

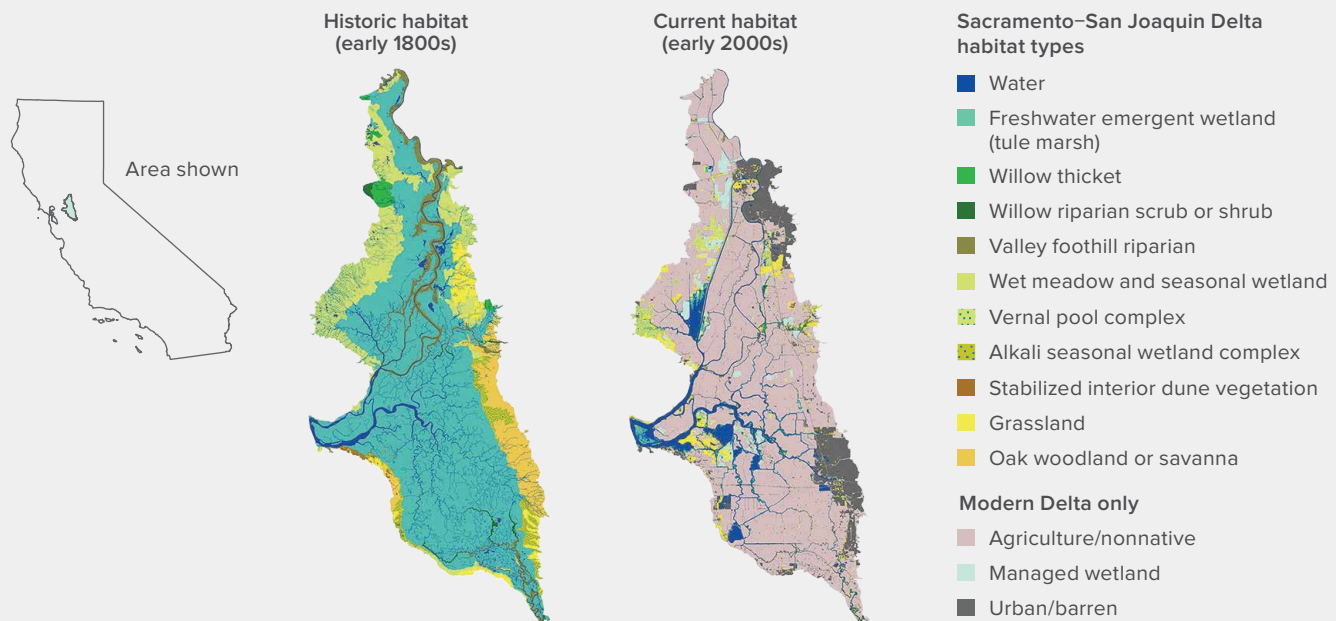
# The Sacramento–San Joaquin Delta

## The Delta is California’s greatest water management challenge

The Sacramento–San Joaquin Delta is a network of engineered channels and agricultural lowlands at the confluence of the Sacramento and San Joaquin Rivers. Together with the San Francisco Bay, the Delta forms the largest estuary on the Pacific Coast of the United States. It is the terminus of California’s largest watershed and a major hub for the state’s water supply. The California State Water Project and the federal Central Valley Project export water from the southern Delta to more than 25 million people and 3 million acres of irrigated farmland in the Bay Area, the San Joaquin Valley, and Southern California. The reliability of this supply is declining. Levees needed to protect Delta farmland and keep salt water at bay are at risk from rising sea levels, winter floods, sinking farmland, and earthquakes. Changes in the ecosystem are harming native species, including salmon and smelt, which are now threatened with extinction. Efforts to protect these species are putting pressure on water supplies. The local Delta economy is also vulnerable to levee failure and declining water quality.

The Delta Reform Act of 2009 requires the state to manage the Delta for the “coequal goals” of providing a more reliable water supply for California and improving the health of the Delta ecosystem, while also protecting it as a unique and evolving cultural, recreational, natural, and agricultural place. Implementing this law has been controversial, but the economic, social, and environmental costs of failure would be high.

### FARMING HAS RADICALLY CHANGED DELTA HABITAT



SOURCE: A. Whipple et al., *Sacramento–San Joaquin Delta Historical Ecology Investigation: Exploring Pattern and Process* (San Francisco Estuary Institute & The Aquatic Science Center, 2012).

## The Delta is changing

Today’s Delta is dramatically different from the Delta that existed before its lands, waterways, and upstream watersheds were developed. This distinctive landscape and ecosystem are still changing in ways that make achieving the Delta Reform Act’s goals difficult.

