progress toward consistently meeting applicable DO standards in the Delta by 2020. (WQ R8, WQ R11, and WQ R12)
- HABs will lessen in severity and spatial coverage in the Delta over the next decade. (WQ R3 and WQ R8)
- The spatial distribution and productivity of nuisance nonnative aquatic plants will decline over the next decade. (WQ R3 and WQ R8)

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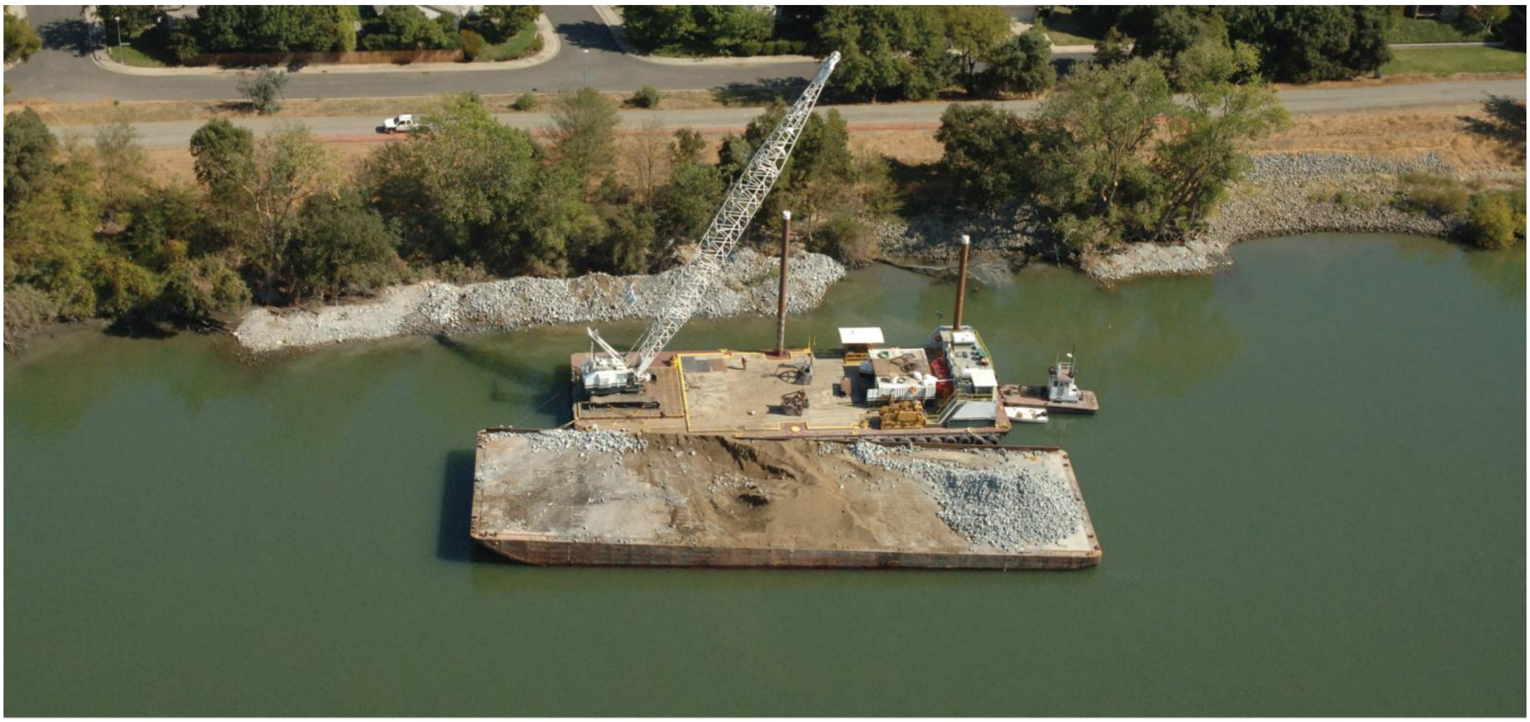
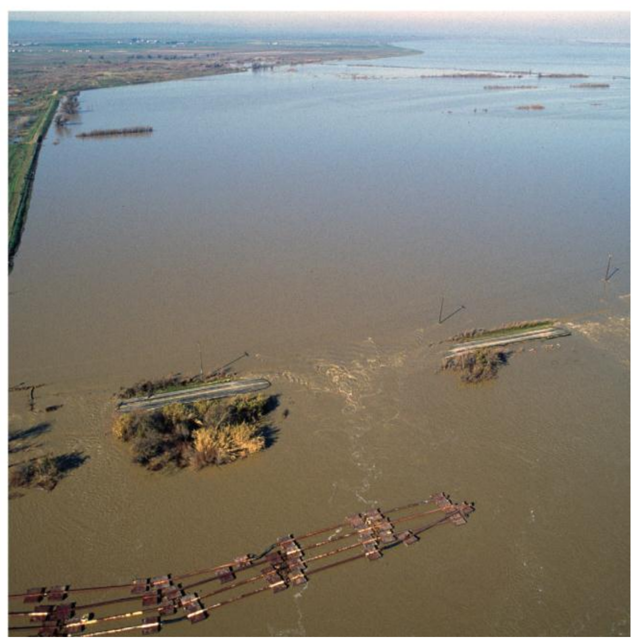
CHAPTER 7

Reduce Risk to People, Property, and State Interests in the Delta





ABOUT THIS CHAPTER

This chapter provides an overview of flood risk in the Sacramento-San Joaquin Delta (Delta), current flood management efforts, and the most pertinent agencies and regulations. It details the Delta Stewardship Council's (Council) core strategies to reduce risk to people, property, and State interests in the Delta. These core strategies form the basis of the four policies and ten recommendations found at the end of the chapter:

- Improve emergency preparedness and response
- Finance and implement flood management activities
- Prioritize flood management investment
- Improve residential flood protection
- Protect and expand floodways, floodplains, and bypasses
- Integrate Delta levees and ecosystem function
- Limit liability

Reducing flood risks in the Delta also relies on locating urban development in the cities where levees are stronger (as proposed in Chapter 5) and retaining rural lands for agriculture, so that development in the most floodprone areas is minimized.

RELEVANT LEGISLATION

Water Code sections 85305, 85306, 85307, and 85309 require the Delta Plan to include or otherwise consider specific components to attempt to reduce risk.

85305(a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting effective emergency preparedness, appropriate land uses, and strategic levee investments.

(b) The council may incorporate into the Delta Plan the emergency preparedness and response strategies for the Delta developed by the California Emergency Management Agency pursuant to Section 12994.5.

85306 The council, in consultation with the Central Valley Flood Protection Board, shall recommend in the Delta Plan priorities for state investments in levee operation, maintenance, and improvements in the Delta, including both levees that are a part of the State Plan of Flood Control and nonproject levees.

85307(a) The Delta Plan may identify actions to be taken outside of the Delta, if those actions are determined to significantly reduce flood risks in the Delta.

(b) The Delta Plan may include local plans of flood protection.

(c) The council, in consultation with the Department of Transportation, may address in the Delta Plan the effects of climate change and sea level rise on the three state highways that cross the Delta.

(d) The council, in consultation with the State Energy Resources Conservation and Development Commission and the Public Utilities Commission, may incorporate into the Delta Plan additional actions to address the needs of Delta energy development, energy storage, and energy transmission and distribution.

85309 The department, in consultation with the United States Army Corps of Engineers and the Central Valley Flood Protection Board, shall consider a proposal to coordinate flood and water supply operations of the State Water Project and the federal Central Valley Project, and submit the proposal to the council for considerations for incorporation into the Delta Plan. In drafting the proposal, the department shall consider all related actions set forth in the Strategic Plan.

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CHAPTER 7

Reduce Risk to People, Property, and State Interests in the Delta

Reducing flood risks to people, property, and State interests is critical to achieving the Delta Reform Act's coequal goals and protecting the Delta as a place. The Legislature has found that the Delta is "inherently floodprone," and that further improvements and continuing maintenance of the levee system will not resolve all flood risks (Public Resources Code section 29704). Living with risk, whether from floods, earthquakes, fires, coastal storms, or other hazards, is often part of life in California. The Delta's hazards, however, are exceptional because they affect so many State interests, including the reliability of its water supplies, the health of the Delta's ecosystem, and the qualities that make the Delta an attractive place to live, work, and recreate.

To reduce these risks to people, property, and State interests in the Delta, the Delta Reform Act requires that the Delta Plan promote effective emergency response and emergency preparedness, and promote appropriate land use (Water Code section 85305). The Delta Reform Act also directs the Council, in consultation with the Central Valley Flood Protection Board (CVFPB), to recommend priorities for State investments in levee operation, maintenance, and improvements in the Delta, including both levees that are a part of the State Plan of Flood Control and nonproject levees (Water Code section 85306).

The Council envisions a future in which risks of flooding in the Delta are reduced, despite an increase in sea levels and altered runoff patterns. The Council sees a future where Delta residents, local governments, and businesses are better prepared to respond when floods threaten. The Council envisions a future where bypasses are expanded; channels are improved; and strong, well-maintained levees protect local communities—but also protect State interests in a more reliable water supply for California, and a protected and restored Delta ecosystem. These improvements will include new or expanded floodways and bypasses, maintaining and improving levees, and floodproofing new development. The Council envisions that rural areas and the Delta's legacy communities will also be protected from flood risks by careful land use planning that discourages urban development in flood-threatened areas. The Council envisions that local agencies will be better financed and protected through a locally controlled emergency response and flood protection district, with fee assessment authority. State funds for desired projects will be focused at State interests in the Delta, but some of that activity will protect local interests as well. Eliminating flood risks will be impossible, but prudent planning, reasonable land development, and improved flood management will significantly reduce risk, and serve the coequal goals of a more reliable water supply, and a protected and restored Delta ecosystem.

Delta Hazards Threaten Both Coequal Goals and the Delta as a Place

The risks that flooding, earthquakes, and other hazards pose to the Delta imperil California's water supplies and the health of the Delta ecosystem. The channels that convey water through the Delta to users in the Bay Area, San Joaquin Valley, or Southern California, and the islands that prevent saltwater intrusion into Delta water supplies depend upon levees for their preservation. Should the levees that protect these channels fail, the impacts on water supplies could be felt statewide. Improving these Delta levees is an investment in water supply reliability. Another way to reduce these risks is for areas that use Delta water to develop plans for possible interruption of these supplies in a catastrophic event, as recommended in Chapter 3. Integrating water supply and flood control efforts is also important to optimize the management of the multipurpose reservoirs that store water for the Central Valley Project (CVP), State Water Project (SWP), and other water users. For example, a potential benefit of wide flood bypasses leading to the Delta may be greater flexibility in these reservoir operations, creating new opportunities to manage water supplies or generate hydroelectric power.

The Delta levees also affect the health of the ecosystem. Many birds, such as waterfowl or sandhill cranes, thrive in areas that depend on levees for their management. In some locations, careful removal or breaching of levees may create new habitats that benefit fish and wildlife and the ecosystem. Setting levees back deliberately, when feasible, can create both more capacity for flood flows and more habitat for fish and wildlife. But unplanned levee failures often create weed-infested depths that harbor nonnative species rather than refuges for smelt, salmon, or other preferred species. Changes in the area protected by levees also alter water circulation through the Delta, changing the benefit of flows released to protect its ecosystem.

The Delta's residents, farms, and businesses also depend on its levees. They shape the Delta landscape, protecting its farms and communities from destruction. The levee system is the foundation on which the entire Delta economy is built, the Delta Protection Commission's (DPC's) *Economic Sustainability Plan* reports (DPC 2012). Delta residents built the levee system over generations, and they are keenly interested in its maintenance and improvement. (See sidebar, Delta Disaster Recalled, for an example of the consequences of levee failure.)

DELTA DISASTER RECALLED

On a moonlit Wednesday night in June 1972, the San Joaquin River flowed slowly after one of the driest winters on record. It gnawed at the Andrus Island levee 6 miles south of Isleton between Bruno's Yacht Harbor and Spindrift Resort, opening a small hole that grew rapidly. By the time sheriff's deputies arrived on scene shortly after 1 a.m., the river had carved a 100-foot break. By 3 a.m., water covered Highway 12. Shortly after sunrise, the breach had grown to 300 feet, and volunteers were hard at work on a 1.5-mile-long bow levee to protect Isleton.

The battle to save Isleton continued throughout the day, but a rising tide and waves created by 30- to 45-mile-per-hour Delta winds hampered efforts. Within a few hours, officials ordered the evacuation of 1,400 Isleton residents and an additional 1,500 residents of Andrus and Brannan islands. At 9:45 p.m. Thursday, the bow levee breached, and a wall of water rushed into the low-lying residential area of Isleton. Although the city's business district was spared, almost all of Andrus Island and portions of Brannan Island were flooded, in some places up to 20 feet deep.

Then-Governor Ronald Reagan declared the islands a disaster area and asked President Richard Nixon to do the same. Over the next 6 months, the levee was repaired, the 12,000-acre lake that had been Brannan and Andrus Islands was drained, and life began returning to normal. A full year after the levee break, however, more than one-third of the residents had neither moved back into their homes nor begun to rebuild.

Officials estimated that damages were $21.8 million, slightly more than half of that from crop loss and saltwater damage to farmland. The cost for levee repairs was put at $800,000, and $500,000 went to pump the 20 square miles of flooded land dry. More than $1.5 million in federal disaster relief was made available. No definitive cause was ever determined for the levee breach, and a subsequent court case absolved the State of liability (DWR 1973, Sacramento River Delta Historical Society 1996).

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Flood Risk in the Delta

The Delta is an inherently floodprone area. This section provides an overview of the causes and risks of floods in the Delta. The Sacramento and San Joaquin rivers collectively drain approximately 42,500 square miles of land. Before the Delta was modified by levees and other human structures, these rivers' natural flows overflowed the Delta's low-lying islands and floodplains for long periods each spring.

The biggest floods occurred when warm Pacific storms swept in from the west and southwest, picking up moisture over the ocean and causing torrential rains when intercepted by the mountains surrounding the Central Valley. The risks of flooding were increased when large amounts of sediment were discharged to Central Valley rivers during the Gold Rush, choking their channels and raising their beds above their natural levels and surrounding lands.

Today, flooding of the Delta's complex labyrinth of islands and waterways is prevented by its levees. This system of flood control is supplemented by the flood facilities of the Sacramento River and San Joaquin River flood control projects and multipurpose reservoirs such as Shasta, Folsom, and Millerton lakes and Lake Oroville on the Sacramento and San Joaquin rivers and their tributaries, which hold back floodwater and provide water supplies and other benefits described in Chapter 3.

Many Delta levees were initially constructed more than a century ago using primitive materials and equipment. History has shown that structural failures of the levee system occur as a result of extraordinary events, imperfect knowledge, and imperfect materials. Delta levees face potential threats such as large runoff events, extreme high tides, wind-generated waves, earthquakes, subsidence, and sea level rise. Individually, each of these threats is enough to cause serious concern; together, they represent the potential for catastrophic disruption of the Delta and its economic and ecological services.

A mass or even partial failure of the levee system would have real life-and-death impacts and property losses that could total billions of dollars. Delta flooding could interrupt the conveyance of water through the Delta for the SWP, the CVP, in-Delta users, the Contra Costa Water District, the cities of Antioch and Stockton, and others who depend on the Delta for reliable water supplies (see Chapter 3 for a discussion of water supply reliability). Levee failures could also damage key features of the Delta ecosystem, including managed wetlands in Suisun Marsh and habitats of wintering greater sandhill cranes at Staten Island and nearby tracts. Unplanned levee failure could also degrade water quality in the Delta, because tidewaters would flood into the bowl created by subsidence of Delta islands. These failures would draw saltwater from San Francisco Bay and pollute Delta water with flood debris, farm chemicals, and other pollutants.

Levee failures also could flood homes, farms, and businesses, including historic structures in the legacy communities, and interrupt recreation and tourism. As noted in Chapter 5, about 116,000 residential structures are located in the 100-year floodplain of the Delta, mostly near Sacramento, West Sacramento, and Stockton. Also, 8,000 residences are below mean higher high water (DWR 2008b). Serious consequences also could result from flood-related damage to critical infrastructure in the Delta, including radio, cellular telephone, and television transmission towers; electrical transmission lines, including Pacific Gas and Electric Company, Sacramento Municipal Utility District, and Western Area Power Administration lines; natural gas pipelines serving local gas fields and regional transmission systems; petroleum pipelines; three state highways; and three interstate highways (DWR 2011a).

In simplistic terms, the concept of flood risk can be described as the likelihood of a flood event occurring and the consequences of that event. To many, flood risk simply means the chance a storm event will overwhelm the flood control system to some extent. Figure 7-1 illustrates the variables, namely the probability of flooding and the financial consequences. However, there are many other causes of flood risk, and the consequences can be far more complicated than the immediate damage to property.

Understanding Delta Flood Risk

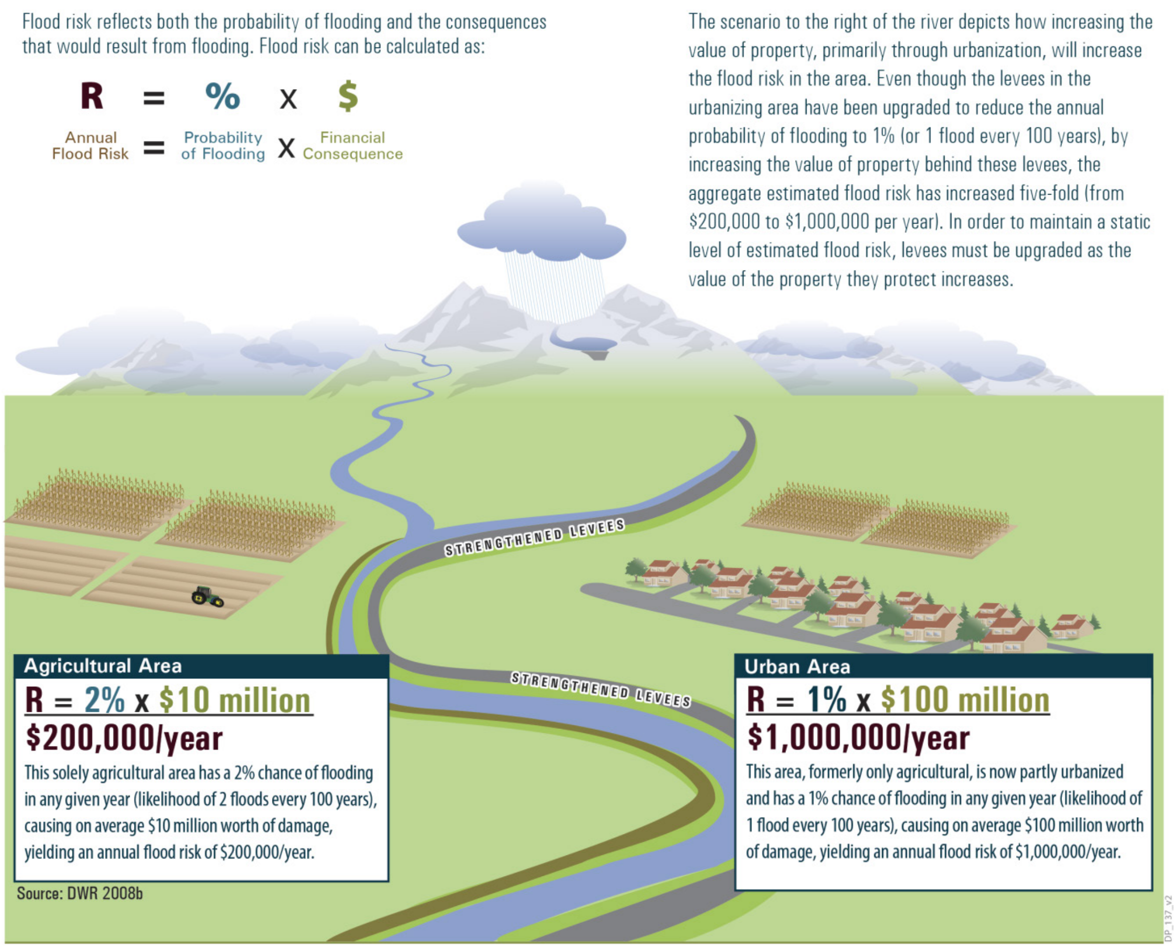

Figure 7-1

The best defense against these risks is first to better understand the Delta's flood hazards, and then manage and control those risks to the extent possible through public awareness; adequate emergency management planning; structural and nonstructural improvements, including enforcement of existing flood management regulations; and repairs, rehabilitation, and improvement of levees (including setback levees) and flood channels. Improving our understanding of risks through further evaluation and analysis of the flood control system and the assets it protects is essential to developing a rational, prioritized approach to flood management and public investment.

Floods

Flooding during winter storms that results in high water surface elevations and high winds has been a common cause of levee failures in the Delta. For example, the Sacramento River at Rio Vista may flow in excess of 300,000 cubic feet per second (cfs) during winter and early spring floods, 30 times typical late-summer flows of 10,000 cfs. Peak discharges place high stress on Delta levees and can create flood conditions, especially when coupled with high tides.

The likelihood of levee failures caused by high water is substantial, based on the historical performance of these levees over the last century. During the last century, there have been more than 140 levee failures and island inundations, most of which occurred during flood seasons (DWR 2005). High water in the Delta can overtop levees, as well as increase the hydrostatic pressure on levees and their foundations, causing instability and increasing the risk of failure due to through-levee and/or under-levee seepage. Most levee failures in the Delta have occurred during winter storms and related high-water conditions, often in conjunction with high tides and strong winds.

Earthquakes

The Delta's levees are also at risk from the active seismic zones west of the Delta, including the San Andreas and Hayward faults. Less active faults underlie the Delta. A strong earthquake could damage Delta levees because of the potential for liquefaction of levee embankments and foundations. Saturated levees composed of dredged materials in other parts of the country and the world have performed poorly during moderate to strong earthquake shaking (DWR 2009; Delta Stewardship Council Staff 2010a). If a levee failed during high flows or if a flood were to occur soon after an earthquake, the protected area could be inundated.

The risks of earthquakes causing levee breaches and island inundations in the Delta have long been recognized. A California Department of Water Resources (DWR) report begins:

> *There is a long history of levee failures in the Delta that have resulted in extensive economic damage, but no failures of Delta levees are known to be directly attributable to earthquakes. Even so, two factors indicate a possible bleak picture for the future of many Delta levees. First, no serious causative quakes have occurred on the nearby major faults since the San Francisco earthquake of 1906. Second, the Delta levees of today are vastly different than those in the 1906 Delta, which had limited size and extent. (DWR 1980)*

The DWR Delta Risk Management Strategy Phase 1 study evaluated the performance of Delta levees under various seismic threat scenarios, and analyzed potential consequences for water supply, water quality, ecosystem values, and public health and safety. The study concluded that a major earthquake of magnitude 6.7 or greater in the vicinity of the Delta Region has a 62 percent probability of occurring sometime between 2003 and 2032 (DWR 2009). Figure 7-2 illustrates a potential flood scenario in which a 6.5-magnitude earthquake causes a 20-island failure. Although the probabilistic nature of earthquake prediction makes it difficult to quantify the timing and magnitude of seismic threats, it is important to address the threats posed by earthquakes to the Delta levee system because of the potential adverse effects of such events.

High Tides and Sunny-day Risks

Even without an earthquake or flood, Delta levees can fail during high tides or even on sunny days. Generally, these failures may be the result of a combination of high tide, and pre-existing internal levee and foundation weaknesses caused by burrowing animals, internal erosion of the levee and foundation through time, and human interventions such as dredging or excavation at the toe of the levee (DWR 2008b). Examples of sunny-day failures include the Brannon Andrus Tract in 1972 and Upper Jones Tract in 2004. It is estimated that, based on current conditions, a sunny-day failure would occur once every 9 years on average (DWR and DFG 2008).

Other hazards that affect the performance of Delta levees include encroachments, penetrations, and burrowing animals. Encroachments such as structures or farming practices on or close to the levee; penetrations of the levee, such as culverts or pipelines; and burrows created by rodents, especially beavers, muskrats, and squirrels, can weaken the structural integrity of levees. Because of unregulated historical construction, levees also contain many hidden hazards. Active programs of inspection, oversight, and maintenance are essential to minimize these hazards.

Simulation of Delta Salinity after a 20-island Failure Caused by a Magnitude 6.5 Earthquake

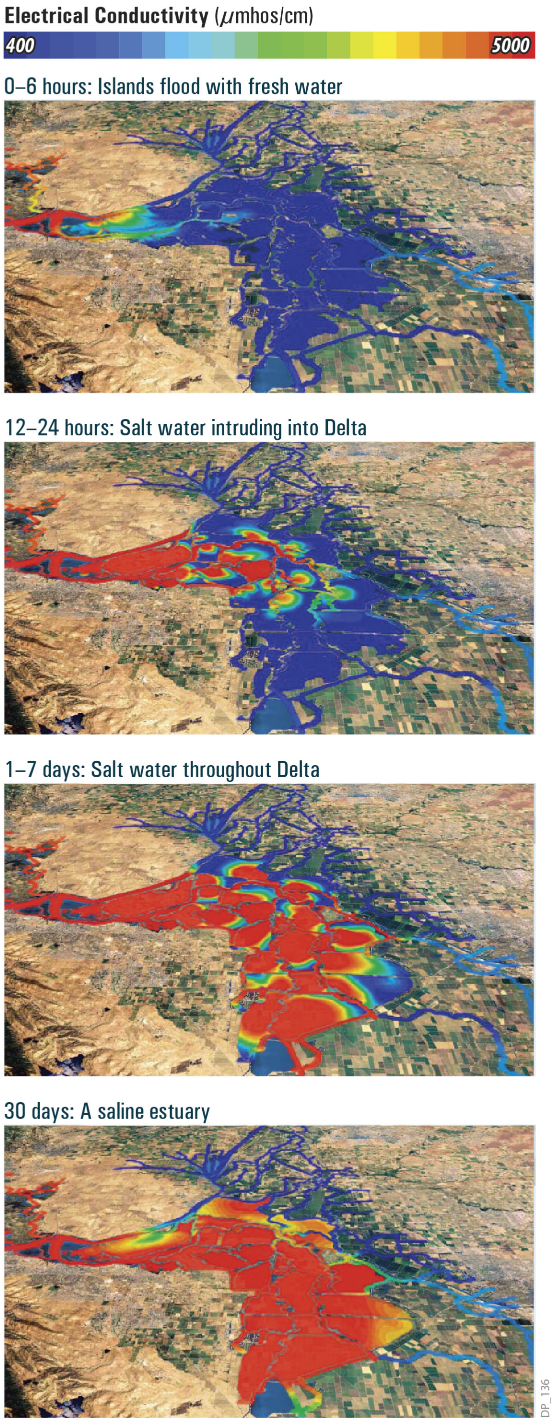

Figure 7-2 *Source: MWD 2010*

Land Subsidence

Because of the land subsidence described in Chapter 5, much of the central Delta is below sea level. Some islands are 12 to 15 feet below sea level, requiring levees 20 to 25 feet in height that act as dikes, holding back water continually rather than only during seasonal floods or extreme tides. As subsidence progresses, accommodation space increases, and levees must be continually maintained, strengthened, and periodically raised to support the increasing hydraulic stresses (Miller 2008, Mount and Twiss 2005). The hydraulic stress also can drive seepage through and under levees, and place levee foundations under more stress. The thinning of the peat soil layer also causes shallow or artesian groundwater conditions. More seepage onto islands will increase the drainage costs associated with additional pumping and decrease levee stability (Deverel and Leighton 2010).

Climate Change and Flood Risk

Climate change has major implications for the Delta, and especially for flood risk management. It is estimated that by the year 2100, sea levels may rise 31 to 69 inches (California Climate Action Team 2010, California Ocean Protection Council 2011), putting additional stress on levees and increasing their risk of failure. Projected changes in the timing and intensity of runoff may increase peak storm runoff and high-frequency flood events (DWR 2008c). Such floods could interrupt water conveyance through the Delta for those who depend on the Delta for water.

Additionally, scientific understanding of large-scale precipitation events is growing, as demonstrated by the ARkStorm scenarios being investigated by the U.S. Geological Survey, which indicate that massive storms and subsequent flooding have occurred and are likely to occur again (USGS 2011). Failure of significant parts of the Delta's flood management system may be unavoidable.

Planning for Flood Management

This section summarizes the current state of flood management planning for the Delta. To reduce the risk of flooding, Delta landowners, local governments, and State and federal agencies have planned and built an extensive levee system in the Delta, and significant flood control works upstream of the Delta. Other government flood control programs plan for emergency response in the event of floods, or help manage flood risks through land use planning, building standards, and flood insurance. The Delta Reform Act refers to these government-sponsored flood control programs in its provisions regarding covered actions (Water Code section 85057.5(a)(4)). The sidebar, What Is a Government-sponsored Flood Control Program?, highlights those programs referenced in statute; and proposed actions in the Delta that will have a significant impact on the implementation of one of these programs may be considered covered actions. Chapter 2 provides details about covered actions.

There are more than 1,000 miles of project and nonproject levees in the Delta and Suisun Marsh. Differences in how levees are classified can influence reports about their length and condition. Approximately 65 percent of the levees in the Delta and all levees in the Suisun Marsh are owned or maintained by local agencies or private owners and are not part of the flood control projects on the Sacramento or San Joaquin rivers. Most of these nonproject levees are maintained by local reclamation districts created and funded by landowners, initially for the purpose of draining ("reclaiming") Delta islands and tracts. The reclamation districts continue to maintain levees and other water control facilities today. These nonproject levees are defined in Water Code section 12980(e).

Many facilities throughout the Delta also drain rainfall runoff from land into Delta channels. Local cities and districts own and maintain urban storm drains in developed areas. Stockton, Sacramento, West Sacramento, Lathrop, Manteca, and Tracy are Delta cities with storm drainage facilities.

WHAT IS A GOVERNMENT-SPONSORED FLOOD CONTROL PROGRAM?

Any State or federal strategy, project, approval, funding, or other effort that is intended to reduce the likelihood and/or consequence of flooding of real property and/or improvements, including risks to people, property, and State interests in the Delta, that is carried out pursuant to applicable law, including, but not limited to, the following code:

- State Water Resources Law of 1945, Water Code section 12570 et seq.
- Sacramento-San Joaquin River Flood Control Projects (Flood Control Act of 1941, Public Law 77–228)
- Local Plans of Flood Protection (Water Code section 8201)
- Central Valley Flood Protection Plan (Water Code section 9600 et seq.)
- Subventions Program, Special Projects Program (Water Code section 12300 et seq.)
- Way Bill 1973 – Subventions Program, Special Projects Program (Water Code section 12980 et seq.)
- Central Valley Flood Protection Board Authority (California Code of Regulations, Title 23, Division 1)
- National Flood Insurance Program (National Flood Insurance Act of 1968, 42 United States Code 4001 et seq., Public Law 90-448)

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Most Delta islands have a network of agricultural drains and pumps to pump runoff into the Delta channels. Some Delta channels have been dredged to increase their capacity to carry floodwater and to obtain material for levee construction and maintenance.

The flood control projects on the Sacramento and San Joaquin rivers include approximately one-third of the Delta's levees. Known as "project levees," they begin on the left bank of the Sacramento River at Sherman Island, and line most of the riverbanks, as well as the Sacramento River Deep Water Ship Channel and some connecting waterways, north to Sacramento and beyond. The Delta Cross Channel's control gates are an important feature of this levee system, closing during high flows to keep the Sacramento River's floodwaters out of the central Delta. The flood control project also includes the Yolo Bypass, the broad, managed floodplain in Yolo County west of West Sacramento. The wide bypass, which is confined by project levees, draws floodwater through weirs above Sacramento to lower flood heights on the Sacramento River and its tributaries, discharging back to the Delta above Rio Vista. The Yolo Bypass floods about once every 3 years, between December and February. On the San Joaquin River, project levees line the riverbanks from Old River to Stockton. Figure 7-3 shows the locations of project and nonproject levees in the Delta.

Recent evaluations show that some of the flood control project facilities on the Sacramento and San Joaquin rivers are not adequate. Because the system was intended partly to flush Gold Rush-era sediment from rivers and channels, the project levees were often built close to the riverbanks, and are prone to erosion. Many of the system's channels have inadequate capacity to carry the flows for which they were designed, and many levees do not meet contemporary design standards (DWR 2011c).

The CVFPB, as part of its responsibility to oversee the flood control projects on the Sacramento and San Joaquin rivers, has adopted regulations to control encroachments on the project and some of the streams that flow into it. It also regulates encroachments within designated floodways, which are the channels of a river or other watercourse and the adjacent land areas that convey floodwaters (California Code of Regulations [CCR], Title 23, Division 1, Chapter 1, Article 2, Section 4). In the Delta, designated floodways include the Cosumnes River's floodplain and the confluence of the San Joaquin River and the Stanislaus River upstream from Paradise Cut.

Some levees are neither project levees nor nonproject levees. These "unattributed levees" include hundreds of miles of levees in Suisun Marsh and the Delta, and are not part of any State-financed flood control program. They also include some that are unmaintained along the perimeter of permanently flooded islands and no longer serve flood control or drainage purposes.

Multipurpose reservoirs in the Sacramento and San Joaquin river watersheds that play a role in California's water supply also serve critically important roles in managing floods that affect the Delta. The CVP's Shasta, Folsom, and Millerton lakes and New Melones Reservoir; the SWP's Lake Oroville; and other reservoirs are operated in accordance with flood control rules established by U.S. Army Corps of Engineers (USACE), reserving space to capture flood flows that can be released downstream gradually so that channels are not overwhelmed.

Many studies and planning efforts addressing flood management and emergency preparedness, response, and mitigation are under way, and will be considered by the Council for ongoing Delta flood risk management. These studies, efforts, and programs include the following:

- ***Central Valley Flood Protection Plan* (CVFPP).** This strategic plan for improving the flood control projects on the Sacramento and San Joaquin rivers recommends approaches for reducing flood risk and improving the flood control project, including expansion of the Yolo Bypass and construction of a new San Joaquin River Bypass at Paradise Cut (DWR 2011c) (see sidebar, Central Valley Flood Protection Plan).
- **DWR's FloodSAFE Initiative.** In 2006, DWR launched FloodSAFE California—a multifaceted initiative to improve public safety through integrated flood management.
- **DWR's Delta Levees Program.** This program encompasses both the Delta Levees Maintenance Subventions and Delta Levees Special Flood Control Projects programs, which provide State cost-share funding for Delta levee maintenance and upgrades.
- ***Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force Report.*** This report responds to Senate Bill (SB) 27 (Water Code section 12994.5), which called for the task force to make recommendations to the Governor about Delta multi-hazard emergency response and recovery issues.

- **USACE Delta Islands and Levees Feasibility Study, Long-Term Management Strategy for Dredging and Dredge Material Placement, Periodic Inspection Program, and Levee Safety Portfolio Risk Management System.** USACE has multiple programs addressing Delta-related flood management issues, including levee safety, levee integrity, and the beneficial reuse of dredged material.
- **CVP and SWP Reoperation Studies.** DWR's Forecast-coordinated Operations Program and Systems Reoperation Program address reservoir operational criteria, as noted in Chapter 3.

The Council will consider the findings of these studies and may incorporate them into future Delta Plan updates. The CVFPP and FloodSAFE include many concepts relevant to flood protection in the Delta. At the federal level, the National Committee on Levee Safety (2009) submitted a report to Congress that outlined the critical components of a National Levee Safety Program, and a high-level timeframe and steps for its creation. It is up to Congress to act on these recommendations, which will be monitored by the Council as they relate to the Delta Plan.

The CVFPB, DWR, and USACE each play unique and critical roles in Delta flood risk management. Because of this, the Council's role in facilitation, coordination, and integration of various agencies and other parties is of particular importance. Frequent, ongoing collaboration with other State, federal, and local agencies to improve communication and coordination is essential to meeting the Delta Plan's flood management objectives.

CENTRAL VALLEY FLOOD PROTECTION PLAN

The Central Valley Flood Protection Act of 2008 directed DWR to prepare the CVFPP. The CVFPP is a flood management planning effort that addresses flood risks and ecosystem restoration opportunities in an integrated manner. It specifically proposes a systemwide approach to flood management for the areas currently protected by facilities of the State Plan of Flood Control (SPFC). The CVFPP was adopted by the CVFPB in June 2012. It is expected that the CVFPP will be updated every 5 years thereafter.

The CVFPP proposes a systemwide approach to address the following issues:

- Physical improvements in the Sacramento and San Joaquin river basins
- Urban flood protection
- Small community flood protection
- Rural/Agricultural area flood protection
- System improvements
- Non-SPFC levees
- Ecosystem restoration opportunities
- Climate change considerations

The geographic scope of the CVFPP includes the portions of the Delta covered by the SPFC, including about 65 miles of urban, nonproject levees at Stockton; approximately two-thirds of Delta levees are not addressed in the CVFPP.

The effects of systemwide improvements directed by the CVFPP and the potential of redirected impacts to areas within the Delta will be monitored by the Council to ensure alignment with the coequal goals and the Delta Reform Act. Additionally, the Council may, at its discretion, incorporate those portions of the CVFPP into the Delta Plan to the extent that those portions promote the coequal goals (Water Code section 85350).

The 2012 CVFPP is only a descriptive document, highlighting a planning perspective at a reconnaissance level. Follow-on feasibility studies and project-specific development activities will be conducted over the next several years. The Council will continue to monitor and provide input to those activities to ensure that Delta flood risk issues are considered. Flood system improvement actions undertaken upstream of the Delta are of particular concern if not coupled with in-Delta actions that reduce overall systemwide flood risk.

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The Delta's Levees

The levees within the legal Delta protect approximately 740,000 acres of land. They define the Delta's physical characteristics; influence the reliability of its water supplies and its ecosystem health; and are critical to the Delta's residents, farms, businesses, cities, and legacy communities. Because many Delta levees protect land below sea level, they hold back water all day, year-round, rather than only during floods, and so are called "the hardest working levees" in America.

Levees in the Delta

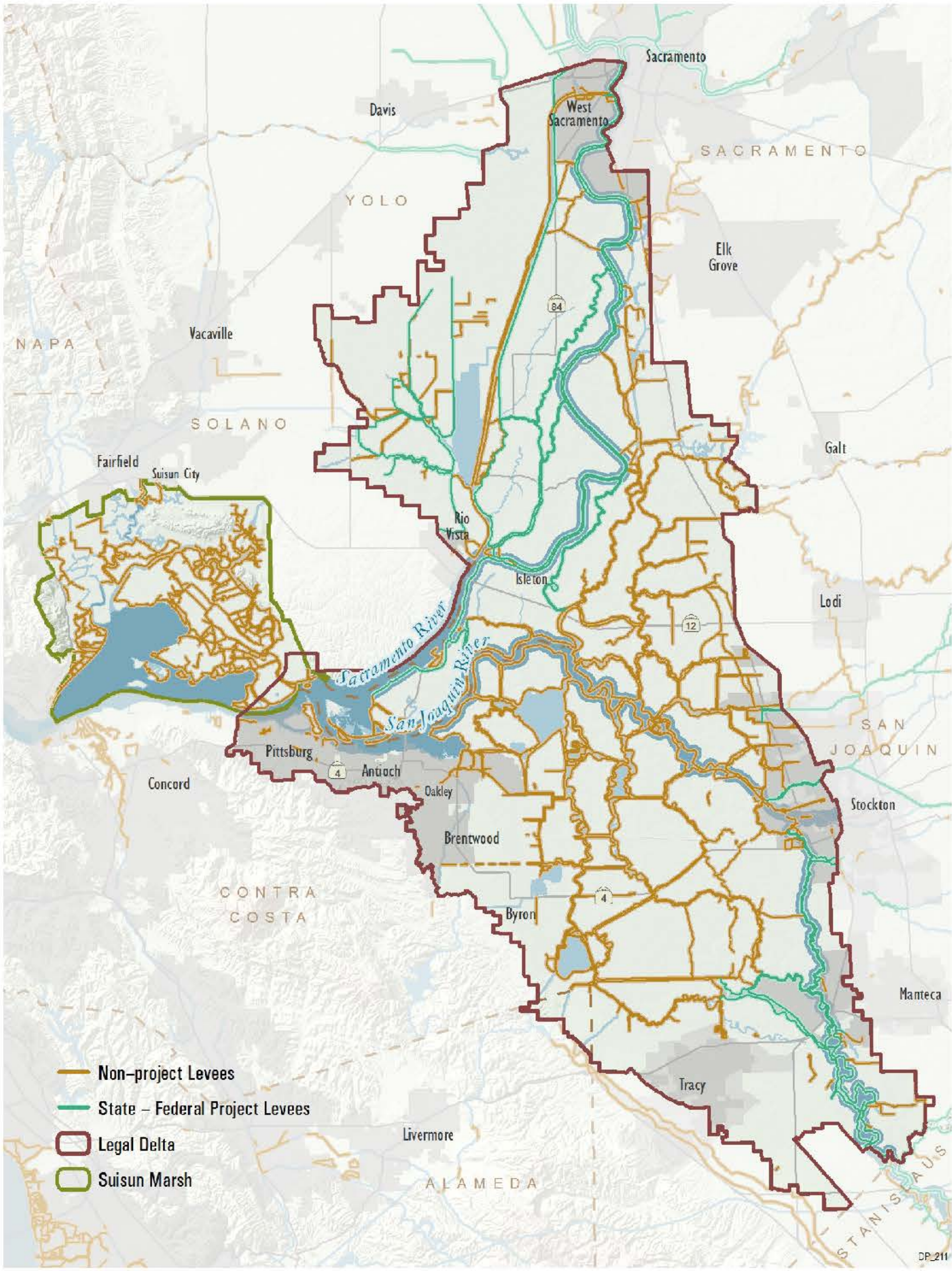


Figure 7-3 *Source: DWR 2011e*

Existing Levee Standards and Guidance

It is more important than ever that the Delta's levees are designed, constructed, and maintained to provide a level of flood risk reduction commensurate with the coequal goals and protection of the Delta's unique values as a place. Over the last few decades, State and federal agencies have developed guidelines and standards for levees. These standards establish minimum criteria for levee design and maintenance. The standards include (1) the level of flood protection California has prescribed for the Central Valley's urban areas, (2) whether sufficient protection is provided by the levees to exempt development financed with federally backed mortgages from requirements to obtain flood insurance, and (3) whether property and infrastructure protected by the levees (including the levees themselves) are eligible for assistance in the event of a catastrophic emergency, including aid from USACE to rehabilitate levees damaged in an emergency or for disaster assistance from the Federal Emergency Management Agency (FEMA).

Four levee standards and guidance applicable to the Delta are discussed below (and shown on Figure 7-4); they are ordered from highest to lowest level of flood protection:

- **DWR 200-year Urban Levee Protection (DWR - 200 Year):** This standard goes beyond criteria for levee height and geometric design to include requirements for freeboard, slope stability, seepage/underseepage, erosion, settlement, and seismic stability (DWR 2011b). It protects against a flood that has a 0.5 percent chance of being equaled or exceeded in any given year (a 200-year level of flood protection). This urban levee standard is the only levee standard that specifically links land uses to levee criteria. State law requires that by 2025, floodprone urban areas with over 10,000 residents must meet this 200-year flood protection standard (Government Code section 65865.5(a)(3)). Compliance likely will be achieved by upgrading levees to meet the 200-year design standard, under development by DWR. Sacramento, West Sacramento, and Stockton are planning levee improvements to attain this level of protection.

  Very few levees in the Delta meet this standard because most Delta levees do not protect urban areas. Under existing law, rural levees are not required to meet this standard.

- **FEMA 100-year (Base Flood) Protection (FEMA – 100 Year):** This "insurance" standard, often called the "1 percent annual chance flood" level of protection, provides criteria that levees must meet to protect against the flooding that is the basis for FEMA's flood insurance rate maps (44 Code of Federal Regulations 65.10). It is often used with established USACE criteria to prescribe requirements for levee freeboard, slope stability, seepage/underseepage, erosion, and settlement. The standard generally does not address seismic stability. In communities where levees provide this level of flood protection, new developments are not required to meet federal floodproofing standards and can obtain federally guaranteed mortgages without purchasing flood insurance.

  Few Delta levees outside of cities meet this standard, and many urban levees need improvement to meet it.

- **Public Law 84-99 (PL 84-99):** The PL 84-99 standard is a minimum requirement established by USACE for levees that participate in its Rehabilitation and Inspection Program (33 United States Code 701n) (69 Stat. 186). Twenty-five Delta reclamation districts, protecting about 31 percent of the legal Delta's land behind about 516 miles of levees, are at or above this standard, according to a recent report to the Council by DWR (DWR 2012). Delta islands or tracts that meet this standard are eligible for USACE funding for levee rehabilitation, island restoration after flooding, and emergency assistance, provided that the reclamation district is accepted into the USACE's program and passes a rigorous initial inspection and periodic follow-up inspections. Eligibility for PL 84-99 was formerly based primarily on levee geometry with minimum freeboard and maximum steepness of slopes. USACE's periodic

Levee Guidance

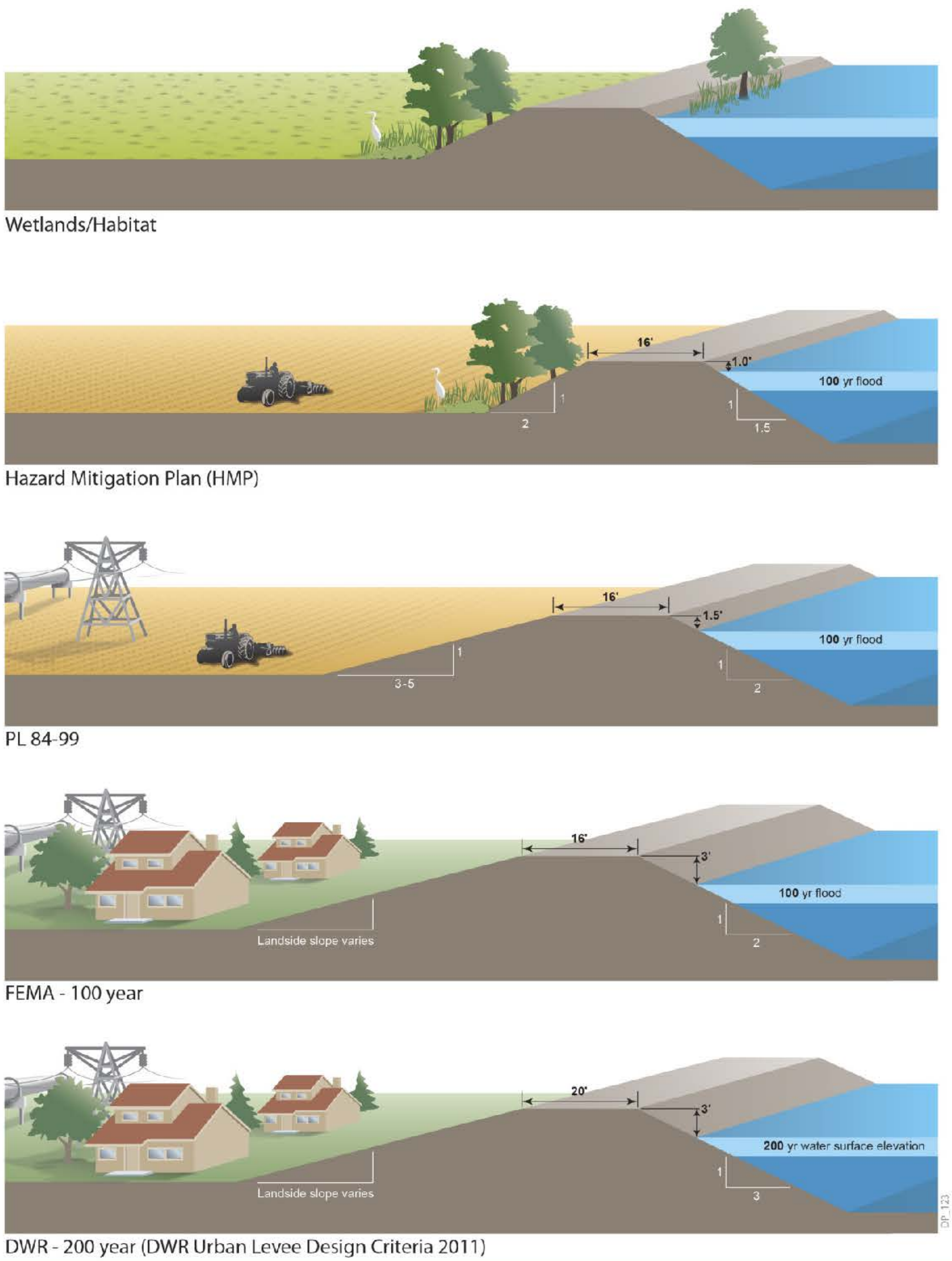


Figure 7-4 *Source: Adapted from Delta Vision Blue Ribbon Task Force 2008 and DWR 2011b*

inspection program incorporates other elements into eligibility, including presence of structure encroachments, vegetation, rodent control programs, and more. The standard for levee geometry implies a minimum levee height and a slope stability factor of safety, but is not associated with a level of protection (such as a 100-year flood) and does not address seismic stability. In 1987, USACE developed a Delta-specific standard based on the Delta's particular organic soils and levee foundation conditions. The CALFED Record of Decision set a goal of improving Delta levees to the PL 84-99 standard, as does the DPC Economic Sustainability Plan, but funding has been inadequate to attain this objective.

- **FEMA Hazard Mitigation Plan (HMP) Guidance:** FEMA, DWR, the California Office of Emergency Services (now the California Emergency Management Agency [Cal EMA]), and the Delta levee-maintaining agencies negotiated the HMP guidance to reduce the likelihood of repetitive flood damage to Delta levees and islands, so that FEMA disaster assistance would not be requested repetitively for the same islands after minor floods. Fifty-three of the Delta's reclamation districts, protecting over 47 percent of the legal Delta's acreage, fall below this standard, which 139 miles of Delta levees do not meet (DWR 2012). Local communities that do not meet the HMP guidance are not eligible for FEMA disaster reimbursement for flood fights or assistance if levees fail or islands flood. If even a portion of the levee around an island or tract does not meet the HMP guidance, assistance from FEMA to recover from levee damage is unavailable. Fifteen districts comply with this guidance, but are below the PL 84-99 standard. FEMA and Cal EMA have a memorandum of understanding, updated in 2010, that sets forth the requirements for FEMA public assistance funding for emergency flood fighting, emergency repair, permanent restoration, and/or replacement of eligible damaged nonproject levees within Delta reclamation districts (Cal EMA and FEMA 2010). The guidance is based on geometric criteria for the levees. The HMP guidance, negotiated between 1983 and 1987, was intended as an interim guidance, but has not been adjusted using subsequent or projected flood elevations.

No State standards currently address design criteria for flood protection of the state highways and interstate highways that traverse the Delta. Federal standards require that interstate highways must be protected from 50-year flood events to qualify for Federal Highway Administration funds (23 Code of Federal Regulations 650.115). Because most roads in the Delta were constructed before these standards were developed, they do not meet the standards. For example, sections of State Route 12 are 10 feet or more below sea level. A flood on the islands this highway traverses could interrupt transportation and trade, and put motorists at risk.

Levees and Ecosystem Function

Historically, most discussion of levees has emphasized reducing flood risks to life and property. However, habitat and ecosystem values and functions can provide multiple benefits, and must be considered in flood management planning and actions. For example, the CVFPP includes a conservation framework and strategy that outline how environmental elements can be integrated into flood management activities and provide an environmental guide for flood project planning. Setting levees back from the riverbank can expand flood conveyance capacity and reduce flood risk while providing ecosystem restoration and recreational opportunities (USACE 2002). Setback levees also allow opportunities for construction of an improved levee foundation and section using modern design and construction practices, thereby reducing risk of failure.

Much discussion has occurred on how to more effectively accommodate ecosystem function with the current levee system, highlighting the following issues (Healey and Mount 2007):

- Current levees tend to be narrow, with steep waterside slopes that provide little upland habitat value.

- Setback levees may provide habitat value and increased levee integrity.
- Levees can be used to promote specific habitat types (such as waterfowl habitat) by ensuring that some areas of freshwater marsh are sustained.
- Where lands are not heavily subsided, levees can allow for multiple land uses including habitat management and wildlife-friendly agriculture.
- Allowing levees to fail on deeply subsided islands would not generate any obvious ecological benefits.
- Subsidence reversal on deeply subsided islands would rely on levees to appropriately manage water levels during tule growth.

As management efforts in the Delta proceed, it will be important to consider ecosystem functions and their interactions with the levee system, as discussed in Chapter 4. An example where these interactions are already being debated is the USACE's current policy requiring removal of vegetation from levees. Scientific support for and against this policy is mixed. Concerns with maintaining woody vegetation on levees include difficulties with inspection and flood fighting, potential for root holes, and trees toppling from erosion. Other evidence, however, suggests that woody shrubs and small trees on levees enhance levee structural integrity while providing environmental benefits. A study on a channel levee along the Sacramento River concluded that roots reinforced the levee soil and increased shear resistance by providing increased stability against slope failures (Shields and Gray 1992). In either case, the widespread removal of vegetation from Delta levees could have significant adverse environmental impacts that are not well understood.

Floodplains and Channels

Floodplains and channels that provide the capacity to carry and store flood flows are critical for managing flood risks, and for overall Delta water management and ecosystem integrity. The CVFPB and FEMA both play roles in designating floodways and floodplains to accommodate flood flows.

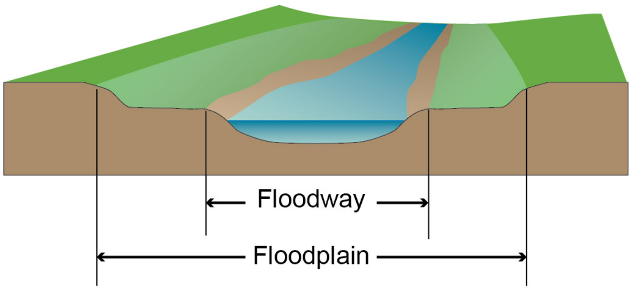
The CVFPB regulates encroachment in floodplains by designating floodways in the Sacramento River and San Joaquin River drainages, including the Delta (Water Code section 8609). A "designated floodway" is the channel of the stream and that portion of the adjoining floodplain, as shown on Figure 7-5, reasonably required to provide for the passage of a specified flood. It may also be the floodway between existing levees as determined by the CVFPB.

The CVFPB regulates encroachments within designated floodways and regulated streams through its permitting authority. The encroachment permit process applies to all projects, existing and proposed (including habitat restoration projects), within State/federal flood control project levees, designated floodways, bypasses, and regulated streams (CCR, Title 23, Division 1). The CVFPB should be consulted prior to the consideration of any projects that may be in a designated floodway in the Delta. Appendix L includes a map of the CVFPB's jurisdictional areas in the Delta.

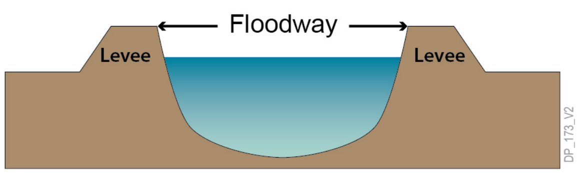
Additionally, under the National Flood Insurance Program, FEMA maps floodplains that have a 1 percent chance of flooding in any year (a 100-year flood). FEMA works with participating communities to regulate development within these floodplains according to federal regulations. No new construction, substantial improvements, or other development (including fill) may be permitted within specified flood zones on the community's Flood Insurance Rate Map unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than 1 foot at any point within the community.

In some flood channels and bypasses, dredging may have benefits because it increases channel capacity and also provides material that can be used for levee maintenance and other flood risk management activities. Because some

Conceptual Diagrams of Floodways



Conceptual Diagram of a Floodway within a Floodplain



Conceptual Diagram of Floodway within a Leveed Channel

Figure 7-5 The floodway is the channel of the stream and that portion of the adjoining floodplain reasonably required to provide for the passage of a specified flood; it is also the floodway between existing levees as determined by the CVFPB or the Legislature.

Source: FEMA 2006

portions of the Delta are within a tidal pool and other areas are riverine, the efficacy of dredging must be addressed on a site-specific basis and cannot simply be considered useful on a Delta-wide basis.

The benefits and impacts of dredging Delta channels are being investigated by a consortium of federal and State agencies, including U.S. Environmental Protection Agency, USACE, DWR, and the Regional Water Quality Control Boards, under the Delta Dredged Sediment Long-Term Management Strategy (LTMS) Program. The LTMS is designed to improve operational efficiency and coordination of the collective and individual agency decision-making responsibilities resulting in approved dredging and dredged material management actions in the Delta. Approved dredging and dredged material management actions will take place in a manner that protects and enhances Delta water quality, identifies appropriate opportunities for the beneficial reuse of Delta sediments for levee rehabilitation and ecosystem restoration, and establishes safe disposal for materials that cannot be reused (USACE 2007).

Investment in Reducing Risk

Because the Delta's levees protect residents; agricultural land; water supplies; and energy, communications, and transportation facilities, the State has invested considerable funding in Delta levees over several decades through various legislative actions. Legislation sponsored by Senator Howard Way in 1973 established the Delta Levees Maintenance Subventions Program, SB 34 (1988) established the Delta Levees Special Flood Control Projects Program, and Assembly Bill 360 (1996) extended these two programs and initiated a requirement for net habitat enhancement. Bond measures passed since the late 1990s have provided sizeable but one-time funding for levee maintenance, repair, and improvements. Propositions 84 and 1E provided substantial public financing toward most of the recent Delta levee projects. An estimated $700 million of State taxpayer money has been spent by DWR on Delta levee maintenance and improvements since the Delta levee funding programs began in the 1970s. This includes $274 million of bond funds that are encumbered for future Delta levee projects. Funding to improve levees that protect urban and urbanizing areas within the Delta is currently provided by the State via the Early Implementation Program managed by DWR.

The Delta's project levees are authorized as part of the federal flood control project and so are eligible for federal funding (as well as the maintenance subventions mentioned below). The CVFPB serves as the nonfederal partner to USACE for the Delta's project levees.

State investments for nonproject levees in the legal Delta are distributed according to guidelines and criteria of the Delta Levees Maintenance Subventions Program or Delta Levees Special Flood Control Projects Program. These two programs provide State matching funds for maintaining and improving Delta levees. Local agencies in the legal Delta receive partial reimbursement for levee maintenance and rehabilitation from the State when funding is available. Currently, the State contributes up to 75 percent of qualifying costs for maintenance of many Delta levees. Local levee-maintaining agencies provide local cost-share matches, and both local and State efforts contribute to Delta flood risk reduction by maintaining continuous efforts to preserve Delta levees. It is often difficult for local agencies to raise funds for the local cost share of State and federal assistance programs. Funding assistance provided by the Delta Levees Maintenance Subventions Program is governed by guidelines developed by DWR and adopted by the CVFPB. State funds are not available for levee maintenance or improvement in most of Suisun Marsh.

Although the State has contributed the majority of costs for maintaining and improving Delta nonproject levees for many years, the concept of shared responsibility with local landowners is key to the long-term success of the Delta levee system. Neither the State nor the federal government is legally obligated to pay the full cost of Delta flood protection projects. The continued participation and financial support of local reclamation districts is essential. As noted in the Delta Reform Act's Section 85003(b), "Delta property ownership developed pursuant to the federal Swamp Land Act of 1850, and state legislation enacted in 1861, and as a result of the construction of levees to keep previously seasonal wetlands dry throughout the year. That property ownership, and the exercise of associated rights, continue to depend on the landowners' maintenance of those nonproject levees and do not include any right to state funding of levee maintenance or repair."

Prioritizing State Investment in Levees

The Delta Reform Act requires that State investments in Delta levees be prioritized to reduce risks to people, property, and State interests in the Delta (Water Code sections 85305(a) and 85306). Prioritizing investment is necessary to ensure that limited public funds are expended responsibly for improvements critical to State interests, rather than simply applying one objective to all Delta levees regardless of priority. These priorities, in combination with the Delta Reform Act directive that State agencies act consistently with the Delta Plan, will ensure that State spending on Delta levees reflects these priorities in the future. The Delta Reform Act provides that activities of the Council in determining priorities for State levee investments in Delta levees do not increase the State's liability for flood protection in the Delta or its watershed (Water Code section 85032(j)).

This Delta Plan outlines a process to prioritize State investments in levee operation, maintenance, and improvements in the Delta. It is also important to prioritize interim actions while longer-term guidelines are being established. Interim actions taken should consider and, where feasible, incorporate habitat and ecosystem values and enhancement in their development and implementation. This will allow for a more coordinated, effective approach to reducing Delta flood risk and prioritizing both immediate and long-term State investments. This approach will also take into account future actions that may be proposed through other planning efforts such as the CVFPP and Bay Delta Conservation Plan.

To effectively prioritize State investments in levees, a framework is needed to adequately assess Delta flood risk. This framework should include the following steps:

- Assess existing Delta levee conditions. Initially, a sufficient understanding of the current status of Delta levees is needed to establish baseline conditions against which future risk reduction efforts can be gauged. Because Delta levee conditions change, it is critical to conduct periodic assessments so that maintenance and improvement actions can be directed rationally. Assessment methods should be used that provide sufficient information to portray a reasonable snapshot of conditions.
- Develop an economics-based risk analysis for each Delta tract and island. This analysis must address several critical parameters, including life safety, private property, impacts on State water supply, critical infrastructure,

Delta water quality, ecosystem values, and systemwide integrity. Accepted risk analysis methods should be used, such as those developed by USACE (1996, 2006). This analysis could include "expected annual damage" assessments as a metric for analyzing flood risk. This approach, which integrates the likelihood and consequences of flooding, provides values that are useful for comparing flood risk at various locations and for ranking alternative levee projects.

- Conduct ongoing Delta flood risk analyses in an open manner for the public. Baseline and subsequent analytical efforts should always be conducted in manner open to scrutiny, with results being readily available for decision makers, interested parties, and the general public. Flood risk analyses will need to take into account future actions that may be proposed through other planning efforts such as the CVFPP and Bay Delta Conservation Plan.
- Develop an updated understanding of Delta hydrology. An updated understanding of water surface elevations in the Delta is critical for levee design purposes and should be addressed.

The approach must be based on sound scientific and engineering principles, and incorporate appropriate economic and hydrologic data.

As these long-term priorities for State investments in levee operation, maintenance, and improvements are developed, State funds for Delta levee projects should focus on the interim priorities set forth in RR P1, including the following actions:

- Provide a 200-year level of flood protection for existing urban and adjacent urbanizing areas (Water Code section 9600 et seq.).
- Improve the levees that protect aqueducts crossing the Delta and the freshwater pathway to Clifton Court Forebay, as depicted on Figure 7-6, to improve the reliability of these water supplies.
- Improve other Delta levees not specifically planned for ecosystem restoration to the FEMA HMP guidance level to ensure that the Delta's reclamation districts are eligible for public funding for emergency flood fighting, emergency repair, permanent restoration, and/or replacement of eligible damaged nonproject levees.
- Continue to fund and implement the Delta Levees Maintenance Subventions Program to maintain Delta levees.

In addition, the Delta Plan proposes creating a regional agency to assist with the planning, implementation, and financing of Delta flood risk reduction activities (see RR R2). Local levee-maintaining agencies have managed the financing and ongoing maintenance, rehabilitation, and repair of Delta levees, and have improved the levels of levee integrity, reducing overall Delta flood risk. Although the State has provided financial assistance over several decades, these programs have been funded primarily through State general obligation bonds, which face an uncertain future. The unencumbered bond funds that remain available for Delta levee projects total only $123 million.

An alternative funding mechanism could provide a more stable, long-term approach to funding in which local participation by all beneficiaries of flood risk management is more broadly incorporated. A regional flood risk management district with fee assessment authority could address a variety of Delta flood risk-related activities, including levee maintenance and improvements; regional flood management planning; flood facilities inspections; data collection; risk notification; and emergency preparedness planning, response, and mitigation. A regional flood risk management district could complement reclamation district activities. Because two ballot measures, Propositions 218 (1996) and 26 (2010) (discussed in Chapter 8), have raised the approval thresholds for new fees and taxes, the proposed regional assessment district will need to be broadly supported.

Delta Flood Management Facilities

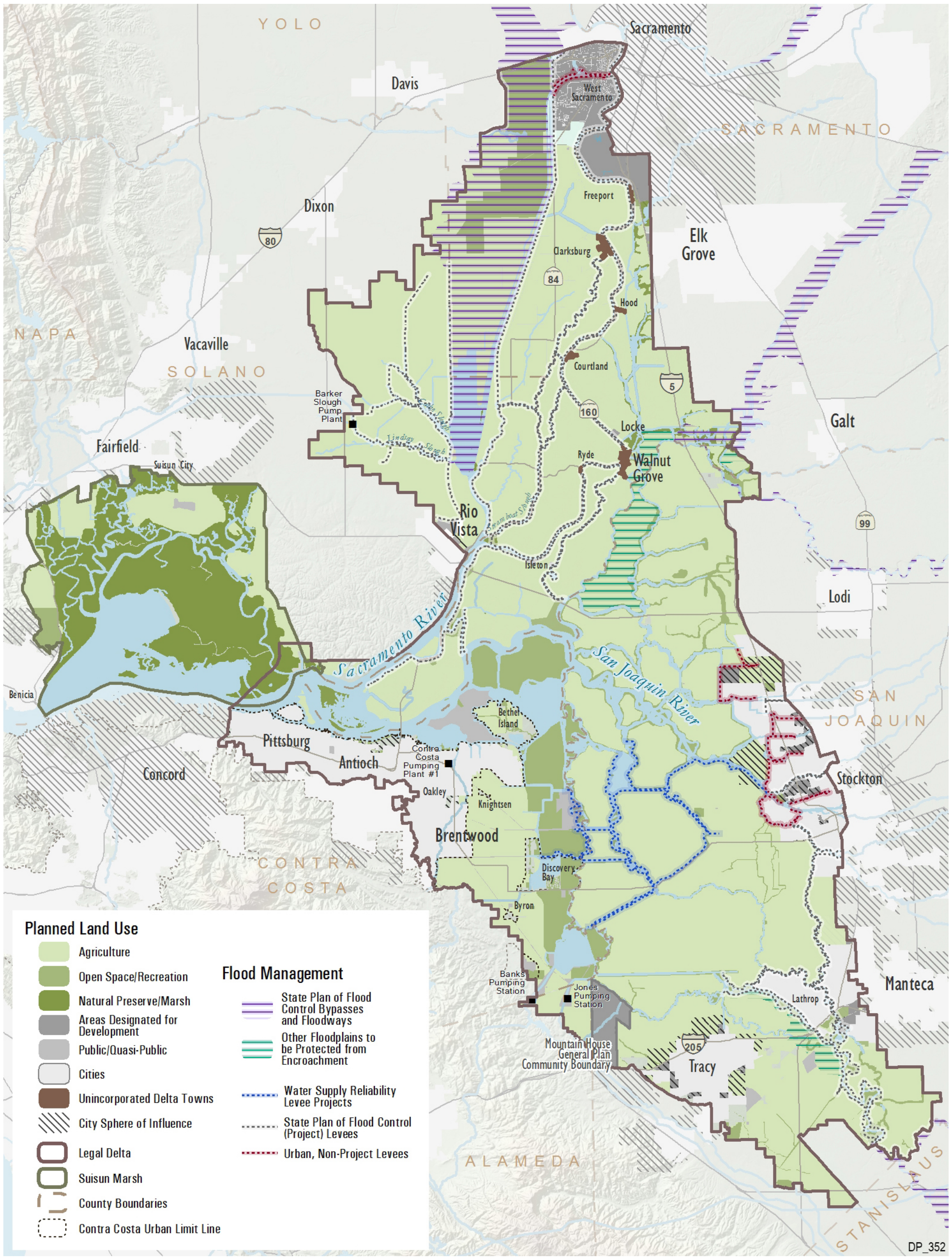


Figure 7-6

The map shows land uses designated by city and county general plans. Within cities' spheres of influences, the map shows land use designations proposed in city general plans, where available. In cases where cities have not proposed land uses within their spheres of influence, the map shows land uses designated by county general plans.

Sources: City of Benicia 2003, Contra Costa County 2008, Contra Costa County 2010, DWR 2011b, DWR 2011c, DWR 2011d, City of Fairfield 2008, Jones & Stokes 2007, City of Lathrop 2012, City of Manteca 2012, Mountain House Community Services District 2008, City of Rio Vista 2001, SACOG 2009, City of Sacramento 2008, Sacramento County 2011, Sacramento County 2012, Sacramento County 2013, San Joaquin County 2008a, San Joaquin County 2008b, Solano County 2008a, Solano County 2008b, South Delta Levee Protection and Channel Maintenance Authority 2011, City of Stockton 2011a, City of Stockton 2011b, City of Suisun City 2011, City of Tracy 2011a, City of Tracy 2011b, City of West Sacramento 2010, Yolo County 2010a, Yolo County 2010b.

Planning for Floodplain Land Use

The most important step in reducing risk to people in the Delta is to stop putting more people at risk behind levees that do not meet minimum modern standards for flood protection. Actions that increase the demand for higher public spending on flood risk reduction and exacerbate flood risk (for example, urbanizing floodprone areas) should be discouraged.

The DPC *Land Use and Resource Management Plan for the Primary Zone of the Delta* also includes important policies to limit development in floodprone areas of the Primary Zone:

> *Local governments shall carefully and prudently carry out their responsibilities to regulate new construction within flood hazard areas to protect public health, safety, and welfare. These responsibilities shall be carried out consistent with applicable regulations concerning the Delta, as well as the statutory language contained in the Delta Protection Act of 1992. Increased flood protection shall not result in residential designations or densities beyond those allowed under zoning and general plan designations in place on January 1, 1992, for lands in the Primary Zone. (DPC 2010)*

As noted in Chapter 5, the legacy community of Bethel Island warrants a special note because of its flood hazards. About 2,100 people reside on the island in about 1,300 residences concentrated on the south central shoreline and four mobile home parks. The island, which is below sea level, is surrounded by approximately 15 miles of levees, limiting the drainage of floodwaters in the event of a levee breach. A single road, Bethel Island Road, links the island to the mainland at the city of Oakley, complicating emergency response or evacuation in the event of flooding. Because developments on Bethel Island are proposed to be served by the Bethel Island Municipal Improvement District or other adjacent public services, the entire island is within the urban limit line adopted by Contra Costa voters in 2006. The high flood risks on the island and the restricted evacuation opportunities, however, indicate the island has greater hazards to lives and property than the Delta's other areas designated for development. For this reason, it is not excluded from the Delta Plan policy prohibiting new subdivisions unless adequate flood protection is provided. This is consistent with provisions of the Contra Costa County General Plan, which require that development other than a single home on existing parcels await resolution of several issues, including improvement of the community's public services, levees, and emergency evacuation routes.

As described in Chapter 5, urban residential, commercial, and industrial uses should be located in cities, other urban areas, and their spheres of influence, where strong levees can be provided, rather than in rural lands protected only by nonproject levees. Outside of these urban and urbanizing areas and the legacy communities, the Delta Plan prohibits major subdivisions of five or more parcels where 200-year flood protection is not available. Recognizing legacy community needs for incidental growth to maintain their unique cultural values, development within community boundaries should continue consistent with existing general plans, and federal and local flood protection laws. Appendix B provides maps of Delta community boundaries. Maintaining most of the Delta in rural, agricultural land use, as described in Chapter 5, complements policies that reduce the number of properties and the population exposed to high flood risks.

Finally, the participation of Delta counties and cities in the National Flood Insurance Program brings with it a requirement that all residential, commercial, agricultural, and industrial buildings comply with FEMA floodproofing standards, including elevating structure ground floors above the 100-year flood elevation. Examples of floodproofing are shown on Figure 7-7.

Examples of Floodproofing

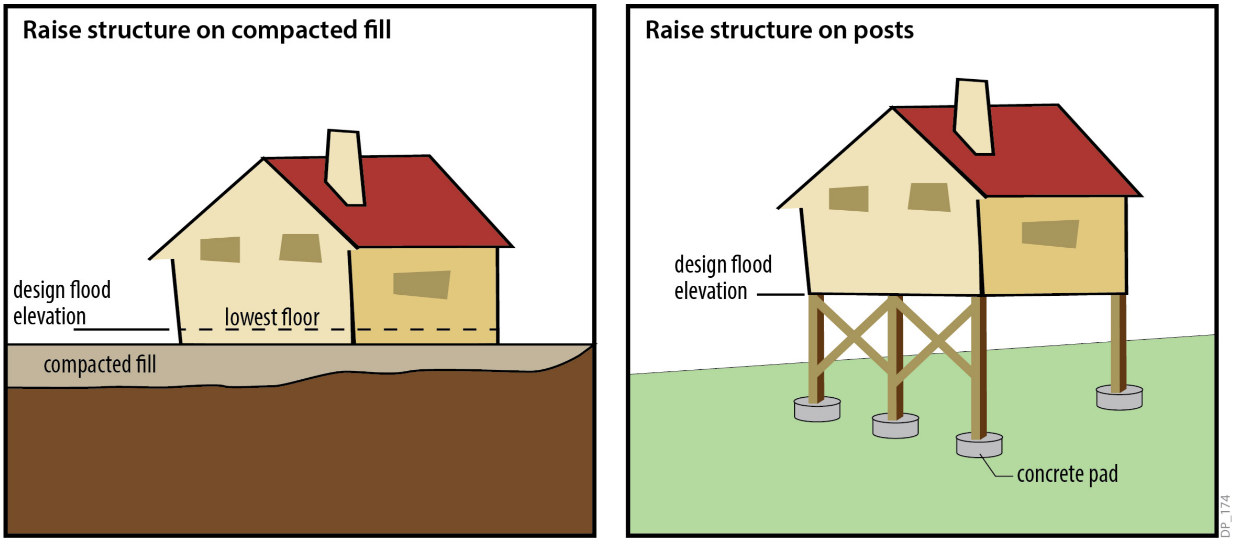


Figure 7-7

Floodproofing in accordance with the National Flood Insurance Program can be achieved through several methods. The illustration on the left shows an example of floodproofing by constructing the lowest floor within a structure above the design flood elevation. The illustration on the right shows floodproofing by raising the bottom of the structure above the design flood elevation.

Source: FEMA 1994; FEMA 2001

Emergency Preparedness and Response

Even with the best-engineered levees, channels, and floodways, a residual risk from flooding will always remain; flood risk can never be eliminated. Although investment in flood protection infrastructure can considerably reduce the likelihood of a catastrophic levee failure, failures are inevitable and will require well-coordinated and carefully developed emergency response efforts. To reduce response time and optimize effectiveness of response efforts, such plans need to leverage the unique capabilities of each agency with a mission in the Delta. This section provides an overview of the agencies and planning involved in emergency preparedness and response in the Delta.

Responsibilities for preparing for, declaring, and responding to flood emergencies are distributed among local, State, and federal agencies. Federal agencies with authority include USACE and FEMA. In California, State and local responsibilities fall to county offices of emergency services, local reclamation districts, Cal EMA, and DWR. In a Delta flood emergency, the response efforts by local and State emergency management professionals are guided by California's Standardized Emergency Management System (SEMS). SEMS was established by Government Code section 8607(a), and provides for effective management of multiagency and multijurisdictional emergencies in California, including flood emergencies. This system consists of five organizational levels, which are activated as necessary: (1) field response, (2) local government, (3) operational area, (4) regional, and (5) State. These levels are activated stepwise as the events warrant additional response and resources, meaning that each level of emergency responder contacts the next level above them should they deem the emergency beyond their capabilities to control. Federal resources are called upon if State resources are exhausted or additional assistance is needed. SEMS incorporates the functions and principles of the Incident Command System, the Master Mutual Aid Agreement, existing mutual aid systems, the operational area concept, and multiagency or interagency coordination. A detailed discussion of SEMS can be found in Cal EMA SEMS Guidelines (Cal EMA 2009). Local governments must use SEMS to be eligible for funding of their response-related personnel costs under State disaster assistance programs.

At the State level, Cal EMA's *California Emergency Plan* is the current guiding plan for all State emergencies. The California Emergency Plan incorporates and complies with the principles and requirements found in federal and State laws, regulations, and guidelines. Cal EMA typically defers to DWR for emergency management during floods. DWR emergency flood management actions are guided by its 2007 *Interim Flood Emergency Operations Plan*. DWR is in the process of developing its Delta Flood Emergency Preparedness Response and Recovery Program (EPRRP), which will be the overall guiding flood emergency management program for DWR activities for project and nonproject levees in the Delta. The Delta Flood EPRRP consists of three components: (1) the plan for flood emergency preparedness, response, and recovery actions in the Delta; (2) multiagency plan coordination, which coordinates DWR's plan with the plans of other Delta flood response agencies; and (3) response facilities implementation, which includes the development of flood emergency response facilities in the Delta.

At the federal level, USACE has a standing All-Hazards Emergency Response Plan and standing contracts for emergency response work in the Delta region, and is ready to assist the State, as requested through PL 84-99. These existing plans and procedures are considered in DWR's flood emergency operations plans and are a critical part of the Delta Flood EPRRP Plan. FEMA is responsible for coordinating the response of several federal agencies to a large natural disaster that overwhelms the resources of State and local authorities. The primary duty of FEMA is to ensure services to disaster victims through operational planning and integrated preparedness measures.

Following a flood disaster, various federal programs can provide disaster assistance. USACE has specific criteria concerning eligibility for assistance under PL 84-99. FEMA's HMP criteria must be met to be eligible for its assistance (Delta Stewardship Council Staff 2010b).

To further address emergency preparedness and response issues in the Delta, the Legislature passed SB 27 (Water Code section 12994.5) to develop and implement multi-hazard preparedness and response strategies for the Delta. This legislation required the Office of Emergency Services (now Cal EMA) to establish the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force. Led by Cal EMA, the task force consisted of representatives from the DPC, DWR, and representatives of the five Delta counties. The task force was directed to do the following:

- Make recommendations to the Secretary of Cal EMA relating to the creation of an interagency unified command system organizational framework, in accordance with the guidelines of the National Incident Management System and SEMS.
- Coordinate the development of a draft emergency preparedness and response strategy for the Delta region for submission to the Secretary of Cal EMA. Where possible, the strategy shall use existing interagency plans and planning processes of the involved jurisdictions and agencies that are members of the DPC.
- Develop and conduct all-hazard emergency response exercises and training in the Delta that are designed to test or facilitate implementation of regional coordination protocols.

The recommendations being prepared by the task force will likely play an important role in planning efforts for the Delta, and will be considered in the Delta Plan. When this Delta Plan was written, the task force recommendations had been approved by the Secretary of Cal EMA and forwarded to the Governor.

San Joaquin County has developed flood contingency maps and urban evacuation maps as part of its coordinated flood emergency planning efforts. These maps and plans could be used as an example by other Delta counties, and State and federal agencies to prepare a Delta-wide emergency response plan.

Liability Concerns

USACE and other federal agencies are generally afforded some immunity from liability for damages from flood events under the concept of sovereign immunity and provisions of the Flood Control Act of 1928 (33 United States Code section 702c). Congress provided immunity to federal agencies for some but not all tort damages. However, this immunity does not apply to nonfederal agencies.

As the risks of levee failure and corresponding damage increase, California's courts have generally exposed public agencies, and the State specifically, to significant financial liability for flood damages (DWR 2005). The most notable recent court decision on flood liability was the California Court of Appeal decision in *Paterno v. State of California* (2003) (113 Cal. App. 4th 998). The court found the State was liable for damages caused by the failure of a project levee on the Yuba River that the State did not design, build, or even directly maintain. This decision makes it possible that the State will ultimately be held responsible for the structural integrity of much of the federal flood control system in the Delta and Central Valley. The *Paterno v. State of California* decision will ultimately cost State taxpayers approximately $464 million in awarded damages.

In *Arreola v. County of Monterey* (2002) (99 Cal. App. 4th 722), the court held local agencies and the California Department of Transportation (Caltrans) liable for 1995 flood damages to property owners that resulted from a failure to properly maintain levees of the Pajaro River project.

The California *Draft FloodSAFE Strategic Plan* states, "Local communities are responsible for land use decisions, but generally have not been found liable for failure of the flood protection system. Continued local actions to approve development within floodplains may increase flood risk, even if levees and other flood protection improvements are made. This creates liability issues which the State is concerned about. Legislation passed in 2007 addresses the need to connect land use planning with diligent and factual consideration of flood risks for areas of proposed development" (DWR 2008a).

In 2007, the Legislature amended the Water Code to address local community liability for approving development in floodprone areas. It provides that "a city or county may be required to contribute its fair and reasonable share of the property damage caused by a flood to the extent that the city or county has increased the state's exposure to liability for property damage by unreasonably approving new development in a previously undeveloped area that is protected by a state flood control project" (Water Code sections 8307(a) and (b)).

Ultimately, however, it is important to note that the State does not own, operate, control, or maintain nonproject levees, and does not have authority to do so. The Delta levee subventions program grants financial assistance to local reclamation districts for their levees. The State conducts evaluations to make sure subventions program funds have been spent appropriately, but not to ensure the quality of the work or the stability or structural integrity of nonproject levees. Rather, the nonproject levees are the sole responsibility of the reclamation districts, and the State is not liable for damages caused by their failure.

POLICIES AND RECOMMENDATIONS

These policies and recommendations are based on the Council's core strategies for reducing flood risks in the Delta, which are:

- Improve emergency preparedness and response
- Finance and implement flood management activities
- Prioritize flood management investment
- Improve residential flood protection
- Protect and expand floodways, floodplains, and bypasses
- Integrate Delta levees and ecosystem function
- Limit liability

Reducing flood risks also relies on locating urban development in the Delta's cities where levees are stronger, as discussed in Chapter 5, and retaining rural lands for agriculture, so that development in the most floodprone areas is minimized.

Improve Emergency Preparedness and Response

To effectively and reliably reduce risks to people, property, and State interests in the Delta, a multifaceted strategy of coordinated emergency preparedness, appropriate land use planning, and prioritized investment in flood protection infrastructure is necessary (Water Code sections 85305(a) and 85306). Federal, State, and local governments—and Californians—must be prepared for a variety of emergency situations.

The recommendations prepared by the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force will likely play an important role in planning efforts for the Delta, and will be considered by the Council for incorporation in future updates of the Delta Plan.

Problem Statement

Levee failures and flooding can and will place human life and property in danger, and can have potentially significant implications for the State's water supply and infrastructure, and the health of the Delta ecosystem. Appropriate emergency preparedness and response planning and implementation activities need to be initiated.

Policies

No policies with regulatory effect are included in this section.

Recommendations

RR R1. Implement Emergency Preparedness and Response

The following actions should be taken by January 1, 2014, to promote effective emergency preparedness and response in the Delta:

- *Responsible local, State, and federal agencies with emergency response authority should consider and implement the recommendations of the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force (Water Code section 12994.5). Such actions should support the development of a regional response system for the Delta.*
- *In consultation with local agencies, the California Department of Water Resources should expand its emergency stockpiles to make them regional in nature and usable by a larger number of agencies in accordance with California Department of Water Resources' plans and procedures. The California Department of Water Resources, as a part of this plan, should evaluate the potential of creating stored material sites by "over-reinforcing" west Delta levees.*
- *Local levee-maintaining agencies should consider developing their own emergency action plans, and stockpiling rock and flood-fighting materials.*
- *State and local agencies, and regulated utilities that own and/or operate infrastructure in the Delta should prepare coordinated emergency response plans to protect the infrastructure from long-term outages resulting from failures of the Delta levees. The emergency procedures should consider methods that also would protect Delta land use and ecosystem.*

Finance and Implement Local Flood Management Activities

The responsibility for securing funding for Delta levee maintenance, repairs, and improvements lies with the numerous local levee-maintaining agencies (primarily reclamation districts). Funding is generated through property assessments of local landowners and also is provided by the State under programs administered by DWR (the Delta Levees Special Flood Control Projects and Delta Levees Maintenance Subventions programs). These programs provide State matching funds for addressing Delta flood risk; however, many other entities that benefit from flood risk management are not assessed, nor do they contribute to maintenance and upkeep of Delta levees, including owners of regional infrastructure that crosses the Delta. The duty of providing for Delta flood risk management should be borne by all entities benefitting from these actions, and an equitable methodology of defining and apportioning assessments should be developed and implemented.

Local levee-maintaining agencies have managed the financing and ongoing maintenance, rehabilitation, and repair of Delta levees, and have improved the levels of levee integrity, reducing overall Delta flood risk. Although financial assistance has been provided by the State over several decades, these programs have most recently been funded exclusively through State general obligation bond financing, which faces an uncertain future. The development of an alternative funding mechanism and authority would provide for a more stable, long-term funding approach in which local participation by all beneficiaries of flood risk management is more broadly incorporated. Propositions 218 (1996) and 26 (2010) raised the approval thresholds for new fees and taxes; these thresholds may make it more difficult for a proposed regional assessment district to gain revenue authority.

The establishment of a regional flood risk management district with fee assessment authority could address a variety of Delta flood risk-related activities, including levee maintenance and improvements; regional flood management planning; flood facilities inspections; data collection; risk notification; and emergency preparedness planning, response, and mitigation. Establishing a more centralized and responsive entity could provide a mechanism for addressing issues at the individual district level and for the Delta region overall for the long term.

Problem Statement

No mechanism exists for ensuring that costs of levee maintenance are borne by all beneficiaries. Current financing of levee operations and maintenance is not well coordinated, and future funding sources are uncertain. Financing of local levee operations, maintenance, emergency preparedness and response, and related data collection and reporting efforts would benefit from greater coordination and integration.

Policies

No policies with regulatory effect are included in this section.

Recommendations

RR R2. Finance Local Flood Management Activities

The Legislature should create a Delta Flood Risk Management Assessment District with fee assessment authority (including over State infrastructure) to provide adequate flood control protection and emergency response for the regional benefit of all beneficiaries, including landowners, infrastructure owners, and other entities that benefit from the maintenance and improvement of Delta levees, such as water users who rely on the levees to protect water quality.

This district should be authorized to:

- *Identify and assess all beneficiaries of Delta flood protection facilities.*
- *Develop, fund, and implement a regional plan of flood management for both project and nonproject levees of the Delta, including the maintenance and improvement of levees, in cooperation with the existing reclamation districts, cities, counties, and owners of infrastructure and other interests protected by the levees.*
- *Require local levee-maintaining agencies to conduct annual levee inspections per the California Department of Water Resources subventions program guidelines, and update levee improvement plans every 5 years.*
- *Participate in the collection of data and information necessary for the prioritization of State investments in Delta levees consistent with RR P1.*
- *Notify residents and landowners of flood risk, personal safety information, and available systems for obtaining emergency information before and during a disaster on an annual basis.*
- *Potentially implement the recommendations of the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force (Water Code section 12994.5) in conjunction with local, State, and federal agencies, and maintain the resulting regional response system and components and procedures on behalf of SEMS jurisdictions (reclamation district, city, county, and State) that would jointly implement the regional system in response to a disaster event.*
- *Identify and assess critical water supply corridor levee operations, maintenance, and improvements.*

RR R3. Fund Actions to Protect Infrastructure from Flooding and Other Natural Disasters

- *The California Public Utilities Commission should immediately commence formal hearings to impose a reasonable fee for flood and disaster prevention on regulated privately owned utilities with facilities located in the Delta. Publicly owned utilities should also be encouraged to develop similar fees. The California Public Utilities Commission, in consultation with the Delta Stewardship Council, the California Department of Water Resources, and the Delta Protection Commission, should allocate these funds among State and local emergency response and flood protection entities in the Delta. If a new regional flood management agency is established by law, a portion of the local share would be allocated to that agency.*
- *The California Public Utilities Commission should direct all regulated public utilities in their jurisdiction to immediately take steps to protect their facilities in the Delta from the consequences of a catastrophic failure of levees in the Delta, to minimize the impact on the State's economy.*
- *The Governor, by Executive Order, should direct State agencies with projects or infrastructure in the Delta to set aside a reasonable amount of funding to pay for flood protection and disaster prevention. The local share of these funds should be allocated as described above.*

Prioritize Flood Management Investment

A method is needed for prioritizing State funds for use in operating, maintaining, and improving Delta levees with a systemwide approach. Although the State has expended millions of dollars since the early 1970s on Delta levees, almost half of the Delta's acreage is not protected by levees that meet the HMP guidance today. Efforts by landowners, reclamation districts, and other parties using local resources to perform levee upgrades, beyond the standards that may be funded by the State, are encouraged and would be consistent with the goal of reducing Delta flood risk. The Delta Reform Act provides that activities of the Council in determining priorities for State investments in Delta levees do not increase the State's liability for flood protection in the Delta or its watershed.

Problem Statement

The Delta Reform Act (Water Code section 85306) requires the Delta Plan to recommend priorities for State investments in Delta levees, including project and nonproject levees. Currently, no comprehensive method exists to prioritize State investments in Delta levee operations, maintenance, and improvement projects. Without a prioritization methodology, the apportionment of public resources into levees may not occur in a manner that reflects a broader, long-term approach.

Policies

RR P1. Prioritization of State Investments in Delta Levees and Risk Reduction

(a) Prior to the completion and adoption of the updated priorities developed pursuant to Water Code section 85306, the interim priorities listed below shall, where applicable and to the extent permitted by law, guide discretionary State investments in Delta flood risk management. Key priorities for interim funding include emergency preparedness, response, and recovery as described in paragraph (1), as well as Delta levees funding as described in paragraph (2).

(1) Delta Emergency Preparedness, Response, and Recovery: Develop and implement appropriate emergency preparedness, response, and recovery strategies, including those developed by the Delta Multi-Hazard Task Force pursuant to Water Code section 12994.5.

(2) Delta Levees Funding: The priorities shown in the following table are meant to guide budget and funding allocation strategies for levee improvements. The goals for funding priorities are all important, and it is expected that over time, the California Department of Water Resources must balance achievement of those goals. Except on islands planned for ecosystem restoration, improvement of nonproject Delta levees to the Hazard Mitigation Plan (HMP) standard may be funded without justification of the benefits. Improvements to a standard above HMP, such as that set by the U.S. Army Corps of Engineers under Public Law 84-99, may be funded as befits the benefits to be provided, consistent with the California Department of Water Resources' current practices and any future adopted investment strategy.

Priorities for State Investment in Delta Integrated Flood Management Categories of Benefit Analysis

Goals	Localized Flood Protection	Levee Network	Ecosystem Conservation
1	Protect existing urban and adjacent urbanizing areas by providing 200-year flood protection.	Protect water quality and water supply conveyance in the Delta, especially levees that protect freshwater aqueducts and the primary channels that carry fresh water through the Delta.	Protect existing and provide for a net increase in channel-margin habitat.
2	Protect small communities and critical infrastructure of statewide importance (located outside of urban areas).	Protect floodwater conveyance in and through the Delta to a level consistent with the State Plan of Flood Control for project levees.	Protect existing and provide for net enhancement of floodplain habitat.
3	Protect agriculture and local working landscapes.	Protect cultural, historic, aesthetic, and recreational resources (Delta as Place).	Protect existing and provide for net enhancement of wetlands.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that involves discretionary State investments in Delta flood risk management, including levee operations, maintenance, and improvements. Nothing in this policy establishes or otherwise changes existing levee standards.

23 CCR Section 5012
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85300, 85305, and 85306, Water Code.

Recommendations

RR R4. Actions for the Prioritization of State Investments in Delta Levees

The Delta Stewardship Council, in consultation with the California Department of Water Resources, the Central Valley Flood Protection Board, the Delta Protection Commission, local agencies, and the California Water Commission, should develop funding priorities for State investments in Delta levees by January 1, 2015. These priorities shall be consistent with the provisions of the Delta Reform Act in promoting effective, prioritized strategic State investments in levee operations, maintenance, and improvements in the Delta for both levees that are a part of the State Plan of Flood Control and nonproject levees. Upon completion, these priorities shall be considered for incorporation into the Delta Plan.

The priorities should identify guiding principles, constraints, recommended cost share allocations, and strategic considerations to guide Delta flood risk reduction investments, supported by, at a minimum, the following actions to be conducted by the California Department of Water Resources, consistent with available funding:

- *An assessment of existing Delta levee conditions. This should include the development of a Delta levee conditions map based on sound data inputs, including, but not limited to:*
  - *Geometric levee assessment*
  - *Flow and updated stage-frequency analysis*
- *An island-by-island economics-based risk analysis. This analysis should consider, but not be limited to, values related to protecting:*
  - *Island residents/life safety*
  - *Property*
  - *Value of Delta islands' economic output, including agriculture*
  - *State water supply*
  - *Critical local, State, federal, and private infrastructure, including aqueducts, state highways, electricity transmission lines, gas/petroleum pipelines, gas fields, railroads, and deep water shipping channels*
  - *Delta water quality*
  - *Existing ecosystem values and ecosystem restoration opportunities*
  - *Recreation*
  - *Systemwide integrity*
- *An ongoing assessment of Delta levee conditions. This should include a process for updating Delta levee assessment information on a routine basis.*

This methodology should provide the basis for the prioritization of State investments in Delta levees. It should include, but not be limited to, the public reporting of the following items:

- *Tiered ranking of Delta islands, based on economics-based risk analysis values*
- *Delta levee conditions status report, including a levee conditions map*
- *Inventory of Delta infrastructure assets*

Improve Residential Flood Protection

To reduce the risk to lives, property, and State interests in the Delta, additional standards are needed to address new residential development. Sea level rise, subsidence, and new residential development combine to potentially put many more lives at risk. The policies in this section are designed to reduce risk while preserving the Delta's unique character and agricultural way of life. These policies should be construed as those required to provide the minimum level of flood protection, and should not be viewed as encouraging development in floodprone Delta areas. Flood insurance, and awareness of local emergency preparedness and response policies is strongly encouraged for all who live in floodprone areas of the Delta.

Consistent with existing law, urban development in the Primary Zone should remain prohibited. Urban development in the Secondary Zone should be confined to existing urban spheres of influence where the 200-year design standard will be fully implemented by 2025. The 2007 flood risk management legislation (SB 5) contained provisions affecting city and county responsibilities relating to local planning requirements, such as general plans, development agreements, zoning ordinances, tentative maps, and other actions (Government Code sections 65865.5, 65962, and 66474.5). Future land use decisions should not permit or encourage construction of significant numbers of new residences in the nonurban Delta. For the legacy communities in the Delta, structures developed in these areas are required to meet the legal standard of a 100-year minimum level of flood protection. However, developing and maintaining adequate flood protection remains difficult.

Problem Statement

Continued residential development without adequate flood protection increases risk to lives, property, and State interests in the Delta. Flood risks are expected to grow in light of anticipated climate change effects related to peak flows and sea level rise.

Policies

The appendices referred to in the policy language below are included in Appendix B of the Delta Plan.

RR P2. Require Flood Protection for Residential Development in Rural Areas

(a) New residential development of five or more parcels shall be protected through floodproofing to a level 12 inches above the 100-year base flood elevation, plus sufficient additional elevation to protect against a 55-inch rise in sea level at the Golden Gate, unless the development is located within:

(1) Areas that city or county general plans, as of May 16, 2013, designate for development in cities or their spheres of influence;

(2) Areas within Contra Costa County's 2006 voter-approved urban limit line, except Bethel Island;

(3) Areas within the Mountain House General Plan Community Boundary in San Joaquin County; or

(4) The unincorporated Delta towns of Clarksburg, Courtland, Hood, Locke, Ryde, and Walnut Grove, as shown in Appendix 7.

(b) For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that involves new residential development of five or more parcels that is not located within the areas described in subsection (a).

23 CCR Section 5013
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85300, 85305, and 85306, Water Code.

Protect and Expand Floodways, Floodplains, and Bypasses

Local land use policies guiding development in floodways are not consistent across Delta counties. Floodways have not been established for many of the channels in the Delta by FEMA or by the CVFPB. In light of these inconsistencies, the Delta Plan addresses these issues and highlights the need for the protection of floodplains and floodways consistent with improved flood protection. Over the next 100 years, Delta floodways may expand and deepen because of sea level rise and changing precipitation patterns. Development in existing or potential future designated floodplain or bypass locations in the Delta or upstream of the Delta can permanently eliminate the availability of these areas for future floodplain usage. It is important to identify floodplain areas now for immediate protection and eventual integration into the flood protection system.

Problem Statement

The carrying capacity of the existing flood control system is diminished by encroachments into floodways, critical floodplains, and existing floodplain or bypass locations in the Delta. Local land use policies guiding development in floodways are not consistent across Delta counties. The existing system is already at suboptimal capacity. Expected changes in sea level rise and runoff patterns due to climate change are expected to exacerbate the problem.

Policies

RR P3. Protect Floodways

(a) *No encroachment shall be allowed or constructed in a floodway, unless it can be demonstrated by appropriate analysis that the encroachment will not unduly impede the free flow of water in the floodway or jeopardize public safety.*

(b) *For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that would encroach in a floodway that is not either a designated floodway or regulated stream.*

23 CCR Section 5014
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85300, 85302, and 85305, Water Code.

RR P4. Floodplain Protection

(a) *No encroachment shall be allowed or constructed in any of the following floodplains unless it can be demonstrated by appropriate analysis that the encroachment will not have a significant adverse impact on floodplain values and functions:*

(1) *The Yolo Bypass within the Delta;*

(2) *The Cosumnes River-Mokelumne River Confluence, as defined by the North Delta Flood Control and Ecosystem Restoration Project (McCormack-Williamson), or as modified in the future by the California Department of Water Resources or the U.S. Army Corps of Engineers (California Department of Water Resources 2010); and*

(3) *The Lower San Joaquin River Floodplain Bypass area, located on the Lower San Joaquin River upstream of Stockton immediately southwest of Paradise Cut on lands both upstream and downstream of the Interstate 5 crossing. This area is described in the Lower San Joaquin River Floodplain Bypass Proposal, submitted to the California Department of Water Resources by the partnership of the South Delta Water Agency, the River Islands Development Company, Reclamation District 2062, San Joaquin Resource Conservation District, American Rivers, the American Lands Conservancy, and the Natural Resources Defense Council, March 2011. This area may be modified in the future through the completion of this project.*

(b) *For purposes of Water Code section 85057.5(a)(3) and section 5001(j)(1)(E) of this Chapter, this policy covers a proposed action that would encroach in any of the floodplain areas described in subsection (a).*

(c) *This policy is not intended to exempt any activities in any of the areas described in subsection (a) from applicable regulations and requirements of the Central Valley Flood Protection Board.*

23 CCR Section 5015
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85020, 85300, 85302, and 85305, Water Code.

Recommendations

RR R5. Fund and Implement San Joaquin River Flood Bypass

The Legislature should fund the California Department of Water Resources and the Central Valley Flood Protection Board to evaluate and implement a bypass and floodway on the San Joaquin River near Paradise Cut that would reduce flood stage on the mainstem San Joaquin River adjacent to the urban and urbanizing communities of Stockton, Lathrop, and Manteca in accordance with Water Code section 9613(c).

RR R6. Continue Delta Dredging Studies

The current efforts to maintain navigable waters in the Sacramento River Deep Water Ship Channel and Stockton Deep Water Ship Channel, led by the U.S. Army Corps of Engineers and described in the Delta Dredged Sediment Long-Term Management Strategy (USACE 2007, Appendix K), should be continued in a manner that supports the Delta Plan and the coequal goals. Appropriate dredging throughout other areas in the Delta for maintenance purposes, or that would increase flood conveyance and provide potential material for levee maintenance or subsidence reversal should be implemented in a manner that supports the Delta Plan and coequal goals. Coordinated use of dredged material in levee improvement, subsidence reversal, or wetland restoration is encouraged.

RR R7. Designate Additional Floodways

The Central Valley Flood Protection Board should evaluate whether additional areas both within and upstream of the Delta should be designated as floodways. These efforts should consider the anticipated effects of climate change in its evaluation of these areas.

Integrate Delta Levees and Ecosystem Function

Setback levees can provide additional levee system stability, more complex land-water interface structure, and shaded riverine aquatic habitat that benefit ecosystem function in appropriate settings. They can also provide flood control benefits in those areas of the Delta not subject to strong tidal influences where channel capacity improvements can actually increase flood-carrying capacity. Not all locations are amenable or useful for setback levee placement. Each site should be investigated for its potential to provide ecological benefits consistent with levee integrity.

Problem Statement

Criteria for the development and implementation of setback levees in the Delta have not yet been developed by relevant agencies. These criteria are needed to provide appropriate guidance when considering setback levee siting and design. Currently, agencies have no consistent method for determining the appropriateness of setback levee incorporation as they relate to habitat enhancement and flood control benefit.

Policies

No policies with regulatory effect are included in this section.

Recommendations

RR R8. Develop Setback Levee Criteria

The California Department of Water Resources, in conjunction with the Central Valley Flood Protection Board, the California Department of Fish and Game, and the Delta Conservancy, should develop criteria to define locations for future setback levees in the Delta and Delta watershed.

Limit State Liability

The Delta Reform Act requires that the Delta Plan attempt to reduce risks to people, property, and State interests in the Delta by, among other things, recommending priorities for State investments in levee operation, maintenance, and improvements in the Delta, including project and nonproject levees (Water Code sections 85305, 85306, and 85307). The law expressly states that these provisions do not affect the liability of the State for flood protection in the Delta or its watershed (Water Code section 85032(j)). Consequently, no action taken by a State agency as required or recommended by, or otherwise in furtherance of, this Delta Plan shall affect State flood protection liability in the Delta or its watershed. Therefore, the Legislature should consider requiring an adequate level of flood insurance for residences, businesses, and industries in floodprone areas.

Problem Statement

As the risks of levee failure and corresponding damage increase, California courts have generally exposed public agencies and the State, specifically, to significant financial liability for flood damages. DWR's 2005 white paper recommends one way that the State should reduce its liability is to require houses and businesses to have flood insurance (DWR 2005).

Policies

No policies with regulatory effect are included in this section.

Recommendations

RR R9. Require Flood Insurance

The Legislature should require an adequate level of flood insurance for residences, businesses, and industries in floodprone areas.

RR R10. Limit State Liability

The Legislature should consider statutory and/or constitutional changes that would address the State's potential flood liability, including giving State agencies the same level of immunity with regard to flood liability as federal agencies have under federal law.

Timeline for Implementing Policies and Recommendations

Figure 7-8 lays out a timeline for implementing the policies and recommendations described in the previous section. The timeline emphasizes near-term and intermediate-term actions.

Timeline for Implementing Policies and Recommendations

TIMELINE **CHAPTER 7: Risk Reduction**

	ACTION (REFERENCE #)	LEAD AGENCY(IES)	NEAR TERM 2012–2017	INTERMEDIATE TERM 2017–2025
POLICIES	Prioritization of State investments in Delta levees and risk reduction (RR P1)	Council, DWR, CVFPB	●	
	Require flood protection for residential development in rural areas (RR P2)	Local agencies	●	●
	Protect floodways (RR P3)	CVFPB	●	●
	Floodplain protection (RR P4)	CVFPB	●	●
RECOMMENDATIONS	Implement emergency preparedness and response (RR R1)	Local, State, and federal agencies	●	
	Finance local flood management activities (RR R2)	Legislature, DPC	●	
	Fund actions to protect infrastructure from flooding and other natural disasters (RR R3)	PUC	●	
	Actions for the prioritization of State investments in Delta levees (RR R4)	Council, DWR, CVFPB	●	
	Fund and implement San Joaquin River Flood Bypass (RR R5)	Legislature, DWR, CVFPB	●	
	Continue Delta dredging studies (RR R6)	USACE	●	●
	Designate additional floodways (RR R7)	CVFPB	●	
	Develop setback levee criteria (RR R8)	DWR	●	
	Require flood insurance (RR R9)	Legislature	●	
	Limit State liability (RR R10)	Legislature	●	

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Agency Key:

Council: Delta Stewardship Council
CVFPB: Central Valley Flood Protection Board
DPC: Delta Protection Commission
DWR: California Department of Water Resources
PUC: California Public Utilities Commission
USACE: U.S. Army Corps of Engineers

Figure 7-8

Issues for Future Evaluation and Coordination

The following list of issues should be considered in future updates of the Delta Plan. These and other issues will need to be considered as additional information and materials become available. The various activities called for in this Delta Plan, as well as issues that arise from other planning efforts, such as the Central Valley Flood Protection Plan, will be considered. Additional areas of interest and concern related to flood risk in the Delta may deserve consideration in the development of future Delta Plan updates, including:

- **Reoperation of Upstream Reservoirs and Peak Flow Attenuation:** Reservoir operations upstream of the Delta can have substantial impacts on flood flows through the Delta; therefore, operation procedures among government agencies should be well coordinated and, where possible, focused more on flexibility to prevent flooding in the Delta. Water Code section 85309 directs DWR to develop a proposal to coordinate flood and water supply operations with appropriate State and federal agencies, and this shall be considered by the Council for future inclusion in the Delta Plan.
- **Utility Corridor Consolidation:** An attempt to consolidate infrastructure into "utility corridors" as facilities are added and upgraded over time should be further investigated to determine whether this can allow for better management of flood risk consequences to these critical assets.
- **State Highways and Sea Level Rise:** The Council will consult with Caltrans regarding the potential effects of climate change and sea level rise on the three state highways that cross the Delta (Water Code section 85307 (c)).

Science and Information Needs

The Delta system and its influencing factors are not static; therefore, research is needed to better understand dynamic issues such as climate change, seismicity, sea level rise, subsidence, and other areas. Continuing investigations into the science, engineering, and economic aspects of the Delta are critical to adaptively managing for expected and unexpected changes, and can provide decision makers and stakeholders with key information for future planning and decision making. Specifically, additional information will be needed in the following areas:

- The interaction between Delta levees and ecosystem function
- Sea level rise: impacts on, and incorporation into, flood risk reduction standards
- Climate change: effects of altered hydrology on levee system integrity
- Effects of seismicity on levee integrity
- Updated flood stage-probability functions
- Potential for subsidence reversal and carbon sequestration from growing native marsh plants
- Understanding the impacts on Delta flood management from upstream flood management infrastructure operations, including reservoir operations
- Technologies for assessing levee integrity

Efforts to address these needs and others that arise during Delta Plan implementation should be undertaken in a systematic fashion so that information developed and lessons learned can be incorporated into future Delta Plan updates.

Performance Measures

Development of informative and meaningful performance measures is a challenging task that will continue after the adoption of the Delta Plan. Performance measures need to be designed to capture important trends and to address whether specific actions are producing expected results. Efforts to develop and track performance measures in complex and large-scale systems like the Delta are commonly multiyear endeavors. The recommended output and outcome performance measures listed below are provided as examples and subject to refinement as time and resources allow. Final administrative performance measures are listed in Appendix E and will be tracked as soon as the Delta Plan is completed.

Output Performance Measures

- New residential development takes into account sea level rise in flood protection planning and development. (RR P2)
- Delta land acreage and the number of reclamation districts with levees below HMP are reduced. (RR P1)
- Freshwater aqueducts passing through the Delta and the primary freshwater channel pathways through the Delta are protected by levees that provide adequate protection against floods and other risks of failure. (RR P1)
- Responsible local, State, and federal agencies with emergency response authority implement the recommendations of the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force (Water Code section 12994.5). (RR R1)
- DWR and the CVFPB construct a bypass and floodway on the San Joaquin River near Paradise Cut. (RR R5)

Outcome Performance Measures

- No lives are lost in the Delta as a result of flood emergencies, and economic damages associated with Delta flood emergencies decrease. (RR R1)
- Emergency response and recovery costs are eligible for FEMA reimbursement. (RR P1)
- Water deliveries to East Bay Municipal Utilities District, Contra Costa Water District, the CVP, and the SWP are not interrupted by floods or earthquakes. (RR P1)

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CHAPTER 8

Funding Principles to Support the Coequal Goals

ABOUT THIS CHAPTER

This chapter provides background information on federal, State of California (State), and local spending for water supply, water quality, flood management, and Delta ecosystem purposes. It proposes the development of a comprehensive finance plan to implement the Delta Plan. It also sets forth guiding principles for the development of a finance plan and proposes near-term funding for support of the Delta Protection Commission, Sacramento-San Joaquin Delta Conservancy, and the Delta Stewardship Council (Council).

A 5-year budget is included in Appendix M. And, as described in Chapter 2, successful implementation of the Delta Plan will depend upon many independent agency authorities and actions under the coordination and leadership of the Council.

CHAPTER 8

Funding Principles to Support the Coequal Goals

In establishing the coequal goals, the Delta Reform Act affirmatively reset spending priorities for the Delta ecosystem and water management. Inherent in the coequal goals is a new governance structure (primarily the Council), which the Legislature intended to have the "authority, responsibility, accountability, scientific support, and adequate *and secure funding to achieve these objectives*." The Council was directed to develop a long-term, legally enforceable management plan for the Delta, and in implementing the Delta Plan, to "direct actions across State agencies," in part through the establishment of an Interagency Implementation Committee. Additionally, as addressed in the preceding Delta Plan chapters, the Delta Reform Act set forth a number of policy objectives and other requirements for how the Delta Plan must be developed and what it must contain, ranging from broad guidance on types of projects the Plan should promote, to specific performance measures for evaluating progress on ecosystem restoration. Accordingly, the Council set forth several priority recommendations and regulatory policies, which together make up this Delta Plan.

The Delta Reform Act does not require the development of a financing plan for the implementation of the Delta Plan; however, given the current economic climate, recent uneven funding for water and ecosystem investment, and the critical nature of what is at stake should the coequal goals fail to be achieved, the Council affirmed the need for a financing plan and is committed to its development.

As the Public Policy Institute of California succinctly stated in its 2011 report on water management in California, "Although money alone is not sufficient for successful water management, it is necessary" (Public Policy Institute of California 2011). In introducing any discussion on financing, particularly in the public sector, it is necessary to acknowledge the political and economic context. America is currently suffering a severe recession, and California's economy has fared even worse. The State has experienced a multiyear budget crisis in which annual spending exceeds available revenue. As a result, financing infrastructure and new programs has become immensely challenging for State and local governments.

Today's economic conditions may limit the ability to adequately finance a full range of water and ecosystem improvements necessary to achieve the coequal goals in the near term. However, the planning timeframe for the Delta Plan runs to the year 2100, and decisions on long-term, sustainable financing for water, ecosystem, and flood protection cannot be delayed much longer without grave and expensive consequences. A long planning horizon allows near-term foundational steps to be taken now toward improving the situation and for implementing agencies to stage actions, policies, and projects over time consistent with an adaptive management structure based on science. Additionally, some activities to implement the Delta Plan are currently funded or can be undertaken with no additional cost, and many of the actions called for in the Delta Plan are certain to result in significant long-term cost savings.

Because of the complex nature of the policy issues and of certain funding and finance methods, a comprehensive and supportable Delta Plan finance plan will take time to develop. Thorough research is needed to identify entities that may be assessed user or stressor fees, determine appropriate levels for these fees, establish tiered fee structures, calculate the public benefits, and work through the legal implications of any financing strategy, including the practical effects of Propositions 218 and 26 on State and local financing mechanisms.

Background

Since the CALFED Bay-Delta Program was instituted in 1995 to restore ecological health and improve water management in the Delta, significant expenditures have been made in the Delta. An estimated $400 million has been spent annually, on average, by federal, State, and local water users.

Traditionally, the State has financed water infrastructure with general obligation bonds. These bonds were approved by the voters, and repayment is guaranteed by the State's general taxing power. With respect to State Water Project (SWP) debt, however, even though repayment was secured by taxes, general obligation bonds were paid back primarily by the water contractors. Since 2000, California voters have authorized $19.4 billion in water-related general obligation bonds spread over six separate bonds (LAO 2008). Several of these bonds authorize expenditures for a multitude of purposes, including assorted water projects, parkland acquisition, habitat restoration, and local assistance grants. One benefit of financing water projects with general obligation bonds is that any expenditure made for a public purpose is repaid by taxpayers, the primary beneficiaries. Currently, remaining fund balances for active bond accounts total approximately $2.2 billion out of the authorized total of $19.4 billion, only a portion of which is for Delta-related spending.

Table 8-1 summarizes the current balances for general obligation bonds by individual bond act related to water, ecosystem restoration, and flood protection. It is important to note that these remaining balances are not fungible; that is, statute generally dictates the specific types of projects or programs on which funds can be spent.

Currently scheduled for the November 2014 ballot, the Safe, Clean, and Reliable Drinking Water Supply Act of 2012 would authorize, upon voter approval, the issue and sale of $11.14 billion in general obligation bonds for financing drought relief projects, water supply reliability projects, Delta sustainability projects, water system improvements, watershed and conservation protection programs, groundwater protection and water quality projects, and water recycling projects. Key Delta projects include $2.25 billion for protection of water supplies from catastrophic levee failure, drinking water quality improvements, levee and flood control facilities improvements, lost property tax replacement, ecosystem restoration, and contaminants reduction.

General Obligation Bonds – California (as of January 2013)

TABLE 8-1

Bond Act (Year)	Authorized ($ Thousands)	Committed ($ Thousands)	Balance ($ Thousands)
Proposition 12 (2000)	2,024,486	6,189	18,456
Proposition 13 (2000)	2,103,000	1,823,874	279,126
Proposition 40 (2002)	2,471,600	16,556	26,536
Proposition 50 (2002)	3,382,630	0	0
Proposition 1E (2006)	4,090,000	4,024,354	65,646
Proposition 84 (2006)	5,388,000	5,080,840	307,160
Total	**$19,378,411**	**$17,221,349**	**$2,157,062**

Although general obligation bonds have been an important part of how California has funded water and ecosystem projects in the past, because of the uncertainty regarding voter approval of future bonds, a more sustainable and long-term financing approach for water, ecosystem, flood protection, and related projects is needed. As new revenue sources are developed, the use of revenue bonds may become more prevalent. For example, the SWP routinely sells and redeems revenue bonds to pay the costs of planning and construction, bond interest, and project operating expenses, as do many local agencies.

Federal-level expenditures in California in recent years have declined as grant programs for wastewater treatment in the late 1970s and 1980s expired, and flood control spending was reduced. It is likely that large federal budget deficits for the foreseeable future will preclude any increases in federal funds for California water projects.

Although State-level expenditures for water-related programs and projects in recent years have been almost entirely funded with general obligation bonds, this contrasts somewhat with the financing methods available to local agencies. Although many of these agencies have at times issued general obligation bonds and revenue bonds, it is more common for them to establish stable income streams by charging dedicated fees to ratepayers to pay the costs of infrastructure projects including water treatment and wastewater systems.

The ability of local agencies to fund flood control and stormwater projects, however, is specifically governed by the provisions of Proposition 218, approved by California voters in 1996. Under Proposition 218, direct voter approval by a majority of property owners or a two-thirds vote of the general public is required to raise funds for these purposes. Results of local Proposition 218 elections in recent years have been mixed, with some agencies gaining voter approval and others falling short of funding needed for local projects. For example, Sacramento voters successfully approved new assessments for flood control projects in 2007, but 1 year later, voters in Orinda (East Bay Area) and Burlingame (Bay Area) failed to approve new assessments for the same purpose (Public Policy Institute of California 2011).

A companion measure, Proposition 26, approved by voters in 2010, effectively raised voting requirements for most State and local regulatory fees from a simple majority to a two-thirds majority. Regulatory fees with a broad public purpose are considered taxes and are subject to a two-thirds vote of the Legislature. Local agencies are also required to seek a two-thirds vote of the general public.

The best available information shows that total annual federal, State, and local spending on water and wastewater treatment in California is approximately $24 billion (see Table 8-2). Operations, maintenance, and capital expenditures for water infrastructure consume significant economic resources in California. This total likely includes some overlap, but the expenditures are significant. Other sources cite higher expenditures for some of these categories. During development of the finance plan, this table will be updated to reflect the most recent data.

Bay Delta Conservation Plan

Described in various sections of this Delta Plan, the Bay Delta Conservation Plan (BDCP) is a massive water and ecosystem public works planning process under way in the Delta. The Council supports the completion of the BDCP according to the provisions set forth in the Delta Reform Act. The scope or type of any water facility improvements, related Delta ecosystem mitigation, and other habitat improvements to be included is very preliminary at this time. The BDCP's ongoing planning costs are currently funded by State and federal water contractors. Currently available information from the BDCP indicates that, once it is completed, the first 5 years of implementation will require between $5.7 and $5.9 billion total for capital outlay, of which approximately $5.2 billion is for water conveyance. Additionally, the BDCP estimates that $3.6 billion total plus $46 million annually will be required for Delta ecosystem

Annual Budgets/Expenditures in California for Selected Agencies

TABLE 8-2

	Budget/Expenditures		
Agency	Operating ($ Millions)	Capital ($ Millions)	Source
Local cities, counties, and special districts water	10,100	2,000	California State Controller 2011a, 2011b, 2011c
Local cities, counties, and special districts wastewater	5,400	1,100	California State Controller 2011a, 2011b, 2011c
Local cities, counties, and special districts flood control	1,000	300	California State Controller 2011a, 2011b, 2011c
California Department of Water Resources	2,267	232	California Department of Finance 2012
State Water Resources Control Board	714		California Department of Finance 2012
California Department of Fish and Wildlife	381		California Department of Finance 2012
Bureau of Reclamation	300		Bureau of Reclamation 2008
U.S. Army Corps of Engineers	100	100	U.S. Army Corps of Engineers 2008
Total	**$20,262**	**$3,732**	

restoration (BDCP Steering Committee 2010). The BDCP will include a funding plan that will address estimated implementation costs and sources of funding that will be relied upon to cover these costs. The sidebar, Bay Delta Conservation Plan Costs and Existing Funding Sources, provides additional background information about the BDCP.

Overview of Current State and Federal Delta-related Expenditures

The CALFED Bay-Delta Program was incorporated into the Council in 2010. However, some program elements endure because bond funds are dedicated by law for CALFED purposes. Additionally, the CALFED program is still referenced in federal statutes. For these reasons, an annual cross-cut budget showing State and federal expenditures for active CALFED programs and projects is developed each January.

Because the cross-cut budget includes State and federal expenditure details on all the CALFED programs, those data can be summarized to show expenditures for program elements displayed in the budget. The results are shown in Table 8-3.

Annual State and Federal Expenditures in California by Program Element (2012–2013)

TABLE 8-3

Program Element	California	Federal	Total
Governance	$21,145,596	$20,490,000	$41,635,596
Water Supply Reliability	$161,523,833	$18,774,000	$180,297,833
Ecosystem Restoration	$64,119,524	$92,275,000	$156,394,524
Water Quality	$6,368,631	$5,000,000	$11,368,631
Risk Reduction/Levee Integrity	$8,949,231	$45,560,000	$54,509,231
Total	**$262,106,815**	**$182,099,000**	**$444,205,815**

BAY DELTA CONSERVATION PLAN COSTS AND EXISTING FUNDING SOURCES

Potential future funding sources for the BDCP will likely compete with funding required for implementation of some elements of the Delta Plan, and for the plans and projects of State, federal, and local agencies. The Council does not consider any funding source to be solely available for the BDCP, or for any other program or plan. They are solely considered to be options at this stage.

Based on current information from the BDCP, the approximate costs of a facility and related ecosystem improvements needed for State and federal approval are approximately $15.8 to $16.7 billion in capital costs and an additional $4.9 to $5.6 billion in operating costs over the 50-year permit period. These costs are divided among the BDCP's four primary functions—water conveyance, habitat restoration, management of other stressors, and program oversight—as shown in the table below. The Council notes that preliminary cost estimates are just that: preliminary. Going forward, refined estimates will be required to complete this planning process.

Options for BDCP Funding

The BDCP is premised on the pledge of participating State and federal water contractors to pay the full cost of any new Delta export facility and the associated Delta ecosystem mitigation required to meet the requirements imposed on the BDCP by federal and State laws. Habitat and ecosystem restoration activities, beyond mitigation requirements, are considered to provide a general benefit to the State and should be funded accordingly.

Prior to completion of the BDCP and a full understanding of the Delta ecosystem improvements related to the BDCP, it is impossible to project the detailed funding options that might be necessary. However, it is highly likely that user fees, revenue bonds, and sources other than the State General Fund will be the primary sources of funding.

Summary of BDCP Costs and Existing Funding Sources ($ millions)

	Bay Delta Conservation Plan[a]		
Program Function	**Capital Costs**	**Operating Costs**	**Total**
Water Conveyance[b]	$12,691	$2,936	$15,627
Habitat Restoration[c]	$3,108–$4,009	$346–$437	$3,454–$4,446
Other Stressors[c]	$12–$15	$1,213–$1,679	$1,225–$1,694
Program Oversight[c]		$404–$548	$404–$548
Total	$15,811–$16,715	$4,899–$5,600	$20,710–$22,315

[a] Over 50-year permit period [b] Midpoint cost estimate [c] Range of low-high estimate given

Source: BDCP Steering Committee, 2010

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A Delta Finance Plan

The Council proposes to initiate development of a finance plan following adoption of the Delta Plan. This process will require the active participation of the Interagency Implementation Committee described in Chapter 2. Financing and funding mechanisms to be considered in developing the finance plan are included in Appendix N.

Guiding Principles

A finance plan to fund the Delta Plan should follow these principles:

- The finance plan should first consider currently available funds that can legally support expenditures for Delta-related projects. Spending priorities should be established that address near-term funding requirements as contained in this Delta Plan.
- Implementation of the Delta Plan will undoubtedly require an array of funding sources, including new funding sources and new statutory authority. Broad-based financing and diversity in funding sources will enhance revenue stability. Likewise, State and federal funds for activities that implement the Delta Plan must be reserved for public benefits not otherwise required for project mitigation or required by law for other purposes. Appendix N describes potential funding sources.
- The Delta Plan recommends many projects that have multiple benefits; this increases opportunities to blend fund sources and builds on the tradition of past investments in multipurpose water projects with diversified fund sources.
- A clear and analytically based methodology for assessing public benefits should be evaluated and implemented.
- Targeted finance plans should be developed for major Delta Plan plans and projects (ecosystem restoration, flood risk reduction, regional water supply investments, science, administration, and water conveyance). Beneficiaries and stressors should be identified in each of these areas, and user fees should be developed to match these stressors and beneficiaries with planned investments in each of these areas.
- Economic and financial analyses should be done as early as possible during the planning of large capital projects. This will assist agencies in the design of cost-effective projects and will help ensure that the projects are actually completed and implemented. Financial analyses should account for all of the costs of a project, both direct and indirect, including acquisition, planning, capital and interest, mitigation, science and monitoring, and operations and maintenance.

User Fees

- User fees, including beneficiary fees and stressor fees, are essential and should be established to support the coequal goals and the implementation of the Delta Plan.
- The "beneficiaries pay" principle is a common financing approach for water projects. The challenge is to determine the beneficiaries and design a cost-allocation method scaled to the benefit.
- A companion principle to "beneficiaries pay" is "stressors pay." Human activity that causes negative operational or environmental impacts should be assessed a fee, or otherwise charged, to repair the damage. An example of the stressors pay approach might be a surcharge on pesticides that are found to negatively impact the Delta ecosystem. Capital construction projects, whether for water reliability purposes or Delta ecosystem improvements, should be undertaken simultaneously with the development of beneficiary and user fees. Delay in establishing beneficiaries/stressors fee structures will inevitably delay any needed capital improvement projects. The development of information related to financing (such as the identification of beneficiaries and stressors, and detailed financing scenarios) should be undertaken simultaneously with the development of major capital decisions so that it can inform planning efforts.

- The finance plan should include mechanisms to ensure that user fees are legally dedicated to their intended purpose. Given State and federal budget constraints, statutory protections must be enacted to assure users that their assessments will not be diverted to other purposes.
- The finance plan should include opportunities to generate revenue when planning projects, where possible, to ensure long-term financing stability.
- To the extent possible, user fees should be based on the amount of water used or, for stressors, the volume of contaminants discharged. Tiered fee structures also should be explored where applicable.
- Long-term, stable funding approaches, such as the Delta Flood Risk Management Assessment District recommended in Chapter 7 or other beneficiary user fees, should be established to support the Delta Levees Maintenance Subventions Program, Delta Levees Special Flood Control Projects Program, and implementation of the Central Valley Flood Protection Plan.

Near-term and Annual Funding Requirements

The following items describe activities that must be addressed and funded as soon as possible. They describe the urgent need to immediately address the steps needed to achieve the coequal goals, begin implementation of the Delta Plan, and establish annual funding for key Delta agencies:

- **Urgent expenditures for water supply reliability and ecosystem protection.** Immediate steps should be taken to protect the existing Delta water export system from flood risks and carry out ecosystem improvements being implemented pursuant to existing mitigation commitments of the SWP and the Central Valley Project. Those immediate needs are discussed in the various chapters of the Delta Plan.
- **Create a regional Delta Flood Risk Management Assessment District.** The Legislature should create a regional district with the authority to assess fees on Delta levee beneficiaries, including landowners, infrastructure owners, and other entities, to fund flood control protection, including levee maintenance and improvement, and emergency response, as recommended in Chapter 7.
- **Fund a strong Delta Science Program.** Funding is needed for continued operation of the Independent Science Board, development of the proposed Delta Science Plan, the State's share of the Interagency Ecological Program, and other activities that support a strong science foundation for Delta Plan implementation. Funding for the Interagency Ecological Program should continue from participating agencies.
- **Fund urban and agricultural water management plans.**
- **Continue the existing operational duties imposed by the Delta Reform Act.** The Act created the Council (which includes the Delta Science Program and Independent Science Board) and the Sacramento-San Joaquin Delta Conservancy, and modified the duties of the Delta Protection Commission. Future estimated annual operating costs for these agencies are provided in Appendix M.
- **Fees for services.** The Legislature should grant authority to the Council to assess fees to cover the costs of providing specified services related to covered actions, specifically early consultations and reviewing appeals of consistency certifications.

POLICIES AND RECOMMENDATIONS

Administrative performance measures for the following recommendations can be found in Appendix E.

FP R1 Conduct Current Spending Inventory

An inventory of current State and federal spending on programs and projects that do or may achieve the coequal goals will be conducted. Data sources to be used include the CALFED cross-cut budget, State bond balance reports, and the annual State budget, among others. Consideration will be given to selecting an independent agency (which could include a nongovernmental organization) to conduct the inventory.

FP R2 Develop Delta Plan Cost Assessment

Costs will be assigned to the projects and programs proposed in the Delta Plan (Chapters 2 through 7), and sources of funding will be identified.

FP R3 Identify Funding Gaps

Current State and federal funding gaps will be identified that are determined to hinder progress toward meeting the coequal goals.

Timeline for Implementing Recommendations

Figure 8-1 lays out a timeline for implementing the recommendations described in the previous section.

Timeline for Implementing Recommendations

TIMELINE — **CHAPTER 8: Funding Principles to Support the Coequal Goals**

	ACTION (REFERENCE #)	LEAD AGENCY	NEAR TERM 2012–2017	INTERMEDIATE TERM 2017–2025
RECOMMENDATIONS	Conduct current spending inventory (FP R1)	Council	●	
	Develop Delta Plan cost assessment (FP R2)	Council	●	
	Identify funding gaps (FP R3)	Council	●	

Agency Key:

Council: Delta Stewardship Council

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Figure 8-1

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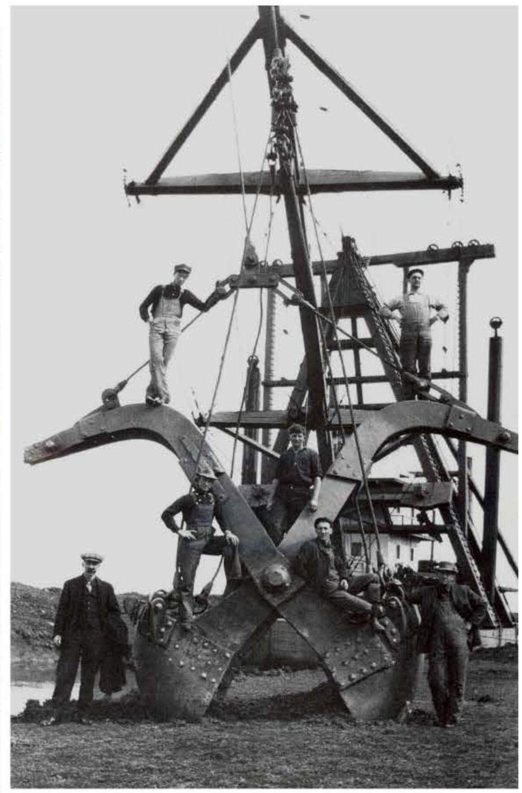
Glossary



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Glossary

The first section of this glossary provides definitions that appear in 23 California Code of Regulations section 5001. The second section provides definitions and explanations of key terms, acronyms, and abbreviations used in the Delta Plan.

Definitions in 23 California Code of Regulations Section 5001

As used in this division, the terms listed below shall have the meanings noted:

(a) "Adaptive management" means a framework and flexible decision-making process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvement in management planning and implementation of a project to achieve specified objectives.

(b) "Agricultural water management plan" means a plan prepared, adopted, and updated by an agricultural water supplier pursuant to the Agricultural Water Management Planning Act, Water Code section 10800 et seq.

(c) "Agricultural water supplier" under the Water Code refers to both agricultural retail water suppliers and agricultural wholesale water suppliers, but not the California Department of Water Resources or the United States Bureau of Reclamation, and includes both of the following:

(1) A water supplier, either publicly or privately owned, providing water to 10,000 or more irrigated acres, excluding recycled water; and

(2) A water supplier or contractor for water, regardless of the basis of the water right, that distributes or sells water for ultimate resale to customers.

(d) "Base Flood" means the flood that has a 1-percent probability of being equaled or exceeded in any given year (also referred to as the 100-year flood).

(e) "Base Flood Elevation" (BFE) means the water surface elevation associated with the base flood.

(f) "Best available science" means the best scientific information and data for informing management and policy decisions. Best available science shall be consistent with the guidelines and criteria found in Appendix 1A.

(g) "Central Valley Flood Protection Board" or "Board" means the Central Valley Flood Protection Board (formerly The Reclamation Board) of the Resources Agency of the State of California as provided in Water Code section 8521.

(h) "Coequal goals" means the two goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place. In addition, "achievement" for the purpose of determining whether a plan, program, or project meets the definition of a ''covered action'' under section 5001(j) is further defined as follows:

(1) "Achieving the coequal goal of providing a more reliable water supply for California" means all of the following:

(A) Better matching the state's demands for reasonable and beneficial uses of water to the available water supply. This will be done by promoting, improving, investing in, and implementing projects and programs that improve the resiliency of the state's water systems, increase water efficiency and conservation, increase water recycling and use of advanced water technologies, improve groundwater management, expand storage, and improve Delta conveyance and operations. The evaluation of progress toward improving reliability will take into account the inherent variability in water demands and supplies across California;

(B) Regions that use water from the Delta watershed will reduce their reliance on this water for reasonable and beneficial uses, and improve regional self-reliance, consistent with existing water rights and the State's area-of-origin statutes and Reasonable Use and Public Trust Doctrines. This will be done by improving, investing in, and implementing local and regional projects and programs that increase water conservation and efficiency, increase water recycling and use of advanced water technologies, expand storage, improve groundwater management, and enhance regional coordination of local and regional water supply development efforts; and

(C) Water exported from the Delta will more closely match water supplies available to be exported, based on water year type and consistent with the coequal goal of protecting, restoring, and enhancing the Delta ecosystem. This will be done by improving conveyance in the Delta and expanding groundwater and surface storage both north and south of the Delta to optimize diversions in wet years when more water is available and conflicts with the ecosystem are less likely, and limit diversions in dry years when conflicts with the ecosystem are more likely. Delta water that is stored in wet years will be available for water users during dry years, when the limited amount of available water must remain in the Delta, making water deliveries more predictable and reliable. In addition, these improvements will decrease the vulnerability of Delta water supplies to disruption by natural disasters, such as, earthquakes, floods, and levee failures.

(2) "Achieving the coequal goal of protecting, restoring, and enhancing the Delta ecosystem" means successfully establishing a resilient, functioning estuary and surrounding terrestrial landscape capable of supporting viable populations of native resident and migratory species with diverse and biologically appropriate habitats, functional corridors, and ecosystem processes.

(3) "Achieving the coequal goals in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place" means accepting that change, including change associated with achieving the coequal goals, will not cease, but that the fundamental characteristics and values that contribute to the Delta's special qualities and that distinguish it from other places can be preserved and enhanced while accommodating these changes. In this regard, the following are core strategies for protecting and enhancing the unique values that distinguish the Delta and make it a special region:

(A) Designate the Delta as a special place worthy of national and state attention;

(B) Plan to protect the Delta's lands and communities;

(C) Maintain Delta agriculture as a primary land use, a food source, a key economic sector, and a way of life;

(D) Encourage recreation and tourism that allow visitors to enjoy and appreciate the Delta and that contribute to its economy;

(E) Sustain a vital Delta economy that includes a mix of agriculture, tourism, recreation, related industries and business, and vital components of state and regional infrastructure; and

(F) Reduce flood and other risks to people, property, and other interests in the Delta.

(i) "Commercial recreational visitor-serving uses" means a land use designation that describes visitor-serving uses, accommodations, restaurants, and shops, that respect the rural character and natural environmental setting. These uses also include campgrounds and commercial recreational facilities.

(j)(1) "Covered action" means a plan, program, or project that meets all of the following criteria (which are collectively referred to as covered action screening criteria):

(A) Is a "project," as defined pursuant to section 21065 of the Public Resources Code;

(B) Will occur, in whole or in part, within the boundaries of the Delta or Suisun Marsh;

(C) Will be carried out, approved, or funded by the State or a local public agency;

(D) Will have a significant impact on achievement of one or both of the coequal goals or the implementation of government-sponsored flood control programs to reduce risks to people, property, and State interests in the Delta; and

(E) Is covered by one or more provisions of the Delta Plan, which for these purposes, means one or more of the regulatory policies contained in Article 3.

(2) ''Covered action'' does not include any plan, program, or project that is exempted pursuant to Water Code section 85057.5(b).

(3) A State or local public agency that proposes to carry out, approve, or fund a plan, program, or project that may be subject to this Chapter must determine whether that proposed plan, program, or project is a covered action. That determination, which is subject to judicial review, must be reasonable, made in good faith, and consistent with the Delta Reform Act and this Chapter.

(4) Nothing in the application of the definition of a "covered action" shall be interpreted to authorize the abrogation of any vested right whether created by statute or by common law.

(k) "Delta" means the Sacramento-San Joaquin Delta as defined in section 12220 of the Water Code and the Suisun Marsh, as defined in section 29101 of the Public Resources Code.

(l) "Delta Plan" means the comprehensive, long-term management plan for the Delta to further the achievement of the coequal goals, as adopted by the Delta Stewardship Council in accordance with the Sacramento-San Joaquin Delta Reform Act of 2009.

(m) "Designated Floodway" means those floodways, as defined in California Code of Regulations, Title 23, section 4(i), under the jurisdiction of the Central Valley Flood Protection Board.

(n) "Encroachment" means any obstruction or physical intrusion by construction of works or devices, planting or removal of vegetation, or by any means for any purpose, into or otherwise affecting a floodway or floodplain.

(o) "Enhancement" or "enhancing," for purposes of section 5001(h)(2), means improving existing desirable habitat and natural processes. Enhancement may include, by way of example, flooding the Yolo Bypass more often to support native species or to expand or better connect existing habitat areas. Enhancement includes many fish and wildlife management practices, such as managing wetlands for waterfowl production or shorebird habitat, installing fish screens to reduce entrainment of fish at water diversions, or removing barriers that block migration of fish to upstream spawning habitats.

(p) "Feasible" means capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors.

(q) "Floodplain" means any land area susceptible to being inundated by flood waters from any source.

(r) "Floodplain values and functions" has the same meaning as set forth in 33 Code of Federal Regulations section 320.4(l)(1).

(s) "Floodproofing" means any combination of structural and nonstructural additions, changes, or adjustments appropriate for residential structures, which reduce or eliminate risk of flood damage to real estate, improved real property, or structures with their contents.

(t) "Floodway" means the portion of the floodplain that is effective in carrying flow (that is, the channel of a river or other watercourse and the adjacent land areas that convey flood waters).

(u) "Government-sponsored flood control program to reduce risks to people, property, and State interests in the Delta" means any State or federal strategy, project, approval, funding, or other effort that is intended to reduce the likelihood and/or consequences of flooding of real property and/or improvements, including risks to people, property, and State interests in the Delta, that is carried out pursuant to applicable law, including, but not limited to the following:

(1) State Water Resources Law of 1945, Water Code section 12570 et seq.;

(2) Sacramento-San Joaquin River Flood Control Projects (Flood Control Act of 1941, P.L. 77-228);

(3) Local Plans of Flood Protection prepared pursuant to the Local Flood Protection Planning Act (Water Code section 8200 et seq.), that are consistent with the Central Valley Flood Protection Plan pursuant to Water Code section 9612;

(4) Central Valley Flood Protection Plan (Water Code section 9600 et seq.);

(5) Subventions Program, Special Projects Program (Water Code section 12300 et seq.);

(6) Way Bill 1973-Subventions Program, Special Projects Program (Water Code section 12980 et seq.);

(7) Central Valley Flood Protection Board Authority (California Code of Regulations, Title 23, Division 1); and

(8) National Flood Insurance Program (National Flood Insurance Act of 1968, 42 U.S.C. 4001 et seq., P.L. 90-448).

(v) "Nonnative invasive species," for purposes of section 5009, means species that establish and reproduce rapidly outside of their native range and may threaten the diversity or abundance of native species through competition for resources, predation, parasitism, hybridization with native populations, introduction of pathogens, or physical or chemical alteration of the invaded habitat.

(w) "Nonproject levee" means a local levee owned or maintained by a local agency or private owner that is not a project facility under the State Water Resources Law of 1945, Chapter 1 (commencing with Water Code section 12570) and Chapter 2 (commencing with section 12639 of Part 6 of the Water Code).

(x) "Project levee" means a federal flood control levee that is a project facility under the State Water Resources Law of 1945, Chapter 1 (commencing with Water Code section 12570) and Chapter 2 (commencing with section 12639 of Part 6 of the Water Code).

(y) "Proposed action" means a plan, program, or project that meets the covered action screening criteria listed in section 5001(j)(1)(A) through (D). Proposed action is also a "covered action," and therefore subject to compliance with the regulatory policies contained in Articles 2 and 3—if the proposed action meets the covered action screening criterion listed in section 5001(j)(1)(E).

(z) "Protection" or "protecting," for purposes of section 5001(h)(2), means preventing harm to the ecosystem, which could include preventing the conversion of existing habitat, the degradation of water quality, irretrievable conversion of lands suitable for restoration, or the spread of invasive nonnative species.

(aa) "Regulated stream" means those streams identified in Table 8.1 of California Code of Regulations, Title 23, section 112, under the jurisdiction of the Board.

(bb) "Restoration" or "restoring," for purposes of section 5001(h)(2), has the same meaning as in Water Code section 85066. Restoration actions may include restoring interconnected habitats within the Delta and its watershed, restoring more natural Delta flows, or improving ecosystem water quality.

(cc) "Setback levee" means a new levee constructed behind an existing levee which allows for removal of a portion of the existing levee and creation of additional floodplain connected to the stream. In the Delta, a "setback levee" may not necessarily result in removal of the existing levee.

(dd) "Significant impact" for the purpose of determining whether a project meets the definition of a "covered action" under section 5001(j)(1)(D) means a substantial positive or negative impact on the achievement of one or both of the coequal goals or the implementation of a government-sponsored flood control program to reduce risks to people, property, and State interests in the Delta, that is directly or indirectly caused by a project on its own or when the project's incremental effect is considered together with the impacts of other closely related past, present, or reasonably foreseeable future projects. The following categories of projects will not have a significant impact for this purpose:

(1) "Ministerial" projects exempted from CEQA, pursuant to Public Resources Code section 21080(b)(1);

(2) "Emergency" projects exempted from CEQA, pursuant to Public Resources Code section 21080(b)(2) through (4);

(3) Temporary water transfers of up to one year in duration. This provision shall remain in effect only through December 31, 2016, and as of January 1, 2017, is repealed, unless the Council acts to extend the provision prior to that date. The Council contemplates that any extension would be based upon the California Department of Water Resources' and the State Water Resources Control Board's participation with stakeholders to recommend measures to reduce procedural and administrative impediments to water transfers and protect water rights and environmental resources by December 31, 2016. These recommendations should include measures to address potential issues with recurring transfers of up to 1 year in duration and improved public notification for proposed water transfers;

(4) Other projects exempted from CEQA, unless there are unusual circumstances indicating a reasonable possibility that the project will have a significant impact under Water Code section 85057.5(a)(4), as further defined by this section. Examples of unusual circumstances could arise in connection with, among other things:

(A) Local government general plan amendments for the purpose of achieving consistency with the Delta Protection Commission's Land Use and Resource Management Plan; and,

(B) Small-scale habitat restoration projects, as referred to in CEQA Guidelines, section 15333 of Title 14 of the California Code of Regulations, proposed in important restoration areas, but which are inconsistent with the Delta Plan's policy related to appropriate habitat restoration for a given land elevation (section 5006 of this Chapter).

(ee) "Urban area" means a developed area in which there are 10,000 residents or more.

(ff) "Urbanizing area" means a developed area or an area outside of a developed area that is planned or anticipated to have 10,000 residents or more within the next 10 years.

(gg) "Urban water management plan" means a plan prepared, adopted, and updated by an urban water supplier pursuant to the Urban Water Management Planning Act, Water Code section 10610 et seq.

(hh) "Urban water supplier" refers to both "urban retail water suppliers" and "urban wholesale water suppliers":

(1) "Urban retail water supplier" means a water supplier, either publicly or privately owned, that directly provides potable municipal water to more than 3,000 end users or that supplies more than 3,000 acre-feet of potable water annually at retail for municipal purposes.

(2) "Urban wholesale water supplier" means a water supplier, either publicly or privately owned, that provides more than 3,000 acre-feet of potable water annually at wholesale for municipal purposes.

(ii) "Water supplier" refers to both "urban water suppliers" and "agricultural water suppliers," but for purposes of section 5003, does not include agricultural water suppliers during the time that they may be exempted by section 10853 of the Water Code from the requirements of Parts 2.55 and 2.8 of Division 6 of the Water Code.

23 CCR Section 5001
NOTE: Authority cited: Section 85210(i), Water Code.
Reference: Sections 85057.5, 85059, 85058, 85066, 85020, 85054, 85052, 85302(g), 85308, 85300, 10608.12, and 10853, Water Code.

Key Terms, Acronyms, and Abbreviations Used in the Delta Plan

Term	Definition
100-year flood	A flood event having a 1-in-100 chance of being equaled or exceeded in any given year.
200-year flood	A flood event having a 1-in-200 chance of being equaled or exceeded in any given year.
AB	Assembly Bill
acre-foot	The volume of water that would cover 1 acre of land to a depth of 1 foot; equal to 43,560 cubic feet or 325,851 gallons.
accommodation space	The space in the Delta that lies below sea level and is filled with neither sediment nor water.
Act	See Sacramento-San Joaquin Delta Reform Act of 2009
ACWA	Association of California Water Agencies
administrative procedure	Procedures adopted by the Delta Stewardship Council (Council), in accordance with Water Code section 85225.30, that govern how the Council considers appeals with respect to the following: (1) Adequacy of certifications of consistency with the Delta Plan submitted to the Council by a State or local agency pursuant to Water Code section 85225.10, and (2) Determinations by the California Department of Fish and Wildlife that the Bay Delta Conservation Plan has met the requirements of Water Code section 85320 for inclusion in the Delta Plan.
advanced treatment	Any treatment of sewage that goes beyond the secondary or biological water treatment stage and includes the removal of nutrients, including phosphorus, nitrogen, and a high percentage of suspended solids.
Aeration Facility	Demonstration Dissolved Oxygen Aeration Facility
agricultural water use	Water used for farming, horticulture, or ranching including irrigation, stock watering, or support of vegetation for range grazing. This includes water used for irrigation and nonirrigation purposes. Irrigation water use includes the artificial application of water on land to promote the growth of crops and pasture, or to maintain vegetative growth in recreational lands, parks, and golf courses. Nonirrigation water use includes water used for livestock, which includes water for stock watering, feedlots, and dairy operations, and fish farming and other farm requirements.
agricultural water use efficiency	Defined by California Department of Water Resources as the ratio of applied water to the amount of water required to sustain agricultural productivity. Efficiency is increased through the application of less water to achieve the same beneficial productivity or by achieving more productivity while applying the same amount of water.
AGWA	Association of Groundwater Agencies
anadromous fish	Fish that are born in fresh water, migrate to the ocean to mature, and then return to fresh water to spawn.

Term	Definition
anticipated future stressors	Stressors that require preparation and planning for mitigation in advance of their onset (for example, future land subsidence, urban expansion, and new invasions by nonnative species).
artesian water	A groundwater aquifer under positive pressure. In some cases, the hydrostatic equilibrium elevation of the groundwater is higher than the elevation of the surrounding ground surface. When an artesian aquifer is penetrated by a well, the water level will rise above the top of the aquifer, and even flow out of the ground.
AWWA	American Water Works Association
BAFF	bio-acoustic fish fence
base camp	A park, resort, or town that provides services (for example, park rangers, interpretation, and boat rentals) and facilities (for example, parking, restrooms, picnic sites, boat ramps, and campgrounds). The mix of facilities is determined by adjacent recreation opportunities and nearby public and private facilities.
basin plan	A water quality control plan for a specific basin or region in California. It includes a comprehensive program of actions designed to preserve, enhance, and restore water quality in that basin. The basin plan is the master water quality control planning document for the regional boards. It describes beneficial uses of surface water and groundwater, and establishes water quality objectives to protect those uses.
Bay Plan	San Francisco Bay Plan
Bay-Delta Plan	Bay-Delta Water Quality Control Plan
BCDC	San Francisco Bay Conservation and Development Commission
BDCP	Bay Delta Conservation Plan
beneficial uses	Uses of the waters of the state that include domestic, municipal, agricultural, and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.
beneficiaries	Entities that benefit from using the resources of the Delta, including water supply, conveyance, and recreation.
benthic	The collection of organisms living on or in sea, lake, or river bottoms.
best management practices (BMPs)	Methods or techniques found to be the most effective and practical means of achieving an objective, such as water conservations. BMPs include, but are not limited to, structural and nonstructural controls, and operation and maintenance procedures. Examples of water conservation BMPs include tiered rate structures and water-efficient plumbing and irrigation systems.
bioaccumulation	The process by which a chemical is taken up by an aquatic organism, both from direct exposure to water and through the consumption of food containing the chemical.
biological opinion	A document stating the opinion of the U.S. Fish and Wildlife Service or the National Marine Fisheries Service as to whether or not federal action is likely to jeopardize the continued existence of a threatened or endangered species, or result in the destruction or adverse modification of critical habitat.

Term	Definition
biomagnify, biomagnification	The sequence of processes in an ecosystem by which higher concentrations of a particular chemical, a pesticide for example, are reached in organisms higher up the food chain, generally through a series of prey-predator relationships.
BMP	See best management practices
bypass	An area of land or a large, constructed structure designed to convey excess floodwaters from a river or stream in order to reduce the risk of flooding on the natural river or stream near a city or other population center.
Cal EMA	California Emergency Management Agency
Caltrans	California Department of Transportation
CARB	California Air Resources Board
carbon sequestration	The process of removing carbon from the atmosphere and storing it. Trees and plants, for example, absorb carbon dioxide, release the oxygen, and store the carbon in their biomass. The stored biomass may eventually turn to peat, other soil-borne organic matter, and fossil fuels such as coal or petroleum that will continue to store the carbon until the fuels are burned.
CASGEM	California Statewide Groundwater Elevation Monitoring Program
CCR	*California Code of Regulations*
CDFA	California Department of Food and Agriculture
centrarchids	Small, carnivorous, freshwater, spiny-finned fishes of North America usually having a laterally compressed body and metallic luster (for example, largemouth bass, smallmouth bass, spotted bass, bluegill, warmouth, redear sunfish, green sunfish, white crappie, and black crappie).
certification of consistency	The written certification to the Delta Stewardship Council, with detailed findings, that a covered action is consistent with the Delta Plan. Certifications of consistency are submitted to the Delta Stewardship Council by the State or local agency that is proposing to carry out, fund, or approve a covered action under the California Environmental Quality Act (Water Code section 85225 et seq.).
CEQA	California Environmental Quality Act
cfs	cubic feet per second
channelization	(1) Natural or intentional straightening and deepening of streams through dredging or construction of levees. (2) A marsh-drainage tactic that can disturb fish and wildlife habitats, aggravate flooding, and decrease the capacity to absorb pollution without suffering damage.
climate change	Any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). Climate change may result from (1) natural factors, including changes in the sun's intensity or changes in the Earth's orbit around the sun, (2) natural processes within the climate system (such as changes in ocean circulation), or (3) human activities that change the composition of the atmosphere (for example, through burning fossil fuels) and land surfaces (for example, deforestation, reforestation, urbanization, and desertification).

Term	Definition
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CNRA	California Natural Resources Agency
CO_2	carbon dioxide
COA	Coordinated Operating Agreement
conceptual model	An explicit description of mental models, knowledge, and hypotheses about the structure and function of a system or process.
conjunctive management	The coordinated and planned management of both surface water and groundwater resources to maximize efficient water use. Water is stored in groundwater basins for future use by intentionally recharging the basin during years of above-average surface water supply. Surface water and groundwater resources typically differ significantly in their availability, quality, management requirements, and development and use costs. Managing both resources together, rather than in isolation from one another, allows water managers to use the advantages of both resources for maximum benefit.
conveyance	The movement of water from one place to another. Conveyance infrastructure includes natural watercourses as well as canals, pipelines, and control structures including weirs. Examples of natural watercourses include streams, rivers, and groundwater aquifers. Conveyance facilities range in size from small, local, end-user distribution systems to large systems that deliver water to or drain areas covering multiple hydrologic regions. Conveyance facilities require associated infrastructure including pumping plants, power supply, diversion structures, fish ladders, and fish screens.
Council	Delta Stewardship Council
critical habitat	Specific areas, both occupied and unoccupied, that are essential to the conservation of a listed species and that may require special management considerations or protection (as defined in Section 3 of the federal Endangered Species Act).
current stressors	Stressors that result from ongoing human activities that can, in some cases, be eliminated (for example, fish entrainment at water diversions).
CVFPB	Central Valley Flood Protection Board
CVFPP	Central Valley Flood Protection Plan
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CV-SALTS	Central Valley Salinity Alternatives for Long-Term Sustainability Program
CWA	Clean Water Act
CZMA	Coastal Zone Management Act of 1972
DBW	California Department of Boating and Waterways
DDT	dichlorodiphenyltrichloroethane

Term	Definition
dedicated (or developed) water	Defined by California Department of Water Resources (DWR) as water distributed among urban and agricultural uses, used for protecting and restoring the environment, or storage in surface water and groundwater reservoirs. In any year, some of the dedicated supply includes water that is used multiple times (reuse) and water that is held in storage from previous years. DWR identifies California's average annual dedicated water supply as 85 million acre-feet. *See also: total water use.*
Delta	Sacramento-San Joaquin Delta
Delta Conservancy	Sacramento–San Joaquin Delta Conservancy
Delta Ecological Management Zone	The Delta conservation strategy adopted by the Department of Fish and Wildlife as the *Ecosystem Restoration Program Conservation Strategy for Restoration of the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento and San Joaquin Valley Regions.*
Delta exports	Describes, in general terms, any water diverted from the Delta for use outside the Delta, including water pumped by the State Water Project and Central Valley Project pumping plants, Contra Costa Water District, and other agencies. The term must be precisely defined when applied to specific studies or analyses.
Delta Flood Risk Management Assessment District	As proposed in the Delta Plan, an assessment district authorized to set fees on State and local infrastructure to generate funds for levee maintenance and surveys; adequate flood control protection; and emergency response for the benefit of landowners, infrastructure owners, and other entities that benefit from the maintenance and improvement of Delta levees, including water users who rely on the levees to protect water quality.
Delta Independent Science Board (Delta ISB)	Established by the Sacramento-San Joaquin Delta Reform Act of 2009, the Delta ISB is a standing board of nationally and internationally prominent scientists with appropriate expertise to evaluate the broad range of scientific programs that support adaptive management of the Delta. The Delta ISB will provide oversight of the scientific research, and monitoring and assessment programs that support adaptive management of the Delta through periodic reviews of each of those programs. The overall objective of Delta ISB oversight is to help make the science underlying Bay-Delta programs, the application of that science, and the technical aspects of those programs the best they can be (Water Code section 85280 et seq.).
Delta ISB	See Delta Independent Science Board
Delta Levee Special Flood Control Projects	A California Department of Water Resources program, authorized in Water Code sections 12300 through 12314, that provides financial assistance to local levee-maintaining agencies for rehabilitating levees in the Delta.
Delta Multi-Hazard Coordination Task Force	A task force established to address emergency preparedness and response issues in the Delta by enabling the development and implementation of multi-hazard preparedness and response strategies for the Delta. Led by the California Emergency Management Agency (Cal EMA), the task force consisted of representatives from the Delta Protection Commission, California Department of Water Resources, and representatives of the five Delta counties. The passage of Senate Bill 27 in 2008 required Cal EMA, formerly the Office of Emergency Services, to establish the task force.

Term	Definition
Delta Primary Zone	The Sacramento-San Joaquin River Delta land and water area of primary State concern and statewide significance that does not encompass either the urban limit line or sphere of influence line of any local government general plan or study existing as of January 1, 1992. The precise boundary lines of the Primary Zone include the land and water areas as shown on the map titled "Delta Protection Zones" on file with the California State Lands Commission. Where the boundary between the Primary Zone and Secondary Zone is a river, stream, channel, or waterway, the boundary line is the middle of that river, stream, channel, or waterway. The Primary Zone consists of approximately 500,000 acres (Public Resources Code section 29728).
Delta Reform Act	See Sacramento-San Joaquin Delta Reform Act of 2009
Delta Secondary Zone	All the Delta land and water area within the boundaries of the Delta not included within the Primary Zone, subject to the land use authority of local government, and that includes the land and water areas as shown on the map titled "Delta Protection Zones" on file with the State Lands Commission. The Secondary Zone consists of approximately 238,000 acres (Public Resources Code section 29731).
Delta Vision	Delta Vision Blue Ribbon Task Force
Delta watershed	The watershed of the Sacramento River Hydrologic Region and the San Joaquin River Hydrologic Region as described in the California Water Plan Update 2005, Bulletin 160-05 (Water Code section 85060).
demand management measures	Water conservation measures, programs, and incentives that prevent the waste of water and promote the reasonable use and reuse of available supplies.
desalination	A water treatment process for the removal of salt from water for beneficial use. Source water can be brackish (low salinity) or sea water.
DFG	California Department of Fish and Game
DFW	California Department of Fish and Wildlife (formerly the California Department of Fish and Game)
diversion	A process which, having return flow and consumptive use elements, turns water from a given path. Removal of water from its natural channel for human use. Use of part of a streamflow as a water supply. Channel constructed across the slope for the purpose of intercepting surface runoff, changing the accustomed course of all or part of a stream. A structural conveyance (or ditch) constructed across a slope to intercept runoff flowing down a hillside and divert it to some convenient discharge point.
DO	dissolved oxygen
DOC	California Department of Conservation
DPC	Delta Protection Commission
DPH	California Department of Public Health
DRERIP	Delta Regional Ecosystem Restoration Implementation Plan
drinking water quality	Drinking water quality standards are adopted by the California Department of Public Health (DPH) Drinking Water Program pursuant to the California Safe Drinking Water Act. The standards apply to public drinking water systems and to water delivered to customers, and are enforceable by DPH and local health departments.

Term	Definition
drought	Hydrologic conditions during a defined period, greater than 1 dry year, when precipitation and runoff are much less than average.
DWR	California Department of Water Resources
DWR 200 Year	DWR 200-year Urban Levee Protection
EAD	See expected annual damage
ecosystem	A biotic community and its physical environment, considered as an integrated unit. Implied within this definition is the concept of a structural and functional whole unified through life processes. An ecosystem may be characterized as a viable unit of community and interactive habitat. Ecosystems are hierarchical and can be viewed as nested sets of open systems in which physical, chemical, and biological processes form interactive subsystems. Some ecosystems are microscopic, and the largest comprises the biosphere. Ecosystem restoration can be directed at different-sized ecosystems within the nested set, and many encompass multiple states, more localized watersheds, or a smaller complex of aquatic habitat.
ecosystem enhancement	The improvement of existing desirable habitat and natural processes. Enhancement might include flooding the Yolo Bypass more often, at times, to support native species, or expand or better connect existing habitat areas. Enhancement also includes many fish and wildlife management practices, including managing wetlands for waterfowl production or shorebird habitat, installing fish screens to reduce entrainment of fish at water diversions, or removing barriers that block migration of fish to upstream spawning habitats.
ecosystem protection	Preventing harm to an ecosystem, which could include preventing the conversion of existing habitat, the degradation of water quality, irretrievable conversion of lands suitable for restoration, or the spread of invasive nonnative species.
ecosystem restoration	The application of ecological principles to restore a degraded or fragmented ecosystem and return it to a condition in which its biological and structural components achieve a close approximation of its natural potential, taking into consideration the physical changes that have occurred in the past and the future impact of climate change and sea level rise (Water Code section 85066).
Ecosystem Restoration Program Conservation Strategy	Describes the Ecosystem Restoration Program (ERP) priorities and actions for Stage 2 of the CALFED Bay-Delta Program (summarized in Appendix B). It identifies biologically promising ecosystem restoration opportunities in the Sacramento-San Joaquin Delta Ecological Management Zone and the Sacramento Valley and San Joaquin Valley regions, and it provides the rationale for restoration actions specific to each of these regions. It further provides the conceptual framework and process to guide the refinement, evaluation, prioritization, implementation, monitoring, and review of ERP actions.
ecosystem water quality	The Delta ecosystem is affected by a variety of pollutants discharged into Delta and tributary waters. Pollutants of concern affecting Delta biological species and ecosystem processes include nutrients, pesticides, mercury, selenium, and other persistent bioaccumulative toxic substances. Newly identified pollutants of potential concern (often referred to as emerging contaminants) also should be investigated.
EIR	environmental impact report

Term	Definition
endangered species	As defined by the California Endangered Species Act, an endangered species is a native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, overexploitation, predation, competition, or disease. Any species determined by the Fish and Game Commission as endangered on or before January 1, 1985, is an endangered species (Fish and Game Code section 2062).
entrainment	Defined by the National Marine Fisheries Service as “the incidental trapping of any life stage of fish within waterways or structures that carry water being diverted for anthropogenic use.”
environmental water	Minimum flow levels of a specific quality that are needed in order to assure the continued viability of fish and wildlife resources for a particular water body. This water is used to maintain and enhance the beneficial uses related to the preservation and enhancement of fish, wildlife, and other aquatic resources or preserves as specified in the Porter-Cologne Water Quality Control Act.
environmental water use	Water dedicated to instream environmental needs.
EPRRP	Emergency Preparedness Response and Recovery Program
ERP	Ecosystem Restoration Program
ESA	Endangered Species Act
ESP	The Delta Protection Commission’s *Economic Sustainability Plan for the Sacramento-San Joaquin Delta*
estuary	A place where fresh and salt water mix, such as a bay, salt marsh, or where a river enters an ocean.
expanded water supply reliability element	Additional information water suppliers should include in their water supply reliability element, starting in 2015, as part of the update of any urban water management plan, agricultural water management plan, integrated water management plan, or other plan that provides equivalent information on the supplier's planned investments in water conservation and water supply development. This expanded water supply reliability element must detail how water suppliers are improving regional self-reliance and reducing reliance on the Delta through investments in local and regional programs and projects, and must document actual and projected reductions in reliance on Delta exports. At a minimum, the water reliability element must include the following: (1) A plan for possible interruption of Delta water supply due to catastrophic events. (2) A plan for implementation of anticipated investments in water conservation, water efficiency, and water supply development. (3) Evaluation of regional water balance. (4) Conservation-oriented water rate structure.
expected annual damage (EAD)	A metric for analyzing flood risk that integrates the likelihood and consequences of flooding. Generally defined as the average annual flood damages (in dollars) weighted by the probability that a flood will occur in any given year. The U.S. Army Corps of Engineers describes EAD mathematically in *Manual No. 1110-2-1619, Risk-Based Analysis for Flood Damage Reduction Studies*, August 1, 1996.
FEMA	Federal Emergency Management Agency
FEMA 100 Year	FEMA 100-year (Base Flood) Protection

Term	Definition
flood risk	The likelihood and consequence of inundation by floodwaters. Consequences may include direct or indirect economic costs, loss of life, environmental impacts, or other specified measures of flood effect. Flood risk is a function of (1) loading, which is the frequency and magnitude of flood discharge or stage; (2) limits to exposure to the loading due to flood defense measures; and (3) consequence. Therefore, flood management actions may reduce risk by changing loading, exposure, or consequence. For clarity, flood risk is commonly quantified within an identified area for a specified climate condition, land use condition, and with a flood management system (existing or planned) in place.
flow criteria	The development of specific criteria by the State Water Resources Control Board for flows for the Delta ecosystem, including the volume, quality, and timing of water necessary for the Delta ecosystem under different conditions (Water Code section 85086(c)(1)).
flow objectives	Where protection of beneficial uses requires specific flow volumes at certain times, regional water quality control boards may establish flow objectives in water quality control plans. They differ from typical water quality objectives in that they are implemented by the State Water Resources Control Board through modifications and limitations of existing or future water rights to make sure these flows are met.
flow regime	The regulation of ecological processes in river ecosystems: the magnitude, frequency, duration, timing, and rate of change of hydrologic conditions (Poff and Ward 1989, Richter et al. 1996, Walker 1995). These components can be used to characterize the entire range of flows and specific hydrologic phenomena, including floods or low flows, that are critical to the integrity of river ecosystems. Furthermore, by defining flow regimes in these terms, the ecological consequences of particular human activities that modify one or more components of the flow regime can be considered explicitly.
flow requirements	The amount of water required for instream use by agreement, water rights permit, or State/federal law.
freeboard	The height of the physical top of a levee or floodwall above the median design water surface elevation.
gateway	A community, landmark, or signage on the edge of the Delta or Suisun Marsh that serves as a gateway providing information to visitors about recreation opportunities available in the area and equipping them with supplies.
general obligation bond	A bond issued by the State where the principal and interest is paid out of the General Fund. This is different than a revenue bond, where the principal and interest is paid out of a specific dedicated revenue source.
globally determined stressors	Stressors that result from large-scale human activities or natural processes that cannot be eliminated or mitigated within a limited purview and require larger-scale planning and adaptation (such as global climate change and human population growth).
GPCD	gallons per capita daily
groundwater basin	An alluvial aquifer or a stacked series of alluvial aquifers with reasonably well-defined boundaries in a lateral direction and having a definable bottom.
groundwater management plan	A comprehensive written document developed for the purpose of groundwater management and adopted by an agency having appropriate legal or statutory authority.

Term	Definition
groundwater overdraft	The condition of a groundwater basin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years during which water supply conditions approximate average conditions.
groundwater remediation	The extraction of contaminated groundwater from an aquifer followed by treatment and (1) replacement in the aquifer or (2) use for agricultural or municipal purposes.
groundwater storage	Defined three ways depending on the context: (1) the quantity of water beneath the land surface that fills the pore spaces of the alluvium, soil, or rock formation; (2) the volume of usable physical space available to store water in the pore spaces of the alluvium, soil, or rock formation beneath the land surface; or (3) the act of storing water in the pore spaces of the alluvium, soil, or rock formation beneath the land surface.
HAB	harmful algal bloom
habitat	The location and the living and nonliving surroundings where a particular plant or animal lives. Habitat includes the presence of a group of particular environmental conditions surrounding an organism including air, water, soil, mineral elements, moisture, temperature, and topography.
Habitat Conservation Plan (HCP)	A plan prepared under the Endangered Species Act by nonfederal parties in order to obtain permits for incidental taking of threatened and endangered species. The HCP describes ways to maintain, enhance, and protect a given habitat type needed to protect species. The plan usually includes measures to minimize impacts, and might include provisions for permanently protecting land, restoring habitat, and relocating plants or animals to another area.
habitat restoration	The manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning the majority of natural functions to the lost or degraded native habitat.
Hazard Mitigation Plan (HMP)	Refers to levee guidance negotiated between various federal, State, and local agencies to assist in reducing the likelihood of repetitive flood damage to Delta levees and islands. This guidance provides geometric levee design criteria that, if maintained, make a Delta levee-maintaining agency eligible for federal disaster assistance funds in the event of a flood emergency.
HCP	See Habitat Conservation Plan
HGMP	Hatchery and Genetic Management Plans
HMP	See Hazard Mitigation Plan
hydraulic mining	The use of high-pressure jets of water to dislodge rock material or move sediment.
hydrodynamics	The description of the change in flow or motion of a liquid.
hydrologic region	A geographical division of the state based on local hydrologic basins. The California Department of Water Resources divides California into 10 hydrologic regions, corresponding to the state's major water drainage basins: North Coast, San Francisco Bay, Central Coast, South Coast, Sacramento River, San Joaquin River, Tulare Lake, North Lahontan, South Lahontan, and Colorado River.
IEP	Interagency Ecological Program
incidental take permit	A permit issued by federal fisheries agencies that authorizes take of listed species incidental to otherwise lawful projects.

Term	Definition
instream flow	The use of water within its natural watercourse as specified in a contract, a water rights permit, a court order, a Federal Energy Regulatory Commission license, or other documentation. Instream flows support natural ecosystems, create habitat for plants and animals, and may provide additional benefits including recreation. *See also: flow requirements*.
integrated regional water management	A collaborative effort to manage all aspects of water resources in a specified region. Integrated regional water management crosses jurisdictional, watershed, and political boundaries; involves multiple agencies, stakeholders, individuals, and groups; and attempts to address the issues and differing perspectives of all entities involved through mutually beneficial solutions.
integrated regional water management plan (IRWMP)	At a minimum, an integrated regional water management plan describes the major water-related objectives and conflicts within a region; considers a broad variety of water management strategies; identifies an appropriate mix of water demand and supply management alternatives; provides water quality protections and environmental stewardship actions to provide a long-term, reliable, and high-quality water supply; protects the environment; and identifies disadvantaged communities in the region taking into account the water-related requirements of those communities.
invasive species	An alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112, 1999).
land reclamation	The process to recover land through channelization and levee construction of what was previously marsh land.
IRWMP	See integrated regional water management plan.
LADWP	Los Angeles Department of Water and Power
LAEDC	Los Angeles Economic Development Corporation
LAO	California Legislative Analyst's Office
legacy community	A rural community registered as a Historic District by either a State or federal entity. Delta legacy communities include Bethel Island, Clarksburg, Courtland, Freeport, Hood, Isleton, Knightsen, Rio Vista, Ryde, Locke, and Walnut Grove (Public Resources Code section 32301(f)).
legacy stressors	Stressors that result from past actions that cannot be undone, but whose impact can sometimes be reduced or mitigated (for example, mercury pollution from historical gold mining).
Legislature	California Legislature
levee-maintaining agencies	Local special districts, typically reclamation districts, that are public agencies formed for the purpose of levee maintenance and improvement, among other duties, and are funded by local assessments.
levee standards	Standards designed to either establish minimum criteria that would make levees and the properties protected eligible for Federal Emergency Management Agency (FEMA) grants or U.S. Army Corps of Engineers (USACE) rehabilitation funds both in case of catastrophic emergency, or set minimum criteria that would allow development behind the levees. The four main applicable levee standards and guidance for the Delta are (1) FEMA Hazard Mitigation Plan Guidance, (2) USACE Public Law 84-99, (3) FEMA 100-year (Base Flood) Protection, and (4) DWR 200-year Urban Levee Protection.
LHC	Little Hoover Commission

Term	Definition
low salinity zone (LSZ)	Generally, the region in an estuary with salinity ranging from fresh water up to about 5 parts per thousand (ppt), about one-seventh the salinity of sea water. The part of the salinity gradient centered on 2 ppt is considered to be of particular importance because it is hypothesized to be an area where suspended particulate matter and organisms accumulate. The location in the Bay-Delta where the tidally averaged salinity at 1 meter from the bottom is 2 ppt is known as X2 (measured as distance in kilometers from the Golden Gate Bridge) and serves as a water quality objective regulating Delta outflow.
LPP	Suisun Marsh Local Protection Program
LSZ	See low salinity zone
LTMS	Delta Dredged Sediment Long-Term Management Strategy
μS/cm	microsiemens per centimeter
MAF	million acre-feet
managed wetland	Perched wetlands that receive human-induced seasonal flooding for marshland development.
MCL	maximum contaminant level
mg/L	milligram(s) per liter
MWD	Metropolitan Water District of Southern California
NAS	National Academy of Sciences
National Heritage Area (NHA)	Places designated by the United States Congress where natural, cultural, historic, and recreational resources combine to form a cohesive, nationally distinctive landscape arising from patterns of human activity shaped by geography. These areas tell important stories about the nation and are representative of the national experience through both the physical features that remain and the traditions that have evolved within them.
National Pollutant Discharge Elimination System (NPDES)	A permitting program required for all point sources discharging pollutants into waters of the United States. The purpose of the NPDES program is to protect human health and the environment (Clean Water Act of 1977, 33 United States Code section 1311).
Natural Community Conservation Plan (NCCP)	A conservation plan created to meet the requirements of the Natural Community Conservation Planning Act, which identifies and provides for the regional or areawide protection of plants, animals, and their habitats, while allowing compatible and appropriate economic activity. The primary objective of the NCCP program is to conserve natural communities at the ecosystem level while accommodating compatible land use (Fish and Game Code section 2800 et seq.).
NCCP	See Natural Community Conservation Plan
new water	Defined in part by California Department of Water Resources as water that is legally and empirically available for a beneficial use. New water can be developed through many strategies such as capturing surplus water, desalinating ocean water, and improving water efficiency.
NHA	See National Heritage Area
NMFS	National Marine Fisheries Service

Term	Definition
nonpoint source pollution	Diffused sources that do not have a single point of origin or are not introduced into a receiving stream from a specific outlet. The pollutants are generally carried off the land by stormwater runoff. Common categories of nonpoint sources are agriculture, forestry, mining, construction, land disposal, and salt intrusion.
NPDES	See National Pollutant Discharge Elimination System
NRC	National Research Council
NWR	National Wildlife Refuge
OP	organophosphorus
OPC	California Ocean Protection Council
Paterno v. State of California	In *Paterno v. State of California*, the appellate court found the State liable for flood-related damages caused by the failure of a Yuba River levee incorporated into the State system of flood control, even though the State did not design, build, or even directly maintain it (*Paterno v. State* [2003] 113 Cal. App.4th 998 [6 Cal.Rptr.3d 854]).
PCB	polychlorinated biphenyl
peak flow	Maximum instantaneous flow in a specified period.
pelagic fish	A fish species that spends most of its life swimming in the water column with little contact with or dependency on the bottom. Adult spawning usually occurs in open water, often near the surface.
pelagic organism decline (POD)	A steep decline leading to near-record low populations of four pelagic species in the San Francisco Estuary—delta smelt, young striped bass, longfin smelt, and threadfin shad—widely recognized as a serious issue by 2004.
performance measures	A quantitative or qualitative tool to assess progress toward an outcome or goal. The Delta Plan must include performance measurements that will enable the Delta Stewardship Council to track progress in meeting the objectives of the Plan. Performance measurements must include, but need not be limited to, quantitative or otherwise measurable assessments of the status and trends in all of the following: (1) The health of the Delta estuary and wetland ecosystem for supporting viable populations of aquatic and terrestrial species, habitats, and processes including viable populations of Delta fisheries and other aquatic organisms. (2) The reliability of California water supply imported from the Sacramento River or the San Joaquin River watershed.
PL 84-99	See Public Law 84-99
Plan	Delta Plan
POD	See pelagic organism decline

Term	Definition
point source	Any discernible, confined, and discrete conveyance including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel, or other floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigation agriculture or agricultural stormwater runoff (40 *Code of Federal Regulations* 122.2).
pollutant	Defined as "dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water" (Clean Water Act of 1977, 33 United States Code section 1362(6)).
pollution	Defined as the human-made or human-induced alteration of the chemical, physical, biological, and radiological integrity of water (Clean Water Act section 502(19); 33 United States Code section 1362(19)). Pollution is also defined in California law as an alternation of the quality of the waters of the state by waste to a degree that unreasonably affects either the waters for beneficial uses or the facilities that serve these beneficial uses (Water Code section 13050(k)(1)).
ppb	parts per billion
PPIC	Public Policy Institute of California
ppm	parts per million
ppt	parts per thousand
PRBO CalPIF	Point Reyes Bird Observatory California Partners in Flight
Public Law 84-99 (PL 84-99)	A federal levee standard developed by the U.S. Army Corps of Engineers (USACE). Meeting this standard allows the Delta island or tract to be eligible for USACE funding for levee rehabilitation, island restoration after levee failures, and island inundation, provided that the reclamation district applies for and is accepted into the USACE's Rehabilitation and Inspection Program.
Public Trust Doctrine	This doctrine protects the right of the public to use State sovereign lands and waters for commerce, navigation, hunting, fishing, bathing, swimming, boating, and general recreational purposes, and also protects trust lands and waters in their natural state, so that they may serve as ecological units for scientific study, as open space, and as environments that provide food and habitat for birds and marine life, and which favorably affect the scenery and climate of the area. There is also a separate branch of the Public Trust Doctrine that protects the fishery resources in all State waters, including those in nonnavigable waterways, as public trust resources in and of themselves.

Term	Definition
Reasonable and Beneficial Use Doctrine	This doctrine states that a water right does not include the right to waste water and mandates that the water resources of the state be put to beneficial use. "It is hereby declared that because of the conditions prevailing in this State the general welfare requires that the water resources of the State be put to beneficial use to the fullest extent of which they are capable, and that the waste or unreasonable use or unreasonable method of use of water be prevented, and that the conservation of such waters is to be exercised with a view to the reasonable and beneficial use thereof in the interest of the people and for the public welfare. The right to water or to the use or flow of water in or from any natural stream or water course in this State is and shall be limited to such water as shall be reasonably required for the beneficial use to be served, and such right does not and shall not extend to the waste or unreasonable use or unreasonable method of use or unreasonable method of diversion of water. Riparian rights in a stream or water course attach to, but to no more than so much of the flow thereof as may be required or used consistently with this section, for the purposes for which such lands are, or may be made adaptable, in view of such reasonable and beneficial uses; provided, however, that nothing herein contained shall be construed as depriving any riparian owner of the reasonable use of water of the stream to which the owner's land is riparian under reasonable methods of diversion and use, or as depriving any appropriator of water to which the appropriator is lawfully entitled. This section shall be self-executing, and the Legislature may also enact laws in the furtherance of the policy in this section contained" (California Constitution Article X section 2).
reasonable and prudent alternative	The regulations implementing Section 7 of the Endangered Species Act define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that (1) can be implemented in a manner consistent with the intended purpose of the action, (2) can be implemented consistent with the scope of the action agency's legal authority, (3) are economically and technologically feasible, and (4) would, according to the National Marine Fisheries Service, avoid the likelihood of jeopardizing the continued existence of listed species and avert the destruction or adverse modification of critical habitat (Endangered Species Act of 1973, 16 United States Code section 1536).
Reclamation	Bureau of Reclamation
Recreation Proposal	*Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh*
regional self-reliance	The degree to which a region implements water management options so that it can provide for all of its needs for water from within its own borders.
regional water supplies	Water supplies that are found or developed within a region to be used within its own borders.
reservoir reoperation	Changes to existing operations and management procedures for existing reservoirs and conveyance facilities to increase water-related benefits from these facilities.
resource management strategy	A project, program, or policy that helps federal, State, or local agencies manage water and related resources. Resource management strategies in the California Water Plan are grouped by intended outcomes: reduce water demand, improve operational efficiency and transfers, increase water supply, improve water quality, practice resource stewardship, and improve flood management. Although most of the resource management strategies have multiple potential benefits, any individual site-specific project or program within a resource management strategy may contribute only one, or a few, of the benefits.
riparian area	The land adjacent to a natural watercourse such as a river or a stream. Riparian areas support vegetation that provides important wildlife habitat and important fish habitat when shading the watercourse bank.

Term	Definition
RWCF	Stockton Regional Wastewater Control Facility
RWQCB	Regional Water Quality Control Board
SACOG	Sacramento Area Council of Governments
Sacramento-San Joaquin Delta Reform Act of 2009 (Delta Reform Act or Act)	Included in Senate Bill X71, established a new governance approach for the Sacramento-San Joaquin Delta that is focused on achieving the coequal goals and is fundamentally different from past approaches. The Delta Reform Act created the Delta Stewardship Council and gave it the direction and authority to serve two primary governance roles: (1) set a comprehensive, legally enforceable direction for how the State manages important water and environmental resources in the Delta through the adoption of a Delta Plan, and (2) ensure coherent and integrated implementation of that direction through coordination and oversight of State and local agencies proposing to fund, carry out, and approve Delta-related activities.
Safe Harbor Agreement	A voluntary agreement made between wildlife agencies and landowners in order to recover a listed species.
SAV	submerged aquatic vegetation
SB	Senate Bill
SBX7 1	Senate Bill X7 1
SBX7 7	Senate Bill X7 7
SDWSC	Stockton Deep Water Ship Channel
sea level rise	A change in average global sea level caused by a change in ocean volume. Often discussed in relation to climate change.
seepage	Percolation of water through the soil from unlined canals, ditches, laterals, watercourses, or water storage facilities.
SEMS	See Standardized Emergency Management System
sensitive species	Species not yet officially listed but undergoing status review for listing on the U.S. Fish and Wildlife Service's official threatened and endangered list; species whose populations are small and widely dispersed or restricted to a few localities; and species whose numbers are declining so rapidly that official listing may be necessary.
SFD	San Felipe Division
SHP	State Historic Park
SMPP	BCDC's *Suisun Marsh Protection Plan*
SOI	sphere of influence

Term	Definition
special-status species	Any species that is listed, or proposed for listing, as threatened or endangered by the U.S. Fish and Wildlife Service or National Marine Fisheries Service under the provisions of the Endangered Species Act; any species designated by the U.S. Fish and Wildlife Service as a "listed," "candidate," "sensitive," or "species of concern"; and any species listed by the State in a category implying potential danger of extinction.
SP	State Park
SPFC	State Plan of Flood Control
SRA	State Recreation Area
Standardized Emergency Management System (SEMS)	Established throughout California to manage and coordinate any emergency response involving more than one agency or jurisdiction. It is the cornerstone of the emergency response system and the fundamental structure for the response phase of emergency management. SEMS is authorized under the California Emergency Services Act for managing multiagency and multijurisdictional responses to emergencies in California.
State	State of California
stormwater capture system	A facility operated by a public agency and designed to capture and retain stormwater flowing upon the public right-of-way, or through a public stormwater management system or a public stormwater drainage system, for subsequent use.
stressors (ecosystem)	Actions or factors, whether human or natural, that cause negative impacts on desirable ecosystem elements, processes, and functions. *See also: globally determined stressor, legacy stressors, current stressors, and anticipated future stressors.*
stressor fees	A companion principle to user fee, stressor fees are paid by persons who have been identified as stressing Delta natural systems. The fees fund regulatory and restoration programs.
subsidence	Sinking of the land surface due to a number of factors, including groundwater extraction, agricultural activities, or oil or gas extraction. In the Delta, land subsidence is mainly caused by oxidation of peat soils, but also from wind erosion. Drainage and cultivation dries the saturated peat, reducing its volume by approximately 50 percent.
subsidence reversal	The exposure of bare peat soils to air causes oxidation and decomposition, which results in subsidence, or a loss of soil elevation, on Delta islands. Flooding these lands and managing them as wetlands reduces exposure to oxygen, resulting in less decomposition of organic matter, which stabilizes land elevations. Wetland vegetation cycles lead to biomass accumulation, which sequesters carbon and helps stop and reverse subsidence. As subsidence is reversed, land elevations increase and accommodation space (the space in the Delta that lies below sea level and is filled with neither sediment nor water) on individual islands is reduced. A reduction in accommodation space decreases the potential for water quality impacts from salinity intrusion in the event of one or more levee breaks on deeply subsided Delta islands.

Term	Definition
subventions	Payments made by the State in the form of matching funds for the purpose of maintaining and improving Delta levees. The Delta Levees Maintenance Subventions Program is a cost share program providing technical and financial assistance to local levee-maintaining agencies in the Sacramento–San Joaquin Delta for the maintenance and rehabilitation of nonproject and eligible project levees. The subventions program is authorized by Water Code sections 12980 through 12995 and is managed by the California Department of Water Resources.
surface storage	Reservoirs used to collect and hold water for future release and use.
surface water	Water naturally open to the atmosphere including rivers, lakes, reservoirs, ponds, streams, impoundments, seas, and estuaries.
sustainable communities strategy	Regional transportation agencies are required to develop a sustainable communities strategy. The strategy is intended to demonstrate how the region will meet its greenhouse gas reduction target through integrated land use, housing, and transportation planning.
SWP	State Water Project
SWRCB	State Water Resources Control Board
threatened species	As defined by the California Endangered Species Act, a threatened species is a native species or subspecies of a bird, mammal, fish, amphibian, reptile, or plant that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of the special protection and management efforts required by the act. Any animal determined to be rare on or before January 1, 1985, is a threatened species (Fish and Game Code section 2067).
THM	trihalomethanes
tiered fee structures	Refers to a block-type fee structure where the unit price of a quantified benefit or impact, such as the amount of water used or the volume of contaminants discharged, increases with each additional block of benefit or impact.
TMDL	See total maximum daily load
total maximum daily load (TMDL)	A calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards.
total water use	In the Delta Plan, refers to 60 to 65 million acre-feet of water in California that goes to urban, agricultural, and Central Valley environmental water uses such as instream flow requirements and non-CVP managed wetlands.
tributary	A river or stream that flows into a larger river or stream. Usually, a number of smaller tributaries merge to form a river.
unimpaired flow	The natural water production of a river basin, unaltered by upstream diversions, storage, or by export or import of water to or from other watersheds.
urbanization	The expansion of residential, commercial, and industrial development into rural areas or areas that may have previously been used for agricultural or ecosystem habitat.
urban water use	The use of potable and nonpotable water for urban purposes including, but not limited to, residential, commercial, industrial, recreation, energy production, military, and institutional purposes.

Term	Definition
urban water use efficiency	Water management measures that are implemented in residential, commercial, industrial, and institutional settings that reduce water and per capita water use and result in the most effective use of water to prevent its waste, unreasonable use, or unreasonable method of use.
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
user fees	Fees proposed to fund programs identified in the Delta Plan that are paid by the users or beneficiaries of those programs. Fees may be volume-based or impact-based.
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWMP	See urban water management plan
vector-borne disease	Disease that results from an infection transmitted to humans and other animals by blood-feeding anthropods, including mosquitoes, ticks, and fleas. Examples of vector-borne diseases include Dengue fever, viral encephalitis, Lyme disease, and malaria.
waste discharge requirement (WDR)	An order adopted by a regional water board that regulates and permits specified discharges of waste to surface water and discharges of waste to land.
water balance	An analysis of the total developed/dedicated supplies, uses, and operational characteristics of water in a region. The analysis is intended to determine if actual water use equals supply.
water demand	An economic principle that describes consumer desire and willingness to pay a price for a specific amount of water. Holding all other factors constant, the price of a good or service increases as its demand increases and vice versa.
water export	The amount of water that a hydrologic region transfers to another hydrologic region. *See also: Delta exports.*
water import	The amount of water brought in from another hydrologic region or regions.
water quality criteria	Numeric limitations or levels (for example, concentrations) or narrative statements established to protect uses of a water body under the authority of the Clean Water Act. This term has two separate meanings: (1) Water quality criteria promulgated by the U.S. Environmental Protection Agency under Clean Water Act section 303(c) are enforceable components of water quality standards. (2) Recommended water quality criteria published under Clean Water Act section 304(a) are advisory and may be used by states and tribes to develop their own water quality standards or to implement narrative criteria in water quality standards.
water quality objectives	Numeric limitations or levels (concentrations or narrative statements) that are established for the reasonable protection of the beneficial uses of a water body. Determination of what is reasonable may include factors that are not required in federal development of a water quality criterion. Water quality objectives are included in water quality control plans adopted by regional water boards.

Term	Definition
water quality standards	Pursuant to the federal Clean Water Act, water quality standards are provisions of State or federal law that define the water quality goals of a water body, or portion thereof, by establishing (a) designated uses of water to be protected, and (b) water quality criteria to protect those uses. Water quality standards are enforceable in the bodies of water for which they have been promulgated.
water recycling	(1) The treatment of wastewater to remove solids and certain impurities to meet a beneficial use or a controlled use that would not otherwise occur, thus supplanting or augmenting a potable, or potentially potable, supply. (2) The treatment of municipal, industrial, or agricultural wastewater for reuse.
watershed	The land area that drains into a stream. The watershed for a major river may encompass a number of smaller watersheds.
water shortage contingency element	The Urban Water Management Planning Act requires water suppliers to include a water supply reliability and water shortage contingency element in urban water management plans, recognizing that suppliers need to prepare for extended droughts or the potential catastrophic interruption of water deliveries due to earthquakes or other events.
water supply reliability	See sidebar in Chapter 3, "What Does It Mean to Achieve the Goal of Providing a More Reliable Water Supply for California?"
water supply reliability element	Required components of urban water management plans (Water Code section 10631(c)), agricultural water management plans (Water Code section 10826 (b)(7)), and integrated regional water management plans (Water Code section 10540(c)(1)).
water transfer	A temporary or long-term change in the point of diversion, place of use, or purpose of use due to a transfer or exchange of water or water rights. Many transfers, including transfers among contractors of the State Water Project or Central Valley Project, do not fit this definition. A more general definition of a water transfer is a voluntary change in the way water is normally distributed among water users in response to water scarcity. Compared to water exchanges, which are typically water delivered by one water user to another water user, the receiving water user will return the water at a specified time or when the conditions of the agreement are met (Water Code section 1735).
water year	A compilation of hydrologic records collected over a 12-month period.
water year-type classifications	California Department of Water Resources uses five water year-type classifications for planning and water management purposes: wet, above normal, below normal, dry, and critically dry.
WDR	See waste discharge requirement
Wild and Scenic River	A State- and federal-designated river system that includes 17 California rivers and their many forks and tributaries. Approximately 1,900 miles of river are designated wild, scenic, or recreational under the National Wild and Scenic Rivers Act (1968) and the California Wild and Scenic Rivers Act of 1972.
X2	The location in the Bay-Delta where the tidally averaged salinity is 2 parts per thousand.

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