JUNE 13, 2011
FOURTH STAFF DRAFT DELTA PLAN

This is the fourth of an expected five (5) staff draft versions of the Delta Plan that will be presented to the Delta Stewardship Council prior to the release of the Draft Environmental Impact Report (EIR) in July 2011. The staff draft versions will be released in the following order.

- **February 2011:** First Staff Draft Delta Plan was posted on February 14, 2011 and discussed at Delta Stewardship Council meetings on February 24 and 25, 2011 and March 10 and 11, 2011.
- **March 2011:** Second Staff Draft Delta Plan was posted on March 18, 2011 and discussed at Delta Stewardship Council meetings on March 24 and 25, 2011 and April 14 and 15, 2011.
- **April 2011:** Third Staff Draft Delta Plan was posted on April 22, 2011 and discussed at Delta Stewardship Council meetings on April 28 and 29, 2011 and May 12 and 13, 2011.
- **June 2011:** Fourth Staff Draft Delta Plan was posted on June 13, 2011 and will be discussed at Delta Stewardship Council meetings on June 16, 23, and 24.
- **Early July 2011:** Fifth Staff Draft Delta Plan (for modification and approval by the Delta Stewardship Council to be circulated with the Draft EIR).
- **July 2011:** Draft Delta Plan and Draft EIR are circulated.

After circulation of the Draft EIR, comments obtained on the Draft Delta Plan and Draft EIR will be considered. Delta Stewardship Council staff will prepare written responses to comments received on the Draft EIR; those responses will become part of the Final EIR. The Delta Plan will be finalized in light of the comments and Final EIR. In November 2011, the Delta Stewardship Council will consider the Final EIR for certification under CEQA, and then consider the final Delta Plan for adoption.

At each stage of the development of the Staff Draft Delta Plan there will be public meetings at the Delta Stewardship Council meetings for the purpose of receiving information and comments and for Delta Stewardship Council deliberation. All Delta Stewardship Council meetings are public and simulcast on the Delta Stewardship Council website at www.deltacouncil.ca.gov.

In addition, public comments are welcome during the entire process and will become a formal part of the record. The Delta Stewardship Council encourages written public comments to be submitted to deltaplancomment@deltacouncil.ca.gov. **All comments received by Friday, June 24, 2011**, will be considered for revisions made in developing the Fifth Staff Draft Delta Plan. All comments received are posted to the Delta Stewardship Council web site: http://www.deltacouncil.ca.gov.

RELEVANT POINTS TO THE JUNE 13, 2011 FOURTH STAFF DRAFT DELTA PLAN

- Some graphics remain under development and are not included in the Fourth Staff Draft Delta Plan.
- Technical editing of all information in the Staff Draft Delta Plan versions, including fact-checking, grammatical, and style changes, and inclusion of additional citations and references will be ongoing.
- A redline version was not prepared on the full document because of the substantial changes from the Third Staff Draft Delta Plan. A redline version indicating the changes to the policies and recommendations contained in the 4th staff draft will be posted separately.
- A comment matrix with comments on Third Staff Draft Delta Plan received by May 6, 2011 will be posted separately to indicate methods that the comments were incorporated into the Fourth Staff Draft Delta Plan.

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Executive Summary

California's Great Natural Resource Challenge: The Sacramento–San Joaquin Delta

California is a land of great abundance and great variability, and its residents have been arguing about water resources for at least as long as they have been part of the United States.

Californians also have a long history of solving problems. When local resources were deemed inadequate, local agencies and later the federal and State governments helped to bring water from areas of seeming abundance. To impose on nature's variability, we built dams to store water so we could help control floods and provide irrigation and drinking water during dry times. In the process, we created great agricultural and manufacturing economies, and some of the world's great cities.

Only lately—in the last 30 or 40 years—have Californians insisted that our actions be in harmony with our environment. Reaching this point has itself engendered great debate, especially over the resources provided by the unique delta formed by the confluence of the state's two largest rivers, the Sacramento and the San Joaquin.

California's Delta has long been a battleground for the many competing interests that have a stake in how it is used—and abused. Yet, despite broad agreement on its problems—described for decades in countless government and academic documents, news articles and opinion pieces—efforts in recent years have yielded only incremental progress toward a comprehensive solution. Conflict over what to do, when to do it, and how to pay for it continues to embroil the Delta in controversy. The fundamental question is how a very large, complex, and modern society can continue to grow and protect the Delta ecosystem and other values we prize as a society.

In a rare bipartisan effort, passage of the Delta Reform Act of 2009 and companion legislation set forth groundbreaking new State policy. Foremost was the Act's establishment of coequal goals. According to the law:

> *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. (Water Code section 85054)*

Governance changes to implement the coequal goals, including the creation and empowerment of the Delta Stewardship Council to develop a legally enforceable Delta Plan, represents California's most recent attempt to bring order and oversight to the debate over Delta resources.

Therefore, this Delta Plan seeks to achieve the coequal goals through a mix of near-term actions with comparable focus on each of the coequal goals, and longer-term actions that help California meet goals and objectives over the course of this century. This must be done in a manner that is mindful of those who live, work, and recreate in the Delta region, and in concert with local, regional, and other statewide efforts to ensure the state's water supply reliability. Californians must set aside regional and partisan bickering to continue to solve problems; threats to the current water supply and an ecosystem in decline cannot be ignored much longer.

The Delta Plan: What is it?

The foundation of the Delta Reform Act was the adoption of the coequal goals and direction to the Delta Stewardship Council to adopt a legally enforceable Delta Plan to achieve those goals no later than January 1, 2012. It is inevitable that the Delta Plan will generate controversy. This Delta Plan draws upon existing State and federal laws and policies and ongoing programs to chart a course needed to achieve the coequal goals. The Delta Stewardship Council is but one of many agencies with an interest in the Delta. The Council was not granted unlimited authority. However, specific and targeted authority and actions were provided by the Delta Reform Act.

The Delta Stewardship Council is proud to present a Delta Plan that is foundational, adaptable, practical, and enforceable.

Foundational: The 2012 Delta Plan is a historic effort to address interlocking challenges and establish 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 Plan shines a spotlight on urgently needed Delta habitat projects and the potential for local water supply development. Similarly, immediately halting practices that we know are detrimental to the sustainability of the Delta's many services is fundamentally important.

Adaptable: The Delta Plan is intended to be adaptable over time. It will build on other plans and new information as it becomes available, and portions of the Plan that do not adequately meet stated goals over time will be refined or revised. The Plan will be updated at least every 5 years.

Practical: The Delta Plan aims to be practical. It does so by building on years of planning and by incorporating actions, recommendations, and strategies developed by other entities—government and non-government—who have already invested countless hours on Delta issues and have specialized areas of expertise.

Enforceable: The Delta Plan is different from other government plans because it contains a set of integrated and legally enforceable regulatory policies that apply to certain proposed plans, programs, and projects by local and state agencies known as "covered actions." State or local agencies that propose to undertake covered actions are required by the Delta Reform Act to certify with the Council, before beginning, that their proposed plans, programs, or projects are consistent with the Delta Plan. If that certification is appealed, the Delta Stewardship Council will determine whether the covered action is indeed consistent with the Delta Plan.

Delta Plan Highlights

The Delta Plan has a long-term scope. It is intended to serve as California's guiding policy document for the next 88 years, with frequent updates. The Delta Plan's chapters are built upon findings, supporting information, problem statements, and regulations and recommendations aimed at achieving the coequal goals and other objectives. Here are the highlights:

- While the Delta provides water for millions of Californians, it is not California's dominant water supply. Some water users are entirely dependent on Delta water exports, but most use local water

supplies and depend on Delta water for only for a portion of their supply. Therefore, The Delta Plan calls on water agencies with the capacity to diversify and augment their water supplies to do so through conservation, technological advances, wastewater recycling, stormwater capture, local storage, groundwater remediation, interregional planning and agreements, desalination, and more. These actions will improve reliability within individual regions, and serve to reduce reliance on the Delta.

- Water supplies exported from the Delta are currently at risk and must be made more reliable, because some regions are wholly or substantially dependent on these supplies and have limited alternatives. This aspect of reliability is currently the focus of the Bay Delta Conservation Plan effort to develop a longer-term solution to improved reliability of Delta water, and to make historic investments in the Delta ecosystem to aid species recovery. The Delta Plan supports the timely completion of the Bay Delta Conservation Plan in a manner that complies with the Delta Reform Act.

- The Delta Plan additionally calls for prioritizing the development of water flow objectives for the Delta. Until updated flow criteria are established to protect the Delta ecosystem, it is impossible to determine reliable levels of urban and agricultural water supplies available from the Delta. Once flow objectives are set, conveyance alternatives should be considered that minimize reverse flows and reduce risk to water supplies posed by sea level rise and seismic threat. The Delta Plan also identifies water storage as a key element of adding flexibility and reliability to the Delta system.

- The Delta ecosystem has suffered from 150 years of human modification. Although it is impossible to completely restore the Delta ecosystem to what it once was, the Delta Plan envisions a healthy Delta ecosystem that approximates its natural ecological potential and supports viable populations of native species. Ecosystem restoration in the Delta Plan considers 1) the historical Delta ecosystem and how it has changed, 2) principles of landscape ecology and ecosystem-based management, and 3) how multiple stressors threaten the health of the Delta ecosystem. The Delta Plan focuses on restoring two foundational Delta ecosystem attributes that have been greatly changed and degraded: the natural flow regime and adequate habitat for native species. The Plan recommends expedited action on both.

- Through the actions of State, local, and federal agencies, the Delta Plan seeks to reduce risk to people, property, and state interests in the Delta. Although flood risk cannot be eliminated in the Delta, enhanced standards that require land use to be connected to a standardized minimum level of flood protection are the first step in reducing risk. Improving people's understanding of residual risk (the risk that remains after flood protection actions have been taken) is a critical component of protecting the human lives subject to the constant threat of flooding from numerous factors. The Delta Plan sets forth a number of regulations and recommendations to address multiple aspects of flood risk. Building on current state policy, the Delta Plan requires a 200-year level of flood protection for all major subdivisions in the Delta outside of existing communities. The Delta Plan recommends the creation of a locally controlled Delta levee assessment district to offer a path toward a more coherent long-term policy to protect existing lives and property in the Delta.

- The Delta Plan includes numerous recommendations for improving water quality for humans and the environment, and for enhancing and protecting the Delta as an evolving place through investments in flood protection, recreation, agriculture, and more. Specifically, the Plan promotes the protection of floodplains and lands with recognized habitat values, and includes strategies to preserve the Delta's current rural and agricultural base.

- Finally, a finance plan framework describes potential funding for the actions included in the Delta Plan, but legislative action is necessary to implement it. In all, achievement of the coequal goals hinges upon California's willingness to commit to significant and sustained investment in water and the environment.

Moving Forward

The Delta poses one of the most complicated environmental and natural resource issues of the modern era. The unmatched challenge of balancing the coequal goals in the context of such a highly altered landscape amid complex multi-generation debates over water supplies for people, industry, and the environment will require unprecedented effort, creativity, and compromise.

Foundational problems manifested as ecosystem decline, water supply uncertainty, and dire flood risks have brought the Delta to an unacceptable level of risk. Climate change will bring rising sea levels and increasingly unpredictable precipitation patterns in the coming century. More unpredictably, an earthquake could strike at any time. For the State of California, and the people who live in and rely upon the Delta, the risks are intolerably high.

Water legislation passed in 2009 marked a paradigm shift for water management in California, and the Delta Plan now has the responsibility for charting the course through the remainder of the century. Achieving the coequal goals and various objectives of the Delta Reform Act will take many years of focused and purposeful work. Projects will be built, future plans will be implemented, and knowledge will expand and change. Undoubtedly the future will bring challenges, some of which we are not yet aware. The Delta Plan will therefore be a living document that will change along with the system it seeks to manage.

Chapter 1
The Delta Plan

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Chapter 1
The Delta Plan

The Delta Stewardship Council (Council) was established as an independent State agency by the Sacramento–San Joaquin Delta Reform Act of 2009 (Delta Reform Act).

The Council's primary responsibility is to develop, adopt, and implement by January 1, 2012, a legally enforceable, comprehensive, long-term management plan for the Sacramento–San Joaquin Delta and the Suisun Marsh—the Delta Plan—that achieves the coequal goals. "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" (Water Code section 85054).

Achieving the coequal goals is the primary and fundamental purpose of the Delta Plan. Additionally, the Delta Reform Act states that the policy of the State is "to achieve the following objectives as inherent in the coequal goals for the management of the Delta:

> *(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.*
>
> *(c) Restore the Delta ecosystem, including its fisheries and wildlife, as the heart of a healthy estuary and wetland ecosystem.*
>
> *(d) Promote statewide water conservation, water use efficiency, and sustainable water use.*
>
> *(e) Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.*
>
> *(f) Improve the water conveyance system and expand statewide water storage.*
>
> *(g) Reduce risks to people, property, and state interests in the Delta by effective emergency preparedness, appropriate land uses, and investments in flood protection.*
>
> *(h) Establish a new governance structure with the authority, responsibility, accountability, scientific support, and adequate and secure funding to achieve these objectives"* (Water Code section 85020 et. seq.) *."*

These core objectives form the foundation of the Delta Plan's policy chapters, underpinned by recognition of the importance of science and a commitment to adaptive management for a changing Delta. This overall framework is supported by a proposed Finance Plan to be implemented with legislative action.

Under the Delta Reform Act, it is now State policy to reduce reliance on the Delta to meet California's future water supply needs. Although the Delta will remain an important part of California's statewide

water supply, the Legislature has recognized the great potential for developing water supplies that reduce negative impacts to the Delta ecosystem and provide greater reliability to California's farms, homes and businesses. The Delta Reform Act specifically calls for reducing "reliance on the Delta through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency. Each region that depends on the 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 section 85021).

The Delta Plan builds on previous State requirements for improved water planning, such as the preparation of Urban Water Management Plans, Agricultural Water Management Plans, Groundwater Management Plans, and Integrated Regional Water Management Plans, and pending State and local actions such as flood management and emergency response planning. The Delta Plan attempts to combine, coordinate, and synthesize the diverse efforts of State and local agencies while being responsive to the mandates of Delta Reform Act, which requires linked actions to achieve a more reliable water supply while retaining regional flexibility and reducing overall reliance on the Delta. In this way, the 2012 Delta Plan simultaneously promotes statewide actions and investments while recognizing the actions of California's local agencies, which are vital to achieving water supply reliability and a protected and improved Delta ecosystem in a manner that respects the unique character of the Delta.

Current Conditions: Today's Delta

As recognized by the California Legislature, the Delta is "a distinct and valuable natural resource of vital and enduring interest to all the people" (Water Code section 85022(c)(1)). The Delta is the largest estuary on the west coasts of North and South America and provides habitat for 55 species of fish and over 750 species of plants, birds, and wildlife.

Today, the valued elements of the Delta ecosystem are, by almost any measure, in serious decline. Reduced freshwater flows into the Delta, water pumping facilities exporting water from the Delta, invasive species, altered waterway geometry, urban growth, and urban and agricultural pollution are among the factors collectively degrading water quality and threatening the survival of multiple native fish species. A detailed description of current ecosystem conditions is included in Chapter 5, Restore the Delta Ecosystem.

The Legislature declared the Delta "inherently flood-prone" in 1992 (Public Resources Code section 29704). Over a century ago, and with little or no engineering analyses and construction tools, Delta residents began to build an intricate levee system to channel water and reclaim land, which converted hundreds of thousands of acres of seasonally flooded wetlands into fertile agricultural land. By 1930, over 313,000 acres of former Delta wetlands were leveed and drained for agriculture. Today, as a result of continued land reclamation and large-scale urbanization, 95 percent of the historical tidal marsh in the Delta has been lost. Riparian habitat has also been extensively eliminated. Despite ongoing maintenance of the levee system, communities that have evolved behind these levees face the ever-present threat of flooding and, in some cases, catastrophic flooding.

Agricultural practices on some Delta islands have led to average subsidence of 12 to 15 feet below sea level, and in some areas up to 25 feet below sea level, creating tremendous pressure on the levees to act as dikes—to hold back water constantly rather than only during peak flow periods. The cost of maintaining, improving, or repairing these levees in some cases may be more than the assessed value of the use of the land they protect (Sumner et al. 2011). This creates an uncertain future for Delta agriculture and for the associated Delta economy and those residents who depend upon it.

The Delta's miles of natural and human-made waterways also serve as the hub for moving water supplies from Northern California to the San Francisco Bay Area, Central California, and Southern California. In the last 100 years, the average annual volume of water flowing into the Delta has been reduced by approximately 30 percent as a result of upstream consumptive use and diversions of water for use outside the watershed.

Although the Delta is at the heart of the state's largest water collection and delivery systems, precipitation determines California's water supply in any given year. Precipitation in the state is highly variable, ranging between 150 million acre feet in dry years and 350 million acre feet in wet years. Over the past century, average annual precipitation has been 200 million acre-feet (MAF), with about 50 to 60 percent unavailable, lost to evapotranspiration or flowing out to sea (DWR 2006, DWR 2009).

Most of the state's annual precipitation occurs in only 5 to 15 days combined, and recent scientific analysis concludes that "larger variations in California necessitate heroic levels of management of the State's water resources to accommodate wider swings of wet and dry years than in any other state" (Dettinger et al. 2011). To serve as a buffer against the state's natural susceptibility to floods and droughts and supplement numerous local storage projects, the State and federal governments built a system of reservoirs upstream of the Delta to divert and release water, some of which eventually flows to the State Water Project (SWP) and the federal Central Valley Project (CVP) pumping and conveyance facilities in the south Delta.

The Sacramento and San Joaquin river systems carry about a quarter of the state's natural river runoff and about half of its total annual runoff (DWR 2009). The Sacramento River is responsible for about three-quarters of the flow into the Delta, and the San Joaquin River and east side tributaries supply the rest. Together, these unimpaired flows are estimated to be 40.3 MAF in an average year, or almost half of California's average annual total water resource of 82.5 MAF. Of the total water flowing into the Delta, almost 30 percent (11.4 MAF) is diverted upstream of the Delta for agricultural (83.8 percent), urban (15 percent), and environmental (1.2 percent) uses. Diversions from the Delta itself average 6.35 MAF, a little more than one-third of total diversions from the Sacramento and San Joaquin rivers. Primarily exported through the SWP and CVP, in-Delta diversions have historically remained fairly constant regardless of water year type. In wet years, combined SWP and CVP exports represent less than 10 percent of total Delta outflows, but in dry years, combined project exports represent as much as 36 percent (DWR 2009).

Nearly two-thirds of the state's population depends on the Delta and these conveyance facilities for some portion of its water supply, as does more than 2 million acres of farmland made more productive by water supplied for irrigation. Although the Delta is an important part of the state's water supply, it is not a dominant part. California has more than 1,200 dams and reservoirs with nearly 43 MAF of surface storage. California imports 4.4 MAF from the Colorado River, down from the high of 5.1 MAF imported in the 1990s (Hanak et al. 2011). In an average water year, groundwater represents about 20 to 30 percent of the state's total water use, and in dry years, it can be almost 40 percent of the total (Newton et. al. 2008).

The dependence of the state's major regional economies on water supplies from the Delta has grown at the same time the reliability of water supplies from the Delta has begun to deteriorate. As one illustration, the 2009 SWP Delivery Reliability Report notes that future water deliveries from the Delta will average 60 percent of maximum contract amounts, down from 63 percent in 2007. Regulatory and court-imposed constraints on Delta water system operations are increasing as native fish populations decline, reducing the reliability of water deliveries, impacting urban and agricultural water users, and threatening the economic vitality of the state.

Significant obstacles exist to achieving statewide water supply reliability. California's water managers do not have enough information about annual statewide water use to sufficiently inform their decision-making in real time. Since 1914, the State Water Resources Control Board (SWRCB) has issued permits

to water diverters in the Delta, but actual annual diversion amounts are not currently known. 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 the 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, but other areas suffer from unsustainable overdraft and require improved management efforts. Groundwater monitoring across California is improving, but is still insufficient for understanding statewide groundwater use and regional water balances and their effect on water supply reliability.

Compounding the complexity of these problems is the increasing volatility of Delta water supplies as a consequence of climate change, including shifting seasonal precipitation and runoff patterns. The potential for catastrophic levee failure in the Delta and the risk to its residents and water delivery infrastructure posed by floods, sea level rise, seismic events, and land subsidence is real, growing, and has outpaced the State's ability to manage and fund risk-reduction measures.

The First Delta Plan: 2012

The Delta Plan is a legally enforceable, long-term management plan that must be updated at least every 5 years. The Delta Plan contains regulatory policies, which are mandatory, and recommendations, which are discretionary.

Any plan, project, or program that meets certain criteria ("covered actions") must be consistent with the Delta Plan, and the agency taking action must certify this consistency. Certain actions are exempted from the definition of covered action, including a regulatory action of a State agency, routine maintenance and operation of the SWP or the CVP, or local public agency routine maintenance or operation of any facility in the Delta (Water Code section 85057(b)). Detailed information regarding covered actions and the Council's certification and appeals processes is included in Chapter 3, Governance.

The Delta Plan also includes a series of nonregulatory recommendations to be considered by other agencies, the Legislature, or the Governor. Achieving the coequal goals will depend on collaborative effort and an unprecedented level of coordination and cooperation among State, federal, and local governments; they cannot be achieved singularly by the Council.

The Delta Plan shows how the diverse water supply system and all its components, including demands for water and how water is currently used, fits together with the need for an improved Delta ecosystem. The planning period is through the year 2100; this long-range planning term indicates the complexity of the job and the need for constant monitoring and adjusting of decisions (commonly called "adaptive management") informed by the best available science.

Concurrent Planning Processes to be Considered in Delta Plan Implementation

The Council would be remiss if the Delta Plan did not explicitly recognize that success in achieving the coequal goals and development of a comprehensive Delta Plan is dependent upon completion of several ongoing planning processes led by State and local agencies. These major planning efforts may significantly affect State and local policy in the Delta over the next decade. The following three are most notable among the major ongoing efforts:

- **The SWRCB's planned flow objective evaluations for the Delta and its major tributaries**: The Delta is currently managed according to flow objectives developed in 1999. Scientific understanding has evolved considerably since that date, and State policy establishing the Delta ecosystem and statewide water supply reliability as coequal is now law. The SWRCB currently

plans to have new flow criteria and objectives established for the Delta by 2014 and flow criteria for key tributaries in the Delta watershed by 2018,[1] and subsequently to develop flow objectives for major tributaries.

- **The Bay Delta Conservation Plan**: An applicant-driven, multi-stakeholder Habitat Conservation Plan/Natural Communities Conservation Plan process for the Delta has been in progress since 2006 and has the dual purpose of achieving greater water supply reliability through an improved Delta export water conveyance system, and contributing to recovery of threatened and endangered species in the Delta. The California Natural Resources Agency is leading the process. The Bay Delta Conservation Plan (BDCP) is not expected to be completed until after the first Delta Plan is adopted by the Council. The Council has a unique potential appellate role with respect to the BDCP outlined in the Delta Reform Act.[2]

- **The Central Valley Flood Protection Plan**: The California Department of Water Resources is developing an integrated flood management plan to protect areas of the Central Valley currently receiving protection from flooding by existing facilities of the State Plan of Flood Control. The Central Valley Flood Protection Plan is scheduled to be submitted to the Central Valley Flood Protection Board for adoption in July 2012 and will be updated every 5 years thereafter.[3]

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 specified conditions. Completion of the Bay Delta Conservation Plan process and the full suite of projects now under consideration in that process would have large impacts on the Delta and would affect the coequal goals. The Delta Reform Act includes a separate, explicit process for incorporation of the BDCP into the Delta Plan (Water Code section 85320). For more information about updating the Delta Plan and the inclusion of the BDCP or other plans in the Delta Plan, refer to Chapter 3, Governance: Implementation of the Delta Plan; Chapter 4, A Reliable Water Supply for California; Chapter 5, Restore the Delta Ecosystem; and Appendix A.

[1] http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/

[2] http://baydeltaconservationplan.com/

[3] http://www.water.ca.gov/cvfmp/

Additional critical processes led by other agencies include emergency response plans for each of the Delta counties and for the State and federal water projects, the Delta Protection Commission's *Economic Sustainability Plan* for the Delta,[4] California Emergency Management Agency's *Delta Multi-Hazard Coordination Task Force Recommendations,* and the Department of Parks and Recreation's *Delta Recreation Plan.*[5]

Pending completion of these plans and Council decisions to incorporate them in whole or in part, the 2012 Delta Plan lays out an initial roadmap for achieving the coequal goals and its inherent objectives over the next 5 years and beyond.

What the Delta Plan Will Achieve by 2100

The Delta Plan must achieve the coequal goals and its inherent objectives in the face of dramatically changing conditions. The Delta of 2100 likely will be very different from the Delta of today. 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 seismicity—most beyond human ability or willingness to control. Human-made changes in land use and water use are also expected to continue.

The Delta Plan lays out a suite of regulatory policies and recommendations intended to address the current and predicted ecological, flood control, 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 will need to adapt.

Table 1-1 summarizes the range of changes anticipated by 2050 and, in some cases, by 2100. These are the expected changes, allowing consideration of new policies and investments. The Delta Plan also must prepare California for the possibility of large, unexpected changes.

Restoring the Delta ecosystem and providing a more reliable water supply to California will require a broad range of linked actions, most of which will need to be developed and adapted over time as new information is developed and as additional resources are made available. These actions will have to anticipate likely changes (see Table 1-1) and adjust to unexpected changes. The guiding vision for the Delta Plan—the achievement of the coequal goals and inherent objectives—is intended to result in the following outcomes by 2100:

- The coequal goals of restoring the Delta ecosystem and providing a more reliable water supply for California 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 California's Constitutional Article 10, Section 2, requirements for beneficial use, reasonable water use, and no waste have produced maximal optimization of 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.

- California's water conveyance and storage facilities in the Delta watershed are significantly improved and better integrated. State and regional storage in the watershed and elsewhere has expanded over the past century. Water is exported from the Delta in a manner that has less impact on the ecosystem. Robust, real-time, and relevant information about water use and availability

[4] http://www.delta.ca.gov

[5] http://www.parks.ca.gov

allows surface supplies and groundwater to be managed in an integrated, adaptable, and sustainable manner statewide.

Table 1-1
Summary of Anticipated Changes Affecting the Delta by 2050 and 2100

	Change predicted by 2050	Change predicted by 2100
Population of California[a]	Increase from 39.1million in 2010 to 59.5 million, a 52% increase	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	40 to 55 inches
Snow pack, relative to 1956–2000 average of 15 MAF[f]	Reduction of 25% (4.5 MAF) to 40% (6 MAF)	

a California Department of Finance 2007

b 2007 Working Group On California Earthquake Probabilities. 2008

c DWR 2008

d For examples, see research by Richard Seager, Colombia 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/background/index.html

e California Ocean Protection Council 2011

- California leads the nation in water efficiency and sustainable water use. Water use by all segments of the economy is reduced, and urban per capita water use is reduced by 50 percent or more statewide.[6] Regions of California that previously had severe groundwater overdraft conditions now sustainably manage these water resources. Significant new local and regional water supplies—recycled water, storm water, desalinated water, and reclaimed impaired groundwater—have been developed. As a result of all these actions, California is less reliant on water supply from the Delta overall, and is able to better withstand imported water interruptions and other expected and unexpected changes of the coming century without severe disruptions to the state's economy or environment.

- Large areas of the Delta have been restored in support of a healthy estuary. A diverse mosaic of interconnected habitats— areas of open water, tidal marshes, floodplains, riparian, and upland areas—is reestablished in the Delta and its watershed. Migratory corridors for fish, birds, and terrestrial wildlife have been largely protected and restored. Actions have been taken to ensure that sufficient freshwater flows following a more natural hydrograph are now dedicated to support a healthy ecosystem. Actions have reduced the impacts caused by invasive species, poor water quality, loss of habitat, and urban development, improving conditions for native species of fish, birds, and wildlife that depend on the Delta and its watershed.

- Delta agriculture remains an important and dynamic part of the Delta. In addition to traditional agricultural pursuits, new frontiers in terms of environmental stewardship and mixed agricultural and environmental innovation may include development of new markets and technologies to sustain and rebuild Delta soils, enhance wildlife, and improve air and water quality. Visitors from

6 From baselines as defined in Water Code section 10608.12(b)

around the world are drawn to the Delta for recreation and to experience its beauty, ecosystem, and agricultural bounty. The Delta is a place where agricultural, recreational, and environmental uses are uniquely integrated and continue to contribute in important ways to the regional economy.

- The Delta—while evolving in response to sea level rise, earthquakes, floods, and major urbanization around the outside—remains a socially and environmentally distinctive and culturally significant region that is overwhelmingly rural. Within that context, the Delta remains a vibrant, changing, and evolving place. Local, State, and federal agencies have worked together to adapt and prepare for future changes caused by natural forces. Land use policies and levee improvements are consistent with the human, property, and statewide interests in the Delta. Although continued changes are expected, progress toward achieving the coequal goals will protect the uniqueness of the Delta and provide a strong foundation for enhancing the resources and cultural and agricultural values of the Delta as an evolving place for the next century.

Phasing of the Delta Plan and the First 5 Years

Over the next 90 years, the Delta Plan will be developed in phases, consistent with the principles of adaptive management and availability of new and improved information. Again, the Council must review the Delta Plan at least every 5 years, but may adopt revisions more frequently. The **initial 5 years** after adoption of the Delta Plan will be critical. Additional, vital sources of information, including the BDCP, Delta water flow standards, and improved water use data are scheduled to become available during this 5-year period.

PHASING OF THE DELTA PLAN – BOX IN DEVELOPMENT

Therefore, the 2012 Delta Plan includes regulatory policies and recommendations for actions that fall into the following three broad categories:

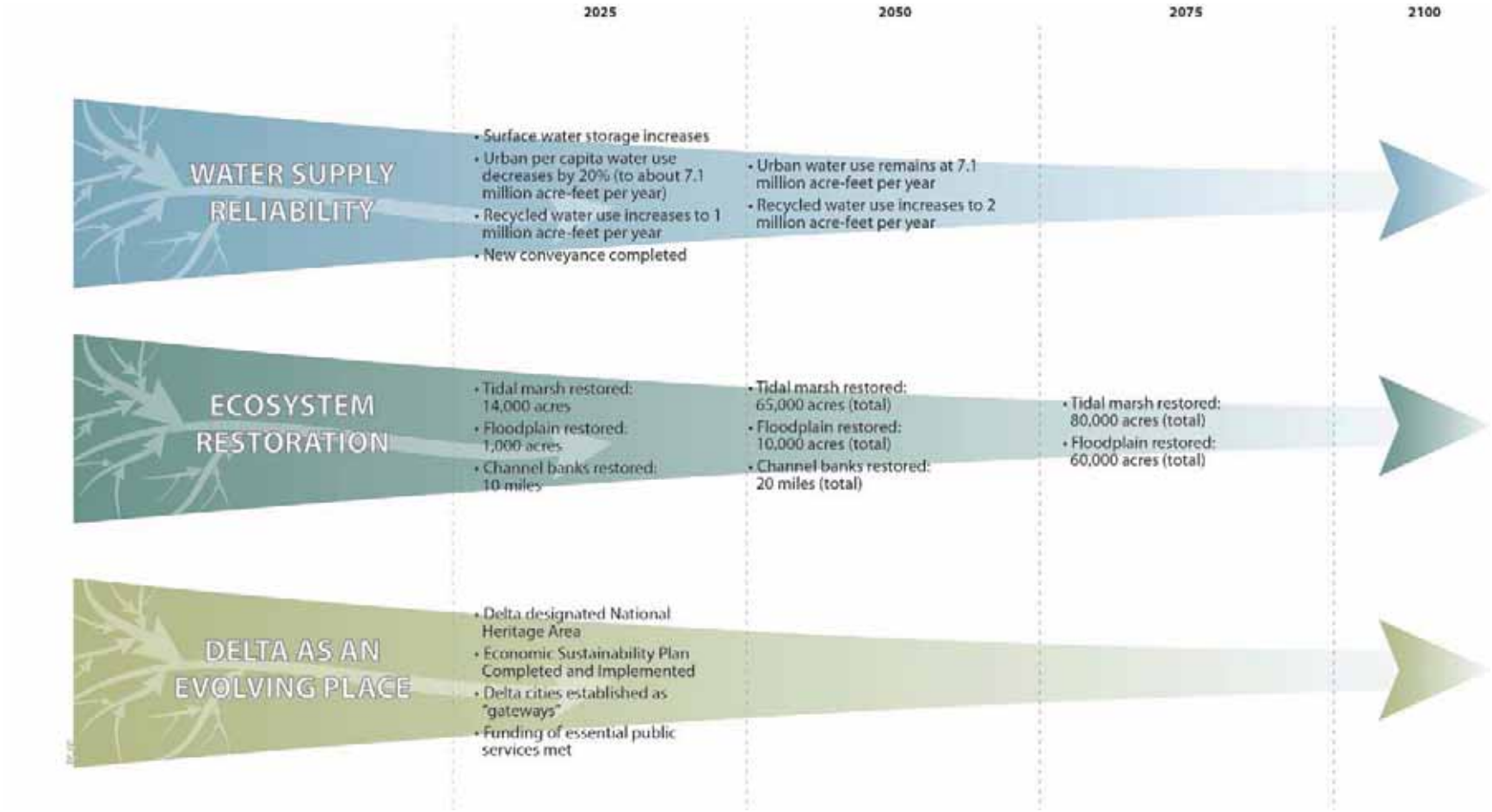
- Actions that prevent worsening the situation
- Actions that improve the situation
- Actions that will make it easier or possible to take additional positive actions in the future

The Delta Plan will have additional key milestones in the future for the Council to evaluate performance toward achieving the coequal goals. Figure 1-1 shows target outcomes for Delta Plan implementation.

Geographic Scope and Use of the Delta Plan

Because California's water supply reliability and Delta ecosystem concerns are united in the Delta, the geographic scope of the Delta Plan must include areas that divert water upstream of the Delta and those areas that receive export water from the Delta. In setting these boundaries, the Council recognized that the Delta Reform Act requires that the Delta Plan address certain statewide water issues vital to sustainable management of the Delta (see, for example, Water Code sections 85020(a),(d),(f), and (h) 85302(b), 85303, 85304, and 85307 (a)).

Figure 1-1
Target Outcomes for the Delta Plan [CONCEPTUAL. DRAFT UNDER DEVELOPMENT.]



The scope of the Delta Plan encompasses the Delta and Suisun Marsh, the Delta watershed, and areas of the state that use water from the Delta watershed, as shown in Figure 1-2.

- The Primary Planning Area includes the legal Delta (as defined by the Delta Protection Act of 1992) and the Suisun Marsh. For purposes of the Delta Plan, the Delta and the Suisun Marsh are collectively referred to as the "Delta," unless otherwise specified. Figure 1-3 shows the Delta and Suisun Marsh.
- The Secondary Planning Area includes the Delta watershed, the Upper Trinity River Watershed, and areas outside the Delta in which exported water is used.

Use of Adaptive Management in the Delta Plan

The Council is required by law to use the best available science and adaptive management as the basis for the Delta Plan. The Delta Plan must include "a science-based, transparent, and formal adaptive management strategy for ongoing ecosystem restoration and water management decisions" (Water Code section 85308(f)).

The scientific body of knowledge of the Delta and California's water conditions is constantly growing and changing, but Delta-related resource management decisions are often made with incomplete information.

Adaptive management provides the necessary flexibility to manage complex natural resources in the face of considerable uncertainty. Adaptive management starts with information. The Delta Plan requires the development and submission of water use data and other data that are currently unavailable or inaccessible. This information is foundational to scientific judgments and adaptive management, and will inform the Council as it updates future versions of the Delta Plan. The next chapter, Science and Adaptive Management for a Changing Delta, describes an adaptive management framework to guide the development and subsequent revisions of the Delta Plan. The framework includes an assessment of progress toward meeting the objectives of the Delta Reform Act and Delta Plan, and identification and assessment of possible adaptive management actions.

In addition, large-scale ecosystem restoration and water management covered actions will be required to adhere to the adaptive management framework described in Chapter 2. Proponents of proposed covered actions must describe how they intend to apply the adaptive management framework, including a commitment for communicating to the public the information learned during the monitoring and assessment of implemented actions. The Council will use the improved understanding gathered through the implementation of covered actions and associated research to revise the Delta Plan.

Organization of the Delta Plan

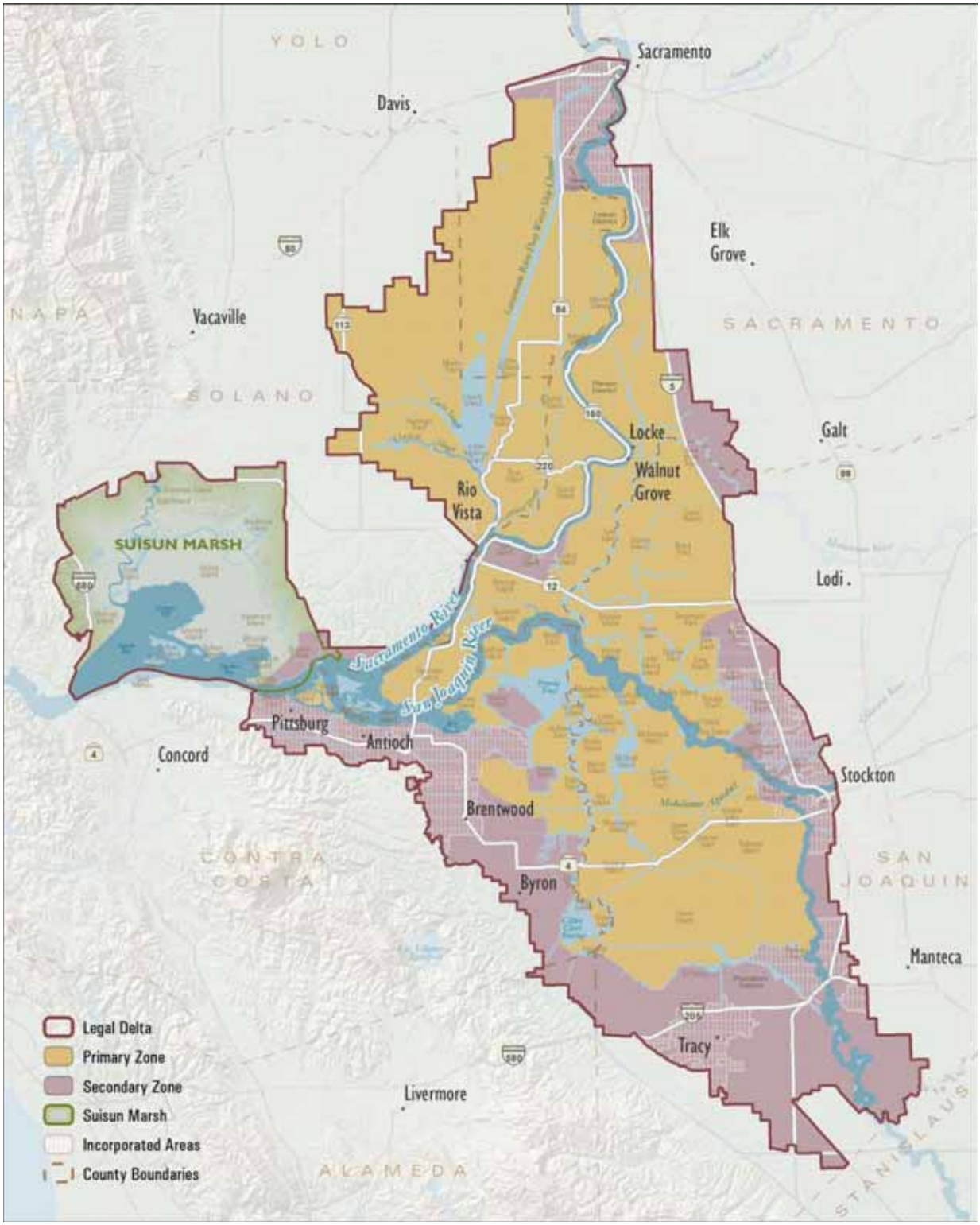
The Delta Plan is organized around the specific subgoals, strategies, actions, and measures set forth in the Delta Reform Act. As mentioned at the beginning of this chapter, Water Code section 85020 provides the general framework for the organization of the Delta Plan chapters.

Chapter 2, Science and Adaptive Management for a Changing Delta, explores the topic of adaptive management, a core practice necessary to achieve the coequal goals. In the Delta Plan, adaptive management is a tool that will be used to evaluate the plan's success with meeting the coequal goals and will also be a required element for certain covered actions as described in Chapter 3.

Chapter 3, Governance: Implementation of the Delta Plan, describes some of the Council's processes and procedures with respect to their appellate role in judging consistency with the Delta Plan, and their responsibility for updating the Delta Plan. Importantly, this chapter includes regulations required of all covered actions.

Figure 1-2
Delta Plan Study Area

Figure 1-3
Legal Delta and Suisun Marsh



Chapters 4 through 8 are policy chapters and are organized as follows:

- Chapter 4, A More Reliable Water Supply for California
- Chapter 5, Restore the Delta Ecosystem.
- 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.
- Chapter 8, Protect and Enhance the Unique Cultural, Recreational, Natural Resources, and Agricultural Values of the California Delta as an Evolving Place.

Chapter 9 presents a Finance Plan framework for funding of water supply and water-supply-related ecosystem investments, current and potential future funding sources, and recommendations to the California Legislature from the Council for future funding strategies.

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Chapter 2
Science and Adaptive Management for a Changing Delta

The Delta Reform Act seeks to provide a strong science foundation for decisions of the Council, seen in both provisions for a science program and an independent science board (Water Code sections 85480):

> *85280 (a) The Delta Independent Science Board is hereby established in state government*
>
> *85280 (a)(3) The Delta Independent Science Board shall provide oversight of the scientific research, monitoring, and assessment programs that support adaptive management of the Delta through periodic reviews of each of those programs that shall be scheduled to ensure that all Delta scientific research, monitoring, and assessment programs are reviewed at least once every four years.*
>
> *85280 (b)(4) The mission of the Delta Science Program shall be to provide the best possible unbiased scientific information to inform water and environmental decisionmaking in the Delta. That mission shall be carried out through funding research, synthesizing and communicating scientific information to policymakers and decisionmakers, promoting independent scientific peer review, and coordinating with Delta agencies to promote science-based adaptive management. The Delta Science Program shall assist with development and periodic updates of the Delta Plan's adaptive management program.*

The Delta Reform Act requires the inclusion of science-based adaptive management in the Delta Plan as defined and stated in Water Code sections 85308(f) and 85052:

> *85308(f) Include a science-based, transparent, and formal adaptive management strategy for ongoing ecosystem restoration and water management decisions*
>
> *85052 "Adaptive management" means 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.*

The Delta Reform Act also requires that the Delta Plan is based upon and implemented using the best available science:

> *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.*
> >
> > *(e) Where appropriate, recommend integration of scientific and monitoring results into ongoing Delta water management.*
>
> *85302(g) In carrying out this section, the council shall make use of the best available science.*

1

Chapter 2
Science and Adaptive Management for a Changing Delta

The Delta Reform Act requires a strong science foundation for Delta Stewardship Council (Council) decisions; specifically, this includes the ongoing provision of scientific expertise to support the Council through the Delta Science Program and Delta Independent Science Board (Water Code section 85280); requires that the Delta Plan is based on and implemented using the best available science (Water Code sections 85308 (a) and (e) and 85302(g)); and requires the use of science-based, transparent, and formal adaptive management strategies for ongoing ecosystem restoration and water management decisions (Water Code section 85308(f)).

Adaptive management is defined in Water Code section 85052 as follows: "'Adaptive management' means a framework and flexible decisionmaking process for ongoing knowledge acquisition, monitoring, and evaluation leading to continuous improvements in management planning and implementation of a project to achieve specified objectives." Adaptive management is not widely practiced and is not currently being used to its fullest extent in the Delta. The Delta Plan calls for more effectively using adaptive management for planning, doing, and evaluating and responding to actions that affect Delta ecology and water operations.

The adaptive management approach provides a structured process that allows for making decisions on the basis of best available science, closely monitoring and evaluating outcomes, and reevaluating and adjusting decisions after more information is learned (Christensen et al. 1996, Abal et al. 2005, Healey et al. 2008). Adaptive management is smart management—it provides the necessary flexibility and feedback to manage natural resources in the face of often considerable uncertainty regarding management effects. Adaptive management closely integrates policy, management, and science in an ongoing, clearly structured, transparent, timely, and inclusive cycle.

Under the Delta Plan, proposed ecosystem restoration and water management covered actions will be required to develop a formal strategy consistent with this adaptive management framework. Proponents of ecosystem restoration and water management covered actions must describe how the adaptive management framework will be implemented per the policy included in Chapter 3, Governance: Implementation of the Delta Plan.

Where appropriate, and as information becomes available, the Council will use adaptive management to revise and update the Delta Plan.

Adaptive Management and the Delta

The Delta and our understanding of the Delta are constantly undergoing change (e.g., Healey et al. 2008, Lund et al. 2010). Adaptive management is an approach to resource management that is applied to

systems that constantly undergo change. Proposed ecosystem restoration and water management covered actions in the Delta must allow and plan for adaptive management of the Delta as a changing place. In addition to presenting a framework for adaptive management for use by the Council in Delta Plan updates, this chapter also provides detailed steps for the application of adaptive management to ecosystem restoration and water management proposed covered actions. The regulatory policy describing how these types of proposed covered actions are expected to demonstrate compliance with the adaptive management framework is provided in Chapter 3.

A Nine-Step Adaptive Management Framework

Several frameworks for adaptive management have been developed elsewhere and provide the basis for the adaptive management approach for the Delta Plan (Christensen et al. 1996, Stanford and Poole 1996, CALFED Bay-Delta Program 2000, Habron 2003, Abal et al. 2005, Healey 2008, Kaplan and Norton 2008, Bay Delta Conservation Plan Independent Science Advisors on Adaptive Management 2009, Williams et al. 2009). Although differences among various frameworks exist, they generally contain three broad areas: Plan, Do, and Evaluate and Respond. Throughout all three areas of the adaptive management process, decisions are made by managers, policy makers and/or technical experts; there is no single decision-making step in the adaptive management framework.

The Council will use the nine-step adaptive management framework in Figure 2-1 to evaluate the use of adaptive management for proposed ecosystem restoration and water management covered actions. This framework and the description of each step are largely derived from Stanford and Poole (1996), CALFED Bay-Delta Program (2000), Abal et al. (2005), and the Bay Delta Conservation Plan Independent Science Advisors on Adaptive Management (2009).

Proposed covered actions should include an adaptive management plan that considers all nine steps of this framework; however, they need not be rigidly included and implemented in the order described here. The intent is to build logical and transparent information flows and decision points into management actions that increase management options and improve outcomes, not to add a new layer of rigid processes and bureaucracy.

Plan

The "plan" area of the adaptive management framework is presented as four steps.

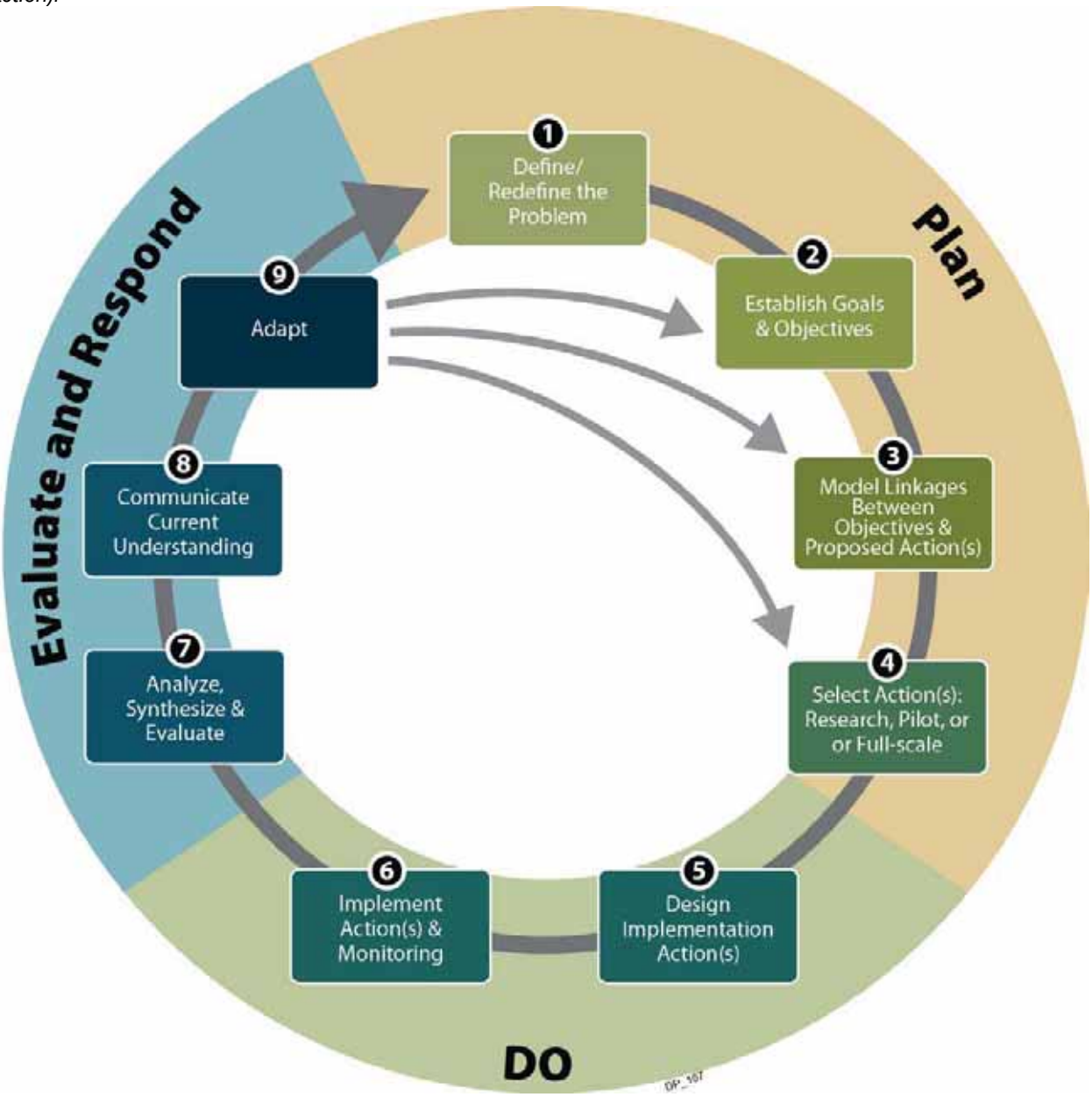
1. Define/Redefine the Problem

The first step of effective adaptive management is to clearly define the problems that will be addressed. This should take the form of a problem statement. The problem statement should clearly link to program goals and to specific objectives, which are to be developed by proponents in an open and transparent manner. All problem statements must be based on the best available science (described later in this chapter) and clearly documented information. Defining a problem commonly requires defining the boundaries of the problem (for example, the geographic scale and the temporal scale).

2. Establish Goals and Objectives

Clear goals and objectives must be established by proponents and be based on the best available science. Goals are broad statements that propose general solutions. Objectives are more specific than goals, and are often quantitative, specific narrative statements of desired outcomes allowing evaluation of how well the objectives are being achieved.

Figure 2-1
A Nine-Step Adaptive Management Framework for the Delta Plan
The shading represents the three broad areas of adaptive management (Plan, Do, and Evaluate and Respond), and the boxes represent the nine steps within the adaptive management framework. The circular arrow represents the general sequence of steps. The additional arrows indicate possible next steps for adapting (for example, adapting the selected action).



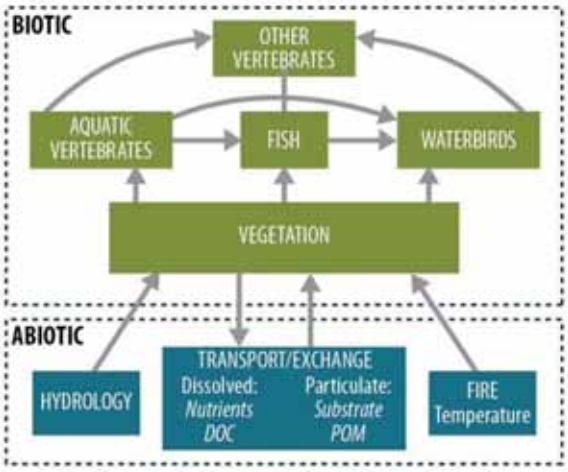
3. Model Linkages Between Objectives and Proposed Action(s)

Models formalize and apply current scientific understanding, develop expectations, assess the likelihood of success, and identify tradeoffs associated with different management actions. Models can be conceptual, statistical, physical, decision support, or simulation. Models link the objectives to the proposed actions and clarify why an intended action is expected to result in meeting its objectives. Models provide a road map for testing hypotheses through statements that describe the expected outcome of an action.

Kissimmee River Restoration Project

The Kissimmee River, located in south-central Florida, was substantively channelized for flood-control purposes in the 1960s (Toth et al. 1998). In the 1990s extensive planning began for a 15-year restoration project designed to restore 70 km of river channel and 104 km2 of floodplain; the largest attempted river restoration project in the world (Dahm et al. 1995). To adaptively manage the restoration of the Kissimmee River system, adaptive research, monitoring, and evaluation programs were developed to provide a scientific foundation for fine-tuning each phase of the restoration effort (Toth et al. 1998). The Kissimmee River restoration project's adaptive management process is a positive example of several steps of the adaptive management framework in practice. To "model linkage between objectives and proposed action(s)", conceptual models were developed to anticipate the restored Kissimmee River ecosystem, predict patterns of response for abiotic and biotic variables, and consider methods and performance measures for evaluating progress toward restoration within the river basin (Dahm et al. 1995). A practical example of the "design and implementation of a monitoring plan" step is the Kissimmee River Restoration Evaluation Program (KRREP), a comprehensive monitoring program designed to evaluate ecosystem responses to the restoration project through comprehensive monitoring and assessment of data collected before and after major construction phases (South Florida Water Management District). When the KRREP observes that changes in the river system following a construction phase do not achieve the expected result, adaptive management strategies are considered. For more information about the Kissimmee River Restoration Project please visit:
http://my.sfwmd.gov/portal/page/portal/xweb%20protecting%20and%20restoring/kissimmee%20river.

Implemented Kissimmee River Restoration Project on February 9, 2001. Photo shows the backfilled canal, degraded soil area ,remnant river channel, the connector channel, and wetland areas.



General conceptual model of ecosystem structure and interactions for the Kissimmee River and floodplain (Dahm et al. 1995)

Both qualitative (conceptual) and quantitative models can effectively link objectives and proposed actions by illuminating if and how different actions meet specific objectives. Conceptual models are particularly useful for decision makers, scientists, and the public because they illustrate the most critical cause-and-

effect pathways. Conceptual models provide an articulation of the hypotheses being tested and how various actions might achieve particular objectives. Conceptual models also help to develop performance measures, which are qualitative or quantitative information that tracks status and trends toward meeting objectives. Conceptual models should be used in adaptive management planning because they help explain how other types of models, research, and actions will be used to explore hypotheses and address specific existing and anticipated uncertainties.

4. Select and Evaluate Action(s): Research, Pilot, and Full-scale

The process for selecting and evaluating an action or suite of actions to meet objectives includes an evaluation of the best available science represented in the conceptual model. This evaluation should inform the level of the action(s) to be taken (research, pilot-scale project, or full-scale project), the geographical and temporal scale of the action(s), the degree of confidence in its benefits, and the consequences of being wrong. The scale of the action selected should be informed by the certainty of the relevant scientific information and account for the potential cost of delaying larger-scale actions. For example, when the best available science cannot predict the outcome of an action with a reasonable degree of certainty and irreversible consequences exist for wrongly predicting the outcomes of an action, further research or a pilot-scale action is likely more appropriate than a full-scale action, unless the cost of delaying a larger-scale action is very high (for example, a species of concern goes extinct or urban water supplies are cut off). In some instances, choosing to take "no action" could be the best selection (when no foreseen benefit would result from a research, pilot-scale, or full-scale action). Where possible, the action(s) selected should test cause-and-effect relationships in the conceptual model so that the model can be adapted using the information learned from implementing the action(s).

Do

The "do" area of adaptive management includes two steps that occur in parallel.

5. Design and Implement Action(s)

The design and implementation of action(s) includes clearly describing specific activities that will occur under the selected action(s) and how they will link to the monitoring plan. Design includes creating a plan for implementing both the action(s) and monitoring responses from the action(s). The design of the action(s) should be informed by existing uncertainties, and directly link to meeting the goals and objectives. Action(s) should be designed with the entire adaptive management process in mind. This means that the monitoring and actions are designed with data-collection methods that allow for analysis using statistical comparisons or other methods of assessment, the duration of implementation covers a time period over which major change is expected to occur, and "what if" scenarios for when to adapt are thought through in advance. Simulation models could be a useful tool for assessing these design components. The design step also includes identifying adequate funding to carry out both the action(s) and the associated monitoring for an appropriate length of time.

6. Design and Implement Monitoring Plan

A well-designed monitoring plan includes a data-management plan. A data-management plan describes the process for organizing and clearly documenting observations, including how data are collected; the methods, quality assurance, and calculations used; the time and space scales of the variables; and accurate site locations and characteristics. Data management is critical for analyses, syntheses, and evaluations.

A well-designed monitoring plan goes beyond data collection and data management. A monitoring plan often includes targeted research to answer why certain results are observed and others are not. A monitoring plan also includes clear communication of the information gathered and current understanding drawn from this information. A complete monitoring plan includes the following types of monitoring: compliance monitoring (required by permits), performance monitoring (measuring achievement of

targets), mechanistic monitoring (testing the understanding of linkages in the conceptual model), and system-level monitoring (holistic and long term). These types of monitoring can measure and communicate various types of information, such as administrative/inputs (such as dollars awarded and spent, projects funded, and the like), compliance/outputs (such as tons of gravel added or acres exposed to tidal action), and effectiveness/outcomes (such as actual outcome expected from implementing an action at the local scale, suites of actions at the system-wide scales, and status and trends assessments) that measure and communicate different types of information. Within the monitoring plan design, an integrated suite of monitoring metrics must be developed that can be integrated and summarized to inform decision makers and the public as described in the *Communicate Current Understanding* step in Figure 2-1.

Implementation of actions and monitoring should be closely coordinated. Before an action is implemented, initial conditions should be clearly documented to the extent practicable so that a baseline is established. Baseline data includes characterization of natural variation observed in the examined system over space and time. For many ecological and hydrological variables, an extensive set of baseline data is available because of the efforts of the Interagency Ecological Program and repositories of information such as the U.S. Geological Survey and the California Department of Water Resources. The implementation of action(s) and monitoring should be executed in a transparent manner and clearly communicated to the public. Status and trends metrics that compare conditions before and after action implementation are often good assessment and communication tools.

Evaluate and Respond

The *Evaluate and Respond* area of adaptive management includes three key steps.

7. Analyze, Synthesize, and Evaluate

Analysis, synthesis, and evaluation of the action(s) and monitoring are critical for improving current understanding. Analysis and synthesis should be informative of how conditions have changed, expectedly and unexpectedly, as a result of implementing the action(s). The evaluation should examine whether or not performance measures indicate that one or more of the objectives have been met as a result of the implemented action(s), and if so, why. If an objective is not met, an explanation of the potential reasons why the objective has not been met should be clearly identified and communicated. The results of the analysis, synthesis, and evaluation step could be published in technical peer-reviewed papers and reports for the purpose of external review, transparency, and accessibility where results warrant this level of communication.

8. Communicate Current Understanding

Communication of current understanding gained through analysis, synthesis, and evaluation of implemented action(s) and monitoring is a key step for informing and equipping policy makers, managers, stakeholders, and the public to appropriately respond and adapt. This step spans the *Do* and the *Evaluate and Respond* areas of adaptive management because the communication of current understanding and related recommendations for change requires both policy and technical expertise. The information communicated should be technically sound, well synthesized, and translated into formats conducive to informing a nontechnical audience (for example, a report card format or a general science outlet such as a newsletter), and should be disseminated to those directly involved in the adaptive management process for the plan, program, or project and to those interested in the outcome of the action.

Technical staff and decision makers should be regularly involved in the exchange of information as data are analyzed and synthesized. Communication should be ongoing and occur at appropriate time scales for which an improved understanding could lead to refining other steps of the adaptive management framework. The key to successful communication is a skilled and dedicated interdisciplinary person or

Healthy Waterways Initiative

Healthy Waterways 2010 Annual Report Card
(grades for 2010 are in brown, grades from 2009. are in gray).

In South East Queensland, Australia, the Healthy Waterways Initiative was designed and implemented to improve the health of regional waterways and catchments including the ecosystems supporting the livelihoods and lifestyles of the people in this rapidly growing part of Australia. The initiative's collaborative partners developed an adaptive management framework as an operating philosophy for their partnership and the Healthy Waterways Plan. Adaptive management is a corner-stone of the decade-long implemented initiative. The initiative's practice of adaptive management has led to an improved understanding for dealing with resource management issues and the flexibility necessary for dealing with changing socio-economic and socio-ecological relationships in South East Queensland (Abal et al. 2005). The Healthy Waterways Initiative has done an exemplary job at the "communicate current understanding" and "adapt" steps of adaptive management. Communication of current understanding is facilitated through a commitment to public education and outreach, annual public report cards, and the use of leading technology to analyze, interpret and communicate waterways information through the health-e-waterways dynamic report cards (http://www.health-e-waterways.org/). These communication efforts have led to adapting actions based on current understanding, which are evaluated in the next year's annual report card.

Details about the Healthy Waterways Initiative and its adaptive management elements can be found at www.healthywaterways.org.

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team who understands the technical information learned, the functional needs of the decisionmakers, and how to best transmit this information.

9. Adapt

Proponents of ecosystem restoration and water management covered actions need to be engaged and prepared to adapt to a change in current understanding. Informed and equipped with new results and understanding, decision makers should reexamine the other steps of the adaptive management framework and revise these steps where current understanding suggests doing so. Possible next steps could include redefining the problem statement, amending goals and objectives, altering the conceptual model, or selecting an alternative action for design and implementation.

Knowledge Base for Adaptive Management

The knowledge base is the foundational scientific understanding of a system, both environmental and social, that creates the context for planning stages of science-based adaptive management. A strong knowledge base informs policy makers and the public. It has wide benefit, as seen in the work of the Council's Delta Science Program (formerly the CALFED Science Program), whose mission is to provide the best possible scientific information for water and environmental decision making in the Delta. The following elements of the knowledge base also provide information necessary to effectively *Plan*, *Do*, and *Evaluate and Respond* within an adaptive management framework: (1) best available science, (2) scientific research, (3) monitoring, and (4) a Delta Science Plan. These elements create the capacity for informed planning, meaningful actions and associated monitoring, and knowledgeable evaluating and responding.

Best Available Science

Best available science is specific to the decision being made and the timeframe 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 shall be developed and presented in a transparent manner, including clear statements of assumptions, the use of conceptual models, description of methods used, and presentation of summary conclusions. Sources of data used shall be cited, and analytical tools used in analyses and syntheses shall be identified. Best available science changes over time, and decisions may need to be revisited as new scientific information becomes available. Targeted investment in science reduces scientific uncertainty and improves best available science.

Best available science must be consistent with the scientific process (Sullivan et al. 2006) that is described below, and includes steps for achieving the best science, guidelines and criteria, effective communication and documentation, and a process for reviewing the scientific rationale upon which Delta Plan strategies and performance measures are built. Ultimately, best available science requires the best 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.

Steps for Achieving the Best Science

Science consistent with the scientific process includes the following elements: well-stated objectives; a clear conceptual or mathematical model; a good experimental design with standardized methods for data collection; statistical rigor and sound logic for analysis and interpretation; and clear documentation of methods, results, and conclusions. The best science is transparent; it clearly outlines assumptions and limitations. The best science is also reputable; it has undergone peer review conducted by active experts in the applicable field(s) of study. Scientific peer review addresses the validity of the methods used, the

adequacy of the methods and study design in addressing study objectives, the adequacy of the interpretation of results, whether the conclusions are supported by the results, and whether the findings advance scientific knowledge (Sullivan et al. 2006).

Several sources of scientific information and tradeoffs are associated with each (Sullivan et al. 2006, Ryder et al. 2010). The primary sources of scientific information, in a generalized ranking of most to least scientific credibility for informing management decisions, include the following: independently peer-reviewed publications including scientific journal publications and books (most desirable); other scientific reports and publications; science expert opinion; and traditional knowledge. Each of these sources of scientific information may be the best available at a given time, containing varying levels of understanding and uncertainty. These limitations shall be clearly documented for scientific information used as the basis for decisions.

Guidelines and Criteria

Best available science for proposed covered actions and for use in the Delta Plan should be consistent with the guidelines and criteria developed by the National Research Council and the State of Washington. Proposed covered actions should document that the science used follows the criteria adapted from the National Research Council report as they apply to the Delta environment, summarized in Table 2-1.

It is recognized that there are differences in the accepted standards of peer review for various fields of study and professional communities. When applying the above criteria for best available science, the Council will recognize that the level of peer review for supporting materials and technical information (such as scientific studies, model results, and documents) included in the scientific justification for a proposed covered action is variable and relative to the scale, scope, and nature of the proposed covered action. The Council understands that varying levels of peer review may be commonly accepted in various fields of study and professional communities, and will consider this when reviewing the scientific justification for proposed covered actions.

Several efforts have been conducted to develop criteria for defining and assessing "best available science." In 2004, the National Research Council Committee on Defining the Best Scientific Information Available for Fisheries Management prepared a report (National Research Council Report) that concluded guidelines and criteria need to be defined in order to apply best available science in natural resource management (National Research Council 2004). Major findings and recommendations included establishing procedural and implementation guidelines to govern the production and use of scientific information. The guidelines were based on six broad criteria: (1) relevance, (2) inclusiveness, (3) objectivity, (4) transparency and openness, (5) timeliness, and (6) peer review.

The Legislature of the State of Washington also developed criteria for assessing best available science that are used by counties and cities in developing policies and regulations pursuant to the Washington State Growth Management Act. The State of Washington criteria include six characteristics for a valid scientific process: (1) peer review, (2) methods, (3) logical conclusions and reasonable inferences, (4) quantitative analyses, (5) context, and (6) references (Washington Administrative Code).

Scientific Research to Inform Delta Decision Making

Scientific understanding about the Delta is not static and has changed considerably over time (Healey et al. 2008, Lund et al. 2010). For example, our understanding of key drivers in ecological and social components of the Delta has evolved (see sidebar, "Changing Perspectives on Science in the Delta").

Table 2-1
Criteria for Best Available Science

Criteria	Description
Relevance	Scientific information used should be germane to the Delta ecosystem and/or biologic organism (and/or process) affected by the proposed covered actions. Analogous information from a different region, but applicable to the Delta ecosystem and/or biota may be the most relevant when Delta-specific scientific information is nonexistent or insufficient. The quality and relevance of the data and information used shall be clearly addressed.
Inclusiveness	Scientific information used shall incorporate a thorough review of relevant information and analyses across relevant disciplines. Many analysis tools are available to the scientific community (e.g., search engines and citation indices).[a]
Objectivity	Data collection and analyses considered shall meet the standards of the scientific method and be void of non-scientific influences and considerations.[b]
Transparency and Openness	The sources and methods used for analyzing the science (including scientific and engineering models) used shall be clearly identified. The opportunity for public comment on the use of science in proposed covered actions is recommended. Limitations of research used shall be clearly identified and explained. If a range of certainty is associated with the data and information used, a mechanism for communicating uncertainty shall be employed.
Timeliness	There are two main elements of timeliness: (1) data collection shall occur in a manner sufficient for adequate analyses before a management decision is needed, and (2) scientific information used shall be applicable to current situations. Timeliness also means that results from scientific studies and monitoring may be brought forward before the study is complete to address management needs.[c] In these instances, it is necessary that the uncertainties, limitations, and risks associated with preliminary results are clearly documented.
Peer Review	The quality of the science used will be measured by the extent and quality of the review process. Independent external scientific review of the science is most important because it ensures scientific objectivity and validity.[d] The following criteria represent a desirable peer review process:[e] Independent External Reviewers. A qualified independent external reviewer embodies the following qualities: (1) has no conflict of interest with the outcome of the decision being made, (2) can perform the review free of persuasion by others, (3) has demonstrable competence in the subject as evidenced by formal training or experience, (4) is willing to utilize his or her scientific expertise to reach objective conclusions that may be incongruent with his or her personal biases, and (5) is willing to identify the costs and benefits of ecological and social alternative decisions. When to Conduct Peer Review. Independent scientific peer review shall be applied informally or formally to proposed projects and initial draft plans, formally in writing after official draft plans or policies are released to the public, and formally to final released plans. Coordination of Peer Review. Independent peer review shall be coordinated by entities and/or individuals that (1) are not a member of the independent scientific review team, (2) have a particular and special expertise in the subject under review, and (3) have had no direct involvement in the particular actions under review.

a. McGarvey 2007.
b. National Research Council 2004, Sullivan et al. 2006.
c. National Research Council 2004.
d. Meffe et al. 1998.
e Adapted from Meffe et al. 1998.

To build the knowledge base for informing adaptive management in the Delta over the next few decades, ongoing investment in research is essential for understanding how the system changes over time. This research should be organized in a science plan for the Delta. Delta-related research should (1) focus upon key uncertainties, (2) support the best and brightest through competitive grant programs, (3) invest in young scientists and researchers, (4) use peer review in the selection of research projects, (5) look to local and outside experts to focus and define research topics, and (6) welcome and support alternative ways of learning about the system (for example, through involvement of local communities in scientific projects and discussions). The Delta Science Program will be the central entity in supporting new research to understand the changing Delta and build upon the knowledge base used to support adaptive management.

Directed research to more rapidly address specific scientific information needs of agencies operating in the Delta will continue to be supported by these agencies through the cooperative Interagency Ecological Program (IEP) for the San Francisco estuary. The IEP is a cooperative effort of nine State and federal agencies to monitor and study ecological changes in the Delta. The IEP works closely with the Delta Science Program to coordinate, integrate, and oversee research activities in the Delta.

Monitoring

A comprehensive monitoring plan that emphasizes routine monitoring and targeted research are essential to the success of adaptive management and should be well described in the science plan for the Delta. Monitoring to detect change in the Delta will require that objectives of the monitoring be clearly linked to actions emanating from well-stated goals and objectives. Monitoring activities in the Delta should build upon the strengths and long-term data sets of the IEP and other regional monitoring programs. The IEP produces publicly accessible data sets that include fish and wildlife status and trends, water quality, estuarine hydrodynamics, and food web monitoring. A comprehensive monitoring plan for the Delta should expand on the work of the IEP and plan for coordinated synthesis, integration, and communication beyond monitoring associated with covered actions.

Changing Perspectives on Science in the Delta

The State of Bay-Delta Science, 2008 was published to summarize and synthesize the current scientific understanding of the Bay-Delta at that time. The Delta Science Program, along with the Department of Fish and Game's [Ecosystem] Restoration Program, fund research to improve scientific understanding of the Bay-Delta ecosystem on topics relevant to decision makers' needs for making informed management and policy decisions.
http://www.science.calwater.ca.gov/pdf/publications/sbds/sbds_final_update_122408.pdf

Interagency Ecological Program 2010 Pelagic Organism Decline Synthesis of Results Through August 2010: The 2010 IEP POD Synthesis report explains the evolution of the IEP's understanding of pelagic organism decline and the Delta ecosystem over time. The 2010 report highlights the evolution of the pelagic organism decline conceptual model from 2005 to the present. The evolution of the conceptual model highlights the change in thinking from a classical food web and fisheries ecology approaches, to species-specific models, to an ecological regime shift model. This evolution in thinking has come from monitoring and analysis of the Delta ecosystem over time.
http://www.water.ca.gov/iep/docs/FinalPOD2010Workplan12610.pdf

Delta Science Plan

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 is essential to support the adaptive management of ecosystem restoration and water management decisions in the Delta. Multiple organizing 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 fully formulated.

The goal of a Delta Science Plan is to organize Delta science activities in an efficient, collaborative, and integrative manner. To meet this goal, the following shall be addressed in the Delta Science Plan: a collaborative institutional organization for conducting science in the Delta; financial needs and funding sources to support science; a plan for prioritizing research; a strategy for addressing uncertainty and conflicting scientific information; a comprehensive monitoring plan; data management and synthesis; and scientific exchange and communication. Effectively addressing these issues in a comprehensive Delta

Science Plan is crucial to the growth of the scientific knowledge base and enhanced scientific understanding of the ever-changing Delta into the future.

The Delta Science Program will play a central role in working with others (such as the Interagency Ecological Program and Bay Delta Conservation Plan) to develop a Delta Science Plan by January 1, 2013. In this role the Delta Science Program will maintain its objectives to support research, synthesize science, promote independent scientific peer review, coordinate science, and communicate scientific information to policymakers and decision makers (Water Code section 85280 (b)(4)). The Delta Independent Science Board will also play a critical role in providing oversight of the scientific research, monitoring, and assessment programs that support adaptive management of the Delta through periodic review of the Delta Science Plan and its operating components at least once every four years (Water Code section 85280(a)(3)).

Effective Governance for Adaptive Management

To be effective, governance to support 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. Governance for adaptive management should provide a decision-making structure that fosters communication between scientists and decision makers, and has clear lines of authority where timely decisions are made and implemented. Decisions made within the adaptive management process for ecosystem restoration and water management covered actions should be made by decision makers for the entity responsible for implementing the adaptive management. Adaptive management decisions relevant to revising and updating the Delta Plan will be made by the Council. Governance to support implementing adaptive management for both ecosystem restoration and water management covered actions and the Delta Plan must provide for the institutional capacity to interact, learn, and adapt.

The Council's regulatory policy requiring the use of the nine-step adaptive management framework and best available science presented in this chapter is located in Chapter 3.

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Chapter 3
Governance: Implementation of the Delta Plan

The Sacramento-San Joaquin Delta Reform Act established the Delta Stewardship Council to achieve more effective governance as reflected in these findings in Water Code section 85300 (a) – (e).

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.

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.

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

(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.

(e) The council shall report to the Legislature no later than March 31, 2012, as to its adoption of the Delta Plan.

1

Chapter 3
Governance: Implementation of the Delta Plan

Introduction

Central to the work of the Delta Stewardship Council (Council) is this Delta Plan. In contrast to plan implementation in most governmental contexts, the Council does not exercise direct review and approval authority over proposed actions for consistency with the Delta Plan. In most cases, the Delta Plan functions as a strategic plan in that it is a guidance and recommendation document. However, in some cases, actions taken by local or State agencies are "covered actions" as defined in Water Code section 85057.5. The State or local agency proposing to carry out, approve, or fund a covered action certifies the consistency of the covered action with the Delta Plan and files a certificate of consistency with the Council. A certificate of consistency may be appealed to the Council by any person within 30 days, alleging that the proposed covered action is not consistent with the Delta Plan. Upon receiving such 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.

Only certain activities qualify as covered actions, and the Delta Reform Act establishes criteria and exclusions. This Delta Plan further clarifies what is and is not a covered action. As an example, routine levee maintenance by a reclamation district in the Delta would not be a covered action because it is statutorily excluded. Also, an addition to a house in the Delta would likely not be a covered action because it would not appear to meet the criteria. This Delta Plan incorporates and builds upon existing State policies where possible, with the intention of meeting the Delta Reform Act's requirements without establishing an entirely new set of policies. For example, Delta Plan regulatory policies related to reducing flood risk incorporate recent California legislation that requires upgrades to levees protecting urban areas.

In other cases, Delta Plan regulatory policies seek to prevent actions that may preclude the future implementation of projects that meet the requirements of the Delta Reform Act, such as the acquisition of floodplain area for construction of a new flood bypass or restoration of certain lands uniquely suited to habitat. Similarly, the Delta Plan includes regulatory policies to protect floodplains and floodways until studies are completed by the Department of Water Resources (DWR).

In recognition that other government agencies have authorities and responsibilities that are critical to the achievement of the coequal goals, the Delta Reform Act requires the Council to establish and oversee a committee of agencies responsible for implementing the Delta Plan. The statute directs each agency to coordinate its actions pursuant to the Delta Plan with the Council and other relevant agencies. The Council will commence coordination meetings of the appropriate and interested federal, State, and local agencies upon adoption of the Delta Plan. Council staff has met with federal agencies and is developing

the Delta Plan in consultation with these agencies in order to pursue future consistency and compliance with the Coastal Zone Management Act, as required by Water Code section 85300(d)(1)(A).

Delta Stewardship Council Governance Roles

The Council has several defined roles under the Delta Reform Act that together constitute how it will satisfy its governance responsibilities. In terms of Council work, the roles are in three groups, shown below. Each role has specific legal authority (illustrative legal authority is provided here; full legal authority is in several sections of the Delta Reform Act and the Constitution of the State of California).

Finding of Consistency under the Covered Actions Review Procedures

Determinations of consistency of covered actions [for example, "... The appeal shall be heard by the council within 60 days of the date of the filing of the appeal..." (Water Code section 85225.20)]

Information, Comments, and Advice

Information [for example, "...the mission of the Delta Science Program shall be to provide the best possible unbiased scientific information to inform water and environmental decision-making in the Delta." (Water Code section 85280(b)(4)]

Comments [for example, "To comment on state agency environmental impact reports..." (Water Code section 85210(j)]

Advice regarding plan consistency [for example, "The council shall review and provide timely advice to local and regional planning agencies regarding the consistency of local and regional planning documents..." (Water Code section 85212)]

Incorporation of Another Plan into the Delta Plan

Incorporation of another plan into the Delta Plan [for example, "The council may incorporate other completed plans... into the Delta Plan to the extent that the other plans promote the coequal goals." (Water Code section 85350)] Criteria for required incorporation of the Bay Delta Conservation Plan are specified in Water Code section 85320(a).

Revision of the Delta Plan [for example, "The council shall review the Delta Plan at least once every five years and may revise it as the council deems appropriate." (Water Code section 85300(c))]

How Will the Regulatory Policies of the Delta Plan Work in Practice?

This section includes a discussion of the general requirements for certifying consistency with the Delta Reform Act and additional examples of covered actions. 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.

Figure 3-1
Delta Stewardship Council Roles

What Is the Definition of a Covered Action? Who Determines Whether a Proposed Plan, Program, or Project Is a Covered Action?

A covered action is defined in the Delta Reform Act as:

> *"…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." (Water Code section 85057.5(a))*

A project proponent's first step in determining whether an action is a covered action is to identify whether the proposed plan, program, or project meets the definition 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.[7] If the action does indeed meet the definition of a project under CEQA, the next step in determining a covered action is to review the four additional conditions in the definition of covered action, all of which must be met by a proposed plan, program, or project.

To qualify as a covered action, the action must occur, in whole or in part, within the boundaries of the Delta or Suisun Marsh. It must be carried out, approved, or funded by the State or a local public agency.

A proposed plan, program, or project must be covered by one or more provisions of the Delta Plan, meaning that a regulatory policy is applicable to the proposed action. The Delta Plan may exclude specified actions; therefore, those actions would not be covered by one or more provisions of the Delta Plan.

In addition, a proposed plan, program, or project must have a "significant impact" under Water Code section 85057.5(a)(4). For this purpose, the Council has determined that "significant impact" means a substantial change in existing conditions that is directly, indirectly, and/or cumulatively caused by a project and that will affect 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.

Certain actions are statutorily excluded from the definition of covered action. Water Code section 85057(b) provides the following examples:

- A regulatory action of a State agency (such as the adoption of a water quality control plan by the State Water Resources Control Board, or the issuance of a California Endangered Species Act permit by the Department of Fish and Game)
- Routine maintenance and operation of the State Water Project or the federal Central Valley Project
- Routine maintenance of levees by a reclamation district

As specified in Paragraph 2 of the Council's Administrative Procedures Governing Appeals (Appendix A), if requested, the Council's staff will meet with an agency's staff during "early consultation" to review the consistency of a proposed action and to make recommendations. The agency's staff may also seek clarification of whether a proposed project is a covered action, provided that the ultimate determination on whether it is a covered action shall be made by the agency, subject to judicial review.

The Council has determined that the following types of projects are not covered actions because they will not have a significant impact under Water Code section 85057.5(a)(4):

[7] It is important to note, however, 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. For example, while one section of CEQA states that its terms do not apply to "ministerial projects" (see Public Resources Code section 21080(b)(1)), those types of projects do fall under the Delta Reform Act's definition of covered action.

1. "Ministerial" projects under CEQA[8] (because they only require the application of fixed standards or objective measurements set forth in an ordinance or other legal or regulatory provision), but only if a certification of consistency has already been filed with the Council for that ordinance or other legal or regulatory provision. Common examples of ministerial actions (absent any relevant "discretionary" provisions in the underlying ordinance or other provision) include building permits, business licenses, and approval of final subdivision maps.

2. "Emergency" projects under CEQA, as defined in Public Resources Code section 21080(b)(2)-(4).

3. Temporary water transfers of up to 1 year in duration pursuant to Article 1 (commencing with section 1725) of chapter 10.5, part 2, division 2 of the Water Code.

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

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

Certifications of Consistency

State or local agencies that propose to undertake covered actions are required to certify with the Council, prior to initiating implementation, that these proposed plans, programs, or projects are consistent with the Delta Plan (Water Code section 85225 et seq.). The Council will develop a checklist that agencies may use to facilitate the process. Additionally, as required in statute, an agency that proposes to undertake a covered action must prepare a written certification of consistency with detailed findings as to whether the covered action is consistent with the Delta Plan (Water Code section 85225). These findings must be submitted to the Council as part of the certification of consistency. Any person may appeal the certification of consistency and, 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 proposed covered action is consistent with the Delta Plan's regulatory policies. More than one regulatory policy in the Delta Plan may apply to a covered action.

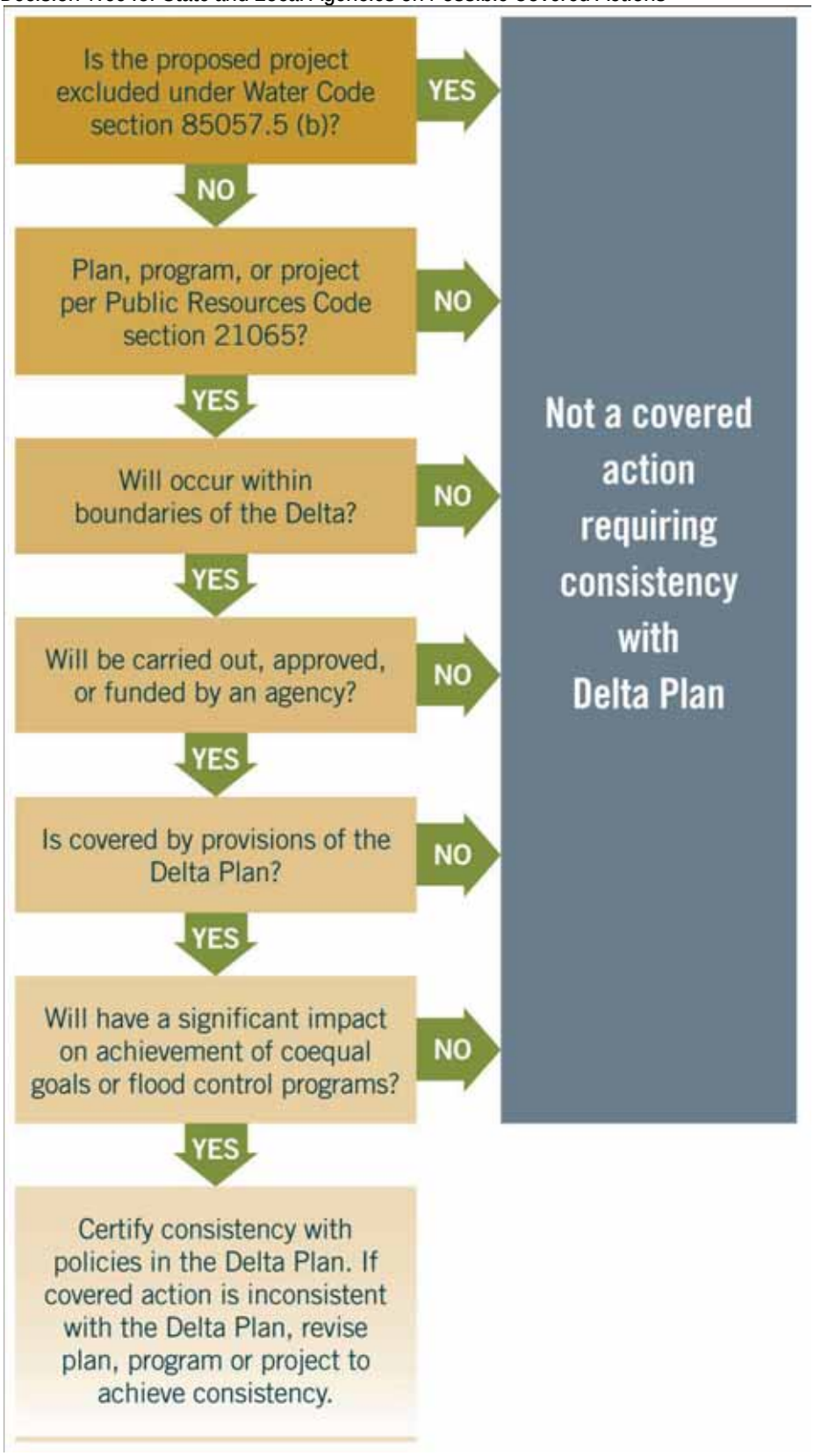
As required by Water Code section 85225 and by the Council's procedures governing appeals, local or State agencies must include in their written certifications of consistency detailed findings as to whether the covered action is consistent with the Delta Plan. Those detailed findings must address consistency with each of the regulatory policies in the Plan that is implicated by the covered action. The Council acknowledges that in some cases, based upon the nature of the covered action, full consistency with all relevant policies may not be possible. In those cases, project proponents must clearly identify areas where consistency is not possible, establish that consistency with those areas is not possible, and explain how the covered action nevertheless, on whole, is consistent with and/or furthers the coequal goals. In such cases, the Council may determine, on appeal, that the covered action is consistent with the Delta Plan.

Certifications of consistency must demonstrate that a covered action is consistent with the Delta Plan by being fully transparent, disclosing potential impacts, and identifying how best available science and information will be used in decision-making and adaptive management.

Short-form certifications of consistency apply when an action is taken in conformance with another plan that has been incorporated into the Delta Plan. See more about short-form consistency and when and where it applies in the section that follows G P1.

[8] Pursuant to Public Resources Code section 21080(b)(1) and the CEQA Guidelines, California Code of Regulations, title 14, sections 15369 and 15268.

Figure 3-2
Decision Tree for State and Local Agencies on Possible Covered Actions



Policy

G P1 Certifications of consistency with the Delta Plan must address the following:

- All covered actions must be fully transparent by disclosing all potentially significant adverse environmental impacts and mitigations of those adverse impacts.
- As relevant to the purpose and nature of the project, all covered actions must document use of best available science (as described in Chapter 2) and information.
- Ecosystem restoration and water management covered actions must include adequate provisions to assure continued implementation of adaptive management consistent with the Delta Plan. This requirement shall be satisfied through:

  a) an adaptive management plan that describes the approach to be taken for each of the nine steps of the adaptive management framework of Chapter 2, and

  b) documentation of access to adequate resources and delineated authority by the entity responsible for the implementation of the full adaptive management process.

Updating the Delta Plan

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. The Council may request that another state agency make recommendations on specific revisions to the Delta Plan.

Discretionary Incorporation of Another Plan into the Delta Plan

The Council may incorporate another plan, in whole or in part, into the Delta Plan if it furthers the coequal goals or inherent objectives of the Delta Reform Act. When incorporated, the plan or its incorporated elements become part of the Delta Plan, and therefore part of the basis for future consistency determinations. At the time the Council uses its discretion to incorporate another plan, the Council will determine the extent of the regulatory effect of the incorporated plan. Specifically, the Council will determine whether:

A. future covered actions within the scope of the incorporated plan only need to be consistent with the incorporated plan, or

B. future covered actions must be both consistent with the incorporated plan and some or all other applicable provisions of the Delta Plan. For example, the Council may incorporate an ecosystem restoration plan, but determine that the plan does not include an adaptive management component and therefore require that future covered actions within the scope of the ecosystem restoration plan be consistent with the incorporated plan as well as with the adaptive management policy of the Delta Plan (G P1, as included in this chapter).

For a plan that has not been incorporated into the Delta Plan, the agency will file a consistency certification. If that consistency certification is not successfully appealed to the Council, a proponent of a project contemplated by that plan must still file a certificate of consistency with the Council. However, the Council encourages the project proponent to utilize and rely on relevant information contained in the larger plan's certification of consistency. Upon appeal, the Council retains the authority to find the specific project inconsistent with the Delta Plan even if the Council finds that the larger plan is consistent with the Delta Plan.

Discretionary Incorporation of Specific Projects into the Delta Plan

The Council may incorporate a specific project into the Delta Plan when the specific project would contribute to achieving the coequal goals or inherent objectives. An agency may propose to the Council that such specific project be incorporated into the Delta Plan, or may include specific projects in its proposal to incorporate a plan into the Delta Plan, as described above. To be incorporated, the specific project must be adequately described, including the project's location, scope, size, and anticipated environmental effects.

Unless the Council specifies additional requirements at the time the project is incorporated into the Delta Plan, when an agency takes a covered action concerning an included project, the agency must file a certificate of consistency finding only that the specific project is the same project (location, scope, size, and anticipated environmental effects) that was incorporated into the Delta Plan.

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 restorations in the Delta. When completed, it must be incorporated into the Delta Plan if it meets certain statutory requirements. 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.

After BDCP's incorporation, an agency proposing a covered action that is included in the BDCP or qualifies for credit under the BDCP must file a consistency certification finding only that the covered action is consistent with the BDCP. The Council retains the authority upon appeal to find the covered action inconsistent with BDCP and therefore the Delta Plan.

Pre-incorporation Use of Bay Delta Conservation Plan Studies or Concepts

The Council has determined that any consideration or use of BDCP-related studies or concepts in the Delta Plan will not have a pre-decisional effect on any possible future appeal of a Department of Fish and Game determination related to BDCP. As required by statute, the Council will base its review of any appeal on the complete record before it, consistent with Water Code section 85320(e) and the Council's adopted appellate procedures.

Amending the Delta Plan

The Council must review the Delta Plan at least once every 5 years and may revise the Delta Plan at any time as it deems appropriate (Water Code section 85300(a)). This authority is consistent with the Council's obligation to base the Delta Plan on the best available scientific information and to adaptively manage the Plan as new information becomes available. Nothing in this section (or elsewhere in the Delta Plan) regarding incorporation of a plan or project is intended to limit this authority.

Transparency and Communications Plan to Implement the Delta Plan

The Council is committed to transparency and effective participation in its processes. To that end, the Council requires full transparency in information provided to it and timely public posting of information relevant to its actions. It will post all communications received.

Council decisions will be posted on its website. A public list of policies and plans determined to be consistent and not consistent with the Act shall be maintained on the Council website and included in reports of the Council on its effectiveness in implementing the Act.

Where required by law or as it deems feasible and appropriate, the Council will provide findings for its actions, which shall be posted publicly.

Information developed by the Council or provided to the Council will be publicly accessible on the Council's website.

Chapter 4
A More Reliable Water Supply for California

The Sacramento-San Joaquin Delta Reform Act declared State policy for California's Water Resources and the Delta (Public Resources Code section 29702):

> *(a) Achieve the two coequal 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.*

Inherent in the coequal goals, 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.*

Increased regional self-reliance and reduced reliance on the Delta for water supplies is established as State policy (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 the implementation of measures to promote the coequal goals and inherent objectives.

> *85302. (c) 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 provides 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.

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Chapter 4
A More Reliable Water Supply for California

One of the Delta Reform Act's coequal goals is "to provide a more reliable water supply for California" (Water Code section 85054). Accordingly, the Delta Plan focuses on policies and recommendations that will increase the reliability of water supplies for the State while simultaneously reducing reliance on the Delta to meet California's future water supply needs, consistent with the requirements of Water Code section 85021.

California has a wealth of water, but this resource is finite, and competition for the state's water supplies is increasing. The total amount of precipitation the state receives has been roughly constant for over 100 years. In an average year, California receives about 200 million acre-feet of water from precipitation. The majority of precipitation (50 to 60 percent) is either consumed by evapotranspiration or flows into Oregon, Nevada, the Pacific Ocean, saline aquifers, and the Salton Sea. The remaining water, an average of about 80 million acre-feet, is used for urban, agricultural, and environmental purposes, or stored for later use in surface water and groundwater reservoirs (DWR 2009). However, only a little more than half the water used by the state, about 40 million acre-feet, falls in areas where California's population resides.

Variability is the dominant characteristic of California's water resources. Precipitation varies from season to season, place to place, and year to year (DWR 2009). The state has a Mediterranean climate with wet winters and long, warm dry summers. Two-thirds of the precipitation and runoff occurs in the northern third of California. Because California typically receives most of its precipitation from relatively few storms, the pattern of extreme fluctuations in the State's water supply is intensified (Dettinger et al. 2011). In years when fewer storms enter California, the state faces the problem of too little water; conversely, a few extra storms may result in flooding caused by too much water.

To manage this variability, a complex and interconnected system of surface reservoirs, aqueducts, and water diversion facilities that store and convey supplemental water from areas that have water available to areas that have water needs has been developed over the last hundred years. These water systems, consisting of local, regional, State, and federal projects, work together with water conservation, water use efficiency, water reuse, desalination, stormwater capture and other local and regional water management programs to help ensure that water is available at the right places and times to meet water needs throughout California.

California's State Water Project (SWP) and the federal Central Valley Project (CVP) are the largest water storage and conveyance systems in the state. These projects take water from the Sacramento River and San Joaquin River watersheds, primarily diverting it at pumping facilities in the south Delta, and export the water south and west to agricultural and urban contractors. Together, these two projects account for about 13 percent of the water used in California, and they provide a portion of the water supply for 25 million people.

Water Supply Reliability

Providing a more reliable water supply for California is one of the coequal goals established by State law and is an essential element of the Delta Plan. Fundamentally, this means that California must match its demands for, and use of water to, the available supply.

California's water supply comes primarily from rain and snow (precipitation), the use of groundwater, extensive reuse of water, and some imported water from other regions (DWR 2009). However, our water supply is volatile; it does not arrive in a regular amount each and every year. Our state's water supplies vary from year to year for many reasons:

- Weather patterns change from year to year, and precipitation amounts vary dramatically from year to year.
- Periodic droughts occur throughout our history.
- Natural and human-made catastrophic events, such as earthquakes, floods, levee breaks, and pipeline failures compound our problems.
- Environmental requirements may limit the amount of water available for other purposes.
- Legal requirements to maintain high water quality standards for drinking water may limit the amount of water than can be exported from regions of the state with a significant supply of fresh water.
- Legal battles between regions of the state, battles between various economic interests, and complicated determinations of water use priorities and impacts have occurred throughout our history as a state.
- Climate change that alters temperature and precipitation and causes sea level rise also impacts how and where water may be used for human purposes and for the environment.

The longstanding policy of California is that urban water suppliers should be prepared to cope with the inherent uncertainty of their water supplies. Since 1983, the Urban Water Management Planning Act has required large urban suppliers to develop long-term water management plans (Water Code section 10610 et. seq.). These plans must identify any water source that "may not be available at a consistent level of use" under normal, dry, and multiple dry year scenarios, and explain how, to the extent practicable, they "will supplement or replace the uncertain supply with either other sources of water or through implementation of water conservation and water efficiency measures" (Water Code section 10631(c)(2)).

The Delta Reform Act and the Delta Plan take similar approaches to improving the reliability of the state's water supply. Both reaffirm that all regions of the state must diversify their water supplies. Both reaffirm that all regions of the state must reduce their reliance on Delta water for future needs. Both require that all regions of the state must adopt conservation and water use efficiency measures to demonstrate reasonable use of water, consistent with California's Constitution, Article 10, Section 2, that water must be used reasonably and that waste of water is not permitted.

Accordingly, decreasing the demand for water, through conservation and water reuse efficiencies, is a necessary step, as are reasonable actions to improve the water system efficiency and seek new water supplies. Those steps go together; they do not stand alone.

For regions of the state that depend on the Delta watershed for some portion of their water supply, the Delta Plan specifically calls upon them to improve their self-reliance by implementing measures that diversify and expand their water supplies from other sources as well as increase conservation and water use efficiency.

The Delta Plan also recognizes that the amount of water available from the Delta must be made more reliable. The Bay Delta Conservation Plan process is the primary focus of the State's effort to develop a long-term solution for the Delta, and it will address the major conveyance and operational improvements as well as ecosystem enhancements that are needed to make this happen. In the interim, the Delta Plan promotes smaller, incremental improvements for storage and conveyance that may be implemented in the Delta watershed over the next 5 to 10 years to improve the reliability of these supplies.

The task of providing a more reliable water supply for California is a responsibility shared by everyone in the state. The Delta Plan calls upon all water suppliers—urban and agricultural—throughout California to prepare a "Water Supply Reliability" element in their respective water plans to demonstrate that each region of the state is taking appropriate steps to improve the management of its existing water supplies and, to the extent possible, increase and diversify its water supplies. Improving water supply reliability for the state means that California is on a track to reduce its water needs, develop more water from more sources, and reduce its reliance on the Delta to meet the state's future water needs.

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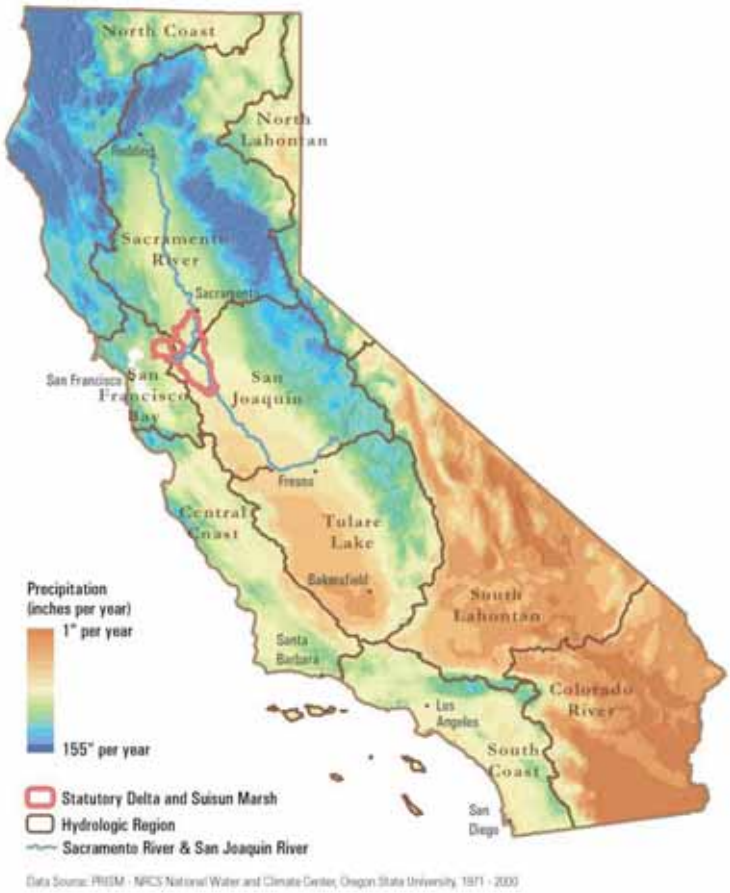
Figure 4-1
Average Annual Precipitation in California (CONCEPTUAL. DRAFT UNDER DEVELOPMENT.)
Source: NRCS National Water and Climate Center



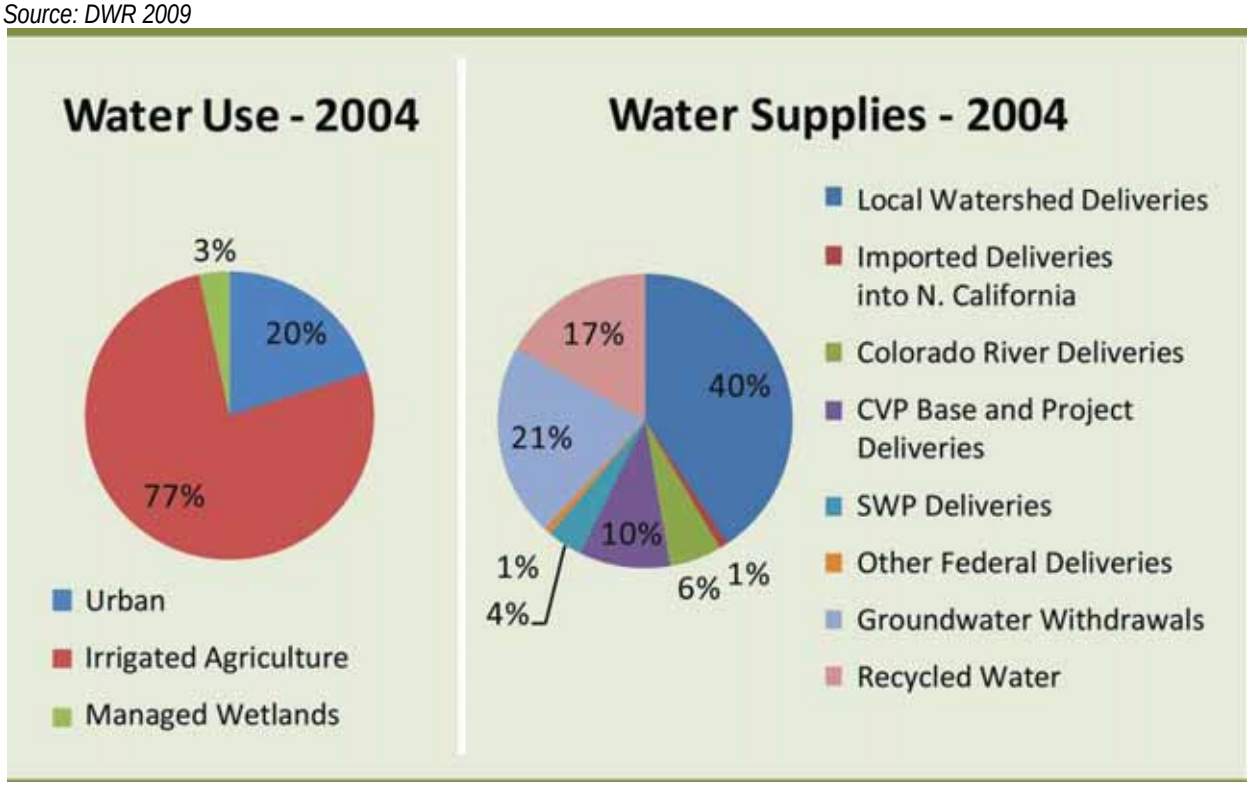
Although the Delta exports are important, they are not the dominant source of California's water supply. In an average year (2004), local surface water deliveries constitute approximately 34 percent of the state's gross water supply. Other supplies include groundwater withdrawals (21percent), reused surface water (17 percent), deliveries from the State and federal water projects (14 percent), imported water from the Colorado River watershed (6 percent), local imported deliveries (1 percent), and currently small amounts from recycled water and desalination (DWR 2009).

Reliance on Delta exports, along with one or more other water sources, varies throughout California from region to region, supplier to supplier, and user to user; this consideration is important for evaluating how the State can best improve water supply reliability while reducing reliance on the Delta. Although most of California's agricultural and urban water suppliers depend upon a combination of local sources, Delta imports, interbasin water transfers, and water efficiency measures, some suppliers and areas depend predominantly on Delta exports. Conflicts over the Delta and its water supplies are increasing—including concerns about the decline in the Delta's ecosystem, greater drought impacts, increased flood risk, impaired water quality, aging infrastructure and climate change—making the need to find new and better ways to develop and share water supplies while reducing reliance on Delta exports becomes paramount.

This chapter addresses five major strategies that need to be implemented to achieve the goal of developing a more reliable water supply for California:

- Reduced reliance on the Delta through improved regional self-reliance
- Updated Delta instream flow criteria and setting of flows
- Expanded water storage and improved conveyance
- Sustainable groundwater management
- Improved reporting and transparency

Figure 4-2
Statewide Water Use
Source: DWR 2009



Policies and Recommendations

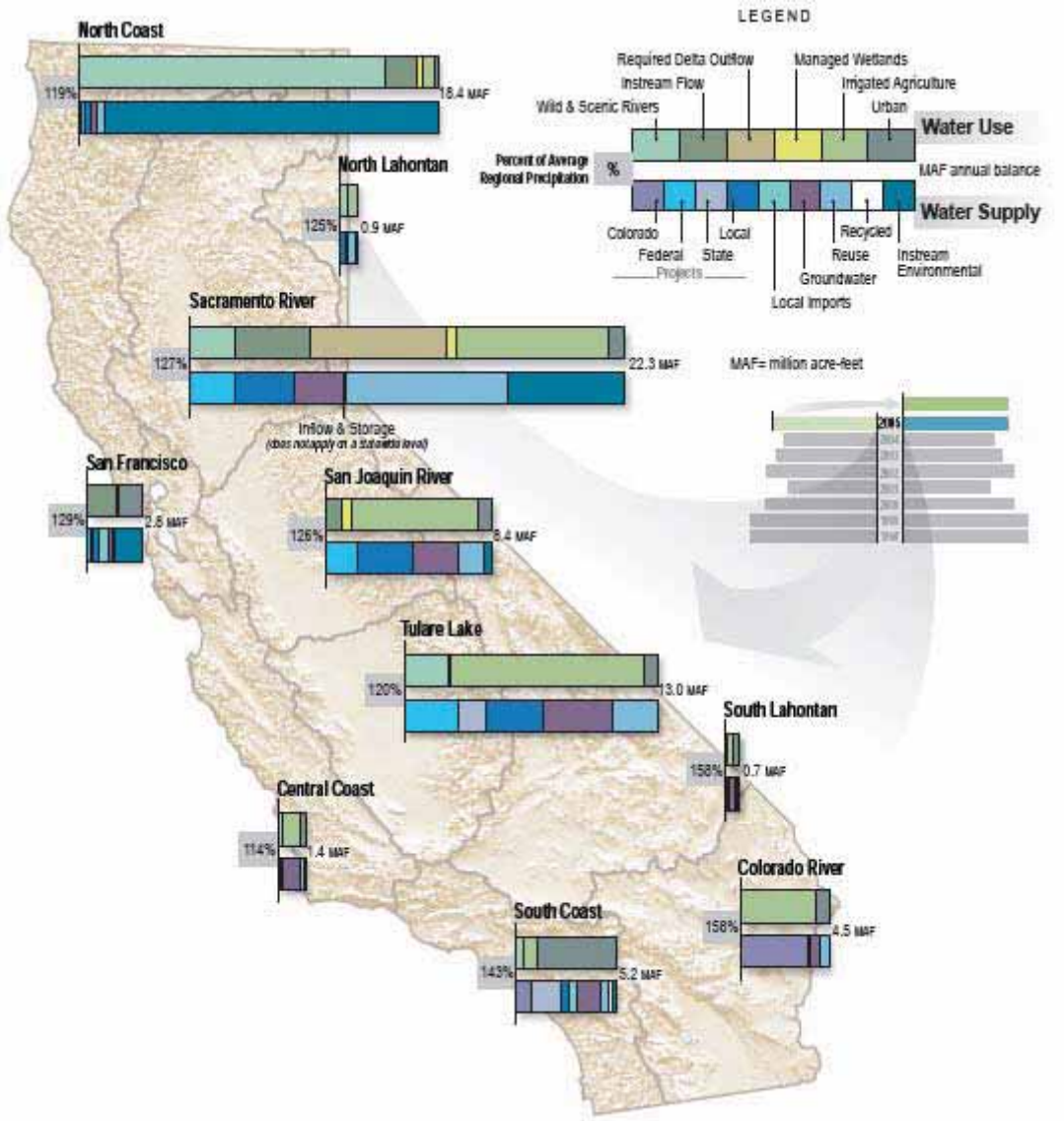
Reduce Reliance on the Delta through Improved Regional Water Self-reliance

The State has long recognized the importance of improving regional water supply self-reliance through conservation, water use efficiency and the increased development of local and regional water supplies. These programs and projects increase the reliability of the state's water supplies by reducing overall demand and developing a diverse array of water sources that, when combined, are more resilient under conditions of drought, emergency shortage, and climate change.

All regions of California have access to multiple water sources, although the portfolio of supplies that each region relies upon differs (DWR 2009). Before construction of the state's major water storage and conveyance systems in the mid-twentieth century, California's communities relied upon local and regional water supplies. Today, most of California's water supplies still comes from local sources that include surface water diversions, local reservoirs, and groundwater, with Delta water exports serving as

an important supplemental source of supply. However, many local areas receive predominant amount of their supply from the Delta and will continue to need this source of water in the future. By planning and implementing programs and projects that further increase the water supply diversity and yield, the State will improve the reliability California's water supplies and help regions to reduce their reliance on the Delta.

Figure 4-3
Statewide Water Balance by Region [CONCEPTUAL. UNDER DEVELOPMENT.]
Source: DWR 2009

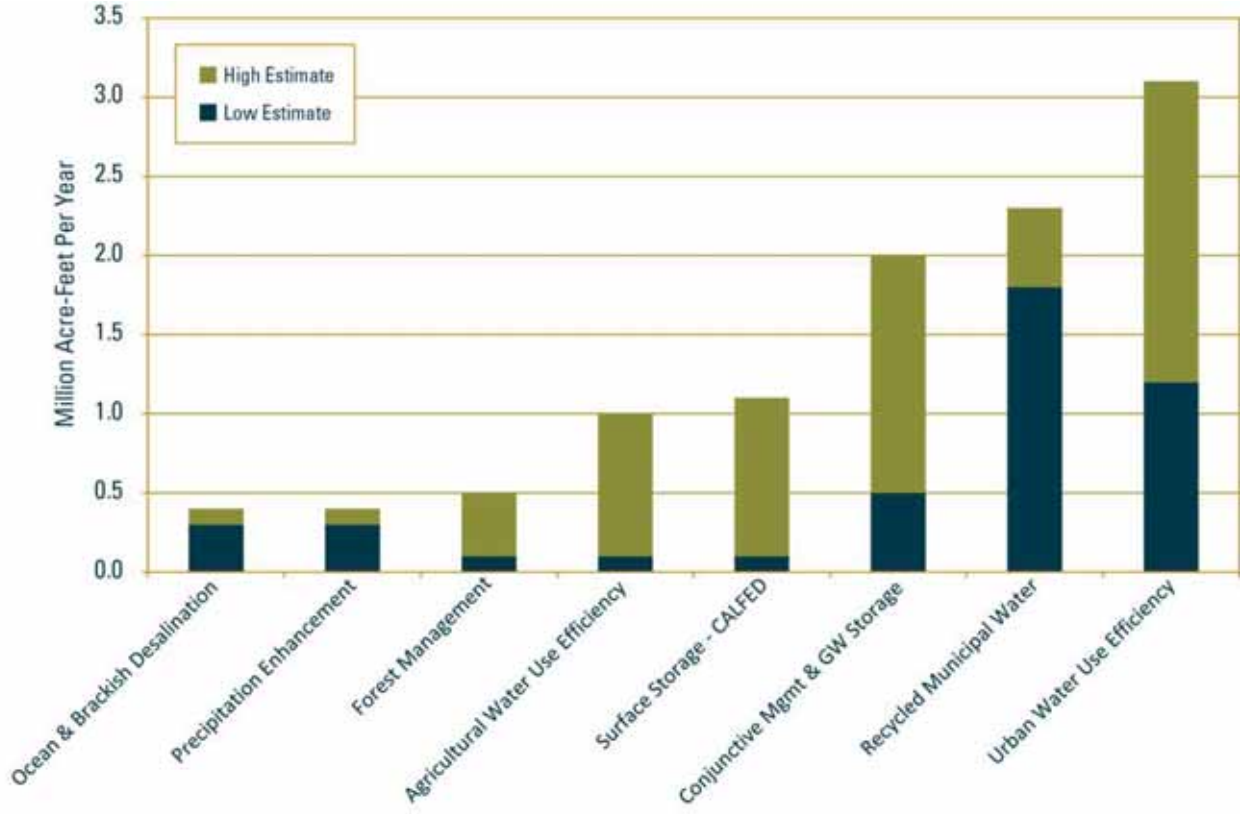


California has a wealth of water resources that can be developed. The California Water Plan 2009 Update estimates that the State could reduce future water demand and increase water supplies in the range of 5 to 10 million acre-feet over the next 40 years.[9] Nearly all of these potential supplies come from improved conservation and water use efficiency in the urban and agricultural sectors, groundwater storage and

[9] DWR notes that the water supply benefits summarized in the California Water Plan are not intended to be additive, recognizing that some resource management strategies may complement or compete with one another for funding, system capacity, or other components necessary for implementation.

conjunctive management, recycled water, and drinking water treatment, groundwater remediation, and desalination. DWR has identified 27 "resource management strategies" that water suppliers should consider when developing their water management programs. Although every resource management strategy may not be feasible in every service area, DWR recommends that water suppliers consider all the strategies during water planning before selecting the combination that is most appropriate to local and regional conditions (DWR 2009).

Figure 4-4
Strategies to Reduce Water Demand and Add Supply
Source: DWR 2009



California has promising opportunities for meeting water needs and diversifying its portfolio of sources. The eight strategies shown could provide 3-8 million acre feet of additional water annually, as estimated by DWR's California Water Plan Update 2009.

DF 140

Source: DWR 2009.

Many resource management strategies make water available from local and regional sources that may have been ignored, underutilized, or unavailable in recent decades. For example, for many years urban runoff has been viewed as a flooding and water quality problem, not as a resource. However, many communities are now capturing this water for groundwater recharge and supply augmentation. Development of alternative water supplies has been made more attractive due to decreased reliability of imported supplies, increased costs of existing supplies, technological advances, and decreasing costs for many local projects. Nevertheless, none of these alternative sources are free; even water conservation, water use efficiency and urban runoff improvements require investments, and some initiatives can be costly (Hanak et al. 2009).

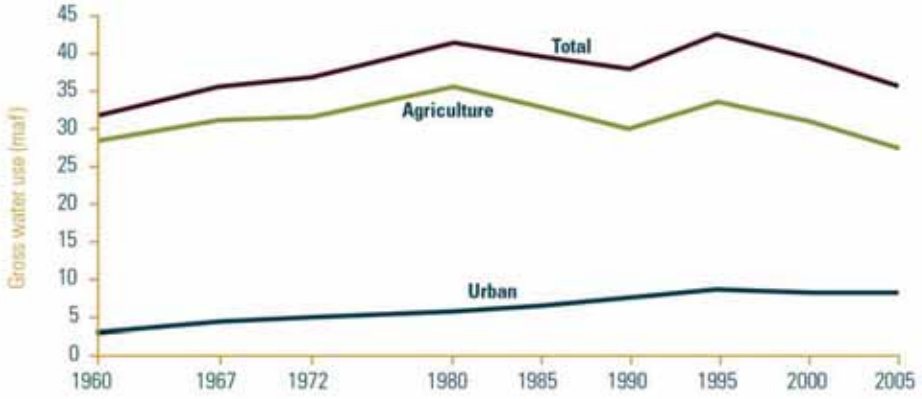
The State has promoted local and regional water supply planning by requiring water suppliers to develop plans, such as Urban Water Management Plans and Agricultural Water Management Plans, that forecast sources of supply and the actions needed (including water conservation and water efficiency measures) to

ensure that future water needs are met over the next 25 years. The law requires that water suppliers include a Water Supply Reliability and Water Shortage Contingency element in their Urban Water Management Plans. 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 import water from other regions (Water Code section 10620).

Since 2000, the State has also promoted voluntary Integrated Regional Water Management planning, recognizing that collaboration among the agencies in a watershed provides opportunities for better water management decisions and coordinated infrastructure investments. A 2006 report on the benefits of investment in integrated regional water management identified over 1.2 million acre-feet of water benefits in combined water supply and demand reductions resulting from $1 billion of investments from State bond funds in local and regional projects (DWR 2009).

Overall, significant statewide progress has been made to reduce demand and increase local and regional water supplies. Despite earlier decades of growth, California's water use appears to be decreasing (Hanak et al. 2011). Agricultural water use today accounts for 77 percent of the state's gross water use, down from 90 percent in 1960. Urban water use has remained relatively constant since the mid-1990 despite substantial population growth. New State laws enacted within the last 5 years will result in additional significant water savings in the coming decade; these laws include compliance with the State's Demand Management Measures, adoption of water-conserving landscape ordinances, a 20 percent reduction in urban water use by 2020, and implementation of cost-effective agricultural water-efficient practices.

Figure 4-5
Trends in California Water Use
Source: DWR 2009



The figure shows gross water use. Urban includes residential and nonagricultural business uses. Pre-2000 estimates are adjusted to levels that would have been used in a year of normal rainfall. Estimates for 2000 and 2005 are for actual use; both years had near-normal precipitation. Estimates omit conveyance losses, which account for 6 percent to 9 percent of the total.

DP_140 Source: Authors' calculations using data from California Water Plan Update (California Department of Water Resources, various years).

The California Water Plan 2009 Update provides an overview of the large array of local and regional water supply projects developed throughout the state in the last 5 years. Projects include significant expansion of recycled water, brackish water desalination, groundwater recharge and pumping, stormwater capture, conjunctive use, and interbasin water transfer facilities. Most notable are the outstanding successes of major population areas such as Los Angeles, where future new water demands are now

projected to be met only through increased conservation and local water supply development (City of Los Angeles 2010).

CASE STUDIES AND INFORMATION TO BE PROVIDED ON REGIONAL SELF-RELIANCE.

With the enactment of the Delta Reform Act, it is now the policy of California to reduce reliance on the Delta to meet future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency (Water Code section 85021). The Delta Reform Act requires that "each region that depends on water from the Delta watershed shall improve 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 section 85021).

However, while voluntary planning and reporting on conservation and water supply projects may occur in a regional context, the decisions to fund and implement these projects remain under the control of individual water agencies. To promote statewide sustainable water use and ensure compliance with the Delta Reform Act, water suppliers need to identify their actions and investments to implement conservation and local water supply projects and account for how these projects are contributing to regional self-reliance and reduced reliance on the Delta. The State's progress in meeting its regional self-reliance goals should be summarized in future California Water Plan updates.

Problem Statement

The State's policy is to reduce reliance on the Delta in meeting California's future water supply needs though a statewide strategy of investing in improved local and regional water supplies, conservation, and water use efficiency. The State currently requires urban and agricultural water suppliers to adopt and implement Urban Water Management Plans, Agricultural Water Managements Plans, and water efficiency and conservation measures as part of its statewide strategy. It also encourages integrated water planning at the regional level through the development of Integrated Regional Water Management Plans. Although some water suppliers are making significant progress in implementing these requirements and reducing their reliance on the Delta, others have done little to help achieve this statewide goal. Compliance with existing State laws and continued planning and implementation of additional conservation, water use efficiency, and water supply projects is needed at the local and regional level to demonstrate reasonable use of existing water supplies and provide a more reliable water supply for California.

Policies

The following policies (WR P1, WR P2, and WR P3) can apply as regulatory policies only where a public agency approves, funds, or carries out a covered action. Where it does, that covered action is inconsistent with the Delta Plan if, and only if, one or both of the following applies:

A. The covered action involves the export of water from the Delta or involves the transfer of water through the Delta, and the need for that covered action is significantly caused by the failure of one or more water suppliers to comply with policies WR P1, WR P2, and/or WR P3.

B. The covered action involves the use of water in the Delta, and the need for that covered action is significantly caused by the failure of one or more water suppliers to comply with policies WR P1, WR P2, and WR P3.

Where, however, neither A nor B applies, the following (WR P1, WR P2, and WR P3) are recommendations.

WR P1 Water suppliers shall demonstrate compliance with existing State laws promoting water supply planning, conservation, and efficiency measures:

- Urban water suppliers[10]
  - Adopt and implement an Urban Water Management Plan and all required elements and measures, meeting the standards and timelines established in Water Code section 10610 et. seq.
  - Adopt and implement a plan to achieve 20 percent reduction in urban per capita water use by December 31, 2020, meeting the standards and timelines established in Water Code section 10608 et. seq.
- Agricultural water suppliers[11]
  - Adopt and implement Agricultural Efficient Water Management Practices including measurement of the volume of water delivered to customers, adoption of a pricing structure based in part on the quantity delivered, and implementation of specific conservation measures that are locally cost effective and technically feasible, meeting the standards and timelines established in Water Code section 10900 et. seq.
  - Adopt and implement an Agricultural Water Management Plan and all required elements, meeting the standards and timelines established in Water Code section 10900 et. seq.

WR P2 To promote accountability throughout the state in achieving the coequal goals, water suppliers shall, no later than December 31, 2015, expand an existing or add a new Water Reliability Element in their Urban Water Management Plan and/or Agricultural Water Management Plan. Water suppliers may also meet this requirement by including a Water Reliability Element in an approved Integrated Regional Water Management Plan or other water plan that provides equivalent information.

The Water Reliability Element shall detail how water suppliers are sustaining and improving regional self-reliance and reducing dependence on the Delta through investments in local and regional programs and projects and shall document actual or projected net reduction in reliance on Delta exports. At a minimum, the Water Reliability Element shall include:

- **A plan for possible interruption of Delta water supply:** Identify how reliable water service will be provided for a minimum periods of 6 months, 18 months, and 36 months in the event that diversions or exports from the Delta are interrupted during an average water year, dry water year, and following three dry water years.[12]

[10] "Urban water supplier" as used in this Delta Plan refers to both "urban retail water suppliers" and "urban wholesale water suppliers" under the Water Code. An "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 annual at retail for municipal purposes (Water Code section 10608.12(p)). An "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 (Water Code section 10608.12(r)).

[11] "Agricultural water supplier" as used in this Delta Plan refers to both "agricultural retail water suppliers" and "agricultural wholesale water suppliers" under the Water Code. An "agricultural water supplier" means a water supplier, either publicly or privately owned, providing water to 10,000 or more irrigated acres, excluding recycled water. An "agricultural water supplier" includes a supplier or contractor for water, regardless of the basis of right that distributes or sells water for ultimate resale to customers. "Agricultural water supplier" does not include DWR (Water Code section 10608.12(a)). Any agricultural water supplier than provides water to less than 25,000 irrigated acres is not required to comply with SBX7-7 requirements unless sufficient funding is provided to the supplier to implement these provisions (Water Code section 10853).

[12] DWR estimates that a moderate to large earthquake capable of causing multiple levee failures could happen in the next 25 years. There is a 40 percent chance of 27 or more islands simultaneously failing during a major earthquake, with most extensive levee failure likely to occur in the west and central Delta. Levee repairs could take more 2.5 years to complete. Delta exports could be disrupted for about a year with a loss of up to 8 million acre-feet (DWR 2010b).

- **Implementation of planned investments in water conservation, water efficiency, and water supply development:** Identify specific programs and projects that will be implemented over a 20-year planning period and how they are consistent with the coequal goals and will contribute to improved regional self-reliance and reduced reliance on the Delta, including, but not limited to, the following strategies:[13]
  - Water conservation
  - Water use efficiency
  - Local groundwater and surface storage
  - Conjunctive use programs
  - Water transfers
  - Water recycling
  - Use of currently non-potable groundwater
  - Storm water capture and recharge
  - Saline water and brackish water desalination
- **Evaluation of regional water balance:** Provide an assessment of the long-term sustainability of the water supplies available to meet projected demands within the supplier's hydrologic region, as defined by the 2009 California Water Plan Update, over the 20-year planning period.[14] If the region's demand exceeds available supplies, identify the steps being taken through the Integrated Regional Water Management Plan to bring the region into long-term balance. If the region's demand exceeds available supplies and it does not have an Integrated Regional Water Management Plan or the Plan does not address the steps being taken to bring the region into balance, then describe how the supplier's programs and projects are helping to bring the region into balance.
- **Conservation-oriented water rate structure:** Evaluate the degree to which the supplier's current rate structure sustainably encourages and supports water conservation.

WR P3 Water suppliers shall, by December 31, 2020, develop and implement a conservation-oriented rate structure, which may include consideration of a water-budget-based rate structure that sustainably encourages and supports more efficient water use without causing a shortfall in system revenues.[15]

Recommendations

WR R1 The California Department of Water Resources, in consultation with the Council, the State Water Resources Control Board, and others, should develop and approve, by December 31,

[14] The purpose of a 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 water balance can be used to compare how water supplies and uses in a region can vary among wet, average, and dry hydrologic conditions and how each region's water balance compares with other regions and with the State's 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).

[15] A sustainable conservation-oriented rate structure has the following characteristics: encourages more efficient water use without causing a shortfall in system revenue; provides for the identification of waste, rewards efficient use, and penalizes excessive use; produces revenues from penalty rates that are used to fund conservation programs; is supported by a water bill that clearly communicates the cost of wasted water to the responsible person; and is supported by a person or staff who can respond to customers' calls for help in reducing usage (State of Utah Division of Water Resources 2001).

2012, guidelines for the preparation of a Water Reliability Element that satisfies the criteria contained in WR P2.

WR R2 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 Council, should revise State grant and loan ranking criteria by December 31, 2012, to provide additional credit (higher ranking) to water suppliers that include a Water Reliability Element in their adopted Urban Water Management Plans, Agricultural Water Management Plans, and/or Integrated Regional Water Management Plans that satisfies the requirements of WR P2. The Council will also work with these agencies to identify additional funding and other incentives to catalyze implementation of local and regional water conservation, water use efficiency, conjunctive management, and other projects that will improve regional self-reliance and reduce reliance on the Delta.

WR R3 To be consistent with the Delta Plan, a proponent for a new proposed point of delivery that results in new or increased demand for diversions from the Delta or the Delta Watershed should demonstrate that the project proponents have evaluated and implemented all other feasible water supply alternatives.

Updated Delta Instream Flow Criteria and Setting of Flows

Long-standing California law has granted to the State Water Resources Control Board (SWRCB) considerable authority in the areas of water rights, water quality protection, and the setting of water flow criteria. The SWRCB also has the authority to enforce the Public Trust Doctrine and the provisions of the California Constitution in Article X, Section 2, which pertain to the reasonable and beneficial use of water.

As competition for California's water supply has intensified, the SWRCB has been at the center of political disputes over how its decisions on water allocations should be made. Often, the decisions needed to protect the State's interests in ecosystem protection and water supply reliability have been blocked by conflicts among competing interests. Consequently, the State has found itself in an increasingly unsustainable situation with native fish populations crashing and reduced reliability of water exports from the Delta.

If the coequal goals are to be achieved, it is essential that the SWRCB complete the work to set flow objectives and criteria for the Delta and the major tributary streams in the Delta watershed. California cannot afford further delay. It is impossible for the State to plan and build a reliable water system where future ecosystem flow requirements are not known. This is true everywhere in the State, but is especially true in the Delta. Water suppliers cannot commit to funding new projects and making effective decisions about billions of dollars of infrastructure investments until the SWRCB process is complete.

The SWRCB is in the midst of a phased process to review and amend—or to adopt new—flow objectives for the Delta and its high-priority tributaries[16]. The SWRCB has set a workplan and schedule for developing flow standards for the Delta and its watershed. The first step was taken in 2009, when the SWRCB committed to a process to review and potentially modify the current Water Quality Control Plan for the Bay-Delta (SWRCB 2008a). In 2010, the SWRCB completed its report titled *Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem* (SWRCB 2010a). This study provides an assessment of the flows needed to protect the Delta and its ecological resources and does not include other public trust considerations. While only the starting point for the broader flow-standard-setting

[16] The current flow objectives established by the SWRCB remain in effect until it formally adopts and implements revised flow objectives.

process, the report underscores the importance to California of resolving what those future flow regimes need to be as soon as possible.

The SWRCB is in the process of addressing San Joaquin River flows and expects to complete the first phase of this process by June 2012. The SWRCB is coordinating with the DWR in its preparation of the BDCP and may consider environmental documentation developed for BDCP in its proceedings. In December 2010, the SWRCB completed a prioritized schedule and estimate of costs to complete the instream flow studies for the Delta, in accordance with Water Code section 85087 (SWRCB 2010b).

Problem Statement

Until the SWRCB updates and adopts flow objectives for the Delta and high-priority tributaries in the Delta watershed necessary to achieve the coequal goals, every action that potentially increases the amount of water diverted from or moved through the Delta is vulnerable to legal challenge over the question of whether sufficient flows are available to protect and restore the environment. The completion and implementation of the Delta water flow objectives is urgently needed to improve reliability of the State's water supplies.

Policies

Policy ER P1 in Chapter 5 addresses this problem statement.

Expanded Statewide Water Storage and Improved Conveyance

California's extensive network of water storage and conveyance system was designed to capture, transport, and deliver water to urban and agricultural end users. Despite the original intent of the SWP designers to operate this part of the system to improve conditions for fish and wildlife, this has not happened.[17]

Figure 4-6
Federal, State, and Local Water Conveyance and Storage Facilities
[UNDER DEVELOPMENT]

The backbone infrastructure operated today is characterized by high levels of conflict between water supply and environmental objectives. The decline of the Delta fisheries and ecosystem has resulted in regulatory and court-ordered limitations on the ability to pump and export water, impacting the reliability of these supplies. The current configuration of storage and conveyance facilities is not sufficiently flexible to meet the coequal goals of ecosystem protection and improvements to the State's water supply reliability. New facilities for conveyance and storage—and a better linkage between the two—are needed to better manage California's water resources (Delta Vision Blue Ribbon Task Force 2008).

The Delta Reform Act potentially gives the Council three distinct but connected roles relating to conveyance: contingent authority to approve proposed conveyance improvements, authority to generally recommend conveyance options in the Delta Plan, and authority to provide comments to other agencies during the BDCP process. These roles are explained in more detail in Appendix A.

Since 2006, the California Natural Resources Agency has been leading the BDCP, an applicant-driven multi-stakeholder habitat Conservation Plan/Natural Communities Conservation Plan process. The BDCP is a major project considering large-scale improvements in water conveyance and large-scale ecosystem restoration in the Delta. The BDCP has the dual purpose of achieving greater water supply reliability through an improved Delta export water conveyance system, and contributing to recovery of threatened and endangered species in the Delta.

[17] The SWP was originally intended to help enhance conditions for fish and wildlife and improve water quality as well as to provide water supplies (DWR 1966).

The BDCP is not expected to be completed until after the first Delta Plan is adopted by the Delta Stewardship Council. The BDCP will be incorporated into the Delta Plan if it meets the requirements of Water Code section 85320. For more information about the inclusion of the BDCP in the Delta Plan, refer to Chapter 1, The Delta Plan; Chapter 3, Governance: Implementation of the Delta Plan; Chapter 5, Restore the Delta Ecosystem; and Appendix A.

The SWP's storage capacity is inadequate, especially south of the Delta, to facilitate export at times when this water can be diverted (DWR 2009). For example, in the spring of 2011, the south Delta pumps were turned off because urban and agricultural water users' needs could be met through local water supplies, and storage opportunities south of the Delta were insufficient to take delivery of the available water.

Looking ahead, these storage and conveyance challenges will be compounded by the predicted impacts of climate change on the California's water supplies as precipitation and runoff patterns shift and sea level rise increases the vulnerability of the Delta to floods. The SWP, which owns and operates the dams in the State's lowest elevation watersheds and controls the Delta intakes for the State system, is particularly vulnerable to the long-term loss of water storage from the Sierra snowpack (Knowles and Cayan 2002).

Improved storage and conveyance are critical tools for meeting the coequal goals. Water supply reliability is most affected during drought conditions, when competition for water resources is most intense. The State can realize multiple benefits from having more storage, surface and/or groundwater, and improved conveyance (DWR 2010):

- The ability to manage the timing of water availability to better match water needs, especially seasonally and during droughts
- Improved management of environmental water flows, timing, and temperature in the river system
- Improved water quality
- Increased ability to quickly respond to emergency disruptions in the State's water supplies
- Enhanced opportunities for conjunctive use of surface water and groundwater supplies and for water transfers

In the past decade, DWR has spent tens of millions of dollars on integrated studies to evaluate how large surface storage and conveyance may be improved. In particular, the State is completing surface storage investigations initiated under CALFED to evaluate 52 potential surface storage reservoir sites. These options have been narrowed to five locations that merit additional study and consideration.[18] DWR anticipates completion of its Surface Water Storage Investigation and the selection of the best options for the State by the end of 2012. Implementation of these large-scale projects will require many years to complete.

In the past 10 years, additional surface has been developed at the regional level. Important storage improvements are also being made through expanded regional groundwater storage, both north of the Delta and to the south. For example, an assessment of groundwater storage opportunities in 2000 identified over 21 million acre-feet of potential conjunctive use storage in Southern California and the southern portion of the San Joaquin groundwater basin (AGWA 2000). Many projects identified in this study have moved forward.

[18] The five locations are Sites Reservoir, additional storage in the San Joaquin River watershed, expansion of Los Vaqueros Reservoir, expansion of Shasta Lake, and the In-Delta Storage Project (DWR 2010a).

Water Transfers

Water transfers are a voluntary change in the way water is distributed among water users in response to water scarcity. The California Water Code defines a water transfer as 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. Temporary water transfers have duration of 1 year or less. Long-term water transfers have duration of more than 1 year.

Water transfers can occur between water districts that are neighboring or part of the same hydrologic basin, or they can take place across the state, provided there is the means to convey and/or store the water. Generally, water transfers are made available by (1) transferring water from storage that otherwise would have been carried over to the following year,(2) pumping groundwater instead of using surface water and transferring the surface rights, (3) transferring previously banked groundwater either by directly pumping and transferring the groundwater or by pumping the banked groundwater for local use and transferring surface water that would have been used locally, (4) reducing the existing consumptive use of water through water use efficiency or crop shifting, and (5) reducing return flows or seepage from conveyance systems that would otherwise be irrecoverable.

Source: DWR 2009

Significant opportunities are available to improve the operation of existing storage and conveyance facilities or build smaller projects in the next 5 to 10 years to enhance California's water supplies. Many cost-effective local and regional projects have been identified through recent applications for State funding or through updated Urban Water Management Plans, Agricultural Water Management Plans, and Integrated Regional Water Management Plans. These include opportunities to revise reservoir management practices and reoperate reservoirs so that more stormwater water could be captured and stored without compromising flood safety. Other projects to increase reliability include construction of infrastructure and facilities that will enhance opportunities for groundwater conjunctive management

programs and water transfers.[19] Urban runoff also holds substantial potential for augmenting local groundwater management programs.[20]

Realistically, the State must be prepared for the possibility that it could take many more years for California to build and operate large-scale storage and conveyance improvements, like those being identified through the BDCP and the Surface Water Storage Investigation study. For this reason, the State should expedite these decisions as quickly as possible.

As an interim step toward increasing the state's water supply reliability, the State should prioritize and implement smaller, more incremental operational and storage improvements (expanding existing facilities or constructing new ones) that can be accomplished within the next 5 to 10 years. These options should include groundwater storage and conjunctive management programs (in combination with conservation, local water supplies such as stormwater capture and recycled water, and water transfer programs) and coordination with State, federal and regional dam operators to develop revised reservoir management practices.

Problem Statement

Improvements in surface and groundwater storage and Delta conveyance are critical to increasing the operational flexibility and enhancing the reliability of water supplies exported from the Sacramento River or the San Joaquin River watershed. However, it is likely that it could take many years for the State to select, build, and operate large-scale conveyance and storage improvement projects. The identification and implementation over the next 10 years of smaller-scale improvements to surface and groundwater storage infrastructure and Delta conveyance facilities is needed to improve the reliability of the California's water supplies.

Policies

There are no policies with regulatory effect included in this section.

Recommendations

WR R4 Recognizing that large storage projects will take more than a decade to construct and bring on line, the Department of Water Resources should complete the Surface Water Storage Investigation of the five proposed offstream surface storage projects as soon as possible and recommend the critical projects that need to be implemented to expand the State's surface storage.

WR R5 The Delta Stewardship Council, in coordination with the California Water Commission and other agencies, should conduct a survey to identify projects that may be implemented within the next 5 to 10 years to expand existing surface and groundwater storage facilities, create new storage, improve Delta conveyance facilities, and improve opportunities for water transfers. The California Water Commission should hold hearings and provide recommendations on priority projects. These recommendations should be used to support water supplier requests for state grants and loans and other sources of funding for these projects.

[19] For example, the South San Joaquin Irrigation District was recently awarded federal funding to construct 12 miles of pressured pipelines, link two surface-water storage basins and capture agricultural runoff for reapplication. The project will provide better quality surface water while reducing use of the aquifer, which also serves Ripon residents. Water use will be cut by 50 percent and farm production is expected to increase by 30 percent. Source: Stockton Record, May 19, 2011.

[20] The Fresno-Clovis metropolitan area has built an extensive network of stormwater retention basins that recharges more than 70 percent of the local runoff (about 17,000 acre-feet) as well as excess Sierra snowmelt (an average of 27,000 acre-feet). Los Angeles County currently recharges an average 210,000 acre-feet of storm runoff, reducing the need for imported water from the Delta. Recent studies estimate that additional stormwater capture opportunities in Los Angeles County could create a new supply of about 132,000 acre-feet (DWR 2009; Los Angeles and San Gabriel Watershed Council 2007). Recent Municipal Separate Stormwater System (MS4) Permits issue in Southern California now requires capture and infiltration of stormwater to the extent feasible.

Sustainable Groundwater Management

Groundwater is a major source of California's water supplies. It provides roughly 20 to 40 percent of the state's urban and agricultural water use, depending on water year type (DWR 2009). In some regions, groundwater can provide 60 percent or more of the supply during dry years (DWR 2003a). Delineated groundwater basins cover about 40 percent of the state's land area.

Despite the critical nature of this water supply, especially during droughts, California does not have a statewide management program or statutory permitting system for groundwater.[21] Many western states have made the development of a comprehensive monitoring network for evaluating the sustainability of their groundwater supplies a core water policy, but California is one of the few that have not. At a minimum, the goal of the State's groundwater management should be to sustainably maintain and maximize long-term reliability of the groundwater resources, with a focus on preventing significant depletion of groundwater in storage over the long term and preventing significant degradation of groundwater quality (DWR 2003a). More-sustainable groundwater management, especially development of management plans for groundwater basins that are chronically overdrafted, is vital to improving California's water supply reliability.

California has a long and, in many areas of the State, successful history of managing groundwater through locally controlled activities. As of 2003, about 200 local and regional agencies had developed voluntary sustainable groundwater plans, and others had adopted groundwater ordinances under their police powers. In regions such as Southern California, historic groundwater overdraft, contamination, and other serious water management problems have forced the adjudication of groundwater basins through court or administrative proceedings and the establishment of mandatory sustainable groundwater management criteria, including sustainable "safe-yield" criteria and replenishment obligations.

Recognizing the sensitivity surrounding local control of groundwater resources, the State has tried to encourage 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), the Integrated Regional Water Management Program (Propositions 13, 50 and 84), and by limiting availability of State funding (Bond funds or State revolving fund loans) for water infrastructure only to those agencies that have adequate groundwater plans in place.[22] The State provides technical assistance to help local agencies to develop monitoring programs, management plans, and groundwater storage projects to more efficiently and sustainably use groundwater resources, and has identified fourteen required and recommended components for groundwater management plans. In addition, the Delta Reform Act established a voluntary program for local reporting groundwater elevation data.[23] DWR has created the California Statewide Groundwater Elevation Monitoring Program (CASGEM), which will collect reported groundwater elevations and make the data available online. The first reporting deadline is January 1, 2012.

[21] The Porter-Cologne Act authorizes the SWRCB to manage discharges to groundwater that may impact water quality. California Water Code sections 2100-2101 authorize the SWRCB to manage groundwater pumping under specific conditions.

[22] Proposition 13, 50, and 84, together with State funding provided for AB 303 Local Groundwater Management Assistance Act, has made over $2 billion available for projects that improve management of groundwater supplies. To be eligible for funding, groundwater management plans need only comply with the required, not recommended, elements for groundwater management plans.

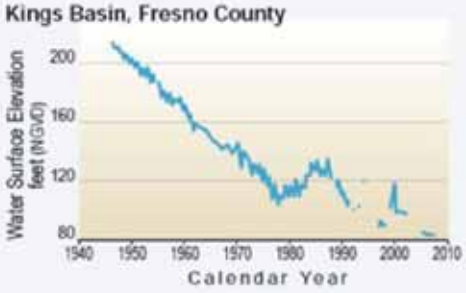
[23] SBx7-6 (Senate Bill 6) adds to and amends parts of Division 6 of the Water Code, specifically Part 2.11 Groundwater Monitoring. The law requires that local agencies monitor and report the elevation of their groundwater basins to help better manage the resource during average water years and drought conditions. DWR will implement groundwater monitoring programs in regions where local agencies fail to implement a program or fail to provide reports. DWR is required by the law to establish a priority schedule for monitoring groundwater basins, and to report to the Legislature on the findings from these investigations by January 2012 and every 5 years thereafter starting in 2015 (Water Code section 10920 et. seq).

What is Groundwater Overdraft?

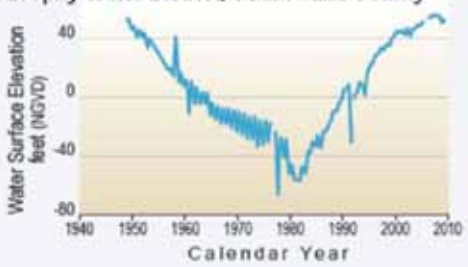
Overdraft is the condition of a groundwater basin in which the amount of water withdrawn by pumping over the long term exceeds the amount of water that recharges the basin. Overdraft is characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years. Overdraft can lead to increased extraction costs, land subsidence, water quality degradation, environmental impacts, and ultimately permanent loss of groundwater storage capacity.
The California Water Plan Update, Bulletin 160-09 (DWR 2009), estimated that groundwater overdraft in California in 2005 was about 2 million acre-feet annually, with most of the overdraft occurring in the Tulare Lake, San Joaquin River, and Central Coast hydrologic regions. However, DWR states in Bulletin 118-03 that the groundwater basin budgets that are used to estimate overdraft conditions are insufficient in many basins to quantify overdraft that has occurred, project future impacts on groundwater in storage, and effectively manage groundwater (DWR 2003a).

The two hydrographs below show the response of groundwater levels to differing water management regimes. The first hydrograph shows groundwater levels declining in response to agricultural development in the San Joaquin Valley. Groundwater levels recover somewhat during the wet period of the early 1980s, but continue to decline through the 1980s and 1990s in the absence of a focused conjunctive water management action. The second hydrograph shows a similar groundwater level decline in response to development in southern Yuba County. However, groundwater levels begin to recover in the early 1980s when surface water imports from Yuba County Water Agency began, resulting in conjunctive water management. The hydrograph shows a decline in groundwater levels during the early 1990s drought as surface water imports were curtailed and groundwater was more heavily relied upon. Thereafter, continued conjunctive water management action resulted in the refilling of the South Yuba Groundwater Subbasin, which continues up to present.

Kings Basin, Fresno County



Brophy Water District, South Yuba County



Until the enactment of the Delta Reform Act, there was no general requirement that groundwater plans be submitted to DWR, and the number adopted plans and status of groundwater management throughout the State was not known (DWR 2003a). Monitoring networks for groundwater levels and water quality will improve significantly as the result of state legislation. However, DWR has not evaluated the available data to ensure that the information accurately represents the conditions in the aquifers.

Basic groundwater budget information (recharge, extraction, change in storage in the aquifers, and water quality condition) is not quantified in many areas of the state. In fact, so little is known about the current status of California's groundwater basins that the DWR was unable to revise the designation of critically

overdrafted basins in its 2003 update on California's Groundwater Resources (Bulletin 118). DWR republished the list of eleven basins identified in 1980—more than 30 years ago.[24]

Unregulated pumping and severe groundwater overdraft in some regions has created serious economic and environmental consequences for the state. In areas of the Central Valley, for example, excessive groundwater pumping has caused as much as 28 vertical feet of subsidence. The collective costs of chronic overdraft are significant in terms of damage to streets, bridges, canals, and the aquifer itself resulting from subsidence, reduced groundwater availability during droughts, impairment of groundwater quality, higher pumping costs to other water users in the region, and environmental damage to streams and wildlife.

Information on changes in groundwater storage, and on groundwater overdraft, is vital to the sustainable management of California's groundwater resources. Improved information will support coordinated management of groundwater and surface water resources, development of conjunctive management programs, and improved water quality. This information is also a critical element in the CALSIM modeling used by DWR to evaluate SWP water operation scenarios and resulting environmental impact assessments.

Problem Statement

California's groundwater constitutes a large percentage of the state's water resources. It is also a vital source of supply during periods of critical water shortages caused by droughts or catastrophic failure of water delivery facilities. The goal of improving water supply reliability cannot be achieved without ensuring that groundwater supplies are being sustainably managed throughout the state. California needs to identify the groundwater basins that are in a critical condition of overdraft and ensure that water suppliers that receive a substantial percentage of their water supplies from these basins have adopted and are implementing sustainable groundwater management plans.

Policies

No policies with regulatory effect are included in this section.

Recommendations

WR R6 The Department of Water Resources, in collaboration with the U.S. Geological Survey and other federal, state, and local agencies, should update Bulletin 118 using field data, California Statewide Groundwater Monitoring Elevation Monitoring (CASGEM), groundwater agency reports, satellite imagery, and other best available science by January 1, 2015, and identify groundwater basins in a critical condition of overdraft. This information will be available for inclusion in the Urban Water Management Plans and Agricultural Management Plans required to be submitted to the state by December 31, 2015.

WR R7 Water suppliers that deliver water diverted or exported from the Delta or the Delta watershed and that receive a significant percentage of their water supplies from groundwater sources should develop 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).

WR R8 Local and regional agencies in groundwater basins that have been identified by the Department of Water Resources as being in a critical condition of overdraft should develop a sustainable groundwater management plan, consistent with both the required and recommended

[24] The eleven basins identified by DWR as being in a critical condition of overdraft are Pajaro Basin, Ventura Central Basin, Chowchilla Basin, Kings Basin, Tulare Lake Basin, Kern County Basin, Cuyama Valley Basin, Eastern San Joaquin Basin, Madera Basin, Kaweah Basin, and Tule Basin.

components of local groundwater management plans identified by the California Department of Water Resources (Bulletin 118, Update 2003), by January 1, 2015. If local or regional agencies fail to develop and implement these groundwater management 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 needed to prevent the destruction of or irreparable injury to the quality of the groundwater consistent with Water Code Section sections 2100-2101.

Improved Reporting and Transparency

Despite the importance to the State and its economy of improving water supply reliability, California has limited information on which to base sound water management decisions. The State's information infrastructure has not kept pace with today's complex water management issues.

A key problem is the lack of a comprehensive and standardized set of monitoring and reporting requirements. The State has very limited compiled data on actual water diversions and use throughout California. For example, the SWRCB has issued permits for the diversion of water from the Delta since 1914, but total diversion amounts are currently unknown and may be unsustainably over-allocated (SWRCB 2008b). In addition, the DWR is responsible for the identification of groundwater basins that are in a critical condition of overdraft, yet DWR has not had access to sufficient groundwater elevation data to update its assessments of overdraft conditions made over 30 years ago (DWR 2003a). Recent satellite measurements of groundwater elevation losses in the Central Valley, one of the regions DWR identified in 1980 as being in critical condition, suggest that 16.5 million acre-feet of water was removed from groundwater storage in the Central Valley between October 2003 and March 2010 (Famiglietti et al. 2011).[25]

With the passage of the Delta Reform Act, significant new monitoring and reporting requirements have been enacted. Provisions for groundwater monitoring (Water Code Section 10920 et. seq), in-Delta water diversion reporting (Water Code section 348 et. seq), tracking compliance with the State's goal of achieving a 20 percent reduction in urban per capita water use by 2020 (Water Code section 10609 et. seq) and improved reporting on agricultural water use efficiency measures (Water Code 10608 et seq and Water Code 10800 et seq) are now in the process of being implemented. In addition, the State Water Resources Control Board has initiated a program to investigate and enforce illegal diversions within the Delta.

The State has made a significant effort in recent years to quantify and report water use estimates by sector as well as by major hydrologic regions of the state in the California Water Plan (DWR 2009). However, much of the water data available to the State from local, regional, State, and federal agencies and organizations is collected by these entities using differing methodologies and levels of detail (Hanak et al. 2011). Some data is reported on only a voluntary basis, such as the submission of annual data on regional groundwater elevations to DWR, or the submittal of water conservation data to the California Urban Water Conservation Council, which, in 2008, was done by only 225 of the largest urban water suppliers (about half of agencies that could report). But even mandatory sources of local and regional water supply and use data, such as the Urban Water Management Plans that urban retail and wholesale water suppliers are required to update and submit to the DWR every 5 years, do not use consistent and transparent assumptions and formats, nor are they compiled electronically in a central database. The information from these plans is important, but it is inaccessible and consequently virtually useless for the purpose of

[25] DWR estimates that annual chronic groundwater overdraft is about 2 million acre-feet statewide, with the majority of the overdraft occurring in the Tulare Lake Hydrologic region (DWR 2003a)

evaluating water conservation and local water supply development trends that will contribute to the overall understanding and management of the state's water supply reliability.

Another important potential source of information about California's water supplies is the contracts and transfer agreements involving water from the SWP or the use of SWP facilities. It is critical that these documents be developed through an open and transparent public process, and that the resulting contracts and agreements that are easy for the public to understand. DWR adopted revised procedures in 2003[26] that, similar to the provisions adopted by the federal Bureau of Reclamation (Reclamation), require negotiations to be conducted in public, with advance notice of the time and place of negotiations and provision of the draft document for public review (DWR 2003b). See Appendix C. Reclamation, as a standard provision in their contracts, also requires submission of a standardized annual water report that includes a full water balance (production from all sources, system losses, and changes in storage and water) and a requirement for implementation of an effective water conservation and efficiency program based on the contractor's approved water conservation plan (Reclamation 2011).

Problem Statement

California cannot achieve its goal of improved water supply reliability for the state without having more—and more accurate—data about current local, regional, and state water needs and supplies and future trends. The State urgently needs to have significantly improved information on which to base its water management decisions.

Policies

WR P4 To be consistent with the Delta Plan, future contracts and agreements to export water from the Delta and/or to move water through the Delta shall be developed in a transparent manner consistent with Department of Water Resources' revised procedures adopted in 2003.

Recommendations

WR R9 The Department of Water Resources, in coordination with the State Water Resources Control Board, Regional Water Quality Control Boards, the Department of Public Health, U.S. Bureau of Reclamation, U.S. Geological Survey, California Water Conservation Council, and the Delta Council, should complete the proposed Water Planning Information Exchange (Water PIE) by January 1, 2014. This new electronic system should consolidate information into a statewide integrated data base that is in an electronic format and make it available online. It should be designed to simplify reporting processes, reduce the number of required reports, and be coordinated with the reporting requirements for the Urban Water Management Plans/Agricultural Water Management Plans and Integrated Regional Water Management Plans. Water suppliers that receive water diverted or exported from the Delta or the Delta watershed should be full participants in the Water PIE when it becomes available. Data collected by DWR should be made available to the public, and a summary of the information collected through the Water PIE should be incorporated in the analysis for the California State Water Plan Update every 5 years.

WR R10 The Department of Water Resources should include a provision in all SWP contracts and transfer agreements that requires the implementation of WR P1, WR P2, and WRP3 as a condition for water suppliers to receive deliveries. This requirement would be consistent with the existing provision in federal contracts and agreements that conditions receipt of CVP water

[26] DWR #0310, Principles Regarding Public Participation Process in State Water Project Contract Negotiations. These guidelines were prepared in connection with the Settlement Agreement, dated May 5, 2003, reached in *Planning and Conservation league et al. v. Department of Water Resources, 83 Cal. App. 4th 892 (2000).*

on implementation of an effective water conservation and efficiency program and detailed annual reporting on CVP water usage.

Performance Measures

Performance measures for improving water supply reliability are placed into three general classes: 1) administrative performance measures, 2) driver performance measures, and 3) outcome performance measures. In general, administrative performance measures describe what resources (funds, programs, projects) are being implemented (or plan to be implemented) for a program or group of related programs. 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 ecosystem responses to management actions or natural drivers. The distinction between performance measure types is not rigid. In some cases, an outcome performance measure for one purpose may become a driver performance measure for another purpose.

The following performance measures address the progress that California makes in achieving the objectives of providing a more reliable water supply for the state while simultaneously reducing reliance on the Delta to meet California's future water supply needs.

Baselines should be measured from the 2010 Urban Water Plan, the 2012 (or most recent) Agricultural Water Plan, the most recent Integrated Regional Water Management Plan, and/or the 2009 California Water Plan update, except where an alternative baseline is provided by law. Future updates will correspond with the 5-year increments required for these water plans and the California Water Plan. It is expected that State's progress toward achieving a more reliable water supply will be reported in future updates of the California Water Plan.

Administrative Performance Measures

- Percentage of urban and agricultural water suppliers that have adopted and are implementing water supply planning, conservation and efficiency measures required by State law, meeting the standards and deadlines established by code.[27]
- Percentage of urban and agricultural water suppliers that incorporated a Water Supply Elements by December 31, 2015.
- Percentage of urban and agricultural water supplies that have adopted conservation based water rate structure by December 31, 2020.
- Completion by DWR and other agencies of planning guidelines and revised grant and loan ranking criteria. Percentage of projects that receive funding as a result of the revised grant and loan ranking criteria.
- SWRCB adopts and implements flow objectives by June 2, 2014, and adopts flow objectives for the major tributary streams to the Delta by June 2, 2018.
- Completion by the DWR of the Surface Water Storage Investigation with recommendations for critical projects that need to be implemented to expand the State's surface storage.

[27] Required measures include Urban Water Management Plan, SBX7 7 20% reduction in GPCD by 2020, Water Conservation Best Management Practices, Agricultural Efficient Water Management Practices, Agricultural Water Management Plans

- Completion of a survey by the Council to identify projects that may be implemented within the next 5 to 10 years to expand existing surface and groundwater storage facilities, create new storage, improve Delta conveyance facilities and improve opportunities for water transfers, and completion of hearings by the California Water Commission to recommend specific projects.
- Completion by DWR of a 2014 update of Bulletin 118 using actual data, and identification of which California groundwater basins are in a critical condition of overdraft.
- Percentage of water suppliers that have developed groundwater management plans that are consistent with the required and recommended components of groundwater management plans consistent with DWR Bulletin 118-03.
- Percentage of groundwater basins identified by DWR as being in a critical condition of overdraft and having groundwater management plans that comply with both the required and recommended components of groundwater management plans consistent with the DWR Bulletin 118-03.
- Activation of the Water Planning Information Exchange by January, 2014. Development of the Exchange is led by DWR in collaboration with other State and federal agencies, water suppliers, and other stakeholders.
- Percentage of SWP contract and transfer agreements that require implementation of WR P1, WR P2, and WR P3 as a condition for water suppliers to receive water deliveries.

Driver Performance Measures

- Progress toward meeting the State's conservation goal of achieving 20 percent reduction in urban water usage by 2020 (per SBX7 7) and toward implementing urban demand management measures and agricultural water efficient practices, reported through the California Water Plan updates.
- Progress toward expanding local and regional water supplies measured by the amount of additional water made available relative to the last 5 years, and the actual or projected reduced reliance on Delta water supplies, reported through the California Water Plan updates.
- Progress toward increasing the reliability of water supply imported from the Sacramento River or the San Joaquin watershed, measured by the amount of water made available relative to the last 5 years, reported through the California Water Plan updates. Progress will also include consideration of increased flexibility of system operations and improved water management and coordination with other water systems.
- Progress toward attaining regional water balance for hydrologic regions identified by DWR, measured by a comparison of the region's water demand with the region's available supply for wet, average, and dry year scenarios and by 5-year increments over the 20-year planning period, to be reported through the California Water Plan update.
- Progress toward implementing a diverse array of projects throughout California within the next five to ten years that expand existing surface and groundwater storage facilities, increase new storage, improve Delta conveyance and increase water transfers, measured by improved availability of water supplies from these sources (measured in amount, timing, and flexibility).
- Progress toward achieving improvements to the management of California's groundwater basins (measured by trends in groundwater levels, groundwater quality, and conjunctive management/usage of basins) and implementation of measures to reverse critical conditions of overdraft in the most severely impacted groundwater basins.

- Progress toward achieving measureable improvements to the statewide collection and evaluation of data on surface and groundwater diversions, water use, and water supplies, summarized in future California Water Plan updates.

Outcome Performance Measures

- Progress toward achieving the State's current numeric goals for urban water conservation (increase urban and industrial conservation by 20 percent by 2020), recycled water (increase use of recycled water over 2002 levels by at least one million acre-feet per year by 2020 and by at least two million acre-feet per year by 2030), and stormwater use (increase use of stormwater by at least 500,000 acre-feet per year by 2020 and by a least one million acre-feet per year by 2030).[28]

- Progress toward completing substantial development and construction of new surface and groundwater storage and associated conveyance facilities by 2020, with the goal of completing all planned facilities by 2030.

- Progress toward achieving increased diversity and reliability of water supplies in all regions of California and for the state as whole, while reducing reliance on Delta water to meet water needs.

- Development and publication of a California Water Plan Update every 5 years that consolidates and summarizes actual data on the status of the State's water supplies, demands, and water balances (by hydrologic regions).

- Progress in reviewing and setting expanded future water management, water supply development, and conservation and water use efficiency targets for the State to continue to meet the Delta Plan objective of providing a more reliable water supply for California.

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Chapter 5
Restore the Delta Ecosystem

The Delta Protection Act of 1992 defined the coequal goals and declared the coequal goals as state policy for the Delta (Public Resources Code section 29702, amended 2009). Section 29702 (a) through (c) are relevant to ecosystem restoration:

> *29702 The Legislature further finds and declares that the basic goals of the state for the Delta are the following:*
>
> > *(a) Achieve the two coequal 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.*
> >
> > *(b) Protect, maintain, and, where possible, enhance and restore the overall quality of the Delta environment, including, but not limited to, agriculture, wildlife habitat, and recreational activities.*
> >
> > *(c) Ensure orderly, balanced conservation and development of Delta land resources.*

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.

1

Chapter 5
Restore the Delta Ecosystem

Introduction

The Delta Reform Act defines "restoration" as "...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).

The Act also recognizes the value of the Delta as "... the most valuable estuary and wetland ecosystem on the west coast of North and South America" (Water Code section 85022) and provides multiple references to specific ecosystem attributes and functions to be "protected, restored or enhanced" in meeting the coequal goals.

An overarching goal for ecosystem restoration in the Act is to restore fish and wildlife to include more viable and resilient populations of native resident and migratory species.

The Delta Plan envisions a healthy Delta ecosystem that approximates its natural ecological potential and supports viable populations of native species. It includes the following attributes:

- Rivers in the Delta and its watershed have expansive riparian edges that are seasonally connected to large floodplains.
- Tidal channels and bays in the Delta and Suisun regions (at the downstream end of the Delta landscape continuum) connect with freshwater creeks and upland grasslands and woodlands.
- Extensive migratory corridors for fishes, birds, and terrestrial wildlife that connect habitats and provide escape routes.
- A more naturally variable hydrograph that makes aquatic, floodplain, and tidal marsh habitats more dynamic and resistant to colonization by nonnative species.
- A system in which impacts from multiple stressors do not exceed the capacity of the system to absorb them and adapt to them.

Restoration of the current "domesticated" Delta back to the historical "wild" ecosystem is not possible, but three categories of understanding can assist in the achievement of restoration goals as they fit within the existing system:

- The first is to understand the historical Delta ecosystem to determine which important ecosystem features or functions may have been changed, degraded, or lost (Palmer et al. 2005). This is

important because native species are adapted to the historical features and functions of the Delta (Moyle et al. 2010).

- The second is to apply principles of landscape ecology and ecosystem-based management so that restored ecosystems are adequately scaled, are resilient to disturbances, and restore native species' competitive advantages over nonnative species.
- The third is to identify and understand the many interacting stressors threatening the health of the Delta ecosystem so that they can be adequately addressed (Delta Independent Science Board 2011).

This chapter focuses on the importance of restoring two key Delta ecosystem attributes that have been greatly changed and degraded – the natural flow regime and adequate habitat for native species – and on reducing impacts of ecosystem stressors. Flows and stressors are also considered in other Delta Plan chapters (especially Chapters 4 and 6).

The Historical Delta Ecosystem

Historically, the Delta was a 700,000-acre mosaic of variable landscape types influenced by tides and river flows (Figure 5-1). Historical Delta landscapes showed considerable seasonal and interannual variability in flow characteristics and inundation patterns. The historical Delta can be divided into three primary landscapes: (1) flood basins in the north Delta, (2) tidal islands in the central Delta, and (3) distributary rivers (multiple branches flowing away from main channels) in the south Delta (Grossinger et al. 2010; Whipple et al. 2010, 2011).

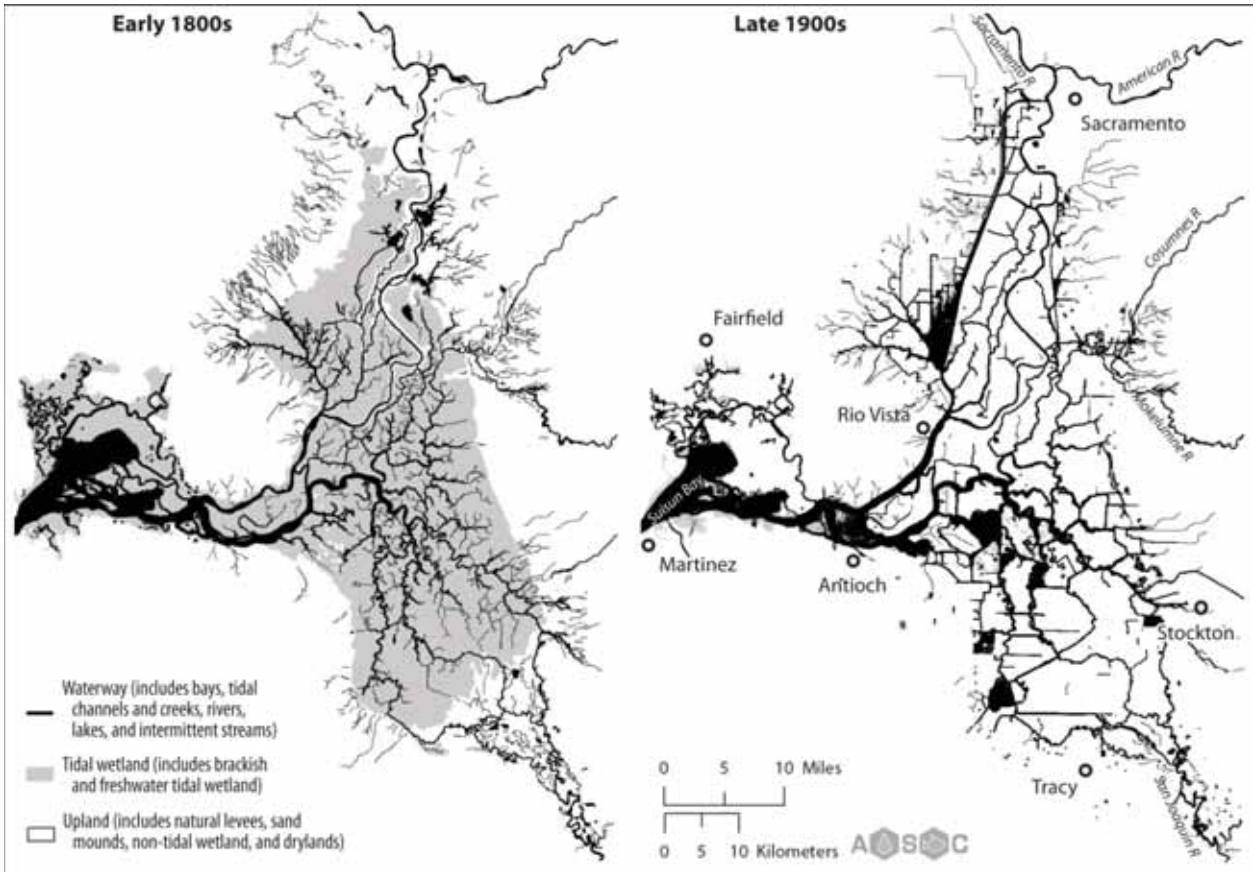
The historical flood basins in the north Delta occurred at the interface between fluvial (riverine) and tidally influenced portions of the Delta where the Sacramento River entered the Delta. A defining characteristic of this region was a broad zone of nontidal, freshwater, emergent plant[29]-dominated (tule) wetlands that transitioned into tidal freshwater wetlands. Other common features included shallow perennial ponds and lakes, riparian forests along natural levees, and seasonal wetlands. The historical central Delta included about 200,000 acres of tidal islands with freshwater emergent plants that were inundated regularly by spring tides. Banks of the tidal islands were commonly covered in tules, while willows, grasses, sedges, shrubs, and ferns grew in the interior of the islands. The historical south Delta contained a complex network of channels with low berms acting as natural levees, large woody debris, willows, and other shrubs with upland areas supporting open oak woodlands. Historical data from the Delta paint a picture of rich habitat complexity at multiple spatial and temporal scales (Grossinger et al. 2010; Whipple et al. 2010, 2011).

Domestication of the historical Delta and Suisun Marsh landscape and ecosystem over the past 160 years has involved constructing approximately 1,115 miles of levees, draining the lands behind the levees for crop production, and diverting water to southern parts of the state (Hanak et al. 2011). This has produced a rich agricultural and urban economy in the Delta and far beyond its borders, but it has come at a cost to the original estuarine ecosystem and its native species.

Most tributary rivers flowing to the Delta have been dammed. Access to areas critical to fish lifecycles is now greatly reduced, including spawning habitats for the state's iconic salmon. The once pronounced seasonal and interannual flow variability has given way to more stable and artificially regulated conditions, and the formerly highly complex landscape of the past has been replaced by a much more uniform landscape resembling a simplified, spatially and temporally fixed grid of straightened river channels used for north-south and east-west water conveyance.

[29] An emergent plant roots in shallow water but has most of its vegetative growth above water.

Figure 5-1
Historical and Current Delta Waterways



Historical sources: Historical Ecology of the Sacramento-San Joaquin Delta Study (draft data), Aquatic Science Center; Bay Area EcoAtlas, San Francisco Estuary Institute, 1999. Note: Detailed mapping of Suisun tidal marsh channels is not available at this time.
Modern sources: Bay Area Aquatic Resources Inventory Dataset [geographic information system file type], San Francisco Estuary Institute, 2007-2011; U.S. Bureau of Reclamation, MPGIS Service Center; Delta Vegetation and Land Use, Aerial Information Systems, Inc. for the California Department of Fish and Game, Vegetation Classification and Mapping Program.

Comparison of historical (early 1800s) and modern Delta waterways. 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 including channel widening, meander cuts, cross levees, and loss of within-island channel networks and tidal wetland.

It is important to recognize that ecosystem restoration in the Delta landscape will not restore the historical "wild" Delta, but knowledge of the historical Delta informs restoration actions by identifying what landscape elements best fit various localities where restoration projects are practical and feasible. Understanding the scales, patterns, and connections of historical landscape components gives us an appreciation for what has been changed, degraded, or lost, and provides a useful guiding image for restoration actions (Grossinger and Whipple 2010). At the same time, it is understood that return to the historical Delta's conditions is not probable or even desirable, because ecosystems are always responding to natural and human-related drivers of change (Folke et al. 2010). This is recognized in the definition of restoration in the Delta Reform Act with the goal of "...close approximation of its natural potential..." (Water Code section 85066).

Landscape Ecology

Landscape ecology offers a manner for maximizing limited restoration opportunities for native species. This perspective considers the ways that species perceive and use the landscape for finding food and refuge and for adapting to change (Simenstad et al. 2000, Lindenmayer et al. 2008). Landscape ecology also considers the role of humans in affecting landscape patterns and processes (Turner 1989). The landscape perspective considers relationships between interacting landscape elements like energy flows and corridor connections that species can navigate (Wiens 2002). The landscape perspective also provides a basis from which to promote processes of landscape self repair, or "self design," especially important in the face of sea level rise, so that historical landscape patterns can reorganize over time (Teal et al. 2009). Self design ultimately increases the sustainability and resilience of restored native species habitats over the long run. The objective of Delta ecosystem restoration is to find and implement strategies that use the least intervention possible to make the limited available land eventually mimic historical landscape functions to a degree that enables native species to use them to meet their needs.

The landscape perspective is important to resource managers because spatial context matters. Restored landscapes have neighboring land uses that include agriculture and urban areas. Each land use affects the other because they are connected by air, land, and water; yet humans desire often conflicting services from each. In addition, ecosystem function (described further on) depends on the interplay and interconnection of pattern and process over broad areas and, therefore, necessarily includes the role of humans in these relationships. Finally, resource managers have a stewardship responsibility to understand and manage the impacts of human activities that alter landscape characteristics and the relationship between ecosystem patterns and processes.

Ecosystem Restoration

According to the Delta Reform Act, the Delta Plan shall include strategies to "restore the Delta ecosystem, including its fisheries and wildlife, as the heart of a healthy estuary and wetland ecosystem" (Water Code section 85020). What, then, is an ecosystem, what makes it healthy, and how can its health be restored? An ecosystem is most simply defined as "a community of organisms together with its environment, functioning as a unit" (American Heritage 2009). Every ecosystem has a unique structure and function. The structure is provided by elements (for example, populations and habitats) and the processes that connect elements with each other (such as natural selection, food web interactions, nutrient cycling, hydrology, and disturbance). The elements and processes work together to achieve ecosystem-specific functions such as supporting a unique native species grouping and providing goods and services that benefit humans (the provision of fresh water, food, recreational opportunities, cultural heritage and spiritual benefits, and purification of water and air).

All ecosystems change over time in response to numerous natural and anthropogenic drivers of change (Healey et al. 2008, Delta Independent Science Board 2011). Change is inevitable, but healthy, dynamic ecosystems change to retain their basic structure and functions—they are resilient. By contrast, degraded ecosystems are less resilient to disturbance and may rapidly shift to an alternative ecosystem regime that no longer supports the full suite of original functions (Folke et al. 2004).

Successful restoration of ecosystem health measurably rehabilitates and strengthens key ecosystem attributes, including key processes and habitats, to restore at least some of the original ecosystem functions and strengthen ecological resilience to future changes. In the Delta, this necessarily includes creating a more natural flow regime, restoring habitats, and reducing threats and stresses.

Policies and Recommendations

Creating a More Natural Flow Regime

Strong scientific consensus supports the concept that water flows more closely reflecting historical flow conditions are best for native communities of aquatic organisms (Poff et al.1997; Bunn and Arthington 2002). Flow is a major environmental driver that ultimately shapes ecological processes, habitat, and biotic composition in riverine and estuarine ecosystems such as the Delta.

Figure 5-2
Unimpaired and Historical Seasonal Flows
Source: Dr. William Fleenor, Environmental Dynamics Lab, University of California, Davis

The State Water Resources Control Board (SWRCB) has recently presented summary determinations regarding flow criteria for the Delta ecosystem (SWRCB 2010). Some key points are as follows:

- Nonflow changes like nutrient composition, channelization, habitat, invasive species, and water quality need to be addressed along with flows.
- Flow and physical habitat interact in many ways, but they are not interchangeable.
- Percent of unimpaired flow into the Delta is one pathway for setting flow criteria.
- More natural flows are important to migratory cues of many fish species.
- Positive changes in flow or flow patterns benefit both humans and fish and wildlife.
- A coordinated land use policy in the Delta is needed.

Creating a more natural flow regime in the Delta is an important step toward meeting the coequal goal of a healthier Delta ecosystem.

Flow is Both Volume and Timing

Flow is not simply the volume of water, but also includes 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. The principles are as follows: (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 non-native 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)

Problem Statement

Native aquatic species in the Delta are adapted to flow regimes characteristic of California's natural climate and hydrology. This includes higher flows in the winter and spring and lower flows in the summer and early fall. Altered Delta flow regimes are detrimental to native aquatic species and encourage nonnative aquatic species.

Policies

ER P1 Prior to the establishment of revised flow criteria and objectives identified in ER R1, the existing Bay-Delta Water Quality Control Plan objectives shall be used to determine consistency with the Delta Plan.

- By June 30, 2013, the Council will request an update from the State Water Resources Control Board on items ER R1 (a) and (b). If the Board indicates the dates in items (a) or (b) cannot be met by the dates provided, the Council will consider and may amend the Delta Plan to achieve progress on the coequal goals in place of the updated flow objectives. For example, the Council could:

  1. Determine that a covered action that would increase the capacity of any water system to store, divert, move, or export water from or through the Delta would not be consistent with the Delta Plan until the revised flow objectives are implemented.

  2. Recommend that the State Water Resources Control Board cease issuing water rights permits in the Delta and the Delta watershed (or, if the absence of flow criteria is specific to one or more of the major tributaries, then the recommendation could be focused on the impacted areas).

Recommendations

ER R1 The State Water Resources Control Board should update the Bay-Delta Water Quality Control Plan objectives and establish flows as follows:

- By June 2, 2014, adopt and implement updated flow objectives for the Delta that are necessary to achieve the coequal goals.
- By June 2, 2018, develop flow criteria for high priority tributaries in the Delta watershed[30] that are necessary to achieve the coequal goals.

Improving Habitat

Habitat is a fundamental ecological concept that refers to the place where an organism lives. This "place" is defined by conditions and resources a given organism or species requires to survive and reproduce (Hall et al. 1997). Because no two species have exactly the same requirements, habitats are species-specific components of ecosystems. The term habitat is also often used when referring to land cover types (such as open water and riparian vegetation). It is important to note, however, that habitat and land cover type are not the same thing (Lindenmayer et al. 2008); an organism's habitat is much more than land cover type. For example, the total area of the Delta covered by open water has not changed substantially over the last few decades, but several open water (pelagic) fish species have undergone steep declines (Sommer et al. 2007), suggesting that at least some of the open water areas in the Delta have become inhospitable to these fishes. The actual functional habitat available to these open water species has shrunk, even though the area covered by open water has remained fairly stable. Similarly, changing land cover patterns (for example, increasing open water areas) does not automatically lead to increases in specific target species if detrimental conditions (such as poor water quality, predation risk, or entrainment) make these areas unsuitable as new habitat.

Habitat loss and fragmentation caused by human land use is an important driver of worldwide species losses (Foley et al. 2005). In estuaries and coastal areas, exploitation (for example, overfishing) and habitat destruction have been identified as the leading causes of species declines and extinctions (Lotze et al. 2006). Habitat restoration can lead to species recovery, especially when carried out in combination with the reduction of other stressor impacts such as exploitation, predation, or pollution (Lotze et al. 2006).

From a landscape perspective, habitats are species-specific "patches" in spatially varied landscapes. The occurrence and abundance of organisms is closely associated with the total amount of usable habitat in a landscape as well as with habitat patch sizes, shapes, and arrangements (Hannon and Schmiegelow 2002). Habitats that are too small, fragmented, or isolated may not support specific organisms over the long term—they are, in effect, no longer functional habitats for these organisms. Because habitats are species-specific, their necessary size, shape, and arrangement in a landscape differ among species. However, more, larger, and better-connected patches of a specific habitat generally are more likely to provide the conditions for the persistence or recovery of species associated with that habitat (Lindenmayer et al. 2008).

Much of the original habitat for native species in the Delta has been destroyed over the last 160 years (Healey et al. 2008, Moyle et al. 2010, Baxter et al. 2010). The current Delta continues to be a productive ecosystem, but the prevailing habitat types and conditions support a much different mix of species than the historical Delta, and many of the currently thriving species are nonnative species. They include

[30] SWRCB staff will work with the Delta Stewardship Council 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 Creed (tributary to Sacramento River), Cosumnes River, and American River (SWRCB 2011a, SWRCB 2011b).

species considered desirable (largemouth bass, a sport fish) and undesirable (the Brazilian water weed *Egeria densa*) or even harmful (the harmful cyanobacteria *Microcystis aeruginosa*) by humans. Many nonnative species in the Delta evolved in ecosystems with much less variable habitat conditions (Moyle et al. 2010). On the other hand, current habitat conditions are insufficient to sustain a number of aquatic and terrestrial native species such as the fishes involved in the sudden "pelagic organism decline" (POD) in the first decade of the twenty-first century (Sommer et al. 2007, Baxter et al. 2010), as well as winter- and spring-run Chinook salmon, giant garter snake, and Suisun thistle, among others (Healey et al. 2008, Moyle et al. 2010). Successful recovery of native species requires aggressive habitat restoration aimed at increasing the extent, quality (including connectivity), and diversity of native species habitats. Habitat restoration aimed at protecting and restoring native species and the ecosystem services they provide (such as native salmon for food; recreation; and cultural, intellectual, and spiritual inspiration) is thus another critical step in meeting the coequal goal of a healthier Delta ecosystem.

As part of the CALFED Record of Decision (ROD), CALFED program implementation was broken into two stages, Stage 1 (2000–2007) and Stage 2 (2008–2030), to allow reevaluation of its preferred conveyance alternative (through-Delta) after Stage 1. An evaluation of program performance was conducted at the end of Stage 1. This evaluation found that CALFED's through-Delta conveyance alternative had not achieved sufficient progress in sustaining viable populations of endangered and threatened aquatic species or in ecosystem restoration, levee stability, or water supply reliability. Consequently, the Ecosystem Restoration Program (ERP) Implementing Agencies (California Department of Fish and Game [DFG], U.S. Fish and Wildlife Service [USFWS], and National Marine Fisheries Service [NMFS]) developed a Stage 2 Conservation Strategy for the Sacramento–San Joaquin Delta Ecological Management Zone (Delta Conservation Strategy) (DFG et al. 2010).

The Delta Conservation Strategy describes the ERP Implementing Agencies' ecosystem restoration goals, objectives, and priorities for the Delta Ecological Management Zone (Delta EMZ) for Stage 2 of the CALFED Bay-Delta Program and serves as an update to the ERP Strategic Plan as it relates to restoration actions in the Delta EMZ. It also follows the ERP principle of a single blueprint for ecosystem restoration and species recovery in the Delta in accordance with the principles of ecosystem-based management. The ERP Implementing Agencies encourage all agencies, groups, or individuals interested in resource conservation and management in the Delta to use this document as a shared vision to coordinate and integrate actions and expect that it will serve as the ecosystem component of any future comprehensive Delta Plan developed by the Delta Stewardship Council (DFG et al. 2010).

State and federal policies to address water supply or flood risk in the Delta should also consider the impact of these policies on remaining habitat. For example, the overall effect of woody vegetation on levees is a topic of considerable current controversy. Current policy recommendations by the U.S. Army Corps of Engineers propose to strip woody vegetation off 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 the vegetation removal policy for earthen levees (FEMA 2005). However, if implemented as proposed, the order would denude many Delta levees, severely reducing already sparse shaded riverine aquatic habitat.

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 tree toppling with scour erosion. Evidence also exists that allowing woody shrubs and small trees on levees enhances 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 in a measurable manner (Shields and Gray 1992), providing increased stability against slope failures.

The benefits and risks of levee vegetation should be weighed carefully, and methods for maximizing benefits and minimizing risks to both habitat and levee structural integrity should be identified.

Problem Statement

Landscape attributes, particularly elevation and other environmental conditions, have changed dramatically in the Delta and the Suisun Marsh over the last 160 years. The resultant reduction in the extent, quality, and diversity of habitats supporting native species has led to declines in populations of native resident and migratory species.

Policies

ER P2 Habitat ecosystem restoration actions shall be consistent with the habitat type locations shown on the elevation map in Figure 5-3, and accompanying text shown in Appendix D, based on the *Ecosystem Restoration Program's Conservation Strategy for Stage 2 Implementation for the Sacramento-San Joaquin Delta Ecological Management Zone* (DFG et al. 2010), with minor alterations.

The Council may amend the Delta Plan to incorporate revised figures and text from the Ecosystem Restoration Program's Conservation Strategy as the strategy is revised.

ER P3 Actions other than habitat restoration, including new or amended local or regional land use plans, shall demonstrate that they have avoided or substantially minimized the adverse impacts to the opportunity for habitat restoration at the elevations shown in Figure 5-3.

ER P4 State and local agencies constructing new levees, or substantially rehabilitating or reconstructing existing levees in the Delta shall evaluate and, where feasible, incorporate alternatives (including use of setback levees) that would increase the extent of floodplain and riparian habitats.

Recommendations

ER R2 The Council acknowledges the importance of expediting habitat restoration in the Delta and its watershed and recommends the prioritization and implementation of habitat restoration projects in the following areas, also shown in Figure 5-4:

- **Cache Slough Complex**. The flood basins entering the Cache Slough Complex are the interface between river and tidally influenced portions of the Delta. A significant portion of the region should return to uplands with vernal pool and grassland habitats and broad nontidal, freshwater, emergent plant-dominated wetlands that grade into tidal freshwater wetlands, shallow subtidal and deep open water habitats. A restoration project in this area is the passively restoring Liberty Island. Projects in the planning stage include the Department of Water Resources Prospect Island restoration project.

- **Cosumnes River–Mokelumne River Confluence**. Unregulated and minimally regulated rivers should allow frequent and regular winter and spring overbank flooding to create seasonal floodplain and riparian habitats grading into tidal marsh and shallow subtidal habitats. A restoration project is the Cosumnes River Preserve floodplain restoration. Projects in the planning stage include the Department of Water Resources North Delta Flood and Ecosystem Restoration Project on McCormack-Williamson Tract.

- **Lower San Joaquin River Floodplain**. 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. Reconnection of significant portions of the floodplain, along with more natural flows, stimulates food webs that support native species. Projects in the planning stage include the Lower San Joaquin Flood Bypass proposed by the South Delta Levee Protection and Channel Maintenance Authority and partners.

Figure 5-3
Elevations and Ecological Management Zones in the Delta-Suisun Marsh
Source: DFG et al. 2010
[UNDER DEVELOPMENT]

- **Suisun Marsh**. The largest contiguous wetland area on the west coast of the continent, Suisun Marsh has been mostly disconnected from the estuary. Restoring significant portions of Suisun Marsh provides the brackish portion of the estuary with sea level rise accommodation space, opportunities for extensive land-water interface dynamics, and compressed chemical and biological gradients that support productive and complex food webs to which native species are adapted. An ongoing restoration project is the California Department of Water Resources' Blacklock Restoration Project. Projects in the planning stage include the Department of Fish and Game Hill Slough Restoration Project.

- **Yolo Bypass.** The current operation of the Yolo Bypass as a flood control project provides substantial ecosystem benefits for Sacramento splittail spawning and rearing and salmon rearing (Figure 5-5) (Sommer et al. 2001, Moyle et al. 2007). Enhancing the ability of Yolo Bypass to be "activated" by higher-frequency, lower-magnitude flood levels provides more opportunity for migrating fish, especially Chinook salmon, to use this system as a migration corridor rich in refugia and food resources. 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 year critical for spawning and rearing of native fish.

  A map of these areas is under development and will be included in the Fifth Staff Draft Delta Plan.

Figure 5-4
Recommended Areas for Prioritization and Implementation of Habitat Restoration Projects
[UNDER DEVELOPMENT]

ER R3 As part of its Strategic Plan, the Delta Conservancy should:

- Develop and adopt criteria for prioritization and integration of large-scale ecosystem restoration in the Delta, 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.

- Recommend sources for long-term financing for restoration programs and projects that include covering costs of long-term operations and management and payment in lieu of taxes.

- Develop and adopt a formal mutual agreement with the Department of Water Resources, Department of Fish and Game, 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 Department of Water Resources, Department of Fish and Game, 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's Conservation Strategy.

- Convene an effort to develop a habitat credit program that provides credit for each of these steps: acquisition in preparation for future restoration; preservation, management, and

enhancement of existing habitat; restoration of habitat, and monitoring and evaluation of habitat evolution and ecological outcomes.

- Work closely with the Delta Science Program to:
  - Incorporate the best available understanding of the scales, patterns, and processes of the historical landscape to guide land acquisition strategies and restoration design.
  - Apply the latest understanding of landscape ecology as a unifying perspective for restoring processes and functions on degraded landscapes.
  - Construct landscape-level conceptual models for key regions of the Delta and Suisun Marsh to clarify how more natural flows and ecosystem restoration confer resilience to native species while promoting processes of self-repair of modified landscapes. Conceptual design models should engage hydrodynamics, transport, particle tracking, and food web models to support and integrate the interdisciplinary perspectives.
  - Study available habitat reference sites to increase understanding of well-functioning habitats and to inform performance measure metrics and trajectories.

Figure 5-5
Better Habitat Equals Greater Growth
Source: Jeffres et al. 2008
Figure illustrates faster growth in floodplain habitat compared to river habitat. Salmon on the left were reared within Cosumnes River channel habitat, while the salmon on the right were reared within Cosumnes River floodplain habitat. All salmon shown are the same age.

ER R4 State and local agencies constructing new levees, or substantially rehabilitating or reconstructing existing levees in the Delta watershed shall evaluate and, where feasible, incorporate alternatives (including use of setback levees) that would increase the extent of floodplain and riparian habitats.

ER R5 In support of the coequal goals, the U.S. Army Corps of Engineers should work with the California Department of Fish and Game and the California Department of Water Resources to execute an agreed-upon variance process to exempt Delta levees from the Corps' levee vegetation policy.

Reducing Threats and Stresses

Ecosystem restoration is challenged by persistent threats and stresses to the processes, habitats, and species it seeks to restore. The current degraded ecological conditions for many native Delta species are the result of the combined impacts of multiple drivers and stressors. The Delta Independent Science Board classified stressors in the Delta into four categories (Delta Independent Science Board 2011):

- **Globally determined stressors** that cannot be eliminated or mitigated within the purview of the Delta Plan (for example, effects of climate change or human population growth);
- **Legacy stressors** that result from past actions in the Delta watershed that cannot be undone (for example, mercury pollution from historical gold mining and past introductions of nonnative species);
- **Anticipated stressors** that scientists can anticipate will result from present or future activities (for example, changed land use and lifestyle choices); and
- **Current stressors** that result from ongoing human activities (such as water management, agricultural practices, urban waste discharges, and similar stressors)

Controlling stressors in the first two categories is difficult or impossible, and management actions aimed at these stressors generally focus on adaptation and mitigation. Stressors in the last two categories should be managed to prevent or reduce their effects by changing human activities that cause the stresses or by allowing or planning for increased adaptation to the stresses. The Delta Independent Science Board (ISB 2011) also urged paying attention to all categories of drivers and stressors, including those acting over long temporal and broad spatial scales. The Delta ISB pointed out that it is difficult to assess and prioritize stressors because they interact with each other, affect ecosystem attributes in varying ways (what may be negative for one stressor may be positive for another stressor), and effects may change in different time periods or locations. The Delta ISB recommended tackling multiple stressors simultaneously, even if the outcomes are uncertain. According to the Delta ISB (2011), there is "no reason to think that reducing one stressor, or several stressors, will solve even a particular problem such as the pelagic organism decline" in the Delta. Instead, "a large number of stressors need to be addressed" to achieve a healthier Delta ecosystem. Promoting the reduction of and adaptation to multiple threats and stresses, wherever possible, is thus a critical step in meeting the coequal goal of a healthier Delta ecosystem.

Problem Statement

Although the Delta and the Suisun Marsh remain productive parts of the San Francisco Estuary ecosystem, their unique, native natural heritage and prized ecosystem services (such as the provisioning of native salmon as a food source, for recreation, and as a source of cultural, intellectual and spiritual inspiration) are in danger of being irretrievably lost because of the interacting effects of multiple drivers and stressors. These include altered flows and reduced habitat quality and quantity (previously addressed in this chapter and Chapter 4), degraded water quality (addressed in Chapter 6), and the effects of nonnative invasive species, entrainment, predation, diminished food resources, migration barriers and hatchery impacts.

Policies

ER P5 Agencies proposing covered actions shall demonstrate that the potential for new introductions of or improved habitat conditions for nonnative invasive species have been fully considered and avoided or minimized in a way that appropriately protects the ecosystem.

Recommendations

ER R6 The Department of Fish and Game and other appropriate agencies should prioritize and fully implement the list of "Potential Stage 2 Actions for Nonnative Invasive Species" (see sidebar) and accompanying text shown in Appendix E taken from the *Ecosystem Restoration Program's Conservation Strategy for Stage 2 Implementation for the Sacramento-San Joaquin Delta Ecological Management Zone* (Department of Fish and Game et al. 2010).

The Council may amend the Delta Plan to incorporate revised figures and text from the Ecosystem Restoration Program's Conservation Strategy as the strategy is revised.

ER R7 The Delta Science Program, in conjunction with the California Department of Fish and Game, the California Department of Water Resources, the State Water Resources Control Board, and other relevant agencies and stakeholders, should conduct workshops to develop recommendations to the Council for measures to reduce stressor impacts on the Delta ecosystem that would support and be consistent with the coequal goals. The resulting recommendations should be provided to the Council by January 1, 2013. For example, workshops would consider options for varying salinity to reduce impacts of nonnative invasive species while providing overall ecosystem benefits and minimally disrupting water supply.

The Bay Delta Conservation Plan

The Bay Delta Conservation Plan (BDCP) is an applicant-driven, multi-stakeholder Habitat Conservation Plan/Natural Communities Conservation Plan development process for the Delta that has been under way since 2006. The California Natural Resources Agency has been leading the process in collaboration with other State, federal and local water agencies, environmental organization and other interested parties. The BDCP is a major project considering large-scale improvements in water conveyance and large-scale ecosystem restoration in the Delta. It has the dual purpose of achieving greater water supply reliability through an improved Delta export water conveyance system, and contributing to recovery of threatened and endangered species in the Delta. The BDCP will include a scientifically based adaptive management program to ensure incorporation of new scientific information into decisions on water management and conservation measures.

The BDCP is not expected to be completed until after the first Delta Plan is adopted by the Delta Stewardship Council. The BDCP will be incorporated into the Delta Plan if it meets the requirements of Water Code section 85320. For more information about the inclusion of the BDCP in the Delta Plan, refer to Chapter 1 The Delta Plan; Chapter 3, Governance: Implementation of the Delta Plan; Chapter 4, A Reliable Water Supply for California; and Appendix A.

Problem Statement

BDCP is expected to significantly affect the Delta Reform Act's coequal goals. Specifically, BDCP aims to promote the recovery of endangered, threatened, and sensitive species and their habitats in the Delta in a way that also will protect and restore water supplies. The BDCP planning process has been under way since 2006, but BDCP will not be completed prior to adoption of the Delta Plan in 2012.

Potential Stage 2 Actions for Non-Native Invasive Species

Action 1: Continue implementing the CALFED NIS Strategic Plan and DFG's California Aquatic Invasive Species Management Plan (CAISMP) to prevent new introductions; limit or eliminate NIS populations; and reduce economic, social and public health impacts of NIS infestation

Action 2: Continue funding the Department of Boating and Waterways Egeria densa mapping program. Also, begin investigation whether non-chemical means of control are possible.

Action 3: Continue research and monitoring programs to increase understanding of the invasion process and the role of established NIS in the Delta's ecosystems including:

- Investigate invasions by Egeria or Microystis to newly restored area.
- Investigate recreating habitats that have a high variability in abiotic factors (e.g. salinity, flows, depth, etc.) as a means of limiting the overbite and Asian clams and Egeria.

Action 4: Continue studies on the effectiveness of local treatment of zebra and quagga mussels using soil bacterium.

Action 5: Standardized methodology for sampling programs to measure changes in NIS populations over a specific timeframe.

Action 6: Collect and analyze water quality sampling data (e.g. salinity and water temperature) for correlation analysis between NIS distribution and habitats.

Action 7: Complete an assessment of existing NIS introductions and identify those with the greatest potential for containment or eradication; this assessment also would be used to set priority control efforts.

Action 8: Establish a program to monitor for new invasions of non-native wildlife, and develop responses to quickly contain and control them.

Action 9: Continue investigating potential parasite(s) as a means to control invasive clam or mussel populations.

1

Recommendation

ER R8 The involved federal, State, and local agencies should complete the Bay Delta Conservation Plan process (i.e., receive required incidental take permits) consistent with the Delta Reform Act and no later than December 31, 2014. If the Bay Delta Conservation Plan process is not completed by this date consistent with the Delta Reform Act, the Council will consider how to proceed with developing ecosystem and conveyance planning.

Performance Measures

Performance measures derive from the goals and objectives in the Delta Reform Act and from mandates for large-scale ecosystem restoration within the Delta. The performance measures should address progress in achieving each of the following objectives in the Delta Reform Act:

> 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(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.

Performance measures for ecosystem restoration are placed into three general classes. These classes are 1) administrative performance measures, 2) driver performance measures, and 3) outcome performance measures. In general, administrative performance measures describe what resources (funds, programs, projects) are being implemented (or plan to be implemented) for a program or group of related programs. 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 ecosystem responses to management actions or natural drivers. The distinction between performance measure types is not rigid. In some cases, an

outcome performance measure for one purpose may become a driver performance measure for another purpose.

Ecosystem processes lend themselves to tracking with comprehensive ecosystem assessment and communication tools (for example, environmental report cards) that clearly and quickly communicate the status and trends of ecosystem recovery to managers and the public. Such tools have not yet been developed for the Delta. Many of the performance measures that follow use the phrase "progress toward" to indicate measures that are amenable to this type of assessment and reporting.

Favorable ecosystem responses to performance measures are central to achieving the coequal goal of protecting, enhancing, and restoring the Delta ecosystem. Recommended performance measures for ecosystem restoration include the following. If applicable, metrics (what we will measure) or targets (numerical value and/or date) are included with each performance measure that follows.

Administrative Performance Measures

- The SWRCB adopts and implements Delta flow objectives by June 2, 2014 and adopts flow objectives for the major tributary rivers to the Delta by June 2, 2018.
- Actions that include ecosystem restoration in the Delta are consistent with the sections from the Ecosystem Restoration Program's Conservation Strategy for Stage 2 Implementation for the Sacramento-San Joaquin Delta Ecological Management Zone (California Department of Fish and Game et al. 2010) referred to in the Delta Plan.
- Actions affecting floodplains in the Delta or in the Delta watershed clearly demonstrate that adverse impacts to the opportunity for habitat restoration have been fully avoided or minimized.
- The Delta Conservancy and others develop and adopt clear strategies (including prioritization) and spatial and temporal targets (locations, number of acres, schedule) for large-scale Delta ecosystem restoration.
- The Delta Science Program supports and guides, with others, the development of a "regional ecosystem assessment and communication tool" (REACT) by January 1, 2014. This tool is intended to more clearly and rapidly communicate information about status, trends, and progress in achieving ecosystem goals and targets to managers and the public and would refine and incorporate metrics associated with ecosystem-related performance measures in the Delta Plan. In addition to incorporating flow, habitat, stressor, and species metrics, REACT development will also include the establishment of metrics to evaluate progress toward restoring and protecting important Delta ecosystem processes.

Driver Performance Measures

- Progress toward restoring in-Delta flows to more natural net flow patterns to support a healthy estuary. Metrics: results from hydrological monitoring and hydrodynamic modeling.
- Pilot-scale Delta habitat restoration projects are developed and initiated in the priority areas described in ER R1. 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.
- Progress toward restoring large areas of diverse and interconnected habitats for native resident and migratory species in the Delta and its watersheds, including migratory bird habitat. Trends in the area of restored habitat (acres) and interconnections among them will be upward over the next decade.

- Progress toward protecting existing habitats that benefit native resident and migratory species, including migratory birds. Trends in the area of native-species habitat (acres) will remain stable or increase over the next decade.
- Progress toward establishment of permanent or appropriate seasonal connectivity along all major migratory routes. Trends in the number and extent (miles, acres) of connections will go up over the next decade.
- Progress toward establishment of contiguous corridors for migration of fish and birds. Trends in the number and extent (miles, acres) of connections will go up over the next decade.
- The Delta Science Program, in collaboration with others, completes recommendations for measures to reduce stressor impacts on the Delta ecosystem that support and are consistent with the coequal goals by January 1, 2013.

Outcome Performance Measures

- Progress toward the documented use of protected and restored habitats and migratory corridors by native resident and migratory Delta species. Trends in occurrence 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.
- Progress toward achieving viable populations of native resident and migratory species. Trends in native Delta species will be upward over the next decade. These trends will be derived from long-term animal and plant monitoring surveys conducted by the IEP agencies and others.
- Progress toward achieving the state and federal "doubling goal" for wild Central Valley salmonids. This performance measure contains a clear target: doubling the salmonid population relative to 1995 levels.[31] These trends will be derived from long-term salmonid monitoring surveys conducted by NMFS, USFWS, and others.
- Progress toward decreasing the annual trend in number of new, uncontrolled harmful invasive species. Trends in new nonnative species arriving and proliferating in the Delta each year will be downward over the next decade. These trends will be derived from long-term animal and plant monitoring surveys conducted by the IEP agencies, the California Department of Boating and Waterways, the U.S. Department of Agriculture, the San Francisco Estuary Institute, and others.
- Progress toward decreasing abundance and distribution of harmful invasive aquatic and terrestrial species. Trends in the abundance and distribution of nonnative species in the Delta each year will be downwards over the next decade. These trends will be derived from long-term animal and plant monitoring surveys conducted by the IEP agencies, the California Department of Boating and Waterways, the U.S. Department of Agriculture, the San Francisco Estuary Institute, and others.

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[31] Central Valley Project Improvement Act Section 3406(b)(1)

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Chapter 6
Improve Water Quality to Protect Human Health and the Environment

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 (Public Resources Code section 29702) directly calls for improving water quality in various sections of the statute:

> *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

Introduction

Impaired water quality is an influential stressor contributing to the problems of the Delta, and improved water quality is inherent in the coequal goals. Many agencies have a role in the regulation of water quality in the Delta. The State Water Resources Control Board (SWRCB) and the Regional Water Quality Control Boards (RWQCB) have primary responsibility for water quality control in California with the oversight of the United States Environmental Protection Agency (USEPA). Drinking water supply is regulated by the California Department of Public Health. This chapter is not intended to provide a complete overview of all water quality issues and regulatory programs associated with the Delta. Instead, focus is on three key areas where best available science shows the need for improved water quality to achieve the coequal goals. The Delta Stewardship Council (Council) urges regulatory agencies to use these recommendations to build on their efforts to improve water quality by applying the best available standards in their programs.

Water quality in the Delta is influenced by freshwater inflows and outflows, in-Delta land uses, dredging, the Delta levee system, tides, point source inputs, nonpoint source inputs, in-Delta water use, and export diversions and operations. Overall, water quality is better in the north Delta than in the central and south Delta because higher-quality Sacramento River inflows are greater than inflows from the San Joaquin River, and because 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 section 303(d) list (SWRCB 2010). Current pollutants of concern include (but are not limited to) insecticides, herbicides, mercury, selenium, nutrients, and legacy organic pollutants such as DDT and PCBs. Additional water quality issues in the Delta include temperature, salinity, turbidity, low dissolved oxygen, bromide, dissolved organic carbon, pathogens, and harmful algal blooms. Amounts of these constituents that are too high or too low can impair the ability of these waters to support beneficial uses, such as municipal water supply, recreational use, agricultural water supply, and healthy fish and wildlife populations.

The RWQCBs develop water quality control plans (known as Basin Plans), which establish water quality standards and implementation plans for achieving standards for all surface water and groundwater within their respective regions. Water quality standards include identification of the affected beneficial use, numeric and narrative water quality objectives established to protect that use, and water quality control policies. In the Delta and the Suisun Marsh, the Sacramento and San Joaquin Rivers Basin Plan (Central Valley RWQCB 1998), the San Francisco Bay Basin Plan (San Francisco Bay RWQCB 2010), and the Water Quality Control Plan for the Sacramento-San Joaquin Delta Estuary (Bay Delta Water Quality

Control Plan) (SWRCB 2006) establish water quality objectives for which implementation is best achieved through assigning responsibilities to water-right holders and water users. This is because the parameters to be controlled are significantly affected by flows and diversions; these responsibilities were established in Water Rights Decision 1641. The Bay Delta Water Quality Control Plan also provides reasonable protection for beneficial uses that require control of salinity and operations of the water projects in the Delta (SWRCB 2006).

Sources of pollution in the Delta include point and nonpoint sources, such as agricultural runoff, urban runoff, wastewater treatment plant discharges, and abandoned mines. The SWRCB and RWQCBs issue National Pollutant Discharge Elimination System (NPDES) permits for municipalities and industries. These permits include general and individual permits (for example, the general permits cover stormwater discharges from industrial and construction activities, and individual NPDES permits cover wastewater treatment facilities). These permits are reviewed and modified, if necessary, at 5-year intervals. The RWQCBs regulate other discharge of waste materials through issuance of Waste Discharge Requirements (WDRs) or waivers of WDRs. For example, the Irrigated Lands Regulatory Board of the Central Valley RWQCB regulates waste discharges from irrigated agriculture. This program grants conditional waivers of WDRs to growers if they comply either individually or as part of an agricultural coalition with program requirements.

Placement of a water body on the list of impaired water bodies, also known as the Clean Water Act section 303(d) list, initiates a process to develop a 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 the sources of a pollutant, including point sources and nonpoint sources (discharges from wastewater treatment facilities; runoff from urban areas, agricultural inputs, and runoff from streets or highways; "toxic hot spots"; and aerial deposition). In addition to accounting for past and current activities, TMDLs may also consider projected future growth that could increase pollutant levels. The TMDL identifies waste load allocations for point sources and load allocations for nonpoint sources. In addition, a margin of safety is included to account for uncertainty. An implementation plan is developed, which specifies a set of actions that must be carried out to ensure that the TMDL results in successful achievement of water quality standards. TMDLs are implemented through amendments to the appropriate Basin Plan.

The 2010 Integrated Report (SWRCB 2010) prioritizes TMDLs to be developed for each water body–pollutant combination on the Clean Water Act section 303(d) list, and establishes a schedule for completion of the TMDLs. A table showing the currently adopted TMDLs and TMDLs under development is presented in Table 6-1.

The USEPA recently 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 Bay-Delta. The document identifies the key water quality issues affecting Bay-Delta aquatic resources and summarizes 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 is 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. In addition to State actions,

BCDC will review federal actions, permits, projects, licenses, and grants affecting the Bay, including Suisun Marsh, pursuant to the federal Coastal Zone Management Act.

Table 6-1
TMDLs Approved and Under Development in the Central Valley, Delta, and Suisun Bay
Source: Central Valley RWQCB 2011; San Francisco Bay RWQCB 2011a

Water Bodies	Pollutants
Upper Sacramento River	Cadmium, Copper, and Zinc
Sacramento and Feather Rivers	Diazinon
Sacramento County Urban Creeks	Diazinon and Chlorpyrifos
Stockton Urban Water Bodies	Pathogens
Stockton Deep Water Ship Channel (Phase I)	Dissolved Oxygen
San Joaquin River	Salt and Boron
San Joaquin River	Diazinon and Chlorpyrifos
San Joaquin River	Selenium
Salt Slough	Selenium
Grasslands	Selenium
Sacramento-San Joaquin River Delta	Diazinon and Chlorpyrifos
Clear Lake	Mercury
Clear Lake	Nutrients
Cache Creek, Bear Creek, Harley Gulch	Mercury
San Francisco Bay Area Urban Creeks	Diazinon
San Francisco Bay (includes Suisun Bay)	Mercury
San Francisco Bay (includes Suisun Bay)	PCBs (Polychlorinated Byphenyls)
Central Valley	Organochlorine
Central Valley	Pesticides
American River	Mercury
Sacramento-San Joaquin River Delta	Mercury
Stockton Urban Sloughs	Dissolved Oxygen
Stockton Urban Sloughs	Pathogens
Stockton Deep Water Ship Channel (Phase II)	Dissolved Oxygen
North San Francisco Bay (includes Suisun Bay)	Selenium

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 Clean Water Act (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 standards, TMDLs, WDRs, and NPDES permits) to reduce pollutant loads and progress toward compliance with reductions of pollutants that are causing water quality impairments in the Delta. The Council also supports and encourages the completion of the elements of the California Water Board'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.

This chapter discusses three major aspects of water quality needed to protect human health and to improve the environment of the Delta and the regions receiving export water: 1) salinity, 2) drinking water quality, and 3) environmental water quality. Environmental water quality is subdivided into sections on nutrients, pesticides, mercury, selenium, and emerging pollutants.

Policies and Recommendations

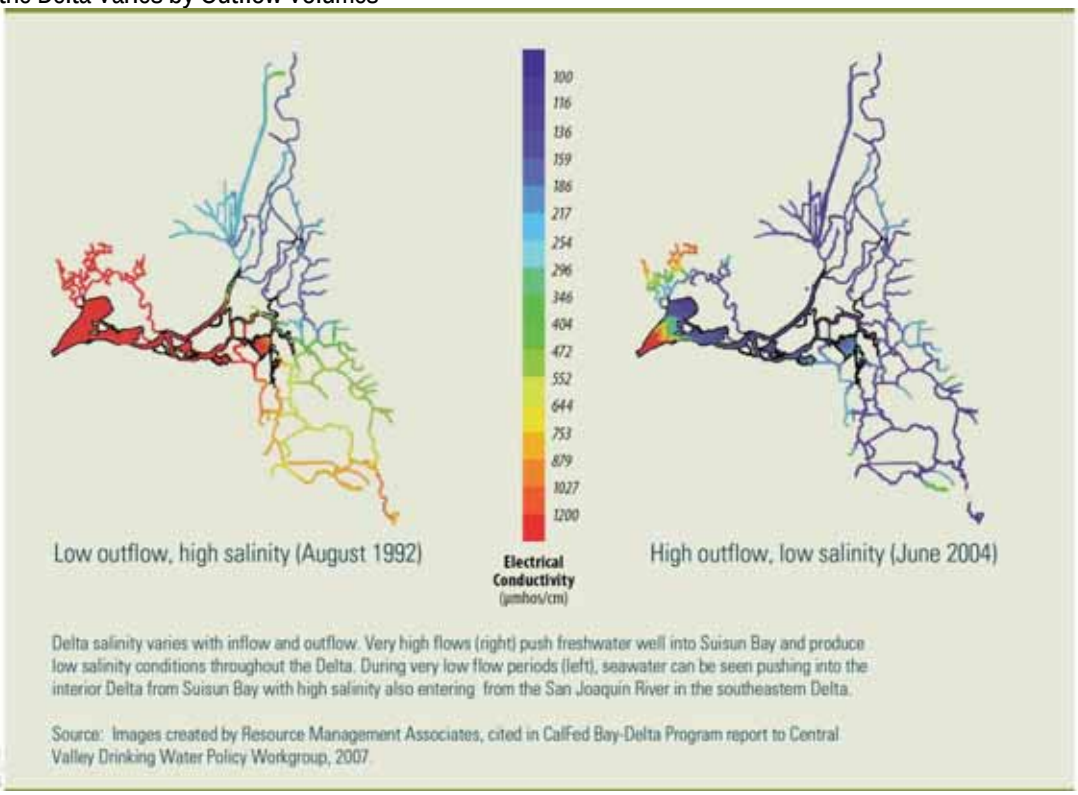
Salinity

Like all estuaries, the Bay-Delta is a place where freshwater mixes with saltwater. The location, extent, and dynamics of the freshwater-saltwater interface are important drivers of many estuarine processes and an important consideration in water management for human uses. The location of the freshwater-saltwater interface along the upstream-downstream axis of the estuary shifts with the seasons and from year-to-year depending on the amount of precipitation and Delta outflow (Kimmerer 2004, Malamud-Roam et al. 2007, Stahle et al. 2011). This freshwater-saltwater gradient has changed over the past 150 years because of landscape modification, water management, and climate variability. Figure 6-1 is a representation of salinity over a range of concentrations relevant to suitability for water supply. It clearly shows the salinity gradient in the west Delta under high and low outflow conditions. Changes to the 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 (Enright and Culberson 2010). Even with these measurable shifts in the salinity gradient caused by diversion, storage, and conveyance of water, the primary driver of salinity variability in the west Delta and Suisun Marsh continues to be the amount of precipitation in the watershed.

The interface between freshwater and saltwater is a critical region of the estuary for 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 freshwater up to about 5 practical salinity units (psu), about one-seventh the salinity of seawater. The part of the salinity gradient centered on 2 psu is considered to be of particular importance since it is hypothesized to be an area where suspended particulate matter and organisms accumulate. The location in the Bay-Delta where the tidally averaged bottom salinity is 2 psu is known as X2 (measured as distance in kilometers from the Golden Gate Bridge) and serves as a water quality standard to regulate Delta outflow. Delta smelt (*Hypomesus transpacificus*) 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 (*Crangon franciscorum*) and longfin smelt (*Spirinchus thaleichthys*). That is, higher outflows (smaller X2 values) are correlated with greater abundance of these species (Kimmerer 2004).

Examination of tree rings throughout the mountains of California provides a good indicator of precipitation over the last 650 years; however, tree rings alone cannot accurately reproduce the details of Delta salinity over this period (Stahle et al. 2011). The evidence is strong, however, that the Delta was a freshwater ecosystem in the western Delta for 2,500 years before human modification in the nineteenth and twentieth centuries (Malamud-Roam and Ingram 2004). Dredging of channels, reduction in the amount of tidal marsh, and construction of levees have changed the Delta salinity gradient by increasing the strength of tides in the Delta, increasing connections between channels, and reducing the moderating effects of wetlands and floodplains on outflow. Simply allowing more variability in Delta outflow will not produce the same salinity gradient patterns that existed before development.

Figure 6-1
Salinity in the Delta Varies by Outflow Volumes



Delta salinity varies with inflow and outflow. Very high flows (right) push freshwater well into Suisun Bay and produce low salinity conditions throughout the Delta. During very low flow periods (left), seawater 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: Images created by Resource Management Associates, cited in CalFed Bay-Delta Program report to Central Valley Drinking Water Policy Workgroup, 2007.

Most of the Delta is maintained as a stable freshwater environment year-round for water supply purposes under current water project operations. It has been hypothesized that allowing seasonal and interannual variability more in keeping with natural flows will benefit native fish species (Moyle et al. 2010, Baxter et al. 2010). Native fish species that evolved in a system with seasonal and interannual variability in salinity are challenged by the lack of salinity variability, and introduced aquatic plants and introduced fish species such as largemouth bass, bluegill, and catfish now thrive (Moyle et al. 2010). The area and volume of low salinity habitat in the Delta is also hypothesized to be a controlling factor for populations of Delta smelt and other species of concern (Feyrer et al. 2010). While scientists and engineers can model how changes to flows and physical changes to the Delta (such as dredging channels and restoring wetlands) will affect salinity with a fair degree of accuracy, how the ecosystem will respond is much less certain. Additional research and application of adaptive management experiments on relationships of salinity to desired ecosystem outcomes are needed.

Although seawater is the primary source of salinity in the west Delta and Suisun Marsh, it is not the only source of salts. Agricultural drainage is another significant source of salinity, particularly in the San Joaquin Valley. Municipal and industrial discharges can also increase salinity. All surface and ground waters contain some amount of salt, and this salt is concentrated with use through evaporation and transpiration of water by plants (CALFED 2007). The remaining water in drainage, return flows, percolated water, or effluent discharges has a higher salt concentration than the supply water. This normal increase in salinity with water use is exacerbated in some parts of the San Joaquin Valley by naturally occurring salts in soils and a Delta water supply that already has a significant salt load. The net result of these processes 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 just meets applicable water quality standards for much of the year. Salinity from seawater mixing into the west Delta and salinity from the San Joaquin

River creates, at times, a Delta with a "freshwater corridor" leading from the Sacramento River to the export pumps.

Water quality at the State Water Project (SWP) and Central Valley Project (CVP) export pumps in the south 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 fish species could impact agricultural and municipal uses of Delta water at SWP, CVP, and other Delta diversion points. Elevated salinity reduces crop yields (Hoffman 2010) or, if high enough, makes water unusable for agricultural purposes. As discussed in the following section on drinking water quality, contamination of municipal water supplies makes water unpalatable, contributes to the formation of harmful disinfection byproducts, and increases corrosion of pipes and equipment. Removal of salts from water supplies is technically difficult and expensive, and the disposal of the concentrated salt waste stream remains a key challenge. Increased salinity affects the reliability of municipal and agricultural water supplies by reducing opportunities for water reuse and recycling (Healey et al. 2008).

In these ways, the salinity regime in the Delta is driven by natural flows, water management, and human land and water uses in the Bay-Delta and its watershed. Achievement of the coequal goals will require updated comprehensive flow standards and water quality control programs for salinity that balance ecosystem and water supply needs.

Problem Statement

The current salinity and flow regime of the Bay-Delta Estuary may be creating conditions unfavorable for native estuarine fish and favorable to introduced species. Current salinity conditions, at certain times and locations, also negatively impact municipal and agricultural uses of Delta water. Allowing salinity to vary in a way that benefits native fish species might further degrade the quality of Delta water for agricultural and municipal uses.

Policies

There are no policies with regulatory effect included in this section. Policy ER P1 addresses this problem statement.

Drinking Water Quality

The Delta is used as a drinking water supply, either solely or partially, for over 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, it 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 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 seawater 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 protozoa, bacteria, and viruses are also present in Delta waters and are a disease risk for both drinking water and body contact recreation.

Disinfection 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). The disinfection byproducts of primary concern in tap water, such as trihalomethanes and haloacetic acids, are carcinogens subject to stringent public health standards. Treatment of water from the Delta is particularly challenging because it can contain elevated levels of 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 freshwaters, 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.

Salinity, frequently measured as electrical conductivity (EC) or total dissolved solids (TDS), has several significant effects on the use of water for domestic uses. Salts make water unpalatable at relatively low concentrations with 500 mg/L TDS 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 component of seawater, bromide, is a disinfection byproduct precursor forming trihalomethanes and haloacetic acids with chlorine or chloramine disinfection and bromate with ozone disinfection.

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 occasionally exceeding recommended levels for 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). 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 indicator bacteria.

For drinking water supplies, excessive levels of nutrients are primarily of concern in the Delta because they can stimulate algae growth both in the Delta and in water storage reservoirs (Tetra Tech 2006a). Algae 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).

The quality of Delta waters with respect to drinking water use varies considerably both geographically and with 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 intrusion. 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).

A major concern for municipalities using Delta water is what the future holds for water quality. Sea level rise, levee failure, salinity variability, and population growth in the watershed all pose a threat to drinking water quality. 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).

The drinking water supply from groundwater for many communities within 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 with 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.

Problem Statement

The Delta receives inputs from regional soils and sediments; from agricultural, urban, and industrial sources from the watershed; and from in-Delta sources that degrade Delta drinking water supplies.

Policies

There are no policies with regulatory effect included in this section.

Recommendations

WQ R1 The Central Valley Regional Water Quality Control Board should complete the Central Valley Drinking Water Policy by July 2013, with implementation to follow.

WQ R2 The Department of Water Resources should complete the North Bay Aqueduct Alternate Intake Project EIR by July 1, 2012, and begin construction as soon as possible thereafter.

WQ R3 The California Department of Public Health should prioritize funding for small and disadvantaged communities that lack access to safe drinking water supplies.

WQ R4 The State Water Resources Control Board and Central Valley Regional Water Quality Control Board should require all recipient regions 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 (CV-SALTS).

Environmental Water Quality

The Delta ecosystem is affected by a variety of pollutants discharged into Delta and tributary waters. Pollutants of concern affecting Delta species and ecosystem processes include nutrients, pesticides, mercury, selenium, other substances in the food web, and newly identified pollutants of potential concern (often referred to as emerging contaminants).

Nutrients

The role of nutrients and nutrient loading for the Delta and Suisun Marsh has become a topic of much recent interest and debate. A recent review article on water quality in the Delta focused upon salinity, natural organic matter, suspended sediment, selenium, pesticides, and mercury (Luoma et al. 2008). Nutrients were not included in the review because light limitation was generally regarded as the main control on the productivity and structure of the photosynthetic communities in the aquatic ecosystems of the Delta. The generally lower rates of primary production in the open waters of the Delta when compared with many other estuaries worldwide have focused attention on light limitation rather than nutrient limitation.

Recent and current research is reconsidering the role of nutrients for aquatic ecosystems of the Delta. Several peer-reviewed scientific papers on nutrients in the Delta have been published of late, and some hypothesized emerging roles for nutrients are much debated. This overview of nutrients within the Delta will highlight current hypotheses about their roles, various opinions of the significance of these roles, areas of uncertainty and research, and recommendations.

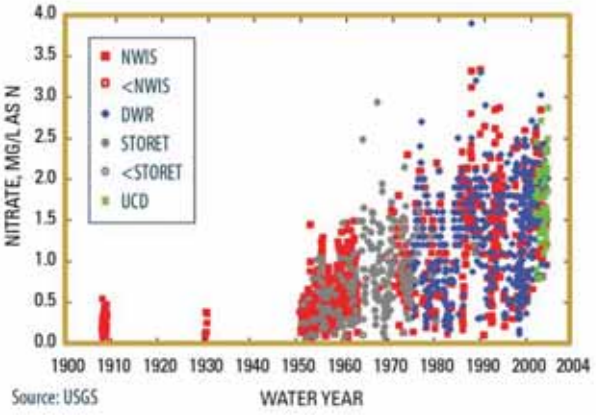
The chemical form of inorganic nitrogen in Delta waters is one area of current consideration and concern. Dugdale et al. (2007) showed that ammonium concentrations above 4 μM (~.056 parts per million) were inhibitory to the growth of phytoplankton in Suisun Bay. Phytoplankton is an important base to the food chain in many aquatic ecosystems including 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. Current research in the Delta is addressing this question.

Glibert (2010) also examined the role of ammonium in impacting the food web of the Delta. Glibert used long-term data from the Interagency Ecological Program (IEP) to describe changes in the phytoplankton community over the past three decades. The phytoplankton community in the Delta has shifted from predominantly diatoms to green algae and cryptophytes to flagellates to cyanobacteria (blue-green algae). Glibert hypothesized an important role for ammonium concentrations and the ratio of inorganic nitrogen to inorganic phosphorus in the changing structure of the phytoplankton community. Glibert also conducted statistical analyses to show that changes in the phytoplankton community cascade through the food web, ultimately affecting the fish community of the Delta. This conclusion has been strongly challenged by Cloern et al. (2011), who argue that the statistical methods used to derive the food web relationships are inappropriate and generate false correlations. Food web effects of ammonium in the Delta remain an open question with much active research and a healthy scientific debate.

Another concern with regard to impacts from nutrient loading in the Delta is the emergence of harmful algal blooms (HABs) over the past decade. The shift toward greater abundance of cyanobacteria in the Delta includes known HABs. In particular, *Microcystis aeruginosa* has become a common bloom-forming component of the phytoplankton of the Delta during the warm summer and early fall months (Lehman 2005, 2008). *Microcystis* species prefer warm temperatures, do well in lower- light regimes, and need higher concentrations of inorganic nitrogen like ammonium and nitrate to thrive (Ward and Wetzel 1980). The role of increasing concentrations of inorganic nitrogen in the Delta in stimulating HABs is an important question. Heisler et al. (2008) in a recent review of HABs worldwide concluded that 1) degraded water quality from increased nutrient pollution promotes the development and persistence of many HABs, 2) the composition (not just total quantity) of the nutrient pool impacts HABs, 3) high-biomass blooms require an external source of nutrients to be sustained, 4) both chronic and episodic nutrient delivery promotes HAB development, and 5) management of nutrient inputs to the watershed can lead to significant reductions in HABs. Interactions between nutrients and HABs in the Delta deserve, and are receiving, significant current research support.

Nutrients also affect the productivity of aquatic macrophytes and the structure of the aquatic plant community (Wetzel 2001). The role of nutrients in the proliferation of nonnative aquatic macrophytes in the Delta is another emerging issue. Two nonnative macrophytes, Brazilian waterweed (*Egeria densa*) and water hyacinth (*Eichhornia crassipes*), have become particularly problematic in the Delta. Susan Ustin and colleagues (Underwood et al. 2006, Hestir et al. 2008, Khanna et al. 2011, and Santos et al. 2011) have documented the distribution and spread of these invasive macrophytes in the Delta. The role of nutrient enrichment in the spread and productivity of these nonnative aquatic macrophytes is unknown. Studies on *Egeria densa* in its native South America have shown that biomass is positively correlated with ammonium in the water (Feijoo et al. 1996) and that this submerged macrophyte absorbed more nitrogen from the water when it was present as ammonium than when nitrogen was present as nitrate (Feijoo et al. 2002). Potential links between invasive aquatic macrophytes in the Delta and nutrient inputs require further research.

Figure 6-2
Increasing Nutrients Create Delta Water Problems [CONCEPTUAL. UNDER DEVELOPMENT]



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 dissolved oxygen depletion, growth of nuisance aquatic plants, and taste and odor problems in drinking water. Symbols show the different data sources.

The future role for nutrients in the Delta is another growing concern. Schoellhamer (2011) has documented the sudden clearing of estuarine waters of San Francisco Bay after 1999. The erodible sediment pool in the basin is declining as the legacy sediments from hydraulic gold mining are transported out of the system and the large rim dams capture and store large quantities of sediment. The paradigm of a turbid estuary with primary production limited by light availability may be shifting to a new paradigm where nutrients play an increasingly important role in regulating productivity. Sustained long-term monitoring and research will be necessary to document effects from the sudden clearing that began after 1999 in the Bay-Delta.

Ongoing and recently funded research on the role of nutrients in the Delta will reduce the uncertainty around some of the key questions that have emerged in recent years concerning the role of nutrients in the Delta. Vigorous scientific debate and discussion is ongoing concerning 1) the importance of phytoplankton bloom suppression from ammonium, 2) the role of nutrient loading on HABs in the Delta, and 3) possible linkages between nonnative aquatic macrophytes and nutrient inputs. The effects of increased nutrient inputs also need to be considered in light of a changing Delta with regard to lowered turbidity and warming temperatures. Nutrients have become an increasingly important component in the discussion of water quality issues in the Delta.

Pesticides

Although often used interchangeably with insecticide, a pesticide technically is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest and includes insecticides, herbicides, fungicides, and various other substances used to control pests. In the Bay-Delta region, the primary pesticides of concern include the organophosphorus (OP) pesticides (for example, diazinon and chlorpyrifos), pyrethroid insecticides, and the legacy organochlorine pesticides (for example, DDT, chlordane, and dieldrin), although any pesticide that contributes to water quality

impairment is potentially of concern. These substances are known to have adverse impacts on aquatic organisms or, in some cases (as with the organochlorine pesticides), birds and mammals.

Delta waterways were placed on the Clean Water Act Section 303(d) List for diazinon and chlorpyrifos due to aquatic toxicity (SWRCB 2010). The primary transport pathways of pesticides into Delta waterways are runoff from urban areas and agricultural irrigation return flows (Kuivila and Hladik 2008). OP pesticides and pyrethroid insecticides, which are the common replacements of the OP pesticides, have been implicated as the principal pesticides causing toxicity in surface water samples collected from throughout California (Hunt et al. 2010).

Invertebrates in the water column appear to be the aquatic organisms most affected by chlorpyrifos and diazinon exposure (Giddings et al. 2000), while pyrethroids—because of their high potential to stick to organic matter—can adhere, accumulate, and are transported with sediment and thus can impact sediment-dwelling organisms (Werner and Oram 2008; Weston et al. 2004). In recent years, pyrethroids at toxic concentrations have been detected in the majority of sediment samples collected from water bodies draining agricultural (Weston et al. 2004, 2005, 2010; California Valley RWQCB Agricultural Waiver Program 2007) and suburban areas of the Central Valley (Weston et al., 2005, 2010), as well as from urban creeks in the Bay-Delta region (Amweg et al. 2006; Woudneh and Oros 2006a and 2006b). Dissolved pyrethroid concentrations toxic to aquatic life were detected in water samples from Central Valley agricultural drains and creeks (Bacey et al. 2005; Central Valley RWQCB 2007), and in tributaries to San Francisco Bay (Woudneh and Oros 2006a and 2006b; Werner et al. 2010), and in wastewater treatment plant effluent discharged into the Sacramento and San Joaquin Rivers (Weston et al. 2010).

The Sacramento, San Joaquin, and Feather Rivers, the Delta, and numerous agriculturally dominated streams in the Central Valley either are listed as impaired or are currently covered under an existing TMDL for pesticides (Central Valley RWQCB 1998, 2006). Smaller agriculturally dominated waterways 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. Some of the highest pesticide concentrations have been observed in residential area creeks and waters receiving urban runoff (Weston et al. 2005).

The critical transport pathways identified for pyrethroids in the Delta and Central Valley regions include agricultural stormwater runoff or irrigation return water, drift from aerial or ground-based spraying, and periodic release of agricultural return flows (tailwaters), which is a common practice in rice production (Oros and Werner 2005). Oros and Werner (2005) summarized the major pyrethroid sources as follows: 1) orchards during the winter dormant-spray season; 2) summer irrigation return-flows in agricultural areas; 3) rice fields when the fields are drained; and 4) urban and suburban area runoff.

There has been discussion of the possible role of pesticides in the pelagic organism decline (POD) during the early years of the twenty-first century. Johnson et al. (2010) reported that insufficient chemistry, toxicity, and histological data are available to determine whether contaminants played an important role in the POD. The conclusion drawn from the analysis of chemical pollutants (primarily organophosphorus and pyrethroid pesticides) is that although contaminants are unlikely to be a major cause of the POD, they cannot be eliminated as a possible contributor to these declines in open-water fish populations in the Delta. Baxter et al. (2010) summarize the various ways in which pollutants may have played a role in the POD.

Mercury

The Delta and many Delta tributaries are included in the SWRCB's 303 (d) list of impaired water bodies due to mercury contamination (Central Valley RWQCB 2009). Historical mercury mining in the Coast Ranges and mercury use associated with gold mining in the Sierra Nevada have left an environmental legacy of pervasive mercury contamination in many Northern California watersheds (Alpers and

Hunerlach 2000). The current regulatory environment for mercury includes development of a Delta methylmercury TMDL (Central Valley RWQCB 2008).

Sources of total mercury in the Delta and Yolo Bypass include tributary inflows from upstream watersheds, atmospheric deposition, urban runoff, and municipal and industrial wastewater. More than 97 percent of identified total mercury loading to the Delta and Yolo Bypass comes from tributary inputs; in-Delta sources are a very small component of overall loading (Central Valley RWQCB 2008). The Sacramento Basin, which comprises the Sacramento River and Yolo Bypass tributary watersheds, contributes 80 percent or more of total mercury fluxing through the Delta. Of the watersheds in the Sacramento Basin, the Cache Creek and upper Sacramento River (above Colusa) watersheds contribute the most mercury. The Cache Creek, Feather River, American River, and Putah Creek watersheds in the Sacramento Basin all have relatively large mercury loadings and high mercury concentrations in suspended sediment (Central Valley RWQCB 2008).

Concerns about mercury pollution stem largely from the potential adverse effects of dietary exposure to methylmercury, a highly toxic form of mercury that readily accumulates in biota and can biomagnify to harmful concentrations in organisms at the top of aquatic food webs including predators like bass, sturgeon, fish-eating birds, eagles, and humans (Mahaffey 2000, Clarkson 2002, Wiener et al. 2003, Davis et al. 2003). Health advisories issued by the Office of Environmental Health Hazard Assessment (OEHHA) recommend limiting the consumption of sportfish, including sturgeon and striped bass, caught in the Bay-Delta.

The level of methylmercury in the water column is controlled in part by the concentration of inorganic mercury in the sediment and the rate at which the inorganic mercury in sediment is converted to methylmercury by sulfate-reducing bacteria (Compeau and Bartha 1985, Gilmour et al. 1992, Pak and Bartha 1998, King et al. 2001). The most important sites of microbial methylation in the Bay-Delta ecosystem are generally oxic-anoxic (oxygenated and anaerobic) interfaces in aquatic sediments, wetlands, and seasonally inundated vegetated habitats (St. Louis et al. 1994, Hurley et al. 1995, Kelly et al. 1997, Gilmour et al. 1998).

There is general concern that increased concentrations of methylmercury in water, sediment, and biota might result from restoration of wetland and floodplain habitats in the Bay-Delta and from changes in the conveyance of freshwater across the Delta. 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 biota (Naimo et al. 2000, Wiener and Shields 2000). In addition, flooding of vegetated wetlands or uplands or fluctuating water levels during tidal cycles could stimulate methylmercury production and transport, thereby increasing concentrations of methylmercury in water and biota (Hecky et al. 1991, Hall et al. 1998, Paterson et al. 1998, Bodaly and Fudge 1999).

Monitoring data for water and fish indicate that the central Delta is actually lower in methylmercury than tributary areas such as the Yolo Bypass, Cosumnes River, and San Joaquin River. Preliminary mass balance calculations indicated a net loss of methylmercury in water as it flows through the Delta, meaning that the Delta acts as a net sink for methylmercury (Central Valley RWQCB 2006, 2008). The main causes of methylmercury loss are currently thought to be photodemethylation and sedimentation (Central Valley RWQCB 2008).

The San Francisco Bay Regional Monitoring Program for Water Quality (RMP) routinely measures mercury and methylmercury downstream from the Delta in San Francisco Bay water and sediment. The Bay-wide average methylmercury concentration in 2009 was 0.03 nanograms/liter, while the Bay-wide average for the 4-year period 2006 through 2009 was 0.05 nanograms/liter (SFEI 2010). No regulatory guideline exists for methylmercury in water. For methylmercury concentrations in sediment, the Bay-wide average over the years 2002 through 2009 was 0.5 micrograms/kilogram (SFEI, 2010). In

comparison, Bay-wide average concentrations of total mercury in sediment have ranged from 0.19 milligrams/kilogram in 2005 to 0.30 milligrams/kilogram in 2009.

Concentrations of methylmercury (quantified as total mercury) in several fish species recently sampled from the Bay-Delta and tributary streams exceed 0.3 mg/kg (parts per million) wet weight (Slotton et al. 2002a and 2002b, Davis et al. 2003), a fish-tissue criterion established by the USEPA for the protection of humans who eat noncommercial fish. In comparison, the most recent San Francisco Bay-wide average mercury concentration for striped bass was 0.4 milligrams/kilogram measured in 2009 (SFEI 2010).

Selenium

A naturally occurring element, selenium is an essential nutrient at low concentrations. However, higher concentrations can be toxic to fish and wildlife. Selenium was the root cause of fish mortality and deformities in ducks, grebes, and coots at Kesterson National Wildlife Refuge, which was once the terminus of the San Luis Drain (Ohlendorf et al. 1986; USGS 2004). The major sources of selenium loading in the north San Francisco Bay (North Bay) include the Sacramento River and San Joaquin River inflows, which receive selenium-laden agricultural drainage from the western San Joaquin Valley (Luoma and Presser 2000). Other sources of selenium loading include petroleum refineries, municipal and industrial wastewater, urban and nonurban runoff, atmospheric deposition, and erosion and sediment transport from within the North 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).

Marine sedimentary rocks of the Coast Ranges contribute selenium to soil, surface water, and groundwater in the western San Joaquin Valley (USGS 2004). Irrigated agriculture mobilizes selenium, and it accumulates to levels that can be potentially harmful in the agricultural drainage water from that area. 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 has also been significantly reduced from historical levels under a control program administered by Central Valley RWQCB with plans for further reductions through 2019 (Reclamation 2009).

Recent monitoring results indicate that selenium water column concentrations in the North Bay are much lower than the current 5 µg/L standard for chronic exposure (San Francisco Bay RWQCB 2011b). The San Francisco Bay RMP recently reported that the highest selenium concentration observed in San Francisco Bay water from 2002 to 2009 was 1.15 µg/L, with a Bay-wide average concentration in 2009 of 0.16 µg/L. However, levels of selenium in aquatic organisms and fish show that the current criteria may not be fully protective. In spite of 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 are shifting from water-column concentrations to the concentration of selenium in the tissues of affected organisms (San Francisco Bay RWQCB 2011b).

Once selenium enters the aquatic environment, it has a high potential to bioaccumulate in zooplankton and benthic 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). Because bivalves have a slower rate constant for loss of selenium than do crustaceans such as copepods and mysids, bivalves tend to retain higher levels of selenium. Among the benthic-based food webs, the white sturgeon, which is a clam-eating bottom feeder, is particularly vulnerable to selenium exposure in the North Bay. Sturgeon feed predominantly on benthic organisms including the invasive clam *Corbula amurensis*, which is very efficient in accumulating and retaining selenium. Sturgeon exposure is exacerbated by its long reproductive cycle during which selenium is transferred and stored in developing eggs, forming a stable selenium reservoir in reproductive

females. For the North Bay TMDL, a sturgeon-based fish-tissue numeric target has been proposed as the most direct way to address selenium impairment and assess protection of beneficial uses (San Francisco Bay RWQCB 2011b). If adopted, the fish-tissue target of 6 to 8.1 micrograms/gram dry weight identified for sturgeon, the most sensitive fish species, should be protective of other species that reside and forage in the North Bay.

Emerging Pollutants

"Emerging pollutants" are unregulated compounds where evidence suggests adverse effects might occur at environmentally relevant concentrations. The term is also meant to include the wide range of compounds whose anticipated risks, or existing but so far unrecognized risks, might justify precautionary management interventions (Hoenicke et al. 2007). The potential for manufactured chemicals to alter the integrity of water and the ecosystem is high, given the large number of manufactured chemicals in high-volume use. Examples of manufactured chemicals found in water bodies include flame retardants, pesticides, human and veterinary pharmaceuticals, and ingredients in personal care products (Kolpin et al. 2002, Daughton 2004; Hoenicke et al. 2007).

Emerging pollutants are typically relatively persistent, may have bioaccumulation potential, and are toxic, including endocrine system disruption (Oros 2003). The primary sources for most emerging pollutants include effluents from wastewater treatment plants, agricultural fields, and stormwater runoff. Many chemicals identified as emerging pollutants have not been tested for their potential toxicological effects on aquatic biota. Most emerging pollutant maximum concentrations in the environment are well below established lethal concentration value for even the most sensitive aquatic species. The sublethal and chronic low-level exposures are of primary concern (Oros 2003; Brander 2009; Ostrach 2009).

The San Francisco Bay RMP, which has been monitoring for emerging pollutants since 2001, has focused largely on several groups of emerging pollutants, including polybrominated diphenylethers (PBDEs), perfluorinated compounds, and pharmaceuticals. Additionally, region-specific monitoring studies from the San Francisco Bay ecosystem have reported on the occurrence of emerging pollutants. For instance, PBDEs, which are flame retardants that can bioaccumulate in human and animal tissues (Meerts et al. 2001), have been found in San Francisco Bay area mussels, clams, and oysters (Oros et al. 2005), harbor seal blubber (She et al. 2002), fishes (Holden et al. 2003), seabird eggs (She et al. 2004), and wastewater treatment plant effluent (North 2004). Concern is increasing over exogenous chemicals that disrupt natural endocrine system functions of humans and aquatic species, such as steroid hormones (including synthetic estrogens), detergent metabolites (alkylphenol and alkylphenol polyethoxylates), and pesticides (Jobling et al. 1998; Tyler et al. 2000; Kolodziej and Sedlak 2007; Remperl and Schlenk 2008; Vajda et al. 2008; Benotti et al. 2009). Such chemicals were routinely found in agriculturally impacted surface water samples from the Napa River and Sacramento River. Although their presence was not directly linked to observed fish feminization due to study limitations (Lovado et al. 2009), their occurrence in regional tributaries raises concern about the potential impacts of these compounds.

As a recommendation, regulatory and chemical monitoring programs should adapt to the quickly changing mix of emerging pollutants that are identified through current studies and the peer-reviewed scientific literature. Effective management of emerging pollutants in the Delta will require responsible agencies 1) to conduct monitoring and assessments of the identities, concentrations, and distributions of emerging pollutants, and 2) to demonstrate the linkage between newly identified emerging pollutants to known or suspected adverse impacts such as acute and chronic toxicity (including endocrine system disruption) and bioaccumulation in aquatic species. As region-specific data become available with monitoring and within the context of toxicology literature, further action to implement control measures for emerging pollutants can then be taken by the responsible regulatory agencies (Hoenicke et al. 2007).

Problem Statement

Pollutants contained in municipal, industrial, agricultural, and other nonpoint source discharges to the Delta and its tributary waterways, including pollutants that bioaccumulate and biomagnify in the food web, contribute to the impairment of the Delta ecosystem.

Policies

There are no policies with regulatory effect included in this section.

Recommendations

WQ R5 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 that would improve 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 Council specifically recommends that:

- The State Water Resources Control Board and the San Francisco Bay and Central Valley Regional Water Quality Control Boards should develop and adopt objectives, either narrative or numeric, where appropriate, for nutrients in the Delta and Delta watershed by January 1, 2014.
- 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 San Francisco Bay and Central Valley Regional Water Quality Control Boards 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 San Francisco Bay and Central Valley Regional Water Quality Control Boards should develop and implement Total Maximum Daily Load and Basin Plan Amendments for selenium and methylmercury to address water quality impairment in the Delta, in accordance with the time schedule provided in the 2010 Integrated Report.

WQ R6 The State Water Resources Control Board and Regional Water Quality Control Boards should work collaboratively with the Department of Water Resources, Department of Fish and Game, 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 R7 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.

WQ R8 The State Water Resources Control Board and Regional Water Quality Control Boards should conduct or require special studies of pollutants including emerging contaminants and causes of toxicity in Delta waters and sediments.

WQ R9 To comply with the San Francisco Bay Conservation and Development Commission water quality policies and facilitate the commission's impact determination, proponents of actions potentially affecting water quality in Suisun Marsh should consult with the San Francisco Bay Regional Water Quality Control Board and obtain all necessary authorizations early in the process.

Performance Measures

Performance measures for water quality are placed into three generals classes: 1) administrative performance measures, 2) driver performance measures, and 3) outcome performance measures. 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 ecosystem responses to management actions or natural drivers. The distinction between performance measure types is not rigid. In some cases, an outcome performance measure for one purpose may become a driver performance measure for another purpose.

Recommended performance measures for water quality are described below.

Administrative Performance Measures

- The SWRCB adopts and implements Delta flow objectives by June 2, 2014.
- Central Valley RWQCB and SWRCB adopt policies and regulations necessary to increase participation in CV-SALTS.
- Central Valley RWQCB completes the Central Valley Drinking Water Policy by July 2013.
- Progress toward providing safe drinking water to small and disadvantaged communities that lack access to safe supplies. Levels of annual funding for small and disadvantaged communities for providing safe drinking water supplies increase over the next decade.
- SWRCB and RWQCBs adopt objectives for nutrients in the Delta by January 1, 2014.
- TMDLs and Basin Plan Amendments for diazinon and chlorpyrifos are completed by January 1, 2013.
- The Central Valley Pesticide TMDL is completed by January 1, 2016.
- A Delta regional water quality monitoring program is developed and implemented within the first 5years of the Delta Plan.
- Department of Water Resources completes the North Bay Aqueduct Alternate Intake Project EIR.

Driver Performance Measures

- Progress toward increasing interannual variability of salinity in Suisun Bay and Suisun Marsh. In future years, salinity will trend higher during periods of low river flow and trend lower during periods of high river flow.
- Progress toward reducing concentrations of total ammonia in Delta waters to below 4 micromoles per liter (56 parts per billion) in greater than 95 percent of all monitoring samples collected and measured annually.

- TMDLs for critical pesticides (for example, diazinon, chlorpyrifos, and pyrethroids) in the waters and sediments of the Delta are met by 2020.
- Progress toward reducing concentrations of inorganic nutrients (ammonium, nitrate, and phosphate) in Delta waters over the next decade.
- Routine annual surveys of emerging pollutants within the Delta are designed and implemented during the first 5 years of adoption of the Delta Plan.
- Progress toward consistently meeting applicable dissolved oxygen standards in the Delta by 2020.

Outcome Performance Measures

- Trends in body loads of mercury and selenium in top predatory fish in the Delta will be downward over the next decade.
- Trends in the occurrence of spring diatom blooms in Suisun Bay and Suisun Marsh will be upward.
- Trends in measureable toxicity from pesticides and other pollutants in Delta waters will be downward over the next decade.
- Harmful algal blooms (HABs) will lessen in severity and spatial coverage in the Delta over the next decade.
- The spatial distribution and productivity of nuisance nonnative aquatic macrophytes will decline over the next decade.

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Chapter 7
Reduce Risk to People, Property, and State Interests in the Delta

Water Code sections 85305, 85306, 85307, and 85309 require the Delta Plan to include specific objectives.

> *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 non-project 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.*

Based upon Water Code Section 85309, the Council shall consider a proposal from the Department of Water Resources, in consultation with the Corps of Engineers and the Central Valley Flood Protection Board, to coordinate flood and water supply operations of the State Water Project and the federal Central Valley Project.

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Chapter 7
Reduce Risk to People, Property, and State Interests in the Delta

Introduction

The Delta is an inherently flood-prone area at the confluence of the Sacramento and San Joaquin River watersheds, which collectively drain approximately 43,000 square miles. As discussed in Chapter 5, the Delta was a historically complex and variable system formed through the interaction of fluctuating sea levels and an influx of alluvial sediments from river floods. It is now a complex labyrinth of reclaimed islands and waterways created through the construction of levees, many of which were initially constructed over a century ago using primitive materials and equipment.

The Delta (the legal Delta and Suisun Marsh) includes more than 1,335 miles of levees that protect approximately 839,591 acres of land. These levees face potential threats such as large runoff events, earthquakes, extreme high tides, wind-generated waves, subsidence, and sea level rise. Individually, each of these threats is enough to cause serious concern; together, they represent a potential for catastrophic disruption of the Delta. A mass failure of the levee system would have real life-and-death impacts, and property losses that could total billions of dollars. Levee failures not only create direct damage and potential loss of life from flooding, but also change the configuration of the Delta—both water and land—and alter the mixing of fresh water with salt water. A failure could also have significant effects on California's economy from interruption of service to 25 million urban water users and to approximately 3 million acres of irrigated farmland that depend, in part, on water conveyed through the Delta.

Preventing floods is impossible, but prudent planning and management of flood management activities can significantly reduce vulnerabilities and risk. A portfolio of risk-reduction strategies for the Delta must consider urban and rural communities as well as agricultural lands during the process of identifying, evaluating, and prioritizing investments in the levee system. Risks can be reduced through an emergency preparedness, response, and recovery system; appropriate land uses; water management changes; reservoir reoperation; and strategic levee improvements.

This chapter begins with a general discussion of flood risk in the Delta and descriptions of ongoing State, federal, and local flood management efforts. Eight subsections follow, which together present policies and recommendations to reduce risk to people, property, and State interests in the Delta:

- Floodplain and Floodway Protection
- Levee Classifications for Protection of Land and Resources Uses
- Flood Management Investment
- Emergency Preparedness and Response
- Limitation of Liability
- Financing and Implementation of Local Flood Management Activities

- Subsidence Reduction and Reversal
- Reoperation of Upstream Reservoirs and Peak Flow Attenuation

Flood Risk in the Delta

Flood risk is assessed in terms of the likelihood of a flood event occurring, the chance of failure from that flood event, and the associated consequences. Consequences can entail loss of life and economic and environmental damage. Risk of flooding in the Delta is likely to increase over time as a result of several factors:

- Continued development within the floodplains
- Inadequate levees
- Inadequate channel capacities
- Seismic vulnerability
- Continuing subsidence
- Climate change
- Sea level rise

It is estimated that by the year 2100, sea level rise may reach 55 inches (California Climate Action Team 2010, California Ocean Protection Council 2011). Additionally, understanding about large-scale precipitation events continues to grow, such as the ARkStorm scenarios being investigated by the U.S. Geological Survey (USGS), 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.

Flood risk reduction cannot absolutely prevent harmful inundation from floods, but can reduce its likelihood and social and economic impacts. History has shown that unavoidable structural failures in the system will occur as a result of extraordinary events, imperfect knowledge, and imperfect materials. Risks must be well understood, and then managed and controlled to the extent possible through public awareness, adequate emergency management planning, and enforcement of existing flood management regulations, as well through physical repair, improvements, and levee rehabilitation efforts.

Risks must also be quantified, to the extent practicable, to better understand them and to facilitate the prioritization of flood management activities. Measures such as Expected Annual Damage have great potential and should be incorporated into Delta flood risk management. Expected Annual Damage is discussed in greater detail later in this chapter.

Ongoing Flood Management Efforts by Other Agencies

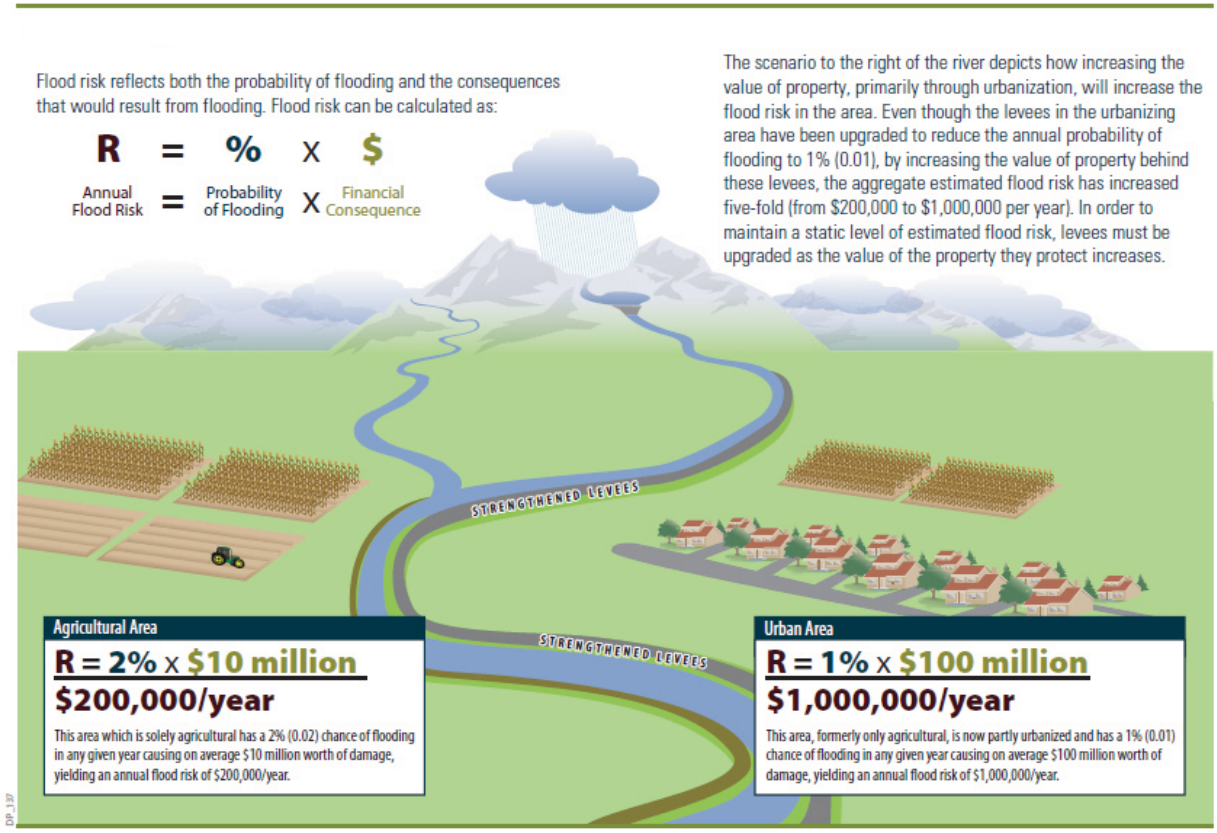
Many studies and planning efforts addressing flood management and emergency preparedness, response, and mitigation are underway, and will be considered by the Council for ongoing Delta flood risk management. These studies and efforts include:

- Central Valley Flood Protection Plan
- FloodSAFE
- Sacramento-San Joaquin Delta Multi-Hazard Coordination Taskforce Report
- U.S. Army Corps of Engineers (USACE) Delta Islands Levees Feasibility Study, Long Term Management Strategy for Dredging and Dredge Material Placement, Periodic Inspection (PI) system, and Levee Safety Portfolio Risk Management System.

The Council will consider the findings of these studies and may elect to incorporate them into future updated versions of the Delta Plan. It is important to note that the Central Valley Flood Protection Plan

(due January 1, 2012, to the Central Valley Flood Protection Board for adoption by July 1, 2012) and FloodSAFE include many concepts relevant to the Delta Plan; however, they largely focus on issues outside of the Delta. At the federal level, the National Committee on Levee Safety (2009) has recently submitted a report to Congress on levee standards that is currently under review.

Figure 7-1
Understanding Delta Flood Risk



Policies and Recommendations

Floodway and Floodplain Protection

Adequate flood flow capacity is critical for managing flood risks, and for overall Delta water management and ecosystem integrity. Both the Federal Emergency Management Agency (FEMA) and the State's Central Valley Flood Protection Board play a role in designating floodways to accommodate flood flows. "Designated Floodway" refers to the channel of the stream and that portion of the adjoining floodplain reasonably required to provide for the passage of a design flood; it is also the floodway between existing levees as adopted by the Central Valley Flood Protection Board or the Legislature.

The Central Valley Flood Protection Board, under Water Code section 8609, has the authority to designate floodways in the Central Valley. The authority of the Central Valley Flood Protection Board in the Delta is limited to the State-Federal levee system. Under the National Flood Insurance Program,

FEMA works with participating communities to regulate development within their floodways in accordance with federal regulations.[32]

Land use policies guiding development in floodways are not consistent across Delta counties. Additionally, floodways have not been established for many of the channels in the Delta by FEMA or by the Central Valley Flood Protection Board. In light of these problems, the Delta Plan should address these issues and highlight the need for policies and recommendations that accommodate floodplain and floodway protection. Concerns that floodways may expand and deepen because of sea level rise and changes to precipitation patterns over the next 100 years must be addressed and accommodated. Development in existing or future floodplain or bypass locations in the Delta or upstream can permanently eliminate the availability of these areas for future floodplain usage.

Problem Statement

Encroachments into floodways, critical floodplains, and potential future floodplain or bypass locations in the Delta could reduce the flood carrying capacity of the Delta. Future Delta floodways and bypasses have not been formally identified and protected.

Policies

The following are policies as to the lands in the Delta, and recommendations as to the lands outside the Delta:

RR P1 Floodways[33] shall not be encroached[34] upon nor diminished without mitigating for future flood flows. This policy would not pertain to ecosystem restoration projects or any ongoing agricultural or flood management activities.

RR P2 The following areas shall not be encroached upon because they are critical floodplains[35] and may also provide ecosystem benefit. This policy would not pertain to ecosystem restoration projects or any ongoing agricultural or flood management activities, provided they do not decrease the existing level of flood protection:

- Areas located in the Yolo Bypass from Fremont Weir through Cache Slough to the Sacramento River including the confluence of Putah Creek into the bypass
- 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 Department of Water Resources or the U.S. Army Corps of Engineers. (DWR 2010a)

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[32] 44 Code of Federal Regulations 60.3(b)(6,7,10) requires the following:
- *Notify, in riverine situations, adjacent communities and the State Coordinating Office prior to any alteration or relocation of a watercourse, and submit copies of such notifications to the Administrator;*
- *Assure that the flood carrying capacity within the altered or relocated portion of any watercourse is maintained;*
- *Require until a regulatory floodway is designated, that no new construction, substantial improvements, or other development (including fill) shall be permitted within Zones A1-30 and AE on the community's Flood Insurance Rate Map (FIRM), 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 one foot at any point within the community.*

[33] As defined by California Code of Regulations, Title 23, Division 1, Chapter 1, Article 2, Section 4: *(n) Floodway. "Floodway" means the channel of a river or other watercourse and the adjacent land areas that convey flood waters.*

[34] *As Described in DWR's "Interim Levee Design Criteria for Urban and Urbanizing Areas in the Sacramento-San Joaquin Valley", (DWR 2010b): Encroachments and vegetation should be evaluated and managed so as to not impact levee safety, while recognizing their benefits.*

[35] As defined by the FEMA National Flood Insurance Program: *Floodplain: Any land area susceptible to being inundated by flood waters from any source.* http://www.fema.gov/business/nfip/19def2.shtm.

- The Lower San Joaquin River Flood Bypass, 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 Flood Bypass Proposal, submitted to the Department of Water Resources by the partnership of the South Delta Water Agency, the River Islands Development Company, RD 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.

Policy ER P4 also addresses this problem statement by recommending that levee rehabilitation or construction include alternatives that increase the extent of floodplain and riparian habitats.

Recommendations

RR R1 The Legislature should fund and the Department of Water Resources and the Central Valley Flood Protection Board should complete their investigation of the bypass and floodways in the San Joaquin River to reduce potential flooding near Paradise Cut, as required by Water Code section 9613(c).

RR R2 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—the *San Francisco Bay Long Term Management Strategy for Dredging and the Delta Dredged Sediment Long-Term Management Strategy*—should be continued and supported so that desirable dredging to support the Delta Plan and the coequal goals might be achieved. Appropriate dredging throughout other areas in the Delta might also increase flood conveyance while at the same time acquiring material that might be used for levee maintenance (USACE 2002).

Levee Classifications for Protection of Land and Resource Uses

The 1992 Delta Protection Act designated the Delta as a flood-prone area and defined the most appropriate land uses as agriculture, wildlife habitat, and where specifically provided, recreation (Public Resources Code section 29704). Although levees were constructed in the Delta to reduce the risk of flooding, the historical performance of many levees in the Delta is poor (DWR 2005). Many levee failures have been attributed to high flood flows, and some levees have failed in the absence of any type of flood. If a significant earthquake does occur on faults near the west Delta, one or more levees could fail or subside (DWR 2009). Figure 7-2 illustrates a flood scenario in which a 6.5-magnitude earthquake causes a 20-island failure. With this in mind, it is more important than ever that the levees in the Delta are designed, constructed, and maintained to provide the level of flood risk reduction commensurate with the land and resource uses they protect.

It is irresponsible to make future land use decisions that permit and encourage construction of significant numbers of new residences in the Delta in the face of the flood hazards that exist there. Current engineering knowledge indicates that those hazards cannot be overcome, and the safety of such new residents cannot be guaranteed, without the expenditure of massive funds for flood protection. Yet, developers and homeowners are unable or unwilling to bear those costs, and the public should not be required to subsidize them. The impacts of climate change—especially rising sea level and increased precipitation and runoff patterns—will only exacerbate future threats to public safety associated with such new residential development in the Delta.

The level of flood protection provided by levees should be related to an acceptable risk for the types of land use located behind the levee (Delta Vision Blue Ribbon Task Force 2008). A classification system is needed that aligns levee design with corresponding appropriate land and resource uses ranging from

habitat or ecosystem protection up to protection of large urban areas comprising thousands of people and homes. During the last few decades, State and federal agencies have developed various levee standards. These standards were designed to either establish minimum criteria that would make the levees and the properties protected eligible for FEMA grants or USACE rehabilitation funds, or set minimum criteria that would allow development behind the levees. The four most prominent existing standards and guidance are listed below:

- **FEMA Hazard Mitigation Plan Guidance:** To be eligible for FEMA disaster grants and assistance following levee failures and island inundation, local communities must prepare a Hazard Mitigation Plan and maintain their levees in accordance with the plan.

- **U.S. Army Corps of Engineers Public Law 84-99:** Meeting this standard allows the Delta island or tract to be eligible for USACE funding for levee rehabilitation and island restoration following levee failures and island inundation, provided that the reclamation district applies for and is accepted into the 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. The new USACE Periodic Inspection (PI) program has incorporated many other elements into eligibility, including presence of structure encroachments, vegetation, rodent control programs, and more. Although the geometry implies a minimum slope stability factor of safety, this standard is not associated with a level of protection and does not address seismic stability.

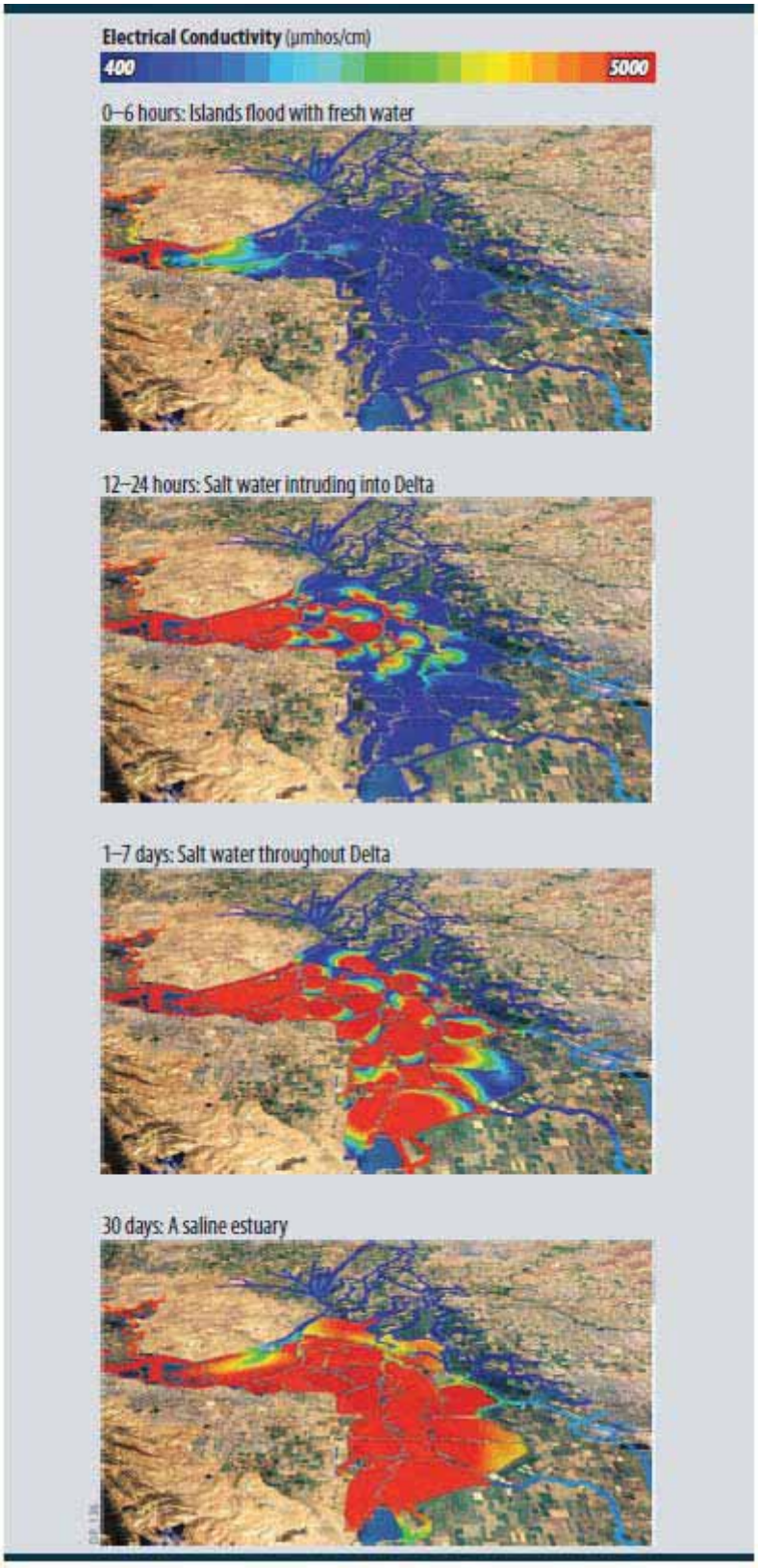
- **FEMA 100-year (Base Flood) Protection:** This "insurance" standard, often called the 1 percent annual chance flood level of protection, is based on criteria established in the Code of Federal Regulations (44 CFR 65.10) and is often used with established USACE criteria to meet certain freeboard, slope stability, seepage/underseepage, erosion, and settlement requirements. Meeting this level of flood protection means that communities will not be required to purchase flood insurance or be subject to building restrictions. This standard generally does not address seismic stability. Very few levees in the central Delta meet this standard.

- **DWR 200-year Urban Levee Protection:** This standard (currently under development within the Central Valley Flood Protection Plan) is similar to the FEMA standard, but for a 200-year level of flood protection. It is generally based on established USACE criteria. However, unlike USACE criteria, the DWR 200-year Urban Levee Protection requires that seismic stability be addressed. Not meeting this standard, or not making adequate progress toward it, will generally prohibit further development. Although almost none of the levees in the central Delta meet this standard, most do not protect urban areas, with the exceptions of the outer fringes of the Delta near West Sacramento, Sacramento's Pocket Area, and Stockton.

- Properly aligning land and resource uses with specific levee design criteria can help ensure that land and resource uses realize appropriate flood risk protection, but also signal that future alterations and changes to land and resource uses must remain in alignment with appropriate levee design criteria. To that end, this section provides policies that address the alignment of land and resource uses with appropriate levee design criteria.

- While most of the attention is typically directed toward flood risk reduction for life and property, flood protection is also a consideration for habitat and ecosystem values and goals. Setback levees that expand flood conveyance capacity and reduce flood risk while providing ecosystem restoration and recreational opportunities are worthwhile (USACE 2002). Setback levees allow opportunities for construction of an improved levee foundation and section using modern design and construction practices, thereby reducing risk of failure.

Figure 7-2
Magnitude 6.5 Earthquake Causing 20-island Failure
Source: MWD 2010



Problem Statement

Many Delta levees are not adequately designed and/or maintained to protect the existing land and resource uses.

Policies

RR P3 Covered actions shall conform to the classifications defined in Table 7-1. Covered actions protected by Class 5 levees must conform by 2025 in accordance with the Central Valley Flood Protection Act of 2008 (Government Code section 65865.5(a)(3)).

Recommendation

RR R3 The Department of Water Resources, in conjunction with the Department of Fish and Game and Delta Conservancy, should adopt criteria to define locations for future setback levees in the Delta and Delta watershed. Until then, any action located next to the land side of a levee should demonstrate adequate area is provided to accommodate setback levees, as determined by a registered civil engineer.

Flood Management Investment

The Delta is inherently flood-prone, but its levees protect its residents, its agricultural land, water supplies, and energy, communications, and transportation facilities vital to the economic health of California (Public Resources Code section 32301(h)). Levee maintenance and levee improvements in the Delta are critical for reducing risks to acceptable levels. Depending on the ownership of the levee, the responsibilities for these activities—and the financial investment required—are assigned to federal agencies, State agencies, and/or local landowners and reclamation districts.

Approximately one-third of the levees in the Delta are "project" levees. Project levees were authorized as part of a federal flood-control project and are eligible for rehabilitation by the USACE under PL 84-99. The Central Valley Flood Protection Board (formerly the Reclamation Board) serves as the non-federal partner to the USACE for all project levees in the Delta. Approximately 65 percent of the levees in the Delta and all levees in the Suisun Marsh are non-project (local) levees owned or maintained by local agencies or private owners. This means they are not part of the State-Federal levee system and are not usually eligible for rehabilitation by the USACE. Local agencies (primarily reclamation districts) receive partial reimbursement for levee maintenance and rehabilitation from the State when funding is available. It is often difficult for local agencies to raise funds for the local cost share of State and federal assistance programs. In addition, few Delta properties have federal or private flood insurance; consequently, these uninsured property owners may be solely responsible for repairs and losses following a levee failure.

With the passage of the Delta Reform Act, the State is now required to promote effective strategic levee investments and recommend prioritization of State investments (Water Code section 85305(a), 85306). Although the State has expended over $250 million since the early 1970s on Delta levee operation, maintenance, and improvement, significant funding would be necessary to raise all Delta levees to PL 84-99 standards. Given the potential threats faced by Delta levees, risk must be reduced through a set of management policies that prioritize strategic and focused investments of resources into levees in a manner that best balances the multitude of uses in the Delta.

Problem Statement

To promote strategic State investments in levee operations, maintenance, and improvements in the Delta, a Delta-wide prioritization framework is needed.

Table 7-1
Levee Classifications for Protection of Land Uses

Levee System Goals								Minimum Design Criteria
		Land Use						
					Residential Development in Non-Urbanized Areas [a, b]			
Levee System Class-ification	Description	Recreation and Wetlands Habitat	Agricultural	Infrastructure	Development of 4 or fewer parcels [c]	Development of 5 or more parcels	Urban Area [c]	
Class 1	No specific goal	Acceptable	Not Acceptable	Not Acceptable	Not Acceptable	Not Acceptable	Not Acceptable	Designed to manage the flood risk to the level appropriate for individual ecosystem restoration projects.
Class 2	HMP (Hazard Mitigation Plan)	Acceptable	Acceptable	Not Acceptable	Not Acceptable	Not Acceptable	Not Acceptable	In accordance with Hazard Mitigation Plans approved by FEMA and defined with geometric levee criteria.
Class 3	PL84-99 (Public Law 84-99)	Acceptable	Acceptable	Acceptable	Not Acceptable [d]	Not Acceptable	Not Acceptable	USACE PL 84-99 Standards as developed by the US Army Corps of Engineers.
Class 4	FEMA 100 year	Acceptable	Acceptable	Acceptable	Acceptable [d]	Not Acceptable	Not Acceptable	In accordance with the FEMA and NFIP regulations, including criteria in 44 CFR 65.10 for Levees accredited by FEMA as providing 100 year flood protection.
Class 5	DWR 200 year	Acceptable	Acceptable	Acceptable	Acceptable	Acceptable [e]	Acceptable [e]	Current DWR urban levee design criteria for the 200–year flood event water surface elevation. In accordance with the Central Valley Flood Protection Act of 2008 (Senate Bill 5, Machado)

[a] Urbanized Areas and Non-Urbanized Areas as defined in California Government Code section 65007(e).

[b] Levee protection for legacy towns should be based on reduction of risk to the town, determined by Expected Annual Damage.

[c] Minor subdivision development as defined in California Government Code section 66445(e).

[d] Other actions which provide 100 year flood protection, such as flood proofing or structural elevation, may be considered on a project specific basis by appropriate local agencies.

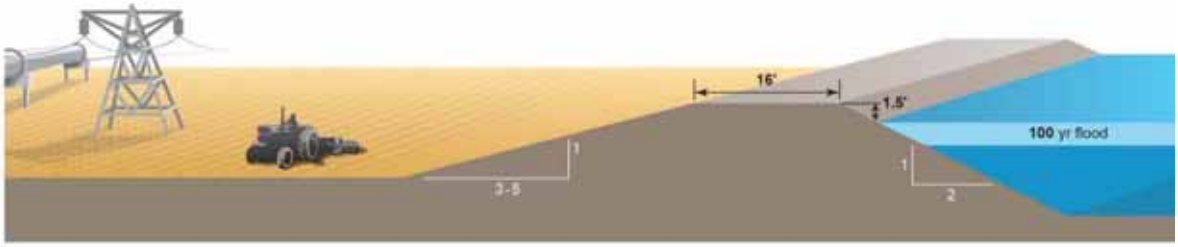
[e] Levees for non-urban and urban residential areas should comply with requirements contained in the DWR's "Interim Levee Design Criteria for Urban and Urbanizing Areas in the Sacramento–San Joaquin Valley." The 200 year level of flood protection will need to accommodate sea level rise due to climate change.

1

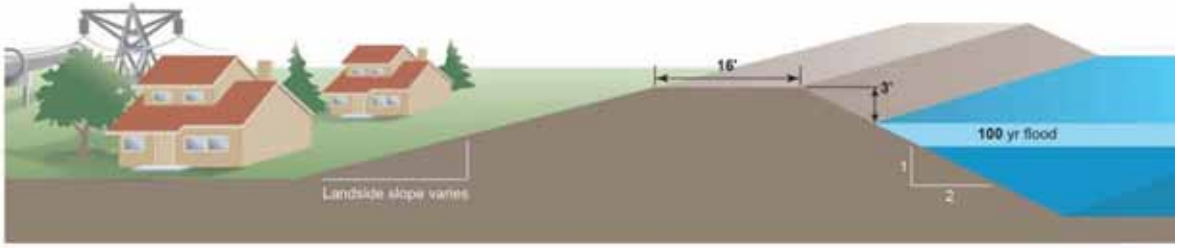
Figure 7-3
Levee Classifications and Land Uses
Source: Adapted from Delta Vision Blue Ribbon Task Force 2008

Class 1: Wetlands/Habitat

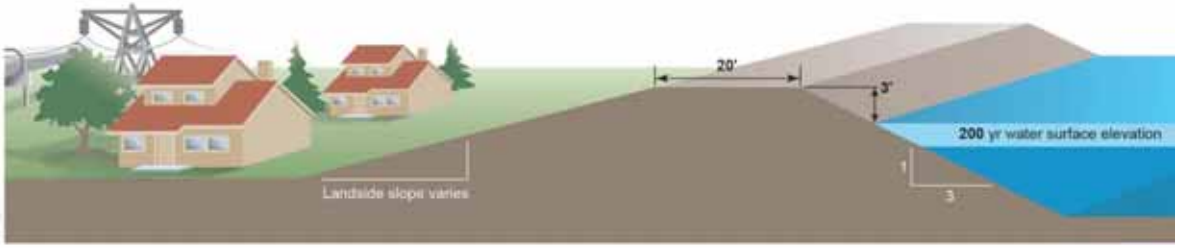
Class 2: Hazard Mitigation Plan (HMP)



Class 3: PL 84-99



Class 4: FEMA - 100 year



Class 5: DWR - 200 year[1]

[1] DWR Interim Levee Design Criteria, 2010

Policies

RR P4 State investments for levee operation, maintenance, and improvements in the Delta shall be directed by the Department of Water Resources'' *A Framework for Department of Water Resources Investments in Delta Integrated Flood Management.* This draft Framework shall be completed by DWR, in consultation with the Central Valley Flood Protection Board, by January 1, 2013. The Framework shall:

- Define State interests related to flood and levee management in the Delta. These State interests shall, at a minimum, include:
  - Reducing risk of loss of life
  - Protecting water supply
  - Protecting water quality and the ecosystem
  - Protecting critical infrastructure
- Define a long-term levee policy for the Delta, which, at a minimum, shall determine those levees critical for protecting State interests.
- Recognize the wide variability of conditions across the Delta including depth of inundation upon failure; current condition of existing levees; and degree of exposure to seismicity, sea level rise, climate change, and river flood levels.
- Define a methodology for assessing initial Delta levee conditions, as well as on a systematic, routine, and coordinated basis, to develop a sound technical understanding and assessment capability to base levee related decisions. This information shall be collected and reported in a transparent manner, and shall include the production of a Delta levee conditions map.
- Define a methodology for proactively identifying, developing, prioritizing, and scheduling specific levee operations, maintenance, and improvement projects.
- Define a method for determining project costs, cost share, and project partners, if appropriate.
- Define procedures that distinguish Delta Levees Special Flood Control Projects from routine levee maintenance projects.

Emergency Preparedness and Response

Even with the best-engineered levees, channels, and floodways, there will always remain a residual risk from flooding. Therefore, it is imperative that federal, State, and local governments—and the citizens themselves—be prepared for a variety of emergency situations. Emergency response should be routinely tested and practiced (Delta Vision Blue Ribbon Task Force 2008).

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 and prudent. Delta levees not only protect life and personal property, but also play a large role in protecting vital infrastructure, including the State's water conveyance system. Despite the risks of levee failure, no published emergency action plan exists that addresses the consequences to federal and State water supply deliveries in the event of catastrophic levee failure in the Delta. Such a failure could lead to long-term salinity intrusion in the southern Delta where the federal and State water supply pumps are located. Although investment in flood protection

infrastructure can considerably reduce the likelihood of a catastrophic levee failure, failures are inevitable and will require the implementation of well-coordinated and carefully developed emergency-response planning efforts. To reduce response time while optimizing the effectiveness of the response effort, such plans will need to harness the unique capabilities of each agency with a mission in the Delta.

Despite the vital importance of adequate preparation, no Delta-wide emergency response plan exists. The California Emergency Management Agency, DWR, and several local agencies are preparing individual emergency response plans for the Delta, but the development of these should be coordinated, tested, and practiced. Strategies being prepared as directed by SB 27 (Water Code Section 12994.5) are anticipated to address this issue and will be considered in the Delta Plan.

As an example of planning efforts being conducted at the local agency level, 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.

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. Currently, no coordinated Delta-wide emergency response plan exists to address levee failures and flooding.

Policies

There are no policies with regulatory effect included in this section.

Recommendations

RR R4 The following actions should be taken to promote emergency preparedness in the Delta:

- Responsible Emergency Management Authorities should consider and implement the recommendations of the 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.

- The Department of Water Resources, the California Emergency Management Agency, and local flood management agencies should prepare and regularly update a Delta-wide emergency response plan and the Inland Region Mass Evacuation Plan. These agencies should participate in emergency response exercises for both periodic and catastrophic flood events, inland mass evacuation exercises, and emergency preparedness public training, notification, and flood risk education and outreach programs. The U.S. Army Corps of Engineers should be a part of all emergency preparedness activities.

- All personnel prepared to respond to Delta flood emergencies should be trained in the Statewide Emergency Management System (SEMS) and the National Incident Management System (NIMS) procedures. All emergency response plans and emergency response training exercises involving the Delta should be SEMS- and NIMS-compliant.

- In consultation with local agencies, the 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 Department of Water Resources plans and procedures. The 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.

- 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.

Limitation of 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 non-project levees (Water Code sections 85305, 85306, 85307). The Act expressly states that its 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 the State's flood protection liability in the Delta or its watershed.

The USACE and other federal agencies are generally afforded some immunity from liability for damages arising from flood events through the concept of sovereign immunity and through provisions of the Flood Control Act of 1928 (FCA 1928) 33 U.S. Code Section 702c. Congress provided immunity to federal agencies for some but not all tort damages, and not for inverse condemnation. However, this immunity is not enjoyed by agencies outside of the federal government.

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 to flooded landowners for inverse condemnation damages caused by the failure of a Yuba River levee 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 Central Valley—approximately 1,600 miles of State-federal project levees that protect more than half a million people and property exceeding $50 billion in value.

In *Arreola v. County of Monterey* (2002) 99 Cal.App.4th 722, the court held local agencies and the California Department of Transportation liable in July 2002 for 1995 flood damages to property owners that resulted from a failure to properly maintain the Pajaro River project. This case also held the California Department of Transportation liable for some of the damages.

The State's FloodSAFE Strategic Plan (DWR 2008) stated, "Local communities are responsible for land use decisions, but generally have not been found liable for failure of the flood protection system. Continued development within the floodplains can increase flood risk, even if levees and other flood protection works are improved. Recent 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."

Problem Statement

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).

Policies

Although there are no policies with regulatory effect included in this section, implementation of the levee standards in Table 7-1 and protections of floodways as provided in RR P1 and RR P2 may substantially limit liability for the State of California.

Recommendations

RR R5 The Legislature should provide specific immunity for public safety flood protection activities, similar to that provided for police and fire protection services.[36]

RR R6 The Legislature should require an adequate level of flood insurance for residences, businesses, and industries in flood-prone areas.

Finance and Implementation of Local Flood Management Activities

No regional authority currently exists to facilitate the assessment and disbursement of funds for Delta levee operations, maintenance, and improvements, or to collect and provide timely data and reporting on levee conditions. Such an authority could act to consolidate activities relating to levees conditions assessment, data collection efforts, emergency preparedness, public notification, and fee authority. This could provide for a more centralized and responsive entity managed on a local basis for Delta interests.

Traditionally, local levee maintaining agencies have managed the financing and ongoing maintenance, rehabilitation, and repair of Delta levees, and have done an admirable job in improving the levels of levee integrity and reducing overall Delta flood risk. Additional assistance has been provided by the State over the last few decades through DWR's Delta Levee Special Flood Control Projects Program and its Delta Levees Maintenance Subventions Program. These programs have most recently been funded through State general obligation bond financing, which faces an uncertain future. The development of an alternative funding mechanism and authority may have the ability to provide for a more stable funding process in which local direction is more broadly incorporated.

Currently, standardized flood risk measurement data is not being developed for the Delta. Standardized methods such as Expected Annual Damage should be incorporated into Delta flood risk management, and can help serve to identify those areas most critically in need of resources, and then allow for the allocation of resources to the most appropriate areas. A systematic process for data collection and reporting should be developed in order to support an ongoing understanding of overall Delta levee conditions. This can then facilitate an orderly allocation of resources to those areas most in need.

Problem Statement

Financing of local levee operations, maintenance, and related data collection and reporting efforts needs improvement in order to provide for a more functional, regional based approach to Delta flood risk management.

Policies

There are no policies with regulatory effect included in this section.

Recommendations

RR R7 A Delta Flood Risk Management Assessment District should be created 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,

[36] Sections 850 – 850.8 (Fire Protection Services). Section 850 provides immunity for the government not providing fire protection services. Sections 850.2 through 850.8 provide governmental immunity related to the actual provision of fire protection services (i.e., failure to maintain sufficient fire protection facilities, injuries sustained while transporting a person from a fire to medical facility, etc.).

Section 845 (Police Protection Services). Section 845 provides governmental immunity for the failure to provide police protection services or the provision of insufficient police protection services.

infrastructure owners, and other entities that benefit from the maintenance of the levees, such as water exporters who rely on the levees to protect water quality.

This district should be authorized to:

- Develop, fund, and implement a regional plan of flood management for both Project and non-project levees of the Delta in cooperation with the existing reclamation districts, cities, counties, and owners of infrastructure and other interests protected by the levees;
- Conduct levee elevation surveys and inspections at least every 5 years, and report data to DWR;
- In coordination with Department of Water Resources and the U.S. Army Corps of Engineers, establish standardized flood risk measurement data. This data should support the development of Expected Annual Damage and loss of life values for the Delta, to be conducted by the District on an annual basis. Expected Annual Damage is a measure of risk that integrates the likelihood and consequences of flooding, and is a standard measure of the benefits of reducing flood risk (USACE 1996, USACE 2006). The U.S. Army Corps of Engineers is currently developing a levee risk management system, including means to evaluate and rank risk of loss of life and flood damages for levee systems;
- Notify residents and landowners of flood risk and emergency preparedness on an annual basis; and
- Potentially implement the recommendations of the Delta Multi-Hazard Coordination Task Force (Water Code section 12994.5).

Subsidence Reduction and Reversal

Portions of Delta lands are composed of peaty soils that exist naturally as fibrous, low-density, compressible soils usually in a saturated state. Agricultural practices have promoted deep subsidence over the last 150 years to the extent that many islands more closely resemble bowls. To grow crops in such soils, farmers constructed levees and dikes around the tracts and drained the fields. This process of drying saturated peat reduced its volume by approximately 50 percent. Early cultivation practices included burning, which further reduced the volume and altered the structure. Over time, long-term oxidation reduced the peaty soils to small particles and gases. Although subsidence has slowed or halted in many areas, some regions of the Delta continue to subside. However, some recent practices that can reverse subsidence have been investigated. The State is participating in subsidence-reversal pilot studies on Sherman and Twitchell islands and other areas (Miller 2008).

Today, much of the central Delta is below sea level, with some islands commonly 12 to 15 feet below sea level, requiring levees that are 20 to 25 feet high to hold back water every day (Figure 7-4.) As subsidence progresses, levees must be continually maintained, strengthened, and periodically raised to support the increasing hydraulic stresses being placed upon them.

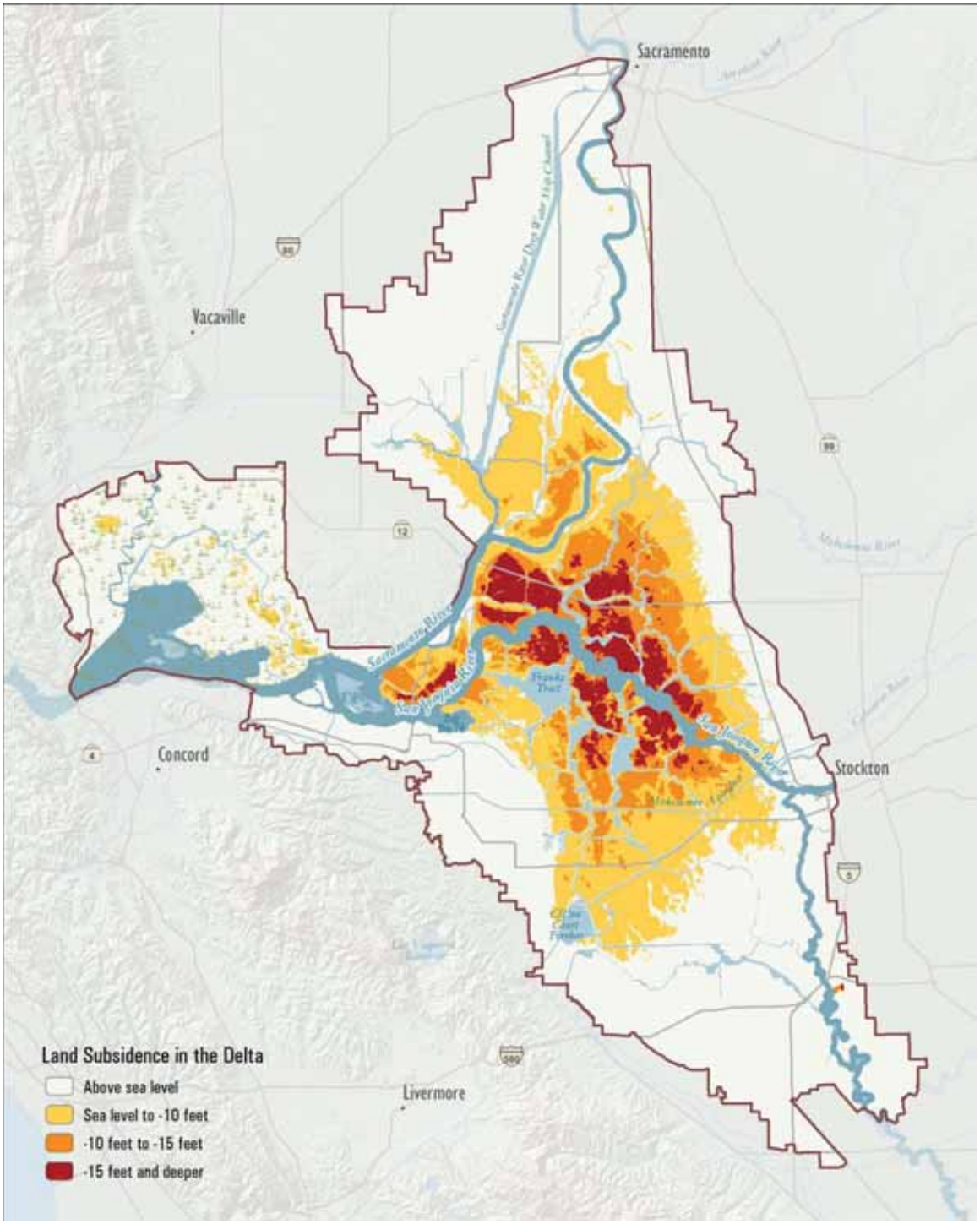
Problem Statement

Deep subsidence has led to increasing stress on Delta levees.

Recommendations

RR R8 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.

Figure 7-4
Subsidence in the Delta
Source: DWR 2007



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. Some non-federal, non-State upstream reservoirs can offer some flood control benefits even when they have no specific designated flood control space in their reservoir. Federal and State agencies have initiated evaluations to modify flood control management procedures on an individual stream basis but have not completed a comprehensive, coordinated Delta watershed analysis. Factors caused by climate change will likely modify runoff patterns, including the timing and duration of runoff, which highlights the need for additional attention to reservoir operations.

Currently, DWR, the National Weather Service California-Nevada River Forecast Center (CNRFC) and USACE are undertaking efforts to improve flood operation coordination among Central Valley reservoirs through DWR's Forecast-Coordinated Operations program.

Reoperation of upstream reservoirs requires intense planning and environmental studies as well as dam safety studies to ensure no increase in dam safety risk. Reoperation evaluations would need to be coordinated with federal, State, and local agencies and with hydropower utilities.

Development of increased upstream (and possibly offstream) storage can also help to attenuate peak flows during major storm events, reducing pressure on Delta levees.

Problem Statement

Flood and water supply operations of upstream reservoirs are coordinated among USACE, DWR, the federal Bureau of Reclamation, local agencies, and hydropower utilities. However, these operations need to be revised, modeled, evaluated, and improved based on the coequal goals and changing conditions, including climate change and other factors.

Policies

There are no policies with regulatory effect included in this section.

Recommendations

RR R9 U.S. Army Corps of Engineers, federal Bureau of Reclamation, California Department of Water Resources, and local agencies and hydropower utilities should evaluate and modify flood control management procedures for reservoirs upstream of the Delta considering sea level rise, changes in timing and form of precipitation, and changes in water supply operations to alleviate potential Delta flooding.

Performance Measures

Performance measures for reducing flood risk in the Delta are placed into two general classes: 1) administrative performance measures and 2) outcome performance measures. In general, administrative performance measures describe what resources (funds, programs, projects) are being implemented (or plan to be implemented) for a program or group of related programs. Outcome performance measures evaluate responses to management actions. The distinction between performance measure types is not rigid.

Recommended performance measures for reducing risk to people, property, and State interests in the Delta are described below.

Administrative Performance Measures

- Progress toward increasing the percentage of Delta levees that comply with the protection classifications shown in Table 7-1 based on corresponding land and resource uses. Trends in Delta levee miles complying with the Table 7-1 classifications will be upward as Delta levees are improved while maintaining appropriate land uses.
- Progress toward increasing the percentage of residential and commercial structures covered by flood insurance in the Delta. This trend will be upward should the Legislature require insurance coverage in flood prone areas.
- Completion and implementation of DWR's A Framework for Department of Water Resources Investments in Delta Integrated Flood Management by January 1, 2013.
- Implementation of the Delta Multi-Hazard Coordination Task Force recommendations by the appropriate authority (Water Code section 12994.5).
- Development of a Delta Flood Risk Management Assessment District.
- Development of a Delta-wide levees conditions map that allows for the assessment of levees on an ongoing basis. The trend will indicate an improvement in Delta levee conditions over time.

Outcome Performance Measure

- Progress toward decreasing Delta area flood risk over time as measured by Expected Annual Damage. The Expected Annual Damage methodology is intended to more clearly quantify flood risk in terms of expected damages given probabilities of flooding. Trends in the reduction of Expected Annual Damage will be developed using data collected by appropriate State and local authorities.

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Chapter 8
Protect and Enhance the Unique Cultural, Recreational, Natural Resources, and Agricultural Values of the California Delta as an Evolving Place

The Delta Protection Act of 1992 declared state policy for the resources and values of the Delta (Public Resources Code section 29702, amended 2009):

> *(a) Achieve the two coequal 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.*
>
> *(b) Protect, maintain, and, where possible, enhance and restore the overall quality of the Delta environment, including, but not limited to, agriculture, wildlife habitat, and recreational activities.*
>
> *(c) Ensure orderly, balanced conservation and development of Delta land resources.*

Inherent in the coequal goals, 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.*

Public Resources Code section 29703.5 declared 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.*

1

Chapter 8
Protect and Enhance the Unique Cultural, Recreational, Natural Resources, and Agricultural Values of the California Delta as an Evolving Place

Introduction

Since the mid-1800s, the Delta's economy and culture have been defined by managing water to create farmable land, and by using the Delta's waterways to move people and goods between the San Francisco Bay Area and Central Valley. In the past 100 years, the importance of the Delta region has been elevated by a growing network of infrastructure, such as roadways, freshwater conveyance, power transmission lines, and pipelines that connect the Delta to other regions of the state. More recently, the population of some Delta communities has grown as people who work in the San Francisco Bay Area, Sacramento, and Stockton regions relocate to enjoy the rural lifestyle offered by the Delta. A growing appreciation of the Delta's character and role in California's history has moved the Legislature to act to protect and enhance the Delta "as an evolving place."

As the region has evolved over the decades, the Delta's predominant land use has remained agricultural, and its varied crops continue to surround small unincorporated and "legacy communities," towns with distinct natural, agricultural, and cultural heritage. Cultural events, specialty local businesses, and recreational opportunities near these towns are attractive to many visitors. Industries in the Delta serve the region's agricultural, transportation, and recreation sectors. The Delta is also an important corridor and crossroads for utilities and other infrastructure; a complex network of pipelines and aboveground transmission lines serve and connect the Delta with surrounding urban regions and other parts of California. This web of natural resources and human activities has led the California Legislature to recommend pursuing federal designation of the Delta as a place of special significance to communicate the Delta's stature as one of America's most distinctive and culturally significant regions and encourage regional investment.

Risks to the Delta are increasing. Urbanization at the edges of the Delta, an aging levee system, climate change, rising sea levels, a changing economic base from which to support an increasing demand on public services, and other pressures threaten to overwhelm the Delta. The Delta's water and environmental resources need long-term management to address these concerns. Despite the need, federal, State, and local decisions influencing land and water uses in the Delta are not well coordinated. There is no clear, consistent regional or statewide plan to collectively address these concerns. Also, the

ways in which these concerns are addressed could affect the very culture and natural heritage the Legislature seeks to protect and enhance.

Figure 8-1
Discover the Delta [DRAFT UNDER DEVELOPMENT]

This chapter discusses key challenges to the Delta's unique sense of place and major aspects of the Delta that must be addressed for the Delta to evolve to meet these challenges. Recommendations are divided into three categories: 1) economic sustainability, 2) land use and resource management, and 3) protection and promotion of the natural, agricultural, and cultural heritage of the Delta.

Critical plans completed by others have been considered by the Delta Stewardship Council (Council) during the development of the recommendations in this section. These include:

- Plan to establish State and federal designation of the Delta as a place of special significance (development by the Delta Protection Commission [DPC]; Water Code section 85301(b)(1)), Phase 1 Report, December 16, 2010.
- Proposal to expand the network of state recreation areas in the Delta (development by the California Department of Parks and Recreation; Water Code section 85301(c)(1)), Draft for Public Review, May 3, 2011. (Final proposal is scheduled to be completed in June 2011.)
- Land Use and Resource Management Plan for the Primary Zone of the Delta (development by the DPC, Public Resources Code section 29760 et.seq.), adopted February 25, 2010.
- Delta Economic Sustainability Plan (development by the DPC; Public Resources Code section 29759), Phase I – Framework Study, Final Draft, December 6, 2010.
- Proposal to establish market incentives and infrastructure to protect and enhance the economic and public values of Delta agriculture (California Department of Food and Agriculture; Water Code section 85301(c)(2)), transmitted to the DPC and Delta Stewardship Council on March 21, 2011 (Sumner and Rosen-Molina 2011.)

Other critical plans are now being developed by others and will be considered by the Council to inform future Delta Plan policies. These include:

- Delta Economic Sustainability Plan (development by the DPC; Public Resources Code section 29759), Phase II, including Working Papers and the Final Economic Sustainability Plan. (Final Plan is scheduled to be completed by September 2, 2011.)
- Plan to establish State and federal designation of the Delta as a place of special significance (development by the DPC; Water Code section 85301(b)(1)), Phase II or Management Plan.
- Proposal to protect, enhance, and sustain the unique cultural, historical, recreational, agricultural, and economic values of the Delta as an evolving place in a manner consistent with the coequal goals (development by the DPC; Water Code section 85301(a)).

Policies and Recommendations

Economic Sustainability

To protect people, property, and state interests in the Delta, the Legislature has directed State agencies to assist with maintaining the socioeconomic sustainability of agriculture, infrastructure, and legacy communities in the Delta. Plans are underway to encourage economic growth in the Delta region through

investments in tourism and recreation, but concerns have been identified about balanced development and prioritized investment. For example:

- The DPC's Land Use and Resource Management Plan for the Primary Zone of the Delta (2010) identifies concerns about funding availability for maintenance of recreational facilities and for the provision of new facilities.
- The Department of Food and Agriculture's proposal to establish market incentives and infrastructure to protect and enhance the economic and public values of Delta agriculture (Sumner and Rosen-Molina 2011) raises concerns about the ability of public investments in recreation or local marketing to provide additional revenue to support Delta agriculture.

The Legislature established that the DPC "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" (Public Resources Code section 29703.5(a)). The DPC is developing an Economic Sustainability Plan, which will inform the Council's policies for economic sustainability in the Delta. The plan will define a baseline of economic values for Delta activities, propose alternative planning scenarios to sustain legacy towns, and prioritize improvements in flood control and public safety critical to counteract the potential impacts of climate change and seismic risks on the economic sustainability of the Delta. The Economic Sustainability Plan will also identify and recommend investments in capital and ongoing operation and maintenance necessary to achieve sustainability goals (California State Lands Commission 2011; University of the Pacific 2011). The California Department of Parks and Recreation also includes economic sustainability recommendations in their proposal, described below.

Public Resources Code section 29778.5 established the Delta Investment Fund in the State Treasury, which can be used for implementing the Economic Sustainability Plan once adopted by the DPC. The Legislature, however, has yet to make appropriations to the fund.

Maintaining public services is vital to sustaining the Delta's culture and public safety. Local governments have expressed concern about lost tax revenue from land converted from agriculture to ecosystem habitat. Additionally, more land has gone into public ownership these last several years. When federal or State government agencies purchase land, they are generally exempt from paying property taxes to the county that originally had jurisdiction over the land. Acquisition can therefore represent a loss of significant funds for the county, making the provision of vital services difficult. The State currently administers a payment-in-lieu-of-taxes program to compensate county governments, but only lands acquired by the California Department of Fish and Game (DFG) for wildlife areas qualify, and budget constraints may affect payments on an annual basis (Working Landscapes Subcommittee 2005).

Problem Statement

Delta economic drivers are changing. Economic development planning and investment is required to sustain the economic vitality of the Delta while achieving the coequal goals. Local public services must continue to be supported when changes in land use or ownership removes tax revenue.

Policies

At this time, there are no policies with regulatory effect included in this section. The Delta Plan will rely heavily on local and regional direction to achieve the recommendations cited below, and relies on the regulatory policies of other sections of the Delta Plan to ensure progress toward the coequal goals.

Recommendations

DP R1 The Economic Sustainability Plan should include, but not be limited to, planning for the following items:

- Public safety, including flood protection
- Continued economic sustainability of Delta agriculture
- Long-term strategies for legacy communities vital to the tourist economy
- Priorities for investments in flood management
- Recreation
- Infrastructure to support the proposed economic strategies

DP R2 The Legislature should consider appropriate funding for implementation of the Economic Sustainability Plan consistent with the Delta Plan.

DP R3 The Legislature should consider reasonable payments-in-lieu-of-taxes to replace lost local government revenues resulting from the removal of properties from property tax rolls for ecosystem habitat or water supply purposes in the Delta.

Land Use and Resource Management

The majority of Delta land is now used for agriculture. Population growth will increase the demand for developable land, particularly in areas near the Bay Area, Stockton, and Sacramento. Historically, this demand has resulted in the conversion of open space, primarily agricultural land, to residential and commercial uses (DPC 2010b). In addition, development in deep floodplains and below sea level, which is hazardous for new residents and existing communities, has not been adequately constrained (Delta Vision Blue Ribbon Task Force 2008).

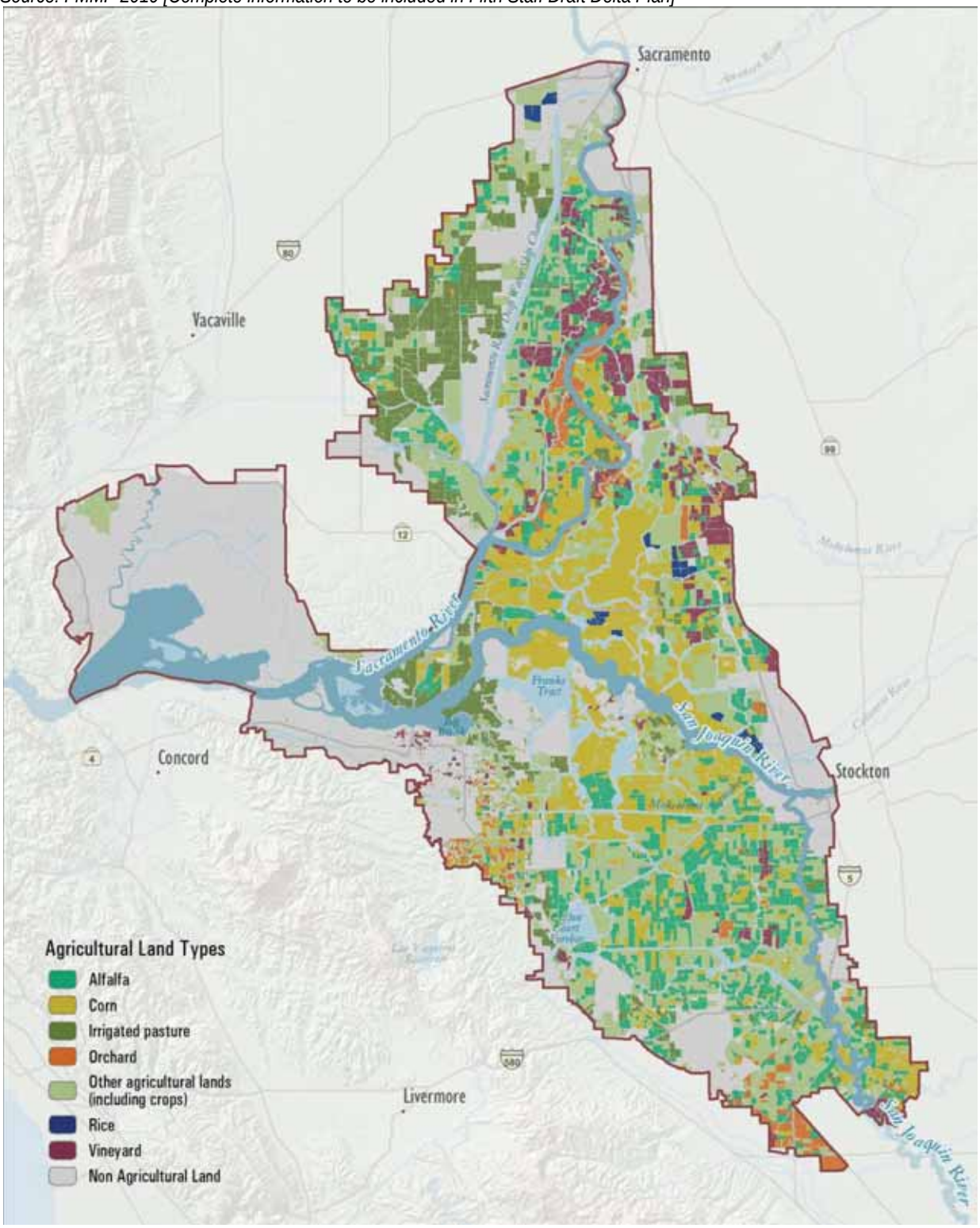
As the Delta Vision Blue Ribbon Task Force found in their Strategic Plan (2008), the Delta's landscape should continue to be dominated by agriculture, habitat, and recreation with mutually beneficial mixtures of these wherever possible. Increasing urbanization of the Delta is fundamentally inconsistent with these preferred land uses, and new residential development projects in the Delta should therefore be strongly discouraged. Therefore, there is a need for the five Delta counties to establish and implement a resources management plan for the Delta, and for the Council to consider that plan and recommendations of the DPC in the adoption of the Delta Plan (Public Resources Code section 29703.5(a)).

As discussed in Chapter 5, many of the native species in the Delta have declined, leading to the listing of several species under the California and/or federal Endangered Species Acts. To support both Delta agriculture and species recovery, farmers in the Delta are encouraged to implement management practices to maximize habitat values, and the DPC supports using incentives such as purchase of conservation easements from willing sellers (DPC 2010b, Natural Resources Policy P-2). Safe Harbor agreements, voluntary agreements between wildlife agencies and landowners whose actions contribute to the recovery of listed species, assure these landowners that the presence of an endangered species on their property will not result in restrictions on 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.

Problem Statement

There are growing concerns that increasing urbanization adjacent to the Delta and within the Secondary Zone may adversely affect resources in the Primary and Secondary Zones. The Delta Reform Act requires orderly, balanced conservation and development of land resources throughout the Delta. Landowners are wary of restoring wildlife habitats on their property because of restrictions that could be imposed by the Endangered Species Act.

Figure 8-2
Agricultural Land Use in the Delta
Source: FMMP 2010 [Complete information to be included in Fifth Staff Draft Delta Plan]



Policies

At this time, there are no policies with regulatory effect included in this section.

Recommendations

DP R4 The Department of Fish and Game and the U.S. Fish and Wildlife Service should 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.

Natural, Agricultural, and Cultural Heritage

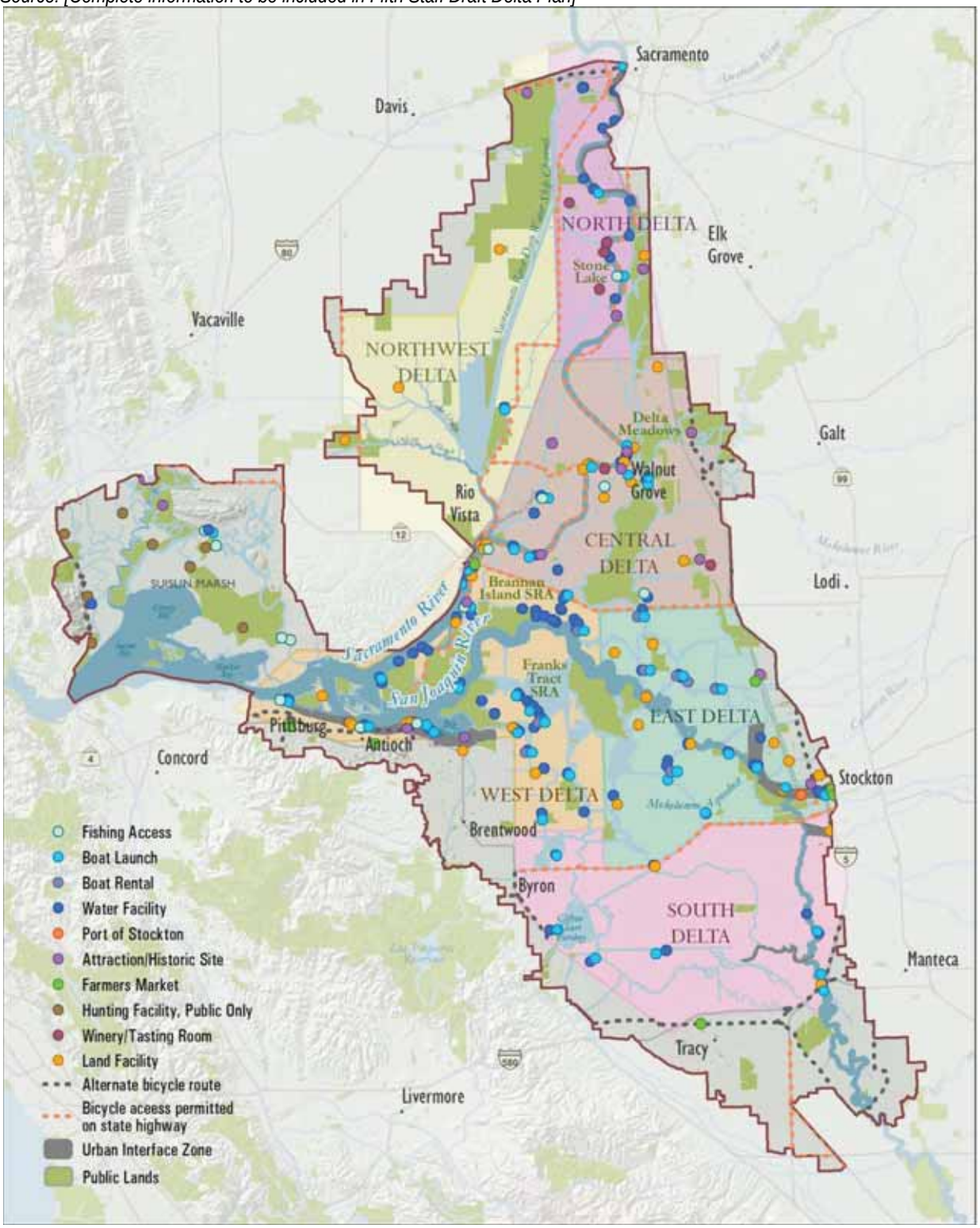
The Delta's history is rich with a distinct natural, agricultural, and cultural heritage. It is home to the community of Locke, the only town in the United States built primarily by early Chinese immigrants. Other legacy communities include Bethel Island, Clarksburg, Courtland, Freeport, Hood, Isleton, Knightsen, Rio Vista, Ryde, and Walnut Grove (Public Resources Code section 32301(f)). The Legislature declared that the cities, towns, and settlements within the Delta are of significant historical, cultural, and economic value and that their continued protection is important to the economic and cultural vitality of the region (Public Resources Code section 29708).

These communities, together with the Delta's landscape and heritage, form a unique and valued area, warranting recognition and special legal status from the State of California (Delta Vision Blue Ribbon Task Force 2008). The California Department of Parks and Recreation has recommended that DPC gain approval for, establish, and manage a National Heritage Area in the region (California Department of Parks and Recreation 2011), and a feasibility study is underway by the DPC. Designation may lead to partnerships and funding for elements that increase recognition and cultural understanding, such as interpretive signage, historic preservation, regional branding, and heritage trail development, while still allowing the Delta's agricultural economy and culture to thrive.

To guide and draw visitors to the area, the California Department of Parks and Recreation recommends that communities on the edge of the Delta or Suisun Marsh with access to major transportation routes be developed as "gateways" to provide supplies and information to visitors about recreation opportunities available in an area (California Department of Parks and Recreation 2011). Gateways identify entrances to a region at transition points in topography or land use and provide a unique sense of identity, transition, and anticipation. Recommended gateway communities include Antioch, Brentwood, Oakley, Pittsburg, Rio Vista, Sacramento, Suisun City, and Stockton. Yolo County also recommends that Clarksburg serve as a gateway for visitors seeking agricultural tourism, ecotourism, and recreational opportunities (County of Yolo 2009, Policy CO-9.14.)

Within the Delta, towns could serve as "basecamps" for recreation and tourism activities and develop or improve services such as boat rentals, parking, restrooms, and picnic sites. Ecological reserves and wildlife areas could attract visitors by improving environmental interpretation (California Department of Parks and Recreation 2011). Increased visitation to museums, recreational trails, community parks, farm stands, community centers, and water access facilities in the Delta would support its cultural heritage, agricultural and economic base, recreational resources, and biological diversity (DPC 2010b, Land Use Policy P-1).With increased visitation and tourism, recreation facilities and public services must be improved, and public safety must be maintained, both on land and water. Increasing numbers of boaters in the area may require the Department of Boating and Waterways to enhance patrol efforts. As described previously, concerns exist about funding availability.

Figure 8-3
Delta Resources and Recreation
Source: [Complete information to be included in Fifth Staff Draft Delta Plan]



Problem Statement

The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resources, and agricultural values of the California Delta as an evolving place. To encourage economic investment in the rich cultural values of the Delta, including recreational and agricultural activities, the Delta needs recognition, special legal status, and enhanced visibility and identity. Recreation access and facilities must be improved as visitation increases.

Policies

At this time, there are no policies with regulatory effect included in this section.

Recommendations

DP R5 The Delta Protection Commission should pursue and the federal government should designate the Delta and Suisun Marsh as a National Heritage Area.

DP R6 The California Department of Transportation should partner with local cities and counties to establish major gateways and improve connecting transportation routes, bike lanes, sidewalks, and trails to promote the Delta's identity, visibility, and access.

DP R7 The California Department of Parks and Recreation should partner with other State and federal agencies, counties, conservancies, nonprofits to add and improve recreation facilities in the Delta and add three new parks at Barker Slough, Elkhorn Basin, and in the South Delta.

DP R8 The California Department of Fish and Game should collaborate with other agencies and non-profits, private landowners, and business partners to expand wildlife viewing, angling and hunting opportunities.

DP R9 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.

Performance Measures

Performance measures for protection and enhancement of the unique cultural, recreational, natural resources, and agricultural values of the California Delta as an evolving place are placed into three general classes: 1) administrative performance measures, 2) driver performance measures, and 3) outcome performance measures. In general, administrative performance measures describe what resources (funds, programs, projects) are being implemented (or plan to be implemented) for a program or group of related programs. 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 ecosystem responses to management actions or natural drivers. The distinction between performance measure types is not rigid. In some cases, an outcome performance measure for one purpose may become a driver performance measure for another purpose.

Recommended performance measures for protection and enhancement of the unique cultural, recreational, natural resources, and agricultural values of the California Delta as an evolving place are described below.

Administrative Performance Measures

- The DPC completes the Delta Economic Sustainability Plan by July 1, 2011.
- The Delta and Suisun Marsh is designated a National Heritage Area by January 1, 2012.

Driver Performance Measures

- Progress toward increased guided visitation and visual identity in the Delta. "Gateways" to the Delta are established at Antioch, Brentwood, Oakley, Pittsburg, Rio Vista, Sacramento, Suisun City, Stockton, and/or Clarksburg by 2020.
- Progress toward meeting the DPC's Economic Sustainability Plan recommendations. Funding of essential public services to adequately provide for Delta residents, visitors, agriculture, and industries is maintained or increased if necessary.

Outcome Performance Measures

- Progress toward improving the economic sustainability of Delta land uses and protection of the Delta's agricultural values. Annual gross revenue from agriculture in the Delta will be maintained in the future.
- Progress toward improving economic sustainability of Delta land uses and protection of the Delta's recreational values. Trends in annual gross revenue from Delta recreation activities will be upward.
- Progress toward improving Delta economic sustainability and enhancing Delta culture by increasing ecotourism and agritourism opportunities. Trends in annual gross revenue from ecotourism and agritourism will be upward.
- Progress toward protection of the Delta's agricultural values. Trends in acreage of annual crops, orchards, rice, and vineyards will be maintained in the future.
- Progress toward achieving balanced land use and resource management in the Delta and protecting the Delta's natural resource values. Acres of undeveloped open space will be maintained in the future rather than converted to other uses.

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California Department of Parks and Recreation. 2011. Recreation Proposal for the Sacramento-San Joaquin Delta and Suisun Marsh. Draft for Public Review. May 3.

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County of Yolo. 2009. 2030 Countywide General Plan. Conservation and Open Space Element. Adopted November 10.

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Chapter 9
Finance Plan Framework to Support Coequal Goals

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Chapter 9
Finance Plan Framework to Support Coequal Goals

America is slowly recovering from a severe recession, and California's economy lags behind the nation's. Together with a multiyear State budget crisis in which annual spending exceeds available revenue, financing infrastructure and new programs becomes immensely challenging for the State and local governments.

The current economic climate will limit the ability to quickly develop the full range of water or ecosystem improvements necessary to achieve the coequal goals. However, the planning timeframe for the Delta Plan runs to the year 2100. This timeframe allows time for gradual steps toward improving the situation, and to stage actions, policies, and projects over time, which fits with an adaptive management structure based on science—a system that constantly modifies, adjusts, and changes actions and projects as new information becomes available.

The Delta Plan includes policies and recommendations for water conveyance, conservation, storage, and efficiency together with ecosystem restoration, flood risk reduction, water quality protection, science, and governance. The Finance Plan Framework proposes strategies to generate ongoing revenue and capital construction funds for these policies and recommendations.

The Finance Plan is based on the following key tenets:

- Beneficiaries (those who benefit from the water resources of the Delta and its watershed) should pay for the benefits they receive.
- Stressors (those whose actions adversely affect the Delta ecosystem) should pay for the stresses they place on the ecosystem.

However, simply stating the principle that beneficiaries pay and those who stress the Delta ecosystem should also pay does not resolve the necessary or appropriate level of the fees. Nor does it adequately ensure funds to pay for large, statewide public benefits. Some funds are currently available and should be spent in ways that truly focus on coequal goals and support significant actions that implement the Delta Plan.

This section outlines the principles of a financing system, background information on federal, State, and local funding for water and Delta ecosystem purposes, and recommendations for financing a staged Delta Plan through the year 2100. It is envisioned that the implemented Finance Plan will be integrated with other ongoing programs by related agencies.

Guiding Principles

As the costs of Delta improvements become known, development of the Finance Plan should be shaped by a set of guiding principles:

- Implementation of the Delta Plan will require an array of funding sources and authority. Diversity in financing 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 by law for other purposes. Appendix F describes potential funding sources.
- The "beneficiary pays" 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 "beneficiary pays" is "stressors pay." Human activity that causes negative operational or environmental impacts should be assessed a fee to repair the damage. An example of the stressors pay approach might be a surcharge on pesticides that were found to negatively impact the Delta ecosystem.
- Capital construction projects, whether for water reliability purposes or improvement in the Delta ecosystem, should be undertaken simultaneously with the development of beneficiary and user fees. Delay in establishing a beneficiary/stressor fee structure 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 remain dedicated to their intended purpose. Given State and federal budget constraints, care must be taken to assure users that their contributions will not be diverted to other purposes.
- Targeted finance plans should be developed for major Delta Plan activities (habitat 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.
- Existing contributions for closely related activities should be considered for crediting. Site-specific contributions by agencies should not be credited (for example, the installation of fish screens and waste treatment costs).
- To the extent possible, user fees should be based on the amount of water used, or for stressors, the volume of the contaminants discharged. Tiered fee structures should also be explored where applicable.

Background

Operations, maintenance, and capital expenditures for water infrastructure consume a significant amount of resources in California. A cursory review of financial data from selected entities that provide water-related services in California found that expenditures in California exceed $20 billion annually (Table 9-1). These expenditures likely include some overlap, but the expenditures are significant.

Table 9-1
Annual Budgets/Expenditures in California for Selected Agencies ($ Millions)

Agency	Budget/Expenditures		Source
	Operating	Non-operating	
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	$7,000	$500	California Department of Finance 2011
State Water Resources Control Board	$700		California Department of Finance 2011
Department of Fish and Game	$400		California Department of Finance 2011
Federal Bureau of Reclamation	$300		Reclamation 2008
U.S. Army Corps of Engineers	$100	$100	USACE 2008
Total	**$25,000**	**$4,000**	

Since the CALFED Bay-Delta Program was instituted in 1995 to restore ecological health and improve water management in the Delta, there have been significant expenditures in the Delta. Roughly $400 million has been spent on average each year by federal, State, and local water users. The California Legislative Analyst's Office (LAO) estimated that $1.3 billion should be spent annually on Delta ecosystem restoration (LAO 2011).

Traditionally, the State has financed water infrastructure with General Fund obligation bonds supported by tax revenues. These bonds were approved by the voters, and repayment is guaranteed by the State's general taxing power. For the State Water Project (SWP), however, even though guaranteed by taxes, general obligation bonds were paid back mainly by user fees. Since 2000, the State has issued close to $20 billion in general obligation bonds for water-related purposes spread over six separate bonds (not all of these bonds have been issued yet) (LAO 2008). A benefit of financing water projects with general obligation bonds is that any costs allocated to the public good (such as some ecosystem benefits) are repaid by taxpayers, the primary beneficiaries.

With the State's current fiscal condition, access to the bond market has become more expensive and existing bond funds are near depletion. Coupled with the reduced likelihood of getting voter approval for general obligation bonds, new approaches to water infrastructure financing are needed. If new revenue sources are developed, the use of revenue bonds may become more prevalent. This does create the need to find an approach to fund those ecosystem costs previously paid for by general obligation bonds.

Financing Needs

The Finance Plan Framework for the Delta Plan has two parts:

- Immediate needs over next 5 years
- Near-term expenditures that might occur through 2025

This framework allows time to develop a Finance Plan that puts financing in place for operational needs while developing a broader-based financing approach for long-term improvements based on phasing, adaptive management, and integration with ongoing programs.

The costs of the Delta Plan will be further refined when a final Bay Delta Conservation Plan (BDCP) is completed and incorporated into the Delta Plan. To meet state and federal requirements, BDCP will identify implementation costs and funding sources. Implementation costs will be determined for planning, construction of a conveyance facility; conservation actions to avoid, minimize, and mitigate the effects of activities covered by the BDCP on species and natural communities addressed by the BDCP; and actions to provide for the conservation of those species. The State and federal contractors have committed to funding the new conveyance and related mitigation costs. Substantial public and other sources of funding are expected to contribute to the cost of implementing the other elements of BDCP that provide benefits to the public and the State and federal contractors. If the BDCP is not completed by this date consistent with the Delta Reform Act, the Council will consider how to proceed with ecosystem and conveyance planning.

Immediate Needs

There are three immediate financing needs:

- **Urgent expenditures for water reliability and ecosystem protection:** Initial steps to protect the existing Delta water export system from flood risks, and ecosystem improvements being implemented pursuant to existing mitigation commitments of the SWP and the Central Valley Project (CVP). Those immediate needs are discussed in the various chapters of the Delta Plan. These recommendations are in addition to other ongoing efforts that should continue to be funded. Examples of these include implementing the Biological Opinions, funding levee subventions, funding science, and many more.

- **Funding a strong Delta Science Program, including funds for the Independent Science Board and the State's share of the Interagency Ecological Program.** Funding for the Delta Science Program and Delta Independent Science Board would be approximately $27 million per year. Funding for the IEP should continue from relevant agencies.

- **Continuing the existing operational duties imposed by the 2009 Delta Reform Act.** The Act created the Delta Stewardship Council (which includes the Delta Science Program and Independent Science Board) and the Delta Conservancy, and modified the duties of the existing Delta Protection Commission. Annual costs for the operation of all of these functions are approximately $50 million per year. This would include $27 million for the Delta Science Program and the Delta Independent Science Board (mentioned above), $8 million to administer the Delta Stewardship Council, $5 million for the Delta Protection Commission, and $10 million for the Delta Conservancy.

Continuation of Near-term Planning, Science, and Related Needs

The Council strongly supports completion of the BDCP. The scope or type of any facility improvements, related Delta ecosystem mitigation, and other habitat investments 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 the BDCP is completed, the first 5 years of implementation will require between $5.7 and $5.9 billion total in capital outlays, of which approximately $5.2 billion are for water conveyance. The BDCP will complete a funding plan that will address both estimated BDCP implementation costs and sources of funding that will be relied upon to cover these costs. The Council will reconsider recommendations for interim State funding once the funding plan is completed.

Bay Delta Conservation Plan Costs and Existing Funding Sources

When the Delta Plan speaks of potential funding sources for the BDCP, it should be understood that the same sources are also "potential" for the Delta Plan, and for many other plans and projects of State, federal, and local agencies interested in California's water and Delta ecosystem. Inclusion here under the BDCP designation is not a determination that the Council considers one or another of the potential sources to be solely available for the BDCP, or for any other activity. They qualify as options as this stage.

On the basis of currently available information from the BDCP, the approximate costs of the conveyance facility and related ecosystem conservation measures needed to gain State and federal approval is 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. California needs hard estimates, and this is one important reason why we support completion of the process.

Options for BDCP Funding

The BDCP has been 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 law. Habitat and ecosystem restoration activities, beyond mitigation requirements, are considered to provide a benefit to the State and would 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 source 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 - $1,769	$1,225 - $1,784
Program Oversight[c]		$404 - $548	$404 - $548
TOTAL	**$15,810 - $16,712**	**$4,896 - $5,598**	**$20,706 - $22,310**

[a]Over 50-year permit period [b]Midpoint cost estimate [c]Range of low-high estimate given

Source: BDCP Steering Committee. Progress Report on the Bay Delta Conservation Plan. November 18, 2010.

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Recommended Financing Strategy for the Delta Plan

The Council considers it unlikely that the General Fund of the State or State general obligation bonds will indefinitely fund implementation of the Delta Plan.

In general, human activities that stress the system should be the starting point of the financial strategy. Large federal and State contributions should be secondary. Because the Delta Plan will be implemented and water system improvements and Delta ecosystem improvements will occur through 2100, any new fees established should be staged over that time.

Immediate Funding Recommendations

Flood Management and Prevention

FP R1 Public and private agencies with infrastructure crossing the Delta should protect their assets from flooding.

- The California Public Utilities Commission should immediately commence a formal hearing to impose a reasonable fee for flood and disaster prevention of regulated privately owned utilities that cross or lie within the Delta. Publicly owned utilities should also be encouraged to develop similar fees. The Council, in consultation with the California Public Utilities Commission and the Delta Protection Commission, should allocate these funds between state and local emergency response and flood protection entities in the Delta, including the State of California. If a regional flood management agency is authorized by law, the local share would be allocated to that agency for its purposes.
- 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, and 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.

FR R2 A regional flood management agency should be created which at first is funded with $10 million dollars to develop a benefit assessment plan for the Delta. The council also recommends an additional $100 million for implementation of flood management improvements, to be funded by Propositions 1E and 84 to match up to 50 percent with non-State funding.

FP R3 The Legislature should allocate a total of $50 million of Proposition 1E funds to the Department of Water Resources and direct the Department of Water Resources to begin the acquisition of land or easements for the proposed San Joaquin/South Delta Flood Plain.

FP R4 Long-term stable funding should be found that supports the Department of Water Resources' Delta Levees Subventions and Special Projects, FloodSAFE, and the Central Valley Flood Protection Board.

Financial Needs Assessment

FP R5 As part of the California Water Plan Update, the Department of Water Resources should prepare an assessment of the state's water infrastructure needs. This should include an assessment of the existing infrastructure's rehabilitation/replacement costs, as well as new improvements to meet projected demands over the planning period. The Department of Water Resources should consider a survey of agencies requesting information on small-scale projects (such as storage or conveyance) that allow the State to improve water supply reliability. In the future, a provision should be added to Urban Water Management Plans and Agricultural Water Management Plans, to gather information on potential local water reliability projects. This could form the basis of future State bond funding decisions and be used to inform the Legislature and the public of systemic needs.

User Fees

FP R6 User Fees/Stressors Fees should support the coequal goals and the Delta Plan.

- The Legislature should grant the Council the authority to develop reasonable fees for beneficial uses, and reasonable fees for those who stress the Delta ecosystem, and apply such fees to the operational costs of the Council, the Delta Conservancy, and the Delta Protection Commission to allow implementation of the Delta Plan. The costs of operations of the Council, Delta Conservancy, and Delta Protection Commission should be advanced for a period of 10 years. As previously discussed, the unified annual budget of the new governance structure is approximately $50 million.
- Repayment of these costs, with interest, would be made in annual amounts commencing in 2022 from the fees imposed as recommended above. Repayment could begin sooner if revenue from fees were available before 2022. Repayment should be completed no later than 2032.
- Revenue bond authority should be granted to implement the Delta Plan should a fiscal partner be found.

FP R7 Clarify assessment authority for local water agencies. The Legislature should amend AB 3030 and SB 1938 to allow local agencies to assess fees under Proposition 218.

Habitat Credit Agreement

FP R8 State and federal fish agencies (California Department of Fish and Game, National Marine Fisheries Service, U.S. Fish and Wildlife Service) should complete ongoing negotiations toward a habitat credit agreement with water supply agencies.

Delta Conservancy

FP R9 No less than $50 million should be allocated from existing bond funds, or from any new funds authorized by voters, to the Delta Conservancy to commence implementation of the ecosystem restoration portion of the Delta Plan. This would include building the capabilities to administer and monitor the Conservancy's projects, as well as funding initial early start projects approved by the Conservancy Board.

FP R10 The Delta Conservancy should investigate carbon offsets as a revenue source for Delta islands.

Near-term Funding Recommendations

Public Goods Charge

FP R11 Establish a public goods charge (or broad-based user fee) for water. The Legislature should create a public goods charge (similar to the energy public goods charge created in 1996) on urban water users and agricultural users. This fund could provide for ecosystem costs that were once paid with general obligation bonds, or could be used for State water management costs such as developing the California Water Plan Update or science programs. Efforts would be necessary to determine administrative details of the program, including how the charge would be assessed, who would be assessed, and how revenues collected would be applied.

Prioritized Levee Investments

FP R12 By January 2015, the Department of Water Resources should complete a report on recommendations for prioritized State investments for levee operations, maintenance, and improvements in the Delta. The report should be developed, based upon a Delta-wide comparative benefit/cost analysis. Benefits should be specifically identifiable and calculable but broadly based, not limited to an analysis of the value of land behind a levee. Such a report should be developed in collaboration with the Council, local agencies, federal agencies, and the proposed new Delta Flood Management Assessment District.

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Appendix A
The Delta Stewardship Council's Role Regarding Conveyance

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Appendix A: The Delta Stewardship Council's Role Regarding Conveyance

The Delta Reform Act potentially gives the Council three distinct but connected roles relating to conveyance: contingent authority to approve proposed conveyance improvements, authority to generally recommend conveyance options in the Delta Plan, and authority to provide comments to other agencies during the Bay Delta Conservation Plan (BDCP) process.[1]

Regulatory Authority over Conveyance

As a practical matter, the Council would have occasion to decide in the first instance what conveyance improvements are permissible only if (a) an agency proposes a conveyance improvement prior to the incorporation of the Bay Delta Conservation Plan into the Delta Plan, (b) the proposed conveyance improvement is a "covered action" under Water Code section 85057.5, and (c) the proposed conveyance improvement, as a covered action, is appealed to the Council as not being consistent with the Delta Plan. For reasons explained below, it is unlikely that an agency will propose a conveyance improvement prior to the completion of (or the failure of) the BDCP process. Accordingly, it would be wasteful now to include in the Delta Plan regulatory Policies prescribing/limiting conveyance. If events in subsequent years reveal that BDCP will not be successful in a timely fashion, the Council will consider then whether to amend the Delta Plan to prescribe conveyance.

The Delta Reform Act mandates that the Council's Delta Plan "promote options" for improving conveyance and storage to meet the coequal goals (Water Code section 85303). Thus, the Council has the authority to dictate in the Delta Plan conveyance improvements it views as meeting the coequal goals. In addition, proposed conveyance improvements that are "covered actions"[2] under the Act must be consistent with the Delta Plan,[3] and the Council determines (upon appeal) consistency.[4] Through specifying conveyance improvements in the Delta Plan (should the Council do so), the consistency requirement, and the Council's appellate role over consistency determinations, the Council has the authority to regulate conveyance improvements.

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[1] This is an attempt to summarize the Council's relationship with BDCP and conveyance for the purpose of clarity. However, it does not purport to summarize the Council's complete authority in this regard. The Council retains all authority provided to it under the Delta Reform Act.

[2] Proposed conveyance improvements would almost certainly be a covered action: Such a project would (1) be a CEQA project; (2) occur at least in part within the Delta; (3) be carried out, approved, or funded by a public agency; (4) would be covered by one or more provisions of the Delta Plan; and (5) have a significant impact on the coequal goals (Water Code section 85057.5.).

[3] An agency proposing a conveyance covered action would have to certify that the project is consistent with the Delta Plan (Water Code section 85225).

[4] The Council would review this consistency determination if and when it was appealed to the Council (Water Code section 85225.10; Council's Appeals Procedures).

This is best viewed as *contingent* regulatory authority. The Council may never get to exercise it. Most relevant and as a practical matter, occasion to exercise that authority is contingent in the near term on BDCP.

Conveyance options are currently being studied *in detail* by the agencies and interested parties preparing the BDCP. A public draft of the BDCP Environmental Impact Statement/Environmental Impact Report is planned for release by the end of 2011. Upon successful completion of the BDCP process, and if BDCP meets certain requirements explained in Water Code section 85320(e), BDCP becomes part of the Delta Plan.[5] Subsequently, if another government agency (Department of Water Resources, most likely) proposes to implement the new conveyance project that is selected by BDCP as the preferred conveyance option and that project qualifies as a "covered action" (it would qualify, most likely), the project would be consistent with the Delta Plan regardless of whether the Delta Plan had previously endorsed a different conveyance option. Accordingly, the Council's regulatory authority over conveyance is contingent upon conveyance being proposed prior to BDCP's incorporation into the Delta Plan.

It is highly unlikely that a conveyance proposal will come before the Council prior to BDCP completion, or at least the anticipated deadline for BDCP completion. The Council considers it highly unlikely that an agency will propose a new conveyance facility while BDCP is underway. Accordingly, the Council does not expect to review a conveyance improvement consistency determination separate from BDCP unless the BDCP process fails.

For this reason, the 2012 Delta Plan does not include any regulatory Policies regarding conveyance. In addition, BDCP has been underway since 2006, and in the last 5 years, the involved agencies and interested parties have invested significant time, resources, and expertise in that process. The lead agencies of BDCP will also be conducting extensive environmental analysis of the various conveyance alternatives they consider. The Council has determined that the best option at this point is to encourage the lead agencies of BDCP to complete their work in short order. It would be a wasteful and duplicative exercise for the Council *now* to include a regulatory policy regarding conveyance. Doing so would require the same extensive policy, scientific, and environmental analysis BDCP is already doing.

However, should the BDCP process not be completed by January 1, 2014, the Council intends to revisit the issue of conveyance to determine how to facilitate improved conveyance facilities without BDCP. If the Council then decides to amend the Delta Plan to include regulatory Policies regarding conveyance, the Council would do so only after extensive analysis of the conveyance options and associated detailed environmental review. Accordingly, the Delta Plan includes the following policy.

Authority to Recommend Options

Implicit in the Council's regulatory authority relating to conveyance (that the Delta Plan shall promote options for improving conveyance) (Water Code section 85304) is its authority to recommend to other agencies conveyance options it views as meeting the coequal goals. This authority can be exercised through making Recommendations about conveyance in the Delta Plan.

The Act, therefore, gives the Council the authority to opine generally about improving conveyance as it may relate to the rest of the Delta Plan and the coequal goals. Accordingly, the Council has authority to recommend to BDCP preferred conveyance options BDCP should evaluate. Nevertheless, for the same reasons the Delta Plan at this time does not include any regulatory Policies regarding conveyance, the Delta Plan likewise does not include any Recommendations (*i.e.,* opinion preferences) regarding

[5] The Department of Fish and Game's decision that BDCP meets the requirements for incorporation into the Delta Plan may be appealed to the Council under Water Code section 85320(e).

conveyance. At this time, the agencies pursuing BDCP are best positioned to develop possible options, evaluate them, and decide on the best one.

Authority to Provide Comment during the BDCP Process

The Delta Reform Act provides the Council with a consultative and responsible agency role in the BDCP process (Water Code section 85320(c).). Thus, the Council may, separate from the Delta Plan, provide comment and guidance to lead agencies regarding BDCP, including the conveyance options those agencies consider, study, and ultimately choose.

Appendix B

I. Administrative Procedures Governing Appeals
II. Statutory Provisions Requiring Other Consistency Reviews
III. Other Forms of Review or Evaluation by the Council

[ADOPTED 9/23/2010]

DELTA STEWARDSHIP COUNCIL

I. ADMINISTRATIVE PROCEDURES GOVERNING APPEALS
II. STATUTORY PROVISIONS REQUIRING OTHER CONSISTENCY REVIEWS
III. OTHER FORMS OF REVIEW OR EVALUATION BY THE COUNCIL

PART I- ADMINISTRATIVE PROCEDURES GOVERNING APPEALS

Introduction

1. Purpose. These administrative procedures govern how the Delta Stewardship Council considers appeals with regard to:

a) Adequacy of certifications of consistency with the Delta Plan submitted to the council by a state or local public agency pursuant to Water Code sections 85225.10 and 85225.30; and

b) Determinations by the Department of Fish and Game that the Bay Delta Conservation Plan has met the requirements of Water Code section 85320 for inclusion in the Delta Plan.

NOTE: Authority cited: Water Code sections 85001, 85020(h), 85022, 85057.5, 85200, 85210, 85212, 85225, 85225.5, 85225.10, 85225.15, 85225.20, 85225.25, 85225.30, 85300, 85320(e).

Review of certifications of consistency with Delta Plan

2. Any state or local public agency proposing to undertake a covered action, as defined in Water Code section 85057.5 is encouraged to consult with the council at the earliest possible opportunity, preferably no later than 30 days before submitting its certification to the council pursuant to Water Code section 85225, to ensure that the project will be consistent with the Delta Plan. The council's staff will meet with the agency's staff to review the consistency of the proposed action and to make recommendations, as appropriate. During this early consultation, the agency's staff may also seek clarification on whether the proposed project is a "covered action"; provided that the ultimate determination on whether it is a covered action shall be made by the agency, subject to judicial review.

NOTE: Authority cited: Water Code sections 85212, 85225, 85225.5, 85225.30.

3. At least 10 days prior to its submission of a certification to the council, a state or local public agency that is not subject to open meeting laws (that is, the Bagley-Keene Open Meeting Act [Gov.Code sec.11120 et seq.] or the Brown Act [Gov.Code sec.54950 et seq.]) with regard to its certification, shall post, for public review and comment, its draft certification conspicuously on its website and in its office, mail it to all persons requesting notice, and include any public comments received in the record submitted to the council in the case of an appeal. A state or local public agency that is subject to open meeting laws with regard to its certification is encouraged to take those actions.

NOTE: Authority cited: Water Code sections 85225, 85225.30.

4. a) Any certification of consistency filed by a state or local agency pursuant to Water Code section 85225 shall set forth detailed findings that the covered action is consistent with the Delta Plan. The council shall prepare a checklist that agencies may use to assist them in preparing the certification and making the required findings.

b) A state or local agency shall submit to the council, no later than 10 days after receiving notice of an appeal pursuant to Paragraph 8, the record that was before the state or local agency at the time it made its certification, including a table of contents of documents contained therein and a brief chronology of events and actions relevant to the covered action. The record shall be certified by the state or local agency as being "full and complete." Given the tight, statutory deadlines for hearing and deciding appeals, a state or local agency is nevertheless strongly encouraged to submit the record at the time it files its certification of consistency, to ensure the opportunity for thorough review by the council in the event of an appeal.

c) The failure by a state or local agency to submit the record to the council on a timely basis as required by subparagraph (b), shall be grounds for the council to affirm the appeal on the basis that there was not substantial evidence presented to support the certification of consistency.

d) Any filings required by this Paragraph (4) shall be submitted in electronic form to facilitate availability and public access, and shall be public records.

NOTE: Authority cited: Water Code sections 85225, 85225.30.

5. Any person, including any member of the council or its executive officer, who claims that a proposed covered action is inconsistent with the Delta Plan and, as a result of that inconsistency, that action will have a significant adverse impact on the achievement of one or both of the goals of the Act 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 no later than 30 calendar days after that submittal.

NOTE: Authority cited: Water Code sections 85225.10 (a), 85225.15, 85225.30.

6. The appeal shall clearly and specifically set forth the basis for the claim that the covered action is inconsistent with the Delta Plan. The appeal shall be in writing and set forth the following information:

a) Appellant's name and address;

b) The name and address of the party, if any, whose proposal is the subject of the appeal;

c) A description of the covered action that is the subject of the state or local public agency certification;

d) The identity of the state or local government body whose certification is being appealed;

e) The specific grounds for appeal; and

f) A detailed statement of facts on which the appeal is based.

The appeal shall be filed in electronic form.

NOTE: Authority cited: Water Code sections 85225.10 (b), 85225.30.

7. The appeal shall be considered "filed" with the council when the appellant's appeal is received, determined by staff to contain all of the information listed in Paragraph 6, and a hard-copy is printed and stamped "Filed" by the council staff with the date of filing indicated.

NOTE: Authority cited: Water Code sections 85225.10, 85225.20, 85225.30.

8. Within five working days of the filing of an appeal with the council, the executive officer shall:

a) Post a notice and brief description of the appeal and its effective date in a conspicuous location in the council's office and on its website;

b) Mail to the affected state or local public agency and to any third party whose proposal is the subject of the certification, a copy of the notice and a brief description, with a copy of the appeal documents filed with the council;

c) Mail copies of the appeal to each member of the council, and to the Delta Protection Commission for informational purposes consistent with Public Resources Code section 29773; and

d) Mail notice to the appellant that the appeal has been filed and stating the effective date of filing.

NOTE: Authority cited: Water Code sections 85225.30.

9. The council or its executive officer may request from the appellant further information necessary to clarify, amplify, correct, or otherwise supplement the information submitted with the appeal, within a reasonable period. The council or by delegation its executive officer may dismiss the appeal for failure of the appellant to provide information requested within the period provided, if the information requested is in the possession of or under the control of the appellant.

NOTE: Authority cited: Water Code sections 85225.10, 85225.20, 85225.25, 85225.30.

10. The council or its executive officer may supplement the record submitted by the state or local agency if the council or its executive officer determines that additional information was part of the record before the agency, but was not included in the agency's submission to the council.

NOTE: Authority cited: Water Code sections 85225.10, 85225.20, 85225.25, 85225.30.

11. The appellant, the state or local agency, the Delta Protection Commission, or any other person may testify before the council regarding an appeal. Presentations may be oral or in writing, shall address only whether the record supports the certification of consistency, and shall be as brief as possible. Written submissions should be provided to the council at least 10 days prior to the hearing to ensure that they, or in appropriate cases, summaries, may be circulated to council members for their review ahead of the hearing. The council's presiding officer may establish reasonable time limits for presentations.

NOTE: Authority cited: Water Code sections 85225.10, 85225.20, 85225.25, 85225.30.

12. All written submissions to the council may be in electronic form.

NOTE: Authority cited: Water Code section 85225.30.

13. The council shall hear all appeals of certifications of consistency filed pursuant to Water Code section 85225 within 60 days of filing unless:

a) The parties agree to a reasonable extension approved by the executive officer, taking into account the circumstances of the matter subject to appeal and the council's hearing schedule and associated workload, or

b) The council, or by delegation its executive officer, determines that the issue raised on appeal is not within the council's jurisdiction or does not raise an appealable issue.

NOTE: Authority cited: Water Code sections 85225, 85225.20, 85225.30.

14. The council shall make its decision on the appeal within 60 days of hearing the appeal, and shall make specific written findings defining the covered action under review and either denying the appeal or remanding the matter to the state or local public agency for reconsideration of the covered action based on the finding that the certification of consistency is not supported by substantial evidence in the record before the state or local public agency that filed the certification.

NOTE: Authority cited: Water Code sections 85225.20, 85225.25, 85225.30.

15. No covered action which is the subject of an appeal shall be implemented unless one of the following conditions has been met:

a) The council has denied the appeal;

b) The public agency has pursuant to Water Code section 85225.5 decided to proceed with the action as proposed or modified and has filed with the council a revised certification of consistency addressing each of the findings made by the council, 30 days has elapsed and no person has appealed the revised certification; or

c) The council or its executive officer has dismissed the appeal for one or both of the following reasons:

1. The appellant has failed to provide information in her possession or under her control within the time requested or
2. The issue raised is not within the council's jurisdiction or fails to raise an appealable issue.

NOTE: Authority cited: Water Code sections 85225.5, 85225.25, 85225.30.

Review of Bay Delta Conservation Plan

16. If the Department of Fish and Game (department) determines that the Bay Delta Conservation Plan (BDCP) referred to in Water Code section 85053 meets all of the requirements of Water Code section 85320 for inclusion in the Delta Plan, it shall file the BDCP and its determination with the council.

NOTE: Authority cited: Water Code sections 85053, 85225.30, 85320.

17. Upon receipt of the department's determination, the executive officer of the council shall:

a) Post a notice and brief description of the BDCP, the department's determination, the date of filing and the right of any person to appeal that determination on its website and in a conspicuous location in the council's office;

b) Mail a notice and brief description of the BDCP, the department's determination and the right of appeal to any person requesting notice; and

c) Mail copies of the determination to each member of the council.

NOTE: Authority cited: Water Code sections 85225.30, 85320 (e).

18. Any person, including any member of the council or its executive officer, may appeal to the council the determination of the department that the BDCP meets all of the requirements of Water Code section 85320 for inclusion in the Delta Plan.

NOTE: Authority cited: Water Code sections 85225.30, 85320 (e).

19. a) Any appeal to the council made pursuant to Paragraph 18 shall be made within 30 days of the later of the following:

1. the filing with the council of the department's determination that the BDCP meets all the requirements of Water Code section 85320 for inclusion in the Delta Plan, or
2. the conclusion of the council's hearing or hearings held pursuant to Water Code section 85320(d).

b) The appeal shall be in writing and filed in electronic form. It shall clearly set forth the specific grounds for the appeal and the specific facts upon which it is based. These shall include a list of each specific requirement of Water Code section 85320 that the BDCP allegedly fails to meet. The appeal shall be considered filed with the council when the appellant's appeal is received, determined by staff to contain all the information required in this paragraph, and a hard-copy is printed and stamped "Filed" by the council staff with the date of filing indicated.

c) If an appeal is filed before the council publicly notices a hearing to be held pursuant to Water Code section 85320(d), the council, in its discretion, may combine the hearing on appeal and the hearing pursuant to Water Code section 85320(d).

NOTE: Authority cited: Water Code sections 85225.30, 85320.

20. Within five working days of the filing of an appeal pursuant to Paragraph 18, the executive director shall:

a) Post a notice and brief description of the appeal on its website and in a conspicuous location in the council's office;

b) Mail a notice and brief description of the appeal to any person requesting copies of such appeals; and

c) Mail copies of the appeal and a brief description of the appeal to each member of the council.

NOTE: Authority cited: Water Code sections 85225.30, 85320 (e).

21. The council or its executive officer may request from the appellant or the department additional information necessary to clarify, amplify, correct, or supplement the information submitted with the appeal within a reasonable period.

NOTE: Authority cited: Water Code sections 85225.30, 85320 (e).

22. Any appeal made pursuant to Paragraph 18 may be dismissed if the council or its executive officer determines that it does not raise an appealable issue or if the appellant has failed to provide requested information to support her charge within a reasonable time, if that information is in the possession of or under the control of the appellant.

NOTE: Authority cited: Water Code sections 85225.30, 85320 (e).

23. The council shall determine, based upon a preponderance of the evidence, whether the department correctly determined that the BDCP meets all of the requirements of Water Code section 85320 for inclusion in the Delta Plan. In reaching its decision, the council shall give weight to the reasoning and factual findings of the department. The council may seek clarification from the department of its reasoning and factual findings prior to the council making its final determination.

NOTE: Authority cited: Water Code section 85225.30, 85320(b), (e).

23.5 a) The council shall conduct any hearing on an appeal made pursuant to Paragraph 18 in a manner deemed most suitable to ensure fundamental fairness to all parties concerned, and with a view toward securing all relevant information and material necessary to render a decision without unreasonable delay.

b) The hearing need not be conducted according to technical rules relating to evidence and witnesses. Any relevant evidence shall be considered if it is the sort of evidence on which responsible persons are accustomed to rely in the conduct of serious affairs, regardless of the existence of any common law or statutory rule which might make improper the admission of such evidence over objection in a court proceeding.

Unduly repetitious or irrelevant evidence shall be excluded upon order of the council or its chairperson.

c) Subject to Paragraph 23, evidence before the council includes, but is not limited to, the record before the department. The record will not include a transcript of any proceedings before the department unless provided by a party to the proceedings or requested by the council.

d) Any interested person may testify before the council regarding an appeal concerning the BDCP. Speakers' presentations shall be to the point and shall be as brief as possible. Visual and other materials may be used as appropriate. The council may establish reasonable time limits for presentations; such time limits shall be made known to all affected persons prior to any hearing. Where speakers use or submit to the council visual or other materials, such materials shall become part of the hearing record and shall be identified and maintained as such. Speakers may substitute reproductions of models or other large materials but shall agree to make the originals available upon request of the executive director.

e) Council members may ask questions of the appellant, the department's representative(s), any third party appearing at the hearing or staff. Questioning of speakers at the hearing by other persons shall not be permitted except by permission of the Chairperson.

f) Interested persons may submit written comments concerning an appeal. Any such comments will be considered by the council if they are received by the council at or before the hearing on the appeal; provided that those written comments should be submitted to the council at least 10 days prior to the hearing to ensure that they, or in appropriate cases, summaries, may be circulated to council members for their review ahead of the hearing.

g) The council may continue the hearing where it determines that a continuance would be appropriate.

NOTE: Authority cited: Water Code sections 85225.30, 85320(e).

24. The council's decision shall include specific written findings. The council shall post its decision on its website and mail copies to the department and all parties requesting notice.

NOTE: Authority cited: Water Code sections 85225.30, 85320(e).

25. If the council decides that the department incorrectly determined that the BDCP meets all of the requirements of section 85320 for inclusion in the Delta Plan, and consequently grants the appeal, the department may revise its determination to meet the issues raised by the council, or may respond to the council's findings in detail, setting forth reasons why it has concluded that the BDCP meets all of the requirements of

section 85320 for inclusion in the Delta Plan. Unless the council decides that the department's determination, as submitted or revised, correctly concludes that the BDCP meets all of the requirements of section 85320 for inclusion in the Delta Plan, the BDCP shall not be incorporated in the Delta Plan and the public benefits associated with the BDCP shall not be eligible for state funding.

NOTE: Authority cited: Water Code sections 85225.30, 85320 (a), (b), (e).

Ex Parte Contact Restrictions Applicable to All Appeals

26. Hearings on appeals are subject to the ex parte communication restrictions of California Administrative Procedures Act (Gov. Code § 11430.10 et seq.). Under that Act, an ex parte communication is a "communication, direct or indirect, regarding any issue in the proceeding, to the [council or council member] from an employee or representative of an agency that is a party or from an interested person outside the agency, without notice and opportunity for all parties to participate in the communication." (Gov. Code § 11430.10.) The restrictions apply from the date that the appeal is filed to the date that the council reaches a final decision on the appeal.

NOTE: Authority cited: Government Code sections 11430.10, 11430.80, Water Code section 85225.30.

27. To ensure compliance with these provisions, members should avoid ex parte communications while an appeal is pending. If they nevertheless receive one, such as by an individual sending a letter to a member concerning a pending matter, the member should notify the council's legal adviser or executive officer so that appropriate measures can be taken.

NOTE: Authority cited: Government Code sections 11430.10, 11430.80, Water Code section 85225.30.

28. At the first appropriate meeting after an appeal is anticipated or filed, the council's legal adviser will remind the council of this restriction and answer questions about its scope.

NOTE: Authority cited: Government Code sections 11430.10, 11430.80, Water Code section 85225.30.

Official Notice

29. Notwithstanding any provision of these procedures to the contrary, the council may take official notice in any hearing that it conducts, of any generally accepted technical or scientific matter within the council's jurisdiction, and of any fact that may be judicially noticed by the courts of this State.

NOTE: Authority cited: Government Code section 11515, Water Code section 85225.30.

Filings and Mailings

30. All filings and mailings required by sections 1-29 of these procedures may be made electronically.

NOTE: Authority cited: Water Code section 85225.30.

Consolidation of Appeals

31. The council, at its discretion, may consolidate appeals raising similar issues.

NOTE: Authority cited: Water Code section 85225.30.

PART II—STATUTORY PROVISIONS REQUIRING OTHER CONSISTENCY REVIEWS (AFTER ADOPTION OF THE DELTA PLAN)

In several other sections of SB X7 1, the council is directed to review for consistency with the Delta Plan, various plans of specified public agencies. This Part is directed at those reviews, which fall outside the scope of the procedures covered by Part I.

1. Delta Protection Commission's Economic Sustainability Plan.

Public Resources Code section 29759 requires the Delta Protection Commission (DPC), by July 1, 2011, to adopt an economic sustainability plan. That plan must include information and recommendations that inform the council's policies regarding the socioeconomic sustainability of the Delta's region.

Public Resources Code section 29761.5(b) requires the DPC to transmit copies of the plan to the council within 60 days of adoption. The council is required, within 180 days of the adoption of the plan, to review the plan for consistency with the Delta Plan.

2. Local and Regional Planning Documents.

Water Code section 85057.5(b)(3), excepts from the definition of "covered action", regional transportation plans prepared pursuant to Government Code section 65080.

Paragraph (4) of that same section, excepts from the definition of "covered action", plans, programs, projects or activities within the secondary zone of the Delta that the applicable metropolitan planning organization under Government Code section 65080 has determined is consistent with either a sustainable communities strategy or an alternative planning strategy that would achieve specified greenhouse gas emission reduction targets as determined by the Air Resources Board.

Because they are not "covered actions", these types of local and regional planning documents are not subject to the statutory provisions governing consistency of state and local public agency actions (Water Code secs. 85225 et seq.), or the council's Administrative Procedures Governing Appeals (Part I, above), with one exception noted in paragraph (d), below.

However, Water Code section 85212 provides a separate requirement and process for consistency review by the council of these types of local and regional planning documents.

In particular:

(a) The council is required to review and provide timely advice to local and regional planning agencies regarding the consistency of local and regional planning documents, including sustainable communities strategies and alternative planning strategies prepared pursuant to Government Code section 65080, with the Delta Plan.

(b)The council's input must include, but not be limited to, reviewing the consistency of local and regional planning documents with the ecosystem restoration needs of the Delta and reviewing whether the lands set aside for natural resources protection are sufficient to meet the Delta's ecosystem needs.

(c) A metropolitan planning organization preparing a regional transportation plan that includes land within the primary or secondary zones of the Delta must consult with the council early in the planning process regarding the issues and policy choices relating to the council's advice.

(d) No later than 60 days prior to the adoption of a final regional transportation plan, the metropolitan planning organization must provide the council with a draft sustainable communities strategy and an alternative planning strategy, if any. Concurrently, the metropolitan planning organization must provide notice of its submission to the council in the same manner in which agencies file a certificate of consistency with regard to covered actions.

(e) If the council concludes that the draft strategies are inconsistent with the Delta Plan, the council must provide written notice of the claimed inconsistency to the metropolitan planning organization no later than 30 days prior to the adoption of the final regional transportation plan.

(f) If the council provides timely notice of a claimed inconsistency, the metropolitan planning organization's adoption of the final regional transportation plan must include a detailed response to the council's notice.

PART III--OTHER FORMS OF REVIEW OR EVALUATION BY THE COUNCIL

1. Interested parties, including federal, state and local public agencies, are encouraged to confer with the council or its executive officer over the scope and potential impacts of the interim plan developed under Water Code section 85084. Interested parties will be provided an opportunity to comment and provide input on the interim plan as it is developed.

2. Similarly, prior to adoption of the Delta Plan, project proponents are encouraged to consult with the council or its executive officer early in the planning stages of projects that may constitute "covered actions" under Water Code section 85057.5 once the Delta Plan is adopted. Subject to available resources, the council may review and comment on planning documents and environmental review documents regarding potential "covered actions".

3. Subject to available resources, the executive officer or his designee may meet with interested parties, upon their request, to help mediate relevant disputes, including disputes, once the Delta Plan is adopted, over whether a project constitutes a "covered action" under Water Code section 85057.5. The intent of this mediation will be to provide an objective and informal forum for dispute resolution that will serve as a more efficient alternative to costly and time- consuming litigation.

4. Interested parties, including federal, state and local agencies, are encouraged to confer and coordinate with the council or its executive officer with regard to agency plans, studies, strategies, and recommendations required, or otherwise suggested, to be considered by the council for incorporation into the Delta Plan.

Appendix C
Select DWR Policies Regarding Contract Negotiations and Water Transfers

Appendix C1
Policy 03-09: Principles Regarding Public Participation Process in State Water Project Contract Negotiations

STATE OF CALIFORNIA • RESOURCES AGENCY • DEPARTMENT OF WATER RESOURCES

NOTICE TO

STATE WATER PROJECT CONTRACTORS

NUMBER: 03-09

DATE: 7/3/03

SUBJECT: Guidelines for Review of Proposed Permanent Transfers of State Water Project Annual Table A Amounts

FROM: INTERIM DIRECTOR, DEPARTMENT OF WATER RESOURCES

The Department of Water Resources is issuing the following guidelines prepared in connection with the Settlement Agreement, dated May 5, 2003, reached in *Planning and Conservation League et al. v. Department of Water Resources, 83 Cal. App. 4th 892 (2000).* These guidelines are effective upon the superior court's approval of the Settlement Agreement on May 20, 2003.

1. Purpose: The purpose of these guidelines is to describe the process for DWR's review of proposed permanent transfers of State Water Project Annual Table A Amounts and, by so doing, provide disclosure to SWP contractors and to the public of DWR's process and policy for approving permanent transfer of SWP Annual Table A Amounts. Such disclosure should assist contractors in developing their transfer proposals and obtaining DWR review expeditiously, and assist the public in participating in that review.

2. Coverage: These guidelines will apply to DWR's approval of proposed permanent transfers of water among existing SWP contractors and, if and when appropriate, to proposed permanent transfers of water from an existing SWP contractor to a new SWP contractor.

3. Interpretation: These guidelines are in furtherance of the State policy in favor of voluntary water transfers and shall be interpreted consistent with the law, including but not limited to Water Code Section 109, the Burns-Porter Act, the Central Valley Project Act, the California Environmental Quality Act, area of origin laws, the public trust doctrine, and with existing contracts and bond covenants. These guidelines are not intended to change or augment existing law.

4. Revisions: Revisions may be made to these guidelines as necessary to meet changed circumstances, changes in the law or long-term water supply contracts, or to address conditions unanticipated when the guidelines are adopted. Revisions shall be in accordance with the Settlement Agreement.

5. Distribution: The transfer guidelines shall be published by DWR in the next available edition of Bulletin 132, and also as part of the biennial disclosure of SWP reliability as described in the Settlement Agreement.

6. Contract Amendment: Permanent transfers of SWP water are accomplished by amendment of each participating contractor's long-term water supply contract. The amendment consists of amending the Table A upwards for a buying contractor and downwards for a selling contractor. The amendment shall be in conformity with all provisions of the long-term water supply contracts, applicable laws, and bond covenants. Other issues to be addressed in the contract amendment will be subject to negotiation among DWR and the two participating contractors. The negotiations will be conducted in public, pursuant to the Settlement Agreement and Notice to State Water Project Contractors Number 03-10.

7. Financial Issues: The purchasing contractor must demonstrate to DWR's satisfaction that it has the financial ability to assume payments associated with the transferred water. If the purchasing entity was not a SWP contractor as of 2001, special financial requirements pertain as described below, as well as additional qualifications.

8. Compliance with CEQA: Consistent with CEQA, the State's policy to preserve and enhance environmental quality will guide DWR's consideration of transfer proposals (Public Resources Code Section 21000). Identification of the appropriate lead agency will be based on CEQA, the CEQA Guidelines, and applicable case law, including *PCL v. DWR.* CEQA requires the lead agency at a minimum to address the feasible alternatives to the proposed transfer and its potentially significant environmental impacts (1) in the selling contractor's service area; (2) in the buying contractor's service area; (3) on SWP facilities and operations; and (4) on the Delta and areas of origin and other regions as appropriate. Impacts that may occur outside of the transferring SWP contractors' service areas and on fish and wildlife shall be included in the environmental analysis. DWR will not approve a transfer proposal until CEQA compliance is completed. The lead agency shall consult with responsible and trustee agencies and affected cities and counties and, when DWR is not the lead agency, shall provide an administrative draft of the draft EIR or Initial Study/Negative Declaration to DWR prior to the public review period. A descriptive narrative must accompany a checklist, if a checklist is used. The lead agency shall conduct a public hearing on the EIR during the public comment period and notify DWR's State Water Project Analysis Office of the time and place of such hearing in addition to other notice required by law.

9. Place of Use: The purchasing contractor must identify the place and purpose of use of the purchased water, including the reasonable and beneficial use of the water.

Typically, this information would be included in the environmental documentation. If a specific transfer proposal does not fit precisely into any of the alternatives listed below, DWR will use the principles described in these Guidelines to define the process to be followed. The information to be provided under this paragraph is in addition to the CEQA information described in Paragraph 8 of these guidelines.

a. If the place of use is within the contractor's service area, the contractor should disclose the purpose of the transferred water, such as whether the water is being acquired for a specific development project, to enhance overall water supply reliability in the contractor's service area, or some other purpose. If the transferred water is for a municipal purpose, the contractor should state whether the transfer is consistent with its own Urban Water Management Plan or that of its member unit(s) receiving the water.

b. If the place of use is outside the contractor's service area, but within the SWP authorized place of use, and service is to be provided by an existing SWP contractor, then, in addition to Paragraph 9(a) above, the contractor should provide DWR with copies of LAFCO approval and consent of the water agency with authority to serve that area, if any. In some instances, DWR's separate consent is required for annexations in addition to the approval for the transfer.

c. If the place of use is outside the SWP authorized place of use and service is to be provided by an existing SWP contractor, the contractor should provide information in Paragraph 9(a) and 9(b). Prior to approving the transfer, DWR will consider project delivery capability, demands for water supply from the SWP, and the impact, if any, of the proposed transfer on such demand. If DWR approves the transfer, DWR will petition State Water Resources Control Board for approval of expansion of authorized place of use. Water will not be delivered until the place of use has been approved by the SWRCB and will be delivered in compliance with any terms imposed by the SWRCB.

d. If the place of use is outside the SWP authorized place of use and service is not to be provided by an existing SWP contractor, DWR will consider the transfer proposal as a proposal to become a new SWP contractor. Prior to adding a new SWP contractor, DWR will consider project delivery capability, demands for water supply from the SWP, and the impact, if any, of the proposed transfer on such demand. DWR will consult with existing SWP contractors regarding their water supply needs and the proposed transfer. In addition to the information in Paragraph 9(a), 9(b), and 9(c), the new contractor should provide information similar to that provided by the original SWP contractors in the 1960's Bulletin 119 feasibility report addressing hydrology, demand for water supply, population growth, financial feasibility, etc.

DWR will evaluate these issues independently and ordinarily will act as lead agency for CEQA purposes. In addition, issues such as area of origin claims, priorities, environmental impacts and use of water will be addressed. The selling contractor may not be released from financial obligations. The contract will be subject to a CCP 860 validation action initiated by the new contractor. If DWR approves the transfer, DWR will petition the SWRCB for approval of expansion of authorized place of use. Water will not be delivered until the place of use has been approved by the SWRCB and will be delivered in compliance with any terms imposed by the SWRCB.

10. DWR Discretion: Consistent with the long-term water supply contract provisions, CEQA, and other provisions of law, DWR has discretion to approve or deny transfers. DWR's exercise of discretion will incorporate the following principles:

    a. As required by CEQA, DWR as an agency with statewide authority will implement feasible mitigation measures for any significant environmental impacts resulting from a transfer if such impacts and their mitigation are not addressed by other public agencies and are within DWR's jurisdiction.

    b. DWR will invoke "overriding considerations" in approving a transfer only as authorized by law, including but not limited to CEQA, and, to the extent applicable, the public trust doctrine and area of origin laws.

If you have any questions or need further information, please contact Dan Flory, Chief of DWR's State Water Project Analysis Office, at (916) 653-4313 or Nancy Quan of his staff at (916) 653-0190.

Appendix C2
Policy 03-10: Guidelines for Review of Proposed Permanent Transfers of State Water Project Annual Table A Amounts

STATE OF CALIFORNIA • RESOURCES AGENCY • DEPARTMENT OF WATER RESOURCES

NOTICE TO
STATE WATER PROJECT CONTRACTORS

NUMBER: 03-10

DATE: 7/3/03

SUBJECT: Principles Regarding Public Participation Process in State Water Project Contract Negotiations

FROM: Michael J. Spear
INTERIM DIRECTOR, DEPARTMENT OF WATER RESOURCES

The Department of Water Resources is issuing the following guidelines prepared in connection with the Settlement Agreement, dated May 5, 2003, reached in *Planning and Conservation League et al. v. Department of Water Resources, 83 Cal. App. 4th 892 (2000).* These guidelines are effective upon the superior court's approval of the Settlement Agreement on May 20, 2003.

1. Policy: Given the importance of the State Water Project to the State of California, and the key role that the long-term water supply contracts play in the administration of the SWP, DWR agrees that public review of significant changes to these contracts is beneficial and in the public interest.

2. Types of Activities to be Covered: Project-wide contract amendments (i.e., contracts with substantially similar terms intended to be offered to all long-term SWP Contractors) and contract amendments to transfer Table A amounts between existing SWP contractors will not be offered to the contractors for execution unless DWR has first complied with the public participation process as described in Paragraphs (3), (4), (5), and (6).

3. The Public Participation Process:

   1) Negotiations will be conducted in public.

   2) The public will be provided with advance notice of the time and place of the negotiations.

   3) The public will be provided the opportunity to observe negotiations and comment in each negotiating session.

4. Timing of Public Participation: Public participation ordinarily will precede the formulation of the project description in the California Environmental Quality Act process in order to assure that the public participation is meaningful. When DWR is a responsible agency, (e.g., when existing SWP contractors agree to transfer Table A amounts between themselves), the public participation will be scheduled to facilitate coordination with the lead agency's CEQA process.

5. Activities That Will Not Be Subject to Public Participation: Informal discussions prior to exchange of formal drafts and discussion of topics that are authorized to be kept confidential by law will not be subject to the public participation process.

6. Contract Amendments Resulting From Litigation: If litigation has been formally initiated, and settlement negotiations result in a proposal to adopt project-wide amendments to settle the litigation, all proposed contract amendments shall be subject to the public participation process before they are approved by DWR.

Notices of public negotiations will be put on the DWR website.

If you have any questions or need further information, please contact Dan Flory, Chief of DWR's State Water Project Analysis Office, at (916) 653-4313, or Nancy Quan of his staff at (916) 653-0190.

Appendix D

Excerpt from Draft Ecosystem Restoration Program's Conservation Strategy for Stage 2 Implementation for the Sacramento-San Joaquin Delta Ecological Management Zone (DFG et al. 2010): "Section II. Habitats" including Figures 4 and 5

II. Habitats

Consistent with existing CALFED and Delta Vision policy, the Delta EMZ element of the overall ERP Conservation Strategy intends to implement ecosystem restoration using land acquisitions (both fee and easement title) and cooperative agreements with willing sellers only. This policy is also consistent with the restoration planning process underway for the Suisun Marsh.

> **ERPP Strategic Objective for Habitat Restoration** is to restore large expanses of all major habitat types, and sufficient connectivity among habitats, in the Delta, Suisun Bay, Suisun Marsh, and San Francisco Bay to support recovery and restoration of native species and biotic communities and rehabilitation of ecological processes.
>
> *ERPP, volume 1, July 2000*

The ERP Strategic Plan states that "…the ERP will restore wetland habitats throughout the Bay-Delta ecosystem as part of an ecosystem-based management approach." The ERPP identified a number of habitat types that would be pursued in the Delta EMZ. These habitat types are currently being reviewed and evaluated as a part of a comprehensive effort to analyze various habitat conservation plans in terms of the natural communities they seek to conserve. It is envisioned that once this exercise is completed, scientists and managers will have a better understanding of these natural communities, and will also be better able to monitor status and trends in these natural communities at a regional scale.

There were two strategies in the *Delta Vision Strategic Plan* that incorporated some ideas regarding the creation and restoration of habitat: Strategy 3.1, "Restore large areas of interconnected habitats—on the order of 100,000 acres—within the Delta and its watershed by 2100"; and Strategy 3.2, "Establish migratory corridors for fish, birds, and other animals along selected Delta river channels". These two strategies list actions regarding inundation of floodplain areas, restoration of tidal and riparian habitat, and protection of grasslands and farmlands.

Development of the Conservation Strategy Map.
This element in the Conservation Strategy identifies restoration opportunities within the Delta EMZ, primarily based on land elevations with consideration of current urban land use constraints (Figure 4). Existing non-urban land uses, infrastructure, and other constraints at these locations were not considered for this map. These features will be addressed in future analyses of site-specific proposals. Figure 4 presents a preliminary view of how the Delta could be configured to restore habitat areas to the maximum extent within the Delta EMZ. For this element of the Conservation Strategy, several broad habitat types were identified for restoration, and in the interest of readability, these habitat types are classified according to three ranges of land elevation in which they would primarily occur: upland areas; intertidal areas; or subsided lands/deep open water areas. After incorporating an elevation map of the Delta (DWR 2007), rough contour lines were drawn to identify potential restoration opportunity areas. Appendix D provides a crosswalk between habitat categories in this Conservation Strategy for the Delta EMZ and those in the ERP Plan.

Aquatic Habitat. In accordance with the recommendations in the Delta Vision Strategic Plan and in light of expected sea level rise, the areas of the Delta EMZ that are of highest priority for restoration include lands that are in the existing intertidal range, floodplain areas that can be seasonally inundated, and transitional and upland habitats. Assuming a rise in sea level of ~55" over the next 50-100 years (Cayan et al. 2009), these areas would become shallow subtidal, seasonally inundated floodplain, and intertidal and upland habitats in the future, respectively. In the near term, managers are also interested in conducting experiments on the creation of deep open water areas such as Franks Tract, which is very important for some of the Delta's native pelagic fish species, to test whether these areas can be managed to optimize the quality of habitat in open waters for native fish species.

Agricultural Lands. It is important to note that despite the significant areas of the Delta currently in agricultural production that are suitable for creation of habitat areas, most areas of the Delta are expected to remain in active agricultural production well into the future. Expected reductions in the availability of freshwater for all beneficial uses due to changing precipitation patterns and extended droughts means that sea level rise will increase salinity into some areas of the Delta, particularly the western and central Delta, even absent any natural perturbations such as an earthquake. There simply will not be enough freshwater in the future to continue maintaining all parts of the Delta as a freshwater pool year-round. It is therefore probable that Delta agriculture will adapt naturally over time to these expected changes in the Delta, through a combination of planting more drought- and salt-tolerant crops as agricultural biotechnology becomes more widely available; growing crops that can be used to produce ethanol or other biofuels; seeking more opportunities for cultural/economic diversification (e.g. ecotourism); and managing wetlands and associated plants for wildlife benefits and/or toward development of a carbon emissions offset trading market. Some U.S. Department of Agriculture programs already exist that provide financial incentives for landowners to manage natural areas on their properties (including but not limited to the Wildlife Habitat Incentives Program, the Environmental Quality Incentives Program, and the Conservation Reserve Program), and while largely successful in other states, funding for implementation of these programs in California must be augmented to make participation more attractive to landowners who face higher capital and production costs.

To accommodate future shifts in habitats and species' distribution, ERP will continue to fund projects on agricultural lands which benefit wildlife and ensure that agricultural properties are not developed or converted to land uses that will not be as well-suited for adaptation to the Delta's future conditions.

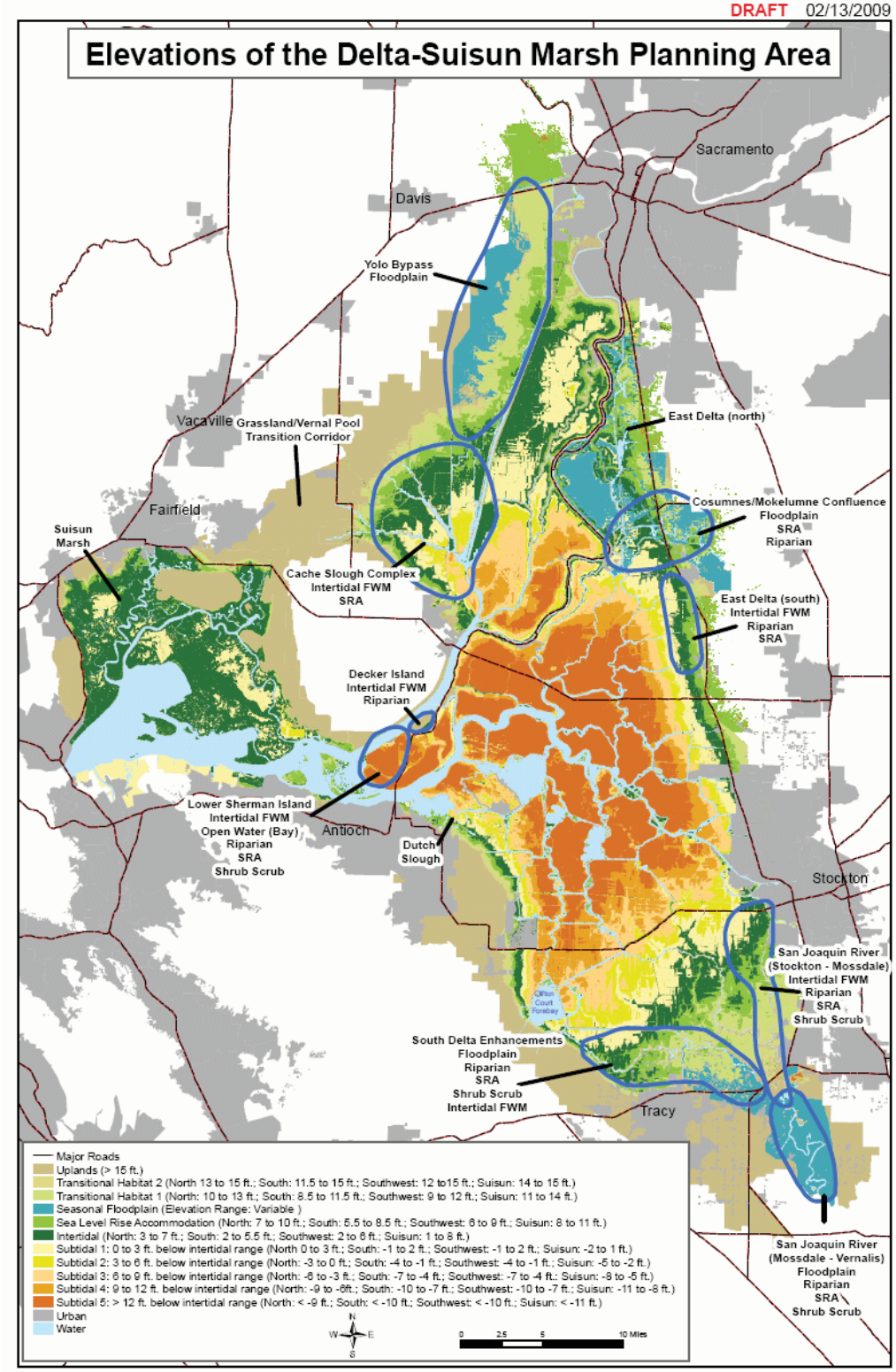

Figure 4: Land elevations in the Delta EMZ will largely determine what habitat types can be accommodated.

II.A. Upland Areas

With increasing sea level, global warming, and regional climate change, Delta habitats and species are going to require connectivity to higher elevation areas. Changes in regional climate are expected to result in precipitation patterns of more rain and less snow, shifting tributary peak runoff from spring to winter, making extreme winter runoff events more frequent and intense, and bringing about longer dry periods in summer. In light of these expected changes, and ongoing conversion of open space lands to urban uses, some of these higher elevation areas will be expected to accommodate additional flood flows in new or expanded floodplain areas.

Upland areas in the Delta EMZ are best characterized as lands well above current sea level (greater than ~5 feet in elevation, depending on location). Aquatic habitats in this category include seasonally-inundated floodplain, seasonal wetlands (including vernal pools), and ponds, while terrestrial habitats in this category include riparian areas, perennial grasslands, and inland dune scrub, as well as agricultural lands. Creating a mosaic of different upland habitat types, increasing their geographic distribution, and enhancing the connectivity between them is important for maintaining genetic diversity of the numerous species which use these areas for all or part of their life cycle. The aquatic and terrestrial habitat types that comprise upland areas often co-occur (e.g. agricultural lands that are seasonally inundated to benefit waterfowl, and perennial grasslands that support vernal pools). Thus, this habitat category highlights the importance of preserving and enhancing a diversity of habitats in support of numerous species and ecological processes, as well as allowing the system to respond to drivers of change such as sea level rise.

The rationales for protection and enhancement of seasonal wetlands, vernal pools, riparian areas, perennial grasslands, and inland dune scrub are contained in the ERPP, and the reader is encouraged to refer to these volumes for more information. For the purposes of this Conservation Strategy, the discussion on restoring upland habitats will be focused on seasonally-inundated floodplains, a proposed corridor of upland transitional habitat linking the Cache Slough area to Suisun Marsh, and protection of agricultural and open space lands for wildlife-compatible uses.

Potential Stage 2 Actions for Upland Areas:

Action 1: Acquire land and easement interests from willing sellers in the East and South Delta that will accommodate seasonal floodplain areas, and shifts in tidal and shallow subtidal habitats due to future sea level rise.

Action 2: Conduct research to determine scale and balance of flow, sediment, and organic material inputs needed to restore riverine ecosystem function.

Action 3: Develop a better understanding of species-habitat interactions, species-species interactions, and species' responses to variable ecosystem conditions in order to better determine natural versus human-induced responses of upland habitat restoration.

Action 4: Determine contaminant and runoff impacts of agriculture and urban areas, and anticipate effects on the ecosystem from future expansion of these land uses.

Action 5: Pursue large-scale riparian vegetation along waterways wherever feasible, including opportunities for setback levees.

Much has been learned about creating habitats in upland areas since 2000,

particularly with respect to seasonally-inundated floodplains and their importance to many of the Delta's aquatic species. As knowledge has increased, the risk and uncertainty associated with restoring this habitat is decreasing. Thus, restoration of seasonally-inundated floodplains is a very high priority for the Delta EMZ in the near term.

Floodplain. A natural floodplain is an important component of rivers and estuaries that allows many essential ecological functions to occur. Healthy floodplains are morphologically complex, including backwaters, wetlands, sloughs, and distributaries that carry and store floodwater. Floodplain areas can constitute islands of biodiversity within semi-arid landscapes, especially during dry seasons and extended droughts. The term *floodplain* as used here means the generally flat area adjoining rivers and sloughs that is flooded by peak flows every 1.5-2 years and exceed the capacity of the channel ("bankfull discharge"). Peak flows in winter and spring that happen every 1.5-2 years are considered by river geomorphologists to be the "dominant discharge" that contributes the most to defining the shape and size of the channel and the distribution of sediment, bar, and bed materials. Larger flood events can cause major changes to occur, but they do not happen often enough to be the decisive factor in river geomorphology.

Floodplain areas have the potential to support highly productive habitats, as they represent a heterogeneous mosaic of habitats including riparian, freshwater tidal marsh, seasonal wetlands, perennial aquatic, and perennial grassland habitats, in addition to agricultural lands. Floodplains are used by numerous native fish for spawning and growth during their life cycles (Moyle 2002). There has been extensive research on the Yolo Bypass and lower Cosumnes River (in addition to some research in the Sutter Bypass) indicating that native resident and migratory fish show a positive physiological response (i.e. enhanced growth and fitness) when they have access to floodplain habitats (Ribeiro et al. 2004, Moyle et al. 2007), which likely benefits them as they complete subsequent stages of their respective life cycles. Inundated floodplain areas provide important spawning and rearing habitat for splittail and rearing habitat for Chinook salmon (Sommer et al. 2001, Sommer et al. 2002, Moyle et al. 2007). Splittail must spawn in floodplains (Moyle et al. 2004); without access to adequate floodplain spawning habitat, splittail reproduction declines drastically as seen during the 1990s.

Managing the frequency and duration of floodplain inundation during the winter and spring, followed by complete drainage by the end of the flooding season, could favor native fish over non-natives (Moyle et al. 2007, Grimaldo et al. 2004) and reduce nuisance insect problems. Duration and timing of inundation are important factors that influence ecological benefits of floodplains. PWA and Opperman (2006) have defined a Floodplain Activation Flow for floodplains on the Sacramento River: desired ecological outcomes likely would arise from an inundation regime that:

- Occurs between March 15 and May 15
- Accommodates active flooding for a minimum of seven days (although floodplain inundation would likely persist considerably longer); and
- Occurs two out of every three years

Floodplain Activation Flows are very important, as are periodic large volume flows. Large-scale events are more effective at reworking the floodplain landscape in a natural way. Studies on the Cosumnes and Sacramento Rivers indicate that dynamic processes are needed to support complex dynamic riparian habitats and upland systems which form the floodplain habitat (Moyle et al. 2007). Native plants and animals adapted to random events that are characteristic of California's hydrology; these random events help to control non-native plants and animals.

In the Sacramento Valley, the Yolo Bypass has the greatest promise for large-scale (8,500+ acres) restoration of floodplain areas and processes at modest flow rates (2,000 cfs) (PWA and Opperman 2006). The Floodplain Activation Flows timing and rate of inundation are minimum values for ecological benefits; as the flow rate increases the ecological benefit increases as well. PWA and Opperman (2006) outlined a methodology to use with other floodplains that can be applied to the San Joaquin River and the lower Mokelumne River.

Research on the Cosumnes River also shows the many ecosystem benefits that floodplains provide. The Cosumnes River is the only remaining unregulated mainstem river on the western slope of the Sierra Nevada. The Cosumnes River Preserve comprises 46,000 acres and includes all associated Central Valley. The free-flowing nature of the river allows frequent and regular winter and spring overbank flooding that fosters the growth of native vegetation and the wildlife dependent on those habitats. In addition to the value of floodplain habitat to the Delta's native species, floodplains are believed to enhance the estuarine food web, as they support high levels of primary and secondary productivity by increasing residence time and nutrient inputs into the Delta (Sommer et al. 2004). Ahearn et al. (2006) found that floodplains that are wetted and dried in pulses can act as a productivity pump for the lower estuary. With this type of management, the floodplain exports large amounts of Chlorophyll *a* to

Potential Stage 2 Actions for Floodplains:

Action 1: Continue Aquatic Restoration Planning and Implementation (ARPI) activities such as habitat enhancement and fish passage improvements in the Yolo Bypass. Continue coordination with Yolo Basin Foundation and other local groups to identify, study, and implement projects on public or private land with willing participants, to create regionally significant improvements in habitat and fish passage.

Action 2: Continue working with the participants in the Yolo Bypass Strategic Plan process to ensure the project scope builds upon investments in the Lower Bypass.

Action 3: Continue implementing projects at the Cosumnes River Preserve, such as restoring active and regular flooding regimes and flood riparian forest habitat; measuring flora and fauna response to restoration; and monitoring surface and groundwater hydrology and geomorphic changes in restored areas.

Action 4: Pursue opportunities for land and easement acquisitions in the Yolo Bypass and along the lower Cosumnes and San Joaquin Rivers, which could be utilized as floodplain inundation areas in the near term or in the future.

the river. Native fish have shown many benefits from floodplain habitat on the Cosumnes Preserve (Moyle et al. 2007, Swenson et al. 2003, Ribeiro et al. 2004, Grosholz and Gallo 2006).

Because floodplain areas are inundated only seasonally, many other habitat types that occur in upland areas can be accommodated on floodplains when high winter and early spring flows are not present. The Department of Water Resources' Flood Protection Corridor Program provides grant funding to local agencies and nonprofit organizations for nonstructural flood management projects that include wildlife habitat enhancement and/or agricultural land preservation, and acquisition of flood easements. Such easements provide a way to bring floodplain benefits to species seasonally, while also accommodating agricultural production in summer, fall, and early winter. Delta crops such as rice, grains, corn, and alfalfa provide food for waterfowl and other terrestrial species, and serve as surrogate habitat in the absence of historical habitat such as tidal marsh. From Highway 99 west to the Cosumnes River Preserve is a good example of an area that provides wildlife-friendly agriculture mix. It is the largest conservation easement acquisition funded by ERP during Stage 1. The ERP also provided funding for planning or for property acquisitions and restoration of wildlife friendly agriculture in the Yolo Bypass, along the Cosumnes River, and along the San Joaquin River near Mossdale Crossing.

Although the benefits of floodplains have been demonstrated, there are a few cautions that must be realized considering seasonal floodplain areas for restoration:

- Restoration must incorporate as much natural connection with the river as possible, to reduce potential stranding of native fish. Large-scale flooding events also help reduce stranding by creating channels on the landscape which allow for natural drainage, and multiple pulse flows help ensure fish receive the migratory cues they need.
- The periodic wetting and drying of floodplain areas make these areas especially prone to methylmercury production and transport. Within the context of the Delta Total Maximum Daily Load (TMDL) for methylmercury that is currently under development, floodplain restoration activities should include the investigation and implementation of Best Management Practices (BMPs) to control methylmercury production and/or transport.

Upland Transitional Corridor. There is interest in establishing a corridor of upland habitats between the Delta's Cache Slough area and the Suisun Marsh, both to protect valuable habitats that occur there and to facilitate the movement of wildlife between the two areas. This proposed corridor currently contains a mosaic of perennial grasslands and vernal pool areas, and has been identified by local planners as having great potential for ecological benefits from restoration. It is possible that channels may also be constructed in this corridor, to provide a migratory route for endemic species that use the Delta and Suisun Bay (e.g. delta and longfin smelt and anadromous fish species).

II.B. Intertidal Areas

Tidal marshes play a critical role for native fish including salmonids by providing forage and refuge from predators (Boesch and Turner 1984, Baltz et al. 1993, Kneib 1997, Kruczynski and Ruth 1997) resulting in higher growth rates.

Intertidal areas in the Delta EMZ are best characterized as lands between one and seven feet above sea level, depending on location (Figure 4). All lands in the intertidal range are assumed to have the ability to support some tidal marsh habitats (either brackish or freshwater) with associated sloughs, channels, and mudflats. Some areas are capable of supporting large areas of contiguous habitat, and others may support only small patches (e.g. mid-channel islands and shoals). Properly functioning tidal marsh habitats have subtidal open water channels with systems of dendritic (branchlike), progressively lower-order intertidal channels that dissect the marsh plain. These diverse habitats provide structure and processes that benefit both aquatic and terrestrial species.

The rationales for protection and enhancement of fresh and brackish tidal marsh areas are contained in the ERPP, and the reader is encouraged to refer to these volumes for more information. For the purposes of this Conservation Strategy, the discussion on restoring habitats in intertidal areas will be focused on what has been learned about the importance of these areas since 2000, particularly as it relates to various species' use of tidal marsh areas and the role of these areas in enhancing the aquatic food web.

Studies of species' use of tidal marsh habitat in the Delta are limited, but ERP and other programs have conducted several studies since the ROD that continue to augment the knowledge regarding the role of intertidal habitats for desirable aquatic species. The largest effort to study tidal marsh habitat in the Delta and its benefits to native fish was a series of projects known as the BREACH studies (http://depts.washington.edu/calfed/breachii.htm), which investigated geomorphology, sedimentation, and vegetation at four reference and six restored tidal marsh sites in the Delta. Of the one reference and three restored sites sampled for fish and invertebrates, relative density of both native and introduced fish species was higher at the reference marsh (Simenstad et al. 2000). Although all of the sites were dominated by non-native fish, the abundance of native fish was highest in winter and spring (Grimaldo et al. 2004). In stomach content analyses, all life stages of chironomids (midges) were shown to be a very important food source for fish, both adjacent to tidal marsh habitats and in open water areas. Chironomids' association with marsh vegetation indicates the importance of this habitat to the aquatic food web. Overall abundance of fish larvae was highest in marsh edge habitat when compared to shallow open water and river channels (Grimaldo et al. 2004). Unfortunately the BREACH study sites are not representative of the Delta's large historic marshes. Most sites are small and severely degraded areas located along the edge of levees or on small channel islands.

An example of an ongoing study of species' use of tidal marsh within intertidal land elevations is the ongoing monitoring associated with restoration of Liberty Island, a 5,209-acre island in the northern Delta that breached naturally nearly ten years ago. The

Liberty Island project provides a good example of passive restoration to various habitat types, including some deeper, open water, subtidal, areas at the southern end and freshwater emergent tidal marsh, and sloughs with riparian habitat at the higher elevations at the northern end. Liberty Island's sloughs are populated with otters, beavers, muskrats, and numerous species of ducks and geese. Native fish species using the area include Chinook salmon, Sacramento splittail, longfin and delta smelt, tule perch, Sacramento pike minnow, and starry flounder. In some areas, native species account for up to 21% of the fish collected, for reference, native species only account for ~2-10% elsewhere (Malamud-Roam et al. 2004). Ongoing monitoring at Liberty Island is showing that fish species assemblages at this restored area, which is approaching eight years', increasingly resembles assemblages at reference marsh sites. The ERP hopes to build upon the success of this restoration project by increasing the size of the project and developing a dendritic channel system on its interior (DFG 2008b).

A number of additional studies are demonstrating that regardless of species' actual use of tidal marsh areas, these habitats could be extremely important for their possible role in augmenting the Delta's aquatic food web, particularly in the saline portion of the estuary.

- Tagging and stomach content studies show that Chinook salmon fry may use intertidal habitat. According to Williams (2006), tagged hatchery fry remain in the Delta up to 64 days and tend to occupy shallow habitats, including tidal marsh. Stomach contents of salmon rearing in the Delta are dominated by chironomids and amphipods, suggesting that juvenile salmon are associated with marsh food production. Juvenile salmon in the Delta also undergo substantial growth (Kjelson et al. 1982, Williams 2006). These findings coincide with studies elsewhere in the Pacific Northwest (Healey 1982, Levy and Northcote 1982, Simenstad et al. 1982), which found that Chinook salmon fry usually occupy shallow, near-shore habitats including tidal marshes, creeks, and flats, where they feed and grow and adapt to salt water (Healey 1982; Levy and Northcote 1982; Simenstad et al. 1982), and that they often move into tidal wetlands on high tides and return to the same channels on several tidal cycles (Levy and Northcote 1982). Also, in estuaries throughout Washington, subyearlings and fry occur mainly in marshes when these habitats are available (Simenstad et al. 1982). In fact, Healey (1982) identified freshwater tidal marshes as the most important habitat to juvenile salmon in the Pacific Northwest. More recently, in the Columbia River estuary, emergent tidal marsh has been shown to support the greatest abundance of insects and highest stomach fullness scores for juvenile salmon (Lott 2004), with chironomids again being the dominant prey item.
- In a study of carbon types and bioavailability, tidal marsh sloughs in Suisun Bay had the highest levels of dissolved, particulate, and phytoplankton-derived carbon (Sobczak et al. 2002). Chlorophyll *a* concentration, used as a measure of standing crop of phytoplankton, was highest in tidal sloughs and supports the greatest zooplankton growth rate (Muller-Solger et al. 2002) when compared to other habitat types, such as floodplains and river channels. High levels of primary production (as measured by chlorophyll a) seen in several regions in the interior of Suisun Marsh is likely due to high residence time of water, nutrient availability, and absence of non-native clams (DFG 2008b).

- Modeling (Jassby et al. 1993 and Cloern 2007) and empirical studies (Lopez et al. 2006) show that productivity from high-producing areas, such as marsh sloughs, is exported to other habitats. Phytoplankton biomass location is only weakly correlated with phytoplankton growth rates across several aquatic habitats, therefore other processes, including mixing and transport, are important in determining phytoplankton distribution in the Delta. The data shows that Suisun Marsh plays a significant role in estuarine productivity by providing an abundant source of primary production and pelagic invertebrates, both of which are significantly depleted in bay and river channel areas (DFG 2008b).
- In a nutrient-rich estuary, tidal freshwater marsh has the ability to transform or retain up to 40% of ammonia entering the marsh during a single flood tide. Nitrification (the conversion of ammonia to nitrate) accounted for a large portion of the transformation (30%). Nitrification rate in the marsh system was measured at 4-9 times that which occurs in the adjacent water column (Gribsholt et al. 2005). The marsh sediment and biofilm (mudflats) are important sites at which this nitrification occurs. Tidal marsh may therefore have the ability to improve the base of the aquatic food web in the Delta by increasing primary production within the marsh itself, and by increasing the ratio of nitrate to ammonia in the estuary. In the absence of actions to reduce inputs of ammonia into the system, tidal marsh restoration is a promising method of mediating the effects of these inputs. Tidal marsh may increase the likelihood of phytoplankton blooms in the estuary through nitrification and retention of ammonia; as presented in the discussion of the aquatic food web, ammonia inhibits phytoplankton blooms in Suisun Bay and possibly other open-water habitats in the Delta, therefore lowering overall productivity (Wilkerson et al. 2006, Dugdale et al. 2007).

Potential Stage 2 Actions for Tidal Marsh (intertidal areas):

Action 1 : Continue habitat restoration, property acquisition, planning, and monitoring on specified sites:

- Hill Slough habitat restoration (Suisun Marsh)
- Mein's Landing restoration (Suisun Marsh)
- Blacklock restoration monitoring (Suisun Marsh)
- Cache Slough complex, including Prospect and Liberty islands, and Lindsey Slough.
- Yolo Bypass Wildlife Area (tidal and seasonal wetlands on 700 acres)

Action 2: Implement and monitor the Dutch Slough restoration project, which would restore up to 483 acres of emergent wetland (a portion of which would be tidal), and generate information on how to best restore tidal marsh habitat.

Action 3: Continue studies in the lower Yolo Bypass to greatly improve understanding of aquatic species' response to tidal wetland restoration. Evaluate physical and geomorphic processes and monitor connectivity and key ecological variables (comparing Yolo Bypass and Cosumnes River systems) to assess effects of seasonal and interannual hydrologic variability.

Action 4: Conduct studies to determine whether fish benefits from tidal marsh that have been demonstrated in the saline portion of the estuary are also true for the freshwater portion of the estuary.

Action 5: Conduct studies to determine whether inundation of marsh plains on the flood tide at night results in cooler water being returned to the channels on the ebb tide.

At the outset of ERP, restoration of intertidal and shallow subtidal areas (at that time, termed "shallow water habitat", defined as water less than two meters in depth at mean

lower low water) was a very high priority, and based on what has been learned since 2000, continues to be a very high priority for the Delta EMZ. However, the extensive spread of non-native submerged aquatic vegetation (SAV) in intertidal and shallow subtidal areas renders them less suitable for native fish (Nobriga and Feyrer 2007, Nobriga et al. 2005, Brown and Michniuk 2007). Brown and Michniuk (2007) reported a long-term decline in native fish abundance relative to nonnative fish. This decline in native fish abundance occurred coincident with the range expansion of non-native SAV (principally *Egeria densa*) and non-native black bass (centrarchids), both of which are discussed further in the Stressors section below. Predation by largemouth bass is one mechanism hypothesized to result in low native fish abundance where SAV cover is high (Brown 2003, Nobriga et al. 2005). Largemouth bass have a higher per-capita predatory influence than all other piscivores in SAV-dominated intertidal zones (Nobriga and Feyrer 2007). Restoration Delta intertidal habitats must, therefore, be designed and managed to discourage non-native SAV, or native fish may not benefit from them (Nobriga and Feyrer 2007, Grimaldo et al. 2004).

In summary, restoration of tidal marsh areas in the Delta remains a very high priority for the ERP; however, several cautions must be kept in mind. A major concern is that restored tidal marsh would be colonized by non-native species, which would in turn limit the benefits to native species. Other potential constraints facing the restoration of intertidal habitats include the methylation of mercury in sediments, and contamination from the placement of dredge spoils to achieve optimal land elevations for marsh creation. Therefore, restoration of tidal marsh within intertidal land elevations should be designed as large-scale experiments, and should be rigorously monitored to establish relationships between this habitat and species' population abundance. As this information continues to be collected and synthesized, the risk and uncertainty associated with restoring this habitat are expected to decrease.

II.C. Subsided Lands/Deep Open Water Areas

Subsided land areas in the Delta EMZ are best characterized as land well below current sea level (deeper than ~ -6 feet in elevation), and include both terrestrial areas (islands that have subsided over time) and deep open water areas (subsided islands that flooded in the past and were never reclaimed). Aquatic habitats in this category include seasonal wetlands and ponds that occur within subsided land areas, in addition to deep open water areas such as Franks Tract (also called pelagic habitat).

With increasing sea level, global warming, and regional climate change, the existing configuration of Delta levees and deeply subsided islands is not expected to remain intact over the long term. A forecast rise in sea level of approximately 55 inches over the next 50-100 years (Cayan et al. 2009) is expected to increase pressure on the Delta's levee system. Changes in regional climate and the shift of tributary peak runoff from spring to winter are expected to make extreme winter runoff events more frequent and intense, further compounding pressure on Delta levees seasonally. In light of these expected changes, in addition to human-induced impacts (e.g. increased runoff from continued conversion of open space lands to urban uses), there is a considerably higher likelihood

of Delta levee failure and subsequent island flooding in the future. ERP implementation must therefore adapt to these expected pressures, including planning for optimizing the value of newly-flooded deep islands for the aquatic species that may utilize them in the future.

Terrestrial areas in this category include mainly agricultural lands, some of which are not in active agricultural production. Central Valley Joint Venture (2006) recognizes that agricultural easements to maintain waterfowl food supplies and buffer existing wetlands from urban development may become increasingly important in basins where large increases in human populations are predicted. In addition, ongoing rice cultivation may help minimize subsidence. Subsidence reversal, carbon sequestration, and wildlife-friendly agricultural projects are appropriate on these deep islands in the near term, as they are expected to begin reversing land subsidence and to provide benefits to the local economy, wildlife, and waterfowl while protecting lands from uses that may be unsustainable over the longer term.

The rationales for protection and enhancement of seasonal wetlands and wildlife-friendly agriculture are contained in the ERPP, and the reader is encouraged to refer to these volumes for more information. For the purposes of this Conservation Strategy, the discussion on restoring habitats on subsided lands will be focused on subsidence reversal and carbon sequestration, and on restoring deep open water areas for the Delta's pelagic fish species.

Subsidence reversal. The exposure of the bare peat soils to air causes oxidation which results in subsidence, or a loss of soil on Delta islands. Flooding these lands and managing them as wetlands reduces their exposure to oxygen, so there is less decomposition of organic matter, which and stabilizes land elevations. Biomass accumulation sequesters carbon and helps stop and reverse subsidence (Fujii 2007). 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 (Mount and Twiss 2005), on individual islands is reduced. A reduction in accommodation space decreases the potential for drinking water quality impacts from salinity intrusion in the case of one or more levee breaks on deeply subsided Delta islands.

A pilot study on Twitchell Island funded by the ERP in the late 1990s investigated methods for minimizing or reversing subsidence which have shown great promise for the Delta's subsided lands. By flooding soils on subsided islands approximately one foot deep, peat soil decomposition is stopped, and conditions are ideal for emergent marsh vegetation to become established. In the Twitchell Island pilot project, researchers saw some initial soil accumulation during the late 1990s and early 2000s, and noted that accretion rates accelerated and land surface elevation began increasing much more rapidly after about seven years, as plant biomass was accumulated over time. Land surface elevation is estimated to be increasing at an annual rate of around 4 inches, and is expected to continue to increase (Fujii 2007).

The USGS is interested in implementing a subsidence reversal program Delta-wide, given the results of their Twitchell Island pilot study. Such a program would involve offering financial incentives to landowners to create and manage wetland areas on their lands (Fujii 2007). Large-scale, whole-island approaches to reversing subsidence would be beneficial for multiple purposes. Programs that offer incentives for 10- or 20-year studies for subsidence reversal on large tracts of land could help improve Delta levee stability and reduce the risk of catastrophic failure. Assuming that accretion rates continue at about 4 inches annually, estimates suggest a 50% reduction in accommodation space in 50 years if subsidence could be pursued throughout the Delta. This reduction in accommodation space jumps to 99% over the next 100 years) (Fujii 2007). Some deeply subsided lands could also be used as disposal sites for clean dredged sediments, providing local flood control improvements while helping raise land elevations on subsided islands more quickly. This accommodation space reduction, in addition to helping stabilize levees over the longer term, would allow future restoration of additional tidal marsh habitats.

Potential Stage 2 Actions for Subsided Lands/Deep Open Water Areas:

Action 1: Implement wildlife-friendly agriculture and wetland projects (e.g. in partnership with Farm Bill programs).

Action 2: Secure easements and land interests on which subsidence reversal projects can occur (e.g. in partnership with USGS).

Action 3: Conduct experiments on the creation and management of deep open water areas. Some potential locations include:

- Lower Sherman Island
- Little Egbert Tract

Action 4: Continue to monitor deep open water areas on Liberty Island for environmental conditions and species use

While the primary objectives of creating wetlands on deep Delta islands would be to reverse subsidence and sequester carbon, there would be significant ancillary benefits to wildlife such as waterfowl. Delta agricultural lands and managed wetland areas provide a vital component to Pacific Flyway habitat for migratory waterfowl by increasing the availability of natural forage, ensuring improved body condition and breeding success (CALFED 2000b).

Deep open water areas. All permanent aquatic habitats in the Delta are occupied by fish of some type. In planning for restoration of Delta aquatic habitats, it is important to consider which fish will occupy what habitat and when; and what type of benefits fish will gain from the habitat. Fish assemblages in the Delta, each with a distinct set of environmental requirements, include native pelagic species (e.g. delta and longfin smelt), freshwater planktivores, dominated by non-native species such as threadfin shad and inland silverside; anadromous species (e.g. salmon and steelhead), slough-residents associated with beds of SAV (e.g. black bass), and freshwater benthic species (e.g. prickly sculpin) (Moyle and Bennett 2008). Habitat diversity is necessary to support multiple fish assemblages in the delta. Restoration efforts need to focus on creating habitats required by desirable species assemblage, while avoiding habitats dominated by undesirable species.

With the increasing threats of levee failure from continuing land subsidence, exacerbated by sea level rise, higher seasonal runoff, and random events such as an earthquake, the Delta is likely to have more large areas of deep, open water in the future (Moyle and Bennett 2008). Important managed attributes include salinity, contaminant inputs, and connectivity to surrounding habitats, to increase habitat variability, and provide a greater diversity in water quality conditions (Moyle and Bennett 2008). Fish assemblages will respond differently to future environmental changes.

New open water habitats may also result from intentional activities on a smaller and more managed scale than whole-island flooding. The intentional removal of levees on islands at the periphery of the Delta in order to create marsh habitat on intertidal land elevations would result in open water below the tidal zone similar to what's developing at Liberty Island. Exchange of materials between the restored tidal marsh with adjacent open water could result in higher productivity in open water habitat. As mentioned in the discussion of tidal marsh restoration, the potential for SAV dominated by non-native species to establish in new shallow water environments is a concern. On Liberty Island, SAV has not become a dominant component of the open water habitat. This may be a result of tidal flow velocities, wind-induced disturbance, or some other factor. Continuing research and monitoring of the Liberty Island project will improve understanding of the dynamics of a large island breach at the periphery of the Delta, and help plan for future marsh or open water restoration projects.

There are many unknowns about future characteristics of flooded island, and open water habitat (Moyle and Bennett 2008). These include configuration and location of flooded islands; physical properties such as depth, turbidity, flow, and salinity; biological properties such as productivity of phytoplankton and copepods; and susceptibility to invasion by non-native species such as *Egeria densa*, centrarchids, and invasive non-native clams. Creation of pelagic habitat is therefore not guaranteed to have a population-level benefit to native fish (Moyle and Bennett 2008). Adaptive management, combined with large-scale experimentation on new open water habitat, would help to reduce uncertainties. This could occur through the planned flooding of at least one Delta island, or through an organized study plan that would go into effect in the event of an unplanned levee breach (Moyle and Bennett 2008).

II.D. Ecological Management Unit (EMU) Restoration Priorities

Based upon the ERPP descriptions of habitat types that fit into the upland, intertidal, and subsided/deep open water classifications, some near-term land acquisition and habitat enhancement priorities have been identified for the four Delta Ecological Management Units (EMUs) of the Delta EMZ (Figure 5). As agricultural lands comprise a significant amount of area within each EMU, it is intended that some conversion of land from agricultural uses will occur to accommodate specific habitat types. In some cases, this conversion would occur over the course of a few years. In others, acquired lands may not be converted to other uses unless or until a new water conveyance facility is constructed and operational. Therefore, it is expected that most agricultural lands will remain in productive agriculture for the foreseeable future, and any funding from the ERP for

wildlife-friendly agriculture projects, subsidence reversal projects, or long-term easements to protect lands from permanent crops (i.e. orchards and vineyards) and other development will be considered on a case-by-case basis. Therefore, discussion of agricultural lands is not included within the descriptions of EMU restoration priorities.

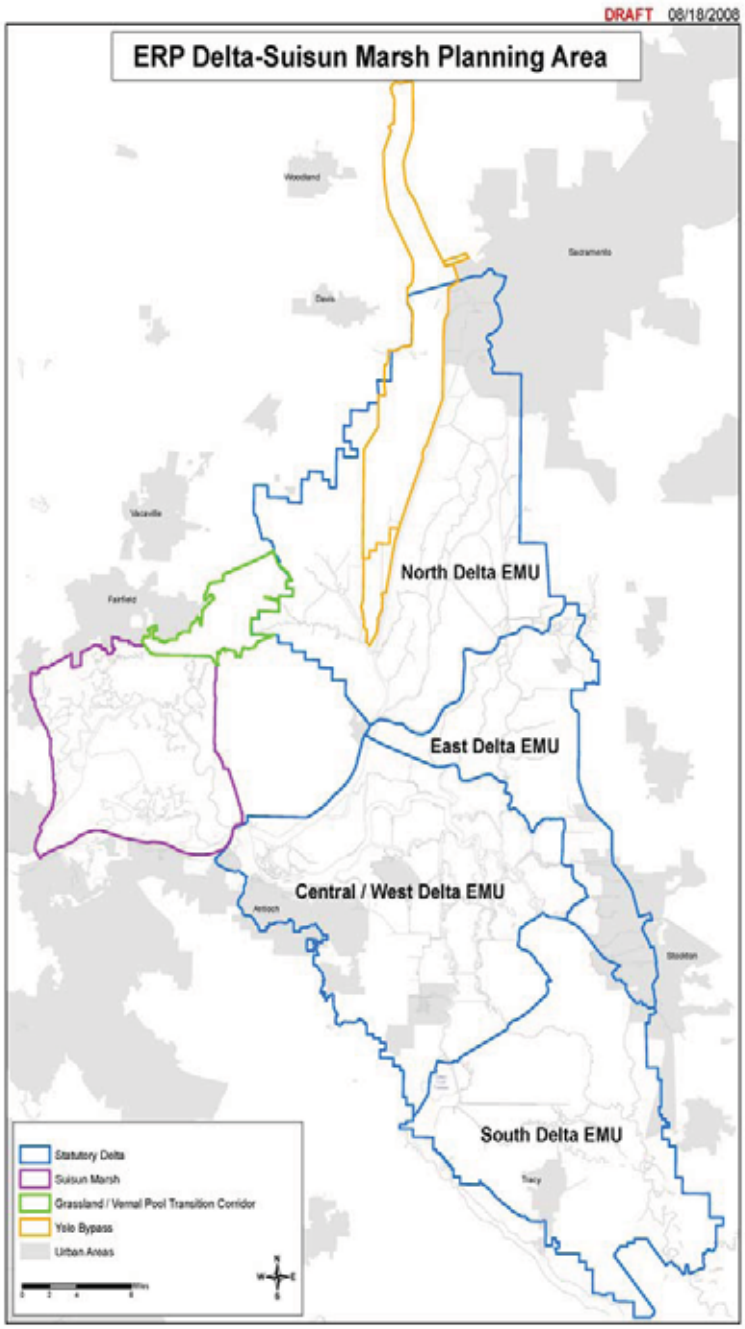

Figure 5: Map of EMUs within the Delta EMZ

North Delta EMU.

- *Cache Slough Complex.* Restore a mosaic of deep open water, shallow subtidal, tidal marsh, riparian, perennial grasslands, and vernal pool habitats. The Cache Slough Complex includes some properties that are currently in public ownership or are already protected for conservation purposes: Prospect Island, which could accommodate tidal marsh, and Liberty Island, which could accommodate deep open water, shallow subtidal, and tidal marsh areas. The Cache Slough Complex also includes Little Egbert Tract, which could accommodate some seasonal floodplain just south of Liberty Island; the elevation of Little Egbert Tract also makes it a good candidate for experimentation on the creation of shallow subtidal and deep open water areas, to help design future restoration projects geared toward benefiting delta smelt.
- *Yolo Bypass.* Restore a mosaic of seasonal floodplain, riparian, perennial grasslands, and vernal pool habitats. The Yolo Bypass area has been under investigation for several years for its potential to provide floodplain habitats benefiting Delta species, and it is a high priority of the ERP to provide these functions in this area in the near term. In addition, private entities are currently acquiring properties in the Yolo Bypass with the intent of restoring habitats and securing water supplies. Over the longer term, this area is expected to also include tidal marsh, as it accommodates sea level rise.

Central/West Delta EMU.

- *Deeply Subsided Islands.* Levees around at least one of these deep subsided islands could be breached or removed in order to create deep open water areas. Recognizing that the land area of the Central/West Delta EMU consists of primarily deeply subsided islands which could accommodate subsidence reversal experiments and wildlife-friendly agricultural practices, land elevations in this area also provide a major opportunity to increase delta smelt habitat area.
- *Dutch Slough.* Construct the Dutch Slough habitat restoration project. This project proposes to create tidal marsh and shallow subtidal areas on lands adjacent to the deep open water areas of Big Break, north of Oakley. Due to the expenditure of funds to acquire the properties, the ecological benefits the project is expected to yield, and the unique opportunity that the design of this project gives to experiment with restoration techniques, this is a high-priority project for implementation in the near term. Implementation of this project is expected to help answer a key question of whether an island will support sustainable native fish habitat (i.e. tidal marsh) if it's surrounded by non-native fish habitat (i.e. shallow subtidal areas at Big Break).
- *Upper Sherman Island.* Pursue opportunity to experiment with creation of deep open water areas. Sherman Island is currently owned by the State of California, and its land elevation, which is significantly below sea level, offers a unique opportunity to create deep open water areas that are expected to benefit the Delta's native pelagic fish species.

East Delta EMU.

- *Cosumnes-Mokelumne Confluence.* Create a mosaic of seasonal floodplain, riparian, shallow subtidal, and tidal marsh areas. The confluence of the Cosumnes and Mokelumne river systems has been an area of extensive property acquisitions (Cosumnes River Preserve), and continues to be an important area for restoring floodplains and seasonal wetlands. In the near term, ERP plans to restore acquired properties (e.g. McCormack-Williamson Tract). In addition, areas north and south of the Cosumnes-Mokelumne confluence are at land elevation, which would accommodate tidal marsh and shallow subtidal areas.
- Acquisition of lands at the eastern periphery of the Delta EMZ, could be restored to shallow subtidal and tidal marsh areas in the future as sea level rises, will also be pursued in the near term; however, restoration of these properties (many of which are currently in private ownership) may not become a high priority unless and until a new water supply conveyance facility is in place.

South Delta EMU.

- *Lower San Joaquin River.* Create a mosaic of seasonal floodplain, riparian, shallow subtidal, and tidal marsh areas. Acquisition of lands in the South Delta EMU that will accommodate shallow subtidal and tidal marsh areas in the future as sea level rises may be pursued in the near term; however, restoration of these properties (many of which are currently in private ownership) may not become a high priority unless and until a new water supply conveyance facility is in place.

Upland Transition Corridor.

- In addition to habitat restoration actions in the four Delta EMUs that comprise the Delta EMZ, there is significant interest in establishing a new connection between the Delta and the Suisun Marsh, by way of a new corridor connecting the Cache Slough Complex to northeastern Suisun Marsh. This proposed corridor currently contains a mosaic of perennial grasslands and vernal pool areas, and has been identified by local planners as having great potential for ecological benefits from restoration. ERP will therefore seek to protect existing habitat areas, and to secure land and easement interests from willing landowners to enhance these resources.

III. Stressors

Restoration of ecosystem processes to help improve the quality and extent of desirable habitats is only part of the solution to species recovery in the Delta. The ERP identified several stressors that negatively affect the Delta's ecosystem health as measured by native species, ecological processes, and habitats. The focus in this element of the Conservation Strategy for the Delta EMZ is on stressors including water diversions, barriers to connectivity of habitats (such as levees), non-native and invasive species, and water quality.

Appendix E
Excerpt from Draft Ecosystem Restoration Program's Conservation Strategy for Stage 2 Implementation for the Sacramento-San Joaquin Delta Ecological Management Zone (DFG et al. 2010): "Section III.B. Invasives"

Nobriga 2008). One criticism of using the E/I ratio to manage effects on Delta fish is that the actual volume of exports can increase substantially while maintaining the same overall E/I ratio. Better resolution of the relationship(s) between salvage and E/I ratio may be achieved if either the export or import term is held constant (NMFS 2009a). Due to their very large hydrodynamic footprint, reducing the negative effects of the SWP and CVP pumps cannot be accomplished through screening and will depend in part on the alternative conveyance chosen in the BDCP planning process.

On August 22 and September 11, 2007, the CALFED Science Program convened workshops to identify and discuss key scientific and technical issues pertaining to conveying Sacramento River water through or around the Delta to the SWP and SVP. Several important broad conclusions emerged:

- All conveyance options involve trade-offs and compromises
- Science can help select, but not choose, the "best" water conveyance alternative
- Clear objectives are critical to a thorough evaluation of conveyance alternatives
- A coastal ocean to watershed perspective is needed to effectively evaluate conveyance alternatives
- Through-Delta conveyance must be made to work effectively for decades into the future
- Adaptive management should be used in implementing any conveyance alternative
- Alternative financing must be found to fund the construction of an alternative conveyance system

III.B. Invasives

Mission of the CALFED Nonnative Invasive Species Program: Prevent establishment of additional non-native species and reduce the negative biological and economic impacts of established non-native species.

ERPP Strategic Plan, July 2000

Non-native invasive species (NIS) have produced immense ecological changes throughout the Bay-Delta ecosystem by altering food webs and habitats, competing with native species for resources, and directly predating upon native species. NIS represents one of the biggest impediments to restoring habitats and populations for native species (CALFED 2000a). NIS have been introduced into the Delta over time via several mechanisms, the most common being discharge of ships' ballast water in ports. Invasive species are also transported from one place to another on recreational boats, "planted" for recreational or other purposes (e.g. largemouth bass), or released from aquariums into the environment. In 2006, the Water Board listed the Delta, upper San Joaquin River, and Cosumnes River on its 303(d) list as impaired for exotic species and is expected to formulate a TMDL program for these waterways within the next ten years (SWRCB 2007).

The *Delta Vision Strategic Plan* that incorporated some ideas regarding the control of harmful invasive species: Strategy 3.3, "Promote viable, diverse populations of native and valued species by reducing risks of fish kills and harm from invasive species." This strategy includes actions to control harmful invasive species at existing locations and minimize or preclude new introductions and colonization of new restored areas.

Much has been learned about NIS since 2000 from activities that have occurred under ERP, as well as from other planning and monitoring efforts. ERP has funded many projects since 2000 to try to control and educate the public about the threat of invasive exotic species. Some projects included a study on the feasibility of ships exchanging their ballast water out in the ocean rather than discharging ballast water into destination ports. While other ERP projects provided outreach geared toward educating recreational boaters and anglers, and individuals involved in the aquarium trade, on the threats posed by exotic species.

As part of the CALFED NIS Program, a Strategic Plan and Implementation Plan were developed, and the Non-Native Invasive Species Advisory Council (NISAC) was established. The NISAC coordinates and implements activities and projects that address NIS issues in CALFED's area of concern, and is currently promoting an invasive species prevention approach known as Hazard Analysis and Critical Control Points (HACCP). HACCP is a planning tool that originated with the food industry, but has been modified to include natural

Potential Stage 2 Actions for Non-Native Invasive Species:

Action 1: Continue implementing the CALFED NIS Strategic Plan and DFG's California Aquatic Invasive Species Management Plan (CAISMP) to prevent new introductions; limit or eliminate NIS populations; and reduce economic, social and public health impacts of NIS infestation.

Action 2: Continue funding the Department of Boating and Waterways *Egeria densa* mapping program. Also, begin investigating whether non-chemical means of control are possible.

Action 3: Continue research and monitoring programs to increase understanding of the invasion process and the role of established NIS in the Delta's ecosystems including:

- Investigate invasions by *Egeria* or *Microcystis* to newly restored areas.
- Investigate recreating habitats that have a high variability in abiotic factors (e.g. salinity, flows, depth, etc.) as a means of limiting the overbite and Asian clams and *Egeria.*

Action 4: Continue studies on the effectiveness of local treatment of zebra and quagga mussels using soil bacterium.

Action 5: Standardize methodology for sampling programs to measure changes in NIS populations over a specific timeframe.

Action 6: Collect and analyze water quality sampling data (e.g. salinity and water temperature) for correlation analysis between NIS distribution and habitats.

Action 7: Complete an assessment of existing NIS introductions and identify those with the greatest potential for containment or eradication; this assessment also would be used to set priority control efforts.

Action 8: Establish a program to monitor for new invasions of non-native wildlife, and develop responses to quickly contain and control them.

Action 9: Continue investigating potential parasite(s) as a means to control invasive clam or mussel populations.

resource management. HACCP identifies and evaluates potential risks for introducing "non-targets", such as invasive species, chemicals, and disease, during routine activities, and focuses attention on critical control points where "non-targets" can be removed.

As a separate effort, DFG issued its California Aquatic Invasive Species Management Plan (CAISMP) in January 2008. CAISMP's focus is on coordinating the efforts of State agencies to minimize the harmful ecological, economic, and human health impacts from aquatic invasive species. CAISMP provides a common platform of background information from which State agencies and other entities can work together to address the problem of aquatic invasive species, and identifies major objectives and associated actions needed to minimize these impacts in California. Depending on the species and the level of invasion, there are different management responses that could be pursued. The CAISMP includes examples of management responses to specific invasive species in the Delta. Some of the NIS that are of highest management concern in the Delta include:

Centrarchids. The most common centrarchids in the Delta are largemouth bass, smallmouth bass, spotted bass, bluegill, warmouth, redear sunfish, green sunfish, white crappie, and black crappie. The increase in non-native SAV has provided conditions that likely assisted with increased populations of these fish (Brown and Michniuk 2007). Centrarchids, which benefit from the use of SAV, can have a large negative impact on native fish through predation and competition (Nobriga and Feyrer 2007, Brown and Michniuk 2007).

Thus, the presence and distribution of centrarchids may be manipulated by managing environmental conditions such as water velocity, salinity, turbidity, and the extent of SAV. Management actions and the resulting impacts to centrarchids are being evaluated using DRERIP conceptual models for potential site-specific restoration.

Overbite Clam. The overbite clam (*Corbula amurensis)*, was first observed in 1986 and has since become extremely abundant in Suisun Bay and the western Delta (Carlton et al. 1990). This species is well adapted to the saltwater areas of the estuary and is largely responsible for the reduction of phytoplankton and some zooplankton in the Bay-Delta region (Kimmerer 2006). This loss of primary and secondary production has drastically altered the food web and is a contributing cause of the POD (IEP 2007b). Overbite clam have been shown to strongly bioaccumulate selenium (Linville et al. 2002); this could have reproductive implications for fish (e.g. sturgeon, splittail) and diving ducks that feed on overbite clam.

Asian Clam. The Asian clam (*Corbicula fluminea)*, was also introduced from Asia. It was first described in the Delta in 1946 (USGS 2001). This clam does not tolerate saline water. It is now very abundant in freshwater portions of the Delta and in the main stem of rivers entering the Delta. Ecologically, this species can alter benthic substrates and compete with native freshwater mussels and clams for food and space (Claudi and Leach 2000); however, Asian clam has not historically been viewed as significantly impacting the aquatic food web.

Because overbite clam and Asian clam have become so well-established in the estuary, there is currently no known environmentally acceptable way to treat or remove these invertebrates (DFG 2008a). The only apparent management action at this time is to determine whether the manipulation of environmental variables, such as salinity, can be used to manage their distribution in the estuary during certain months of the year. There is not consensus among scientists that manipulation of salinity would do much to affect the distribution of these clams or diminish their impacts on the estuarine food web. Many experts believe that the distribution and impacts invasive clams cannot be controlled (CALFED Science Program 2008).

Zebra Mussel. The zebra mussel (*Dreissena polymorpha)* is not yet in the Delta, but it is highly invasive and could become established if introduced there. This species poses threats to the ecosystem similar to those posed by overbite clam and Asian clam. Zebra mussels typically colonize at densities greater than 30,000 individuals per square meter. One of the most predictable outcomes of a zebra mussel invasion and a significant abiotic effect is enhanced water clarity linked to a greatly diminished phytoplankton biomass. For example, rotifer abundance in western Lake Erie declined by 74% between 1988 and 1993, the same time that an enormous zebra mussel population became established in that area. [Claudi and Leach 2000]

Quagga Mussel. Threats from the quagga mussel (*Dreissena bugensis)* are thought to be similar to those of the zebra mussel (Claudi and Leach 2000). Quagga and zebra mussels have very similar life history strategies, with the exception that quagga can live at greater depths (Claudi and Leach 2000). An interagency state and federal coordination team was established to coordinate management responses to the threat of further quagga spread in California. Three subcommittees were established: Outreach and Education, Monitoring, and Sampling/Laboratory Protocols. The quagga mussel scientific advisory panel, convened in April 2007, was charged with considering the full range of eradication and control options without respect to cost. Under the direction of DFG, the San Francisco Estuary Institute is performing a phased risk assessment of California waters in order to rank sites for further monitoring based on the likelihood that quagga or zebra mussels will become established.

There are a couple of relatively recent developments with respect to controlling both zebra and quagga mussels. A common soil bacterium, *Pseudomonas fluorescens*, has proven to be very effective in controlling populations, with a 95% kill rate at treatment sites. The bacterium produces a toxin which destroys the invasive mussels' digestive gland, killing them. Research has indicated that the bacterium does not harm untargeted native fish and mussel species (Science Daily 2007). Also, research is showing that a potassium salt solution may be an effective measure to control relatively localized and isolated infestations. It is possible that these control methods could be used to control zebra and quagga mussel populations, but they should be tested in small, isolated experiments.

Zooplankton. An extensive set of monitoring data from the IEP continues to show how introduced zooplankton species have become important elements of the Bay-Delta.

Eurytemora affinis was probably introduced with striped bass around 1880. Until recently, it was a dominant calanoid copepod in the estuary. In the last decade, however, *Eurytemora* has been replaced by two calanoid copepods introduced from China. It has been postulated that this replacement was a result, in part, of *Eurytemora*'s greater vulnerability to overbite clam grazing (Bouley and Kimmerer 2006).

Populations of the native mysid shrimp *Neomysis mercedis*, another form of zooplankton, began dwindling in the late 1970s. Its population decline was affected by competition with the smaller *Acanthomysis aspera*, an introduced mysid shrimp with similar feeding habits. The decline of the native shrimp species has been identified by the POD work team as one possible cause for the food web decline in the Delta (2007b). Synthesis of IEP's extensive modeling data could help assess trends in rates of invasion and different invasive species' populations.

Plants. Non-native aquatic weeds in the Delta pose serious problems to native flora and fauna. Research, monitoring, mapping, and control are needed for *Egeria densa*, water pennywort, Eurasian watermilfoil, parrot feather, and water hyacinth. These weeds flourish in a wide geographic area, sometimes in high densities, and are extremely harmful because of their ability to displace native plant species, harbor non-native predatory species, reduce food web productivity, reduce turbidity, or interfere with water conveyance and flood control systems. Areas with large densities of SAV have been implicated in reduced native fish larvae and adults (Grimaldo et al. 2004, Nobriga et al. 2005, Brown and Michniuk 2007). Restoration of habitats in intertidal areas must be designed and managed to reduce non-native SAV if conservation goals are to be met (Nobriga and Feyrer 2007).

The California Department of Boating and Waterways (CDBW) is the lead agency for the survey and control of *Egeria densa* and water hyacinth in the Delta. CDBW's control programs use two tools to determine coverage and biomass of these aquatic weeds: hyperspectral analysis and hydroaccoustic measurements. This technology has aided in the assessment of *Egeria densa* coverage and biovolume, which in turn was instrumental in evaluating the effectiveness of mechanical and chemical treatment; a key asset of the technology is that it yields a very rapid, verifiable characterization of the entire water column beneath the transducer (Ruch and Kurt 2006). While this technology has been helpful in controlling localized patches of SAV, ongoing efforts of CDBW's control program may not be successful over time because other aquatic weeds (such as Eurasian watermilfoil or curlyleaf pondweed) may replace *Egeria densa*. Both of these plants have different growth properties that may require different control techniques than those employed in the current control program (CDBW 2006).

Other non-native plants that have been the focus of ERP NIS-related activities include the control of *Arundo donax*, tamarisk, and purple loosestrife in terrestrial areas. Grazing of perennial grasslands has helped control the spread of some invasive weeds in some areas (Stromberg et al. 2007).

As mentioned earlier, NIS have become particularly problematic in the Delta as its management has reduced the historic variability in which native species evolved, in the

interest of maintaining a common freshwater pool for water export and in-Delta agricultural use. It is hypothesized that periodic salinity intrusion into the Delta may help to reduce the abundance and/or distribution of certain harmful invasive species, and give native species a competitive advantage. The Pelagic Fish Action Plan (IEP 2007b) suggests the following actions to address invasive aquatic species in the estuary:

- Support California State Lands Commission's (CSLC) work to control ballast water, including DFG oversight of studies to determine the location and geographic range of NIS in the estuary and assessment of ballast water controls
- Assist CSLC, DFG, and others in the development of regulations or control measures for hull-fouling
- Support implementation of the CAISMP

III.C Water Quality Stressors

The Bay-Delta ecosystem receives a large variety of potentially toxic chemicals, including but not limited to pesticides from agricultural and urban runoff, contaminants discharged from wastewater treatment plants, mercury from gold mining and refining activities, selenium from agricultural practices, and other metals from different mining activities. Scientists must consider the synergistic effects of multiple contaminants when looking at environmental water quality. In addition, stressors such as high water temperatures and low dissolved oxygen levels threaten habitat suitability for a wide range of species.

There were two strategies in the *Delta Vision Strategic Plan* that incorporated ideas for improving environmental water quality in the Delta: Strategy 3.2, "Establish migratory corridors for fish, birds, and other animals along selected Delta river channels"; and Strategy 3.5, "Improve water quality to meet drinking water, agriculture, and ecosystem long-term goals." These strategies include actions to improve fish migration corridors, control contaminants from urban runoff, discharges from wastewater treatment plants and irrigated agriculture, and establishing or implementing TMDL programs for mercury, selenium, and low dissolved oxygen.

Water Temperature. Water temperature is a key factor in habitat suitability for aquatic organisms. Unnaturally high water temperature is a stressor for many aquatic organisms, particularly because warm water contains less dissolved oxygen. Lower water temperatures can also hinder growth and distribution of some non-native species, thus reducing their predation, and competition for food and habitat with native species. Major factors that increase water temperature and negatively impact the health of the Delta are disruption of historical streamflow patterns, loss of riparian vegetation, reduced flows releases from reservoirs, and discharges from agricultural drains.

It may be difficult to manage water temperatures in the Delta, because Delta water temperatures are driven mainly by ambient air temperature. With expected localized warming of air temperatures due to regional climate change, particularly in summer, the problem of maintaining sufficiently low water temperatures in the Delta to sustain native

Appendix F
Funding Sources

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Appendix D: Funding Sources

This section describes some potential funding sources that could be part of a financing strategy. In developing the financing strategy, the approaches used by other major programs around the country were explored. Some of the more innovative approaches are described here.

Capital Funding Sources

To implement the Delta Plan infrastructure improvements, and for financing habitat acquisitions and improvements, capital funding sources will need to be identified. Capital funding sources may include federal appropriations, State General Fund appropriations, State-issued debt, local debt, and private funding.

Federal Appropriations

Federal appropriations pay for the taxpayers' share of capital costs and require the approval of Congress. Federal authorization already exists for several Delta programs, and the challenge will be for Congress to appropriate funds annually. Similar to the State's financial condition, there are increasing demands from all sectors of the federal budget, which makes obtaining federal funding more difficult.

General Fund Appropriations

General Fund appropriations may pay for the taxpayer share of capital and operating costs and may be used for any purpose. However, the State's fiscal condition will limit their availability in the future.

State-issued Debt

The State traditionally has issued two types of debt for water related infrastructure: general obligation bonds and revenue bonds. General obligation bonds must be approved by voters, and their repayment is guaranteed by the State's general taxing power, resulting in typically low interest costs. Revenue bonds do not require voter approval because they are secured by a designated revenue stream, such as water sales. Revenue bonds may be a preferred mechanism.

Local Government Debt

Construction expenditures might be funded by debt issued by local governments or water agencies. Depending on the type of project being financed, local entities may be able to issue debt based on their increased revenue streams or may be able to establish some type of improvement or assessment district.

Conservation Organizations

A variety of conservation organizations provide funds for land and water acquisition and management. The Nature Conservancy, for example, has been active in the region. Nonprofit (501(c) (3)) organizations could be created to accept tax-deductible gifts that could be operated for Delta projects and programs.

Repayment and Operations and Maintenance Funding Sources

A Finance Plan requires identifying revenue sources to repay capital costs and to pay for ongoing operations, maintenance, and replacement costs.

User Charges for Water

Most water agencies generate the bulk of their revenue by selling water. Water sale revenues are normally used to recover water supply and quality costs, including operations and maintenance expenses and debt repayment for infrastructure investments in facilities. The cost of developing new water supplies is usually factored into the price for all water supplies. However, surface water sale revenues are limited by the elasticity of demand. If demand is at all elastic (price responsive), then water users will take less water as price increases (or shift to groundwater if available), and water revenues may fall below expectations. Funding very large investments in new water supplies may exceed the capacity of current users given the economic returns they receive for water. This result is a common feature of markets. Allowing reallocation of resources among users may be required for the long-term economic vitality of the State (allowing water to go the highest use value).

Fines and Forfeitures

Significant dollars are raised annually as the result of administrative and civil enforcement actions. Water Code section 13260 provides that the State Water Resources Control Board (SWRCB) can collect fees to deposit in the Waste Discharge Permit Fund. For fiscal year 2008–2009, revenues and expenditures were about $80 million. Most expenditure is for National Pollutant Discharge Elimination System permit and stormwater programs, and for waste discharge requirements. Within these programs, most costs are for permitting, enforcement, and compliance (SWRCB 2009). The Council should research the potential for assigning fees, fines, and forfeitures generated from actions detrimental to the Delta directed to Delta activities.

Reallocating Funds

Given the number of agencies involved with Delta operations, funds might be generated by reallocating dollars among agencies.

Cost Efficiencies

Water supply and quality improvements, improved ecosystem health, and levee improvements may result in verifiable cost savings. In general, such cost savings represent a potential source of funding for the Delta Plan. Additional studies are needed to determine whose costs and how much cost might be saved.

Carbon Offsets/Tule Farming

Carbon markets are increasingly accepted by State and federal authorities and private markets as a means to offset carbon emissions. A seller can develop carbon offsets to be sold on the market. The offset can be developed based either on sequestration or reduction of greenhouse gas emissions. The cost of an offset has recently ranged from $8 to $30 per ton-year (California Chapter American Society of Farm Managers and Rural Appraisers 2009).

Conversion of farmed Delta islands with peat soils to natural wetlands or water bodies could provide two types of offsets. The Delta subsides at a rate of 1 to 3 inches a year, mostly in the form of carbon dioxide releases (Ingebritsen et al. 2000). In the Delta Wetlands Project 2010 Draft Place of Use EIR, it was estimated that the amount of carbon dioxide emissions from farmed Delta islands is 17 tons per acre per year (Semitropic Water Storage District 2010).

When the land is converted to cattails or tules, this loss is stopped. Dead plant material, largely carbon, accumulates in the form of new peat soil. The U.S. Geological Survey has been measuring carbon sequestration on an experimental plot on Twitchell Island for about 15 years. The additional carbon dioxide sequestered by cattails or tules amounts to another 12 to 20 tons per acre per year using high and low ranges, and potential revenue per acre is $100 to $800 per acre per year. It appears that carbon dioxide offsets might repay a significant share of Delta island acquisition and wetland restoration costs. Net revenue of $200 per acre per year is worth about $3,000 to $4,000 per acre in net present value terms as compared to the cost of land, which may be $3,000 to $10,000 per acre (California Chapter American Society of Farm Managers and Rural Appraisers 2009).

User Fees and Stressor Fees

User fees and stressor fees are conceptually similar but somewhat different. User fees may be assessed because the user benefits from improvements funded by the fee. Stressor fees are justified because fee revenues are used to reduce unwanted stressors, and because the fees provide incentive to reduce stressors. User fees are collected based on amount of a resource used. Stressor fees are collected based on the amount of stressor released or caused. In either case, physical measurement of the amount of use or stressor is required.

Diversion Fees

Diversion fees are commonly assessed based on both use and stress. That is, diversions may benefit from expenditures, but they may also contribute to stress.

A number of factors limit the feasibility of additional diversion fees in California. In particular, water users adamantly oppose any new diversion fees, unless perhaps the fees are developed by water users themselves. In 2005, for example, a letter from 39 water district and city managers to Governor Schwarzenegger included the following request (Senator Perata et al. 2005):

> *…do not include CALFED user fees as part of the 2005-06 state budget. Any such proposal is entirely inappropriate, given that all versions of the CALFED needs assessment aired to date have avoided grappling directly with the "beneficiary pays" principle. CALFED cost allocations should be proposed only after CALFED has conducted an open public hearing process in which all stakeholders have had the opportunity to present testimony on appropriate beneficiary payments. Until this process has been completed, no financing plan for CALFED can be considered complete and ready for implementation as part of the state budget.*

Existing laws, such as Proposition 218, limit the ability of any State or local government to establish new diversion fees. Enabling legislation would be required.

The potential for diversion fees is also limited by the inconsistency and lack of water diversion measurement in some places. Diversions are measured by a variety of methods, and some diversions are not routinely measured. The costs of standardized measurement could be significant relative to the amount of fees collected.

Several efforts in the past estimated the fees that could be collected if the fees were similar to Bureau of Reclamation restoration fees. In 2000, one author estimated that average non-CVP contract diversions of 13.182 million acre-feet with fee levels similar to CVP restoration fees could provide about $105 million in annual revenues (Wahl 2000). In 2004, CALFED estimated that potential fee levels per acre-foot-year of diversion would raise $25 million in annual funds based on "normal" non-CVP contract diversions of 16.522 million acre-feet. These fee levels were $1.50 for all users, or $1.25 for agriculture and $2.50 for urban users, or $3.25 for Delta exporters and $1 for all others (CALFED 2004). CALFED also estimated

that a residential fee of $1 per month per household in the CALFED solution area could raise $106 million annually.

Fishing Fees and Payments

From 2004 through 2009, recreational fishing within the Bay-Delta watershed below the first dam required a Bay-Delta Sport Fishing Enhancement Stamp. In 2009, about 300,000 stamps were sold at a retail cost of $6.30, and gross revenues were about $1.9 million. These funds were used to leverage a 75 percent cost share from the federal Sport Fish Restoration Act. In 2009, Assembly Bill 1052 repealed the stamp (California Department of Fish and Game 2011a). The Council should consider supporting legislation to renew this funding source.

A stressors-based finance charge would collect fees based on removals of desirable species. In 2011, inland steelhead anglers are required to purchase a Steelhead Report Card at a cost of $6.48, and a North Coast Salmon Report Card costing $5.66 is required for all anglers taking salmon in the Smith River System or Klamath-Trinity River System (California Department of Fish and Game 2011b). Annual revenues from 2001 to 2006 from the steelhead card averaged about $200,000 (Jackson 2007). Any person fishing commercially for salmon in California must purchase a commercial fishing salmon stamp for $85. Similar fees might be collected when substantial salmon fishing is again allowed in the Bay-Delta system. In 2006, about 500,000 freshwater and 1 million saltwater days were taken for salmon fishing (California Department of Fish and Game 2010). Revenue potential from recreational salmon cards is perhaps $500,000 to $1 million annually.

Hydropower Fees

Fees could be collected from hydropower generators in the Bay-Delta system. The SWRCB collects fees of $0.017 per kilowatt capacity from licensed Federal Energy Regulatory Commission projects, and higher fees are collected from facilities that recently renewed their Federal Energy Regulatory Commission licenses (SWRCB 2010). These fees must be used to cover authorized costs of the Water Rights Program. The potential for additional revenues from hydropower generators is unknown.

Other Stressor Fees

A variety of stressor fees might be used to help finance programs within the Delta Plan. Seven types of stressor fees have been considered:

1. Water quality loading charge: charge measured pollutant loads in water discharges.
2. Land use charge: charge land use practices that contribute to stressors.
3. Retail sales fees: charge retail sales of products that may become stressors.
4. Habitat alteration fees: charge existing or proposed land alterations that contribute to habitat stressors.
5. Special diversion fees: charge water diversions that contribute more than average to entrainment, stranding, or flow-related habitat loss.
6. Recreation use fees: charge for recreation that contributes to stressors.
7. Hatchery fees: charge hatcheries for management practices that damage Delta resources.

Of these seven stressor-based fees, the water quality loading charge appears to be relatively most feasible. The “polluter pays” principle is well established in law. Many waste dischargers already pay fees that are set by the SWRCB and deposited into the Waste Discharge Permit Fund. For fiscal year 2008–2009, revenues were about $80 million.

Most of the loads of some pollutants (ammonia and certain chemicals in particular) come from known discharges where the amount of load can be measured. The cost of removing the stressors by another means may determine a fair and efficient charge level. There are important measurement and administrative costs, but these could be small compared to revenues.

The other stressor-based fees are generally not as straightforward. For land use charges, a fee for land management practices that release methylmercury, for example, the stressor being introduced is often diffuse, not well measured, and the amount may vary substantially based on location and local conditions. It may be unfair or expensive to set land use changes based on diffuse and hard-to-measure stressors. Proposition 218 procedures must be applied for stormwater fees, so they would likely apply to land use charges as well.

A charge on retail sales of stressor materials such as pesticides or fertilizers might also be problematic because materials are used in a wide variety of locations and situations. The legal feasibility of such charges is not clear.

There is good potential to establish charges for some types of habitat alteration practices, such as wetland conversions. However, such charges might fall under Proposition 218. The special diversion charge would be difficult to justify because the amount of unusual damage via entrainment, stranding, or flow habitat loss would often be difficult to quantify and value. Hatchery management fees might be inefficient compared to other efforts to improve hatchery practices.

The revenue potential from stressors fees is unknown, but not believed to be large. Also, it is likely that any stressor fees could be spent only for a very limited range of activities that would benefit the persons paying the fee. There is some potential for revenues in the form of fishing stamps (probably less than $5 million annually) and additional water quality loading charges.

Water Marketing Fees

Water marketing fees would be applied to water transfers in the Delta watershed. These fees would be above and beyond any existing watershed diversion or export fees. The SWRCB currently collects fees associated with change in water rights required for transfers.

The number of water transfers that occur between existing water agencies is not large compared to total statewide water use. During the drought years of 2008 and 2009, about 400,000 acre-feet of cross-Delta transfers were reported annually.[1] If such transfers paid a fee of $10 per acre-foot, revenues might be $4 million annually. However, the volume of transfers in most years would be much less than in 2008 and 2009.

Public Goods Charges

In 1996 a public goods charge for electricity sold by CPUC-regulated for-profit public utilities was approved in California as part of the energy sector deregulation. The public goods charge is a fee applied to a utility bill to fund public-interest programs related to utility services. More recently, interest in a public-goods charge for water has increased as a potential tool for achieving the objectives of Assembly Bill 32, known as "The Global Warming Solutions Act of 2006." (Griffin, Leventis, and McDonald 2010). In a study prepared for the California Public Utilities Commission by the U.C. Berkeley Goldman School of Public Policy, a public goods charge for water was proposed that consisted of a volumetric charge on individual water utility bills.

While the design of a public-goods charge for water would need to be developed, given the passage of Proposition 26, a two-thirds vote would be required to implement it. The primary purpose of a public-

[1] *Water Strategist*, February 2009 issue provides 2008 summary (Smith 2009).

goods charge should be to fund investments or activities that have broad, statewide benefit. These might include statewide planning, ecosystem enhancements, or investments that reduce reliance on imported supplies. A public-goods charge could ensure a minimum investment by all urban and agricultural water agencies in water user efficiency and other tools that can reduce reliance on imported water. It could also provide consistent funding over time. Actual activities to be funded would need to be more definitely described before it could be presented to the voters.

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