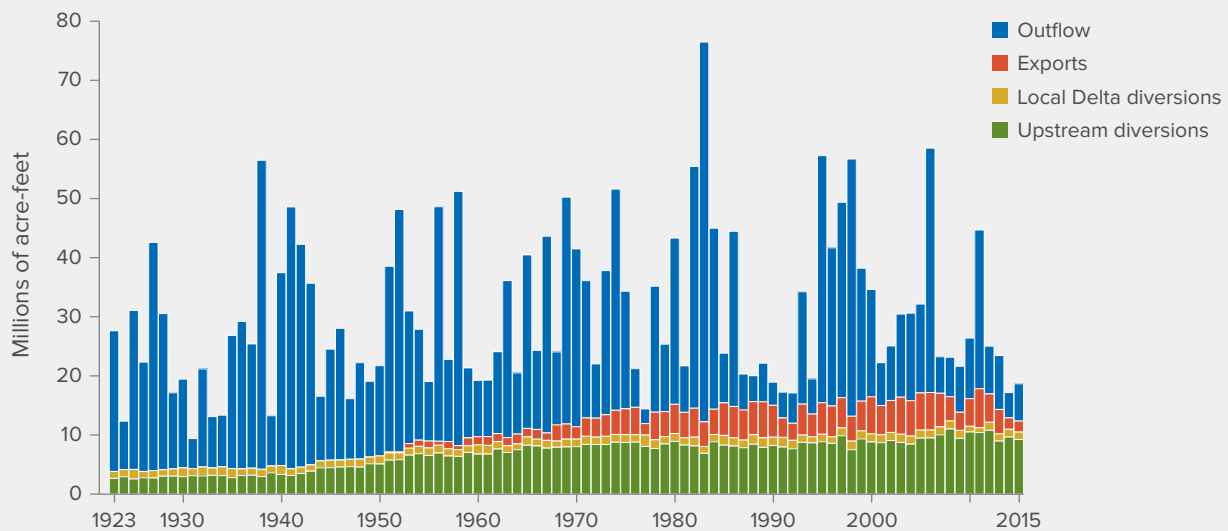
- **Land reclamation for farming transformed the Delta landscape.**

In the late 19th and early 20th centuries, some 1,100 miles of levees were built to convert 700,000 acres of tidal marsh into farms. “Islands” of farmland were created by surrounding marshlands with levees. Farming caused peat-rich soils to oxidize and land to sink. Today, many islands are 10 to 25 feet below sea level. Sinking land causes drainage problems and increases pressure on levees—making flooding more likely.

- **Water supply for farms and cities has reduced Delta outflows.**

The Sacramento–San Joaquin River watershed is California’s largest source of water for farms and urban areas. From 2000 to 2015, on average 33 percent of the water that would otherwise have flowed through the Delta was consumed upstream, 17 percent was exported, and 5 percent was used by farmers in the Delta. The water that remains flows into San Francisco Bay where it supports aquatic species and repels seawater so that water in the Delta remains fresh enough for farming and urban uses. Water management alters seasonal flow patterns, affecting aquatic habitat throughout the Delta.

#### DELTA OUTFLOWS HAVE DECLINED AS FARMS AND CITIES HAVE INCREASED THEIR WATER USE



SOURCE: Updated from Delta Vision Blue Ribbon Task Force, *Our Vision for the California Delta*, Figure 7b (2007). For the period 2010–15, upstream diversions (green) are estimated based on water-year type and historical upstream uses.

- **Ecosystem changes have harmed native species.**

More than 35 native plants and animals that live in or pass through the Delta are now listed under state or federal endangered species acts. Many factors account for the decline of native fishes such as delta smelt, longfin smelt, Chinook salmon, and green sturgeon: loss of habitat, changes in the volume and timing of flows, changes in water quality, and unfavorable hatchery and fishing practices. In addition, many alien species have invaded the estuary, often altering the environment and competing with or preying on native species.

- **Water exports and the Delta economy are also threatened.**

The reliability of water exports is falling as the risk of levee failure increases and conflicts intensify over flows required to protect endangered species. Levee instability also threatens Delta farming and infrastructure. Invasive aquatic plants such as water hyacinth clog water intakes and interfere with boating—a key part of the Delta’s recreation economy.

- **The changing climate will make it harder to achieve all management goals.**

Conflicts between urban and agricultural uses of Delta water and environmental goals are growing. Higher temperatures and increasing climate variability will change the timing and magnitude of flows into the Delta, raising levee failure risks and reducing the reliability of water exports. A rising sea level will put more pressure on levees and require larger outflows to keep Delta waters fresh. Warming, increasing salinity, continued invasions of alien species, and flow changes will compound the threats to native fishes. Meanwhile, population growth will raise the demand for reliable water supplies.

## Balancing water supply and ecosystem goals is a major challenge

California has struggled for decades to find a balance between diverting Delta water for economic purposes and allowing it to flow through the Delta to support the ecosystem. The water quality and endangered species regulations that now govern water exports are controversial. During the latest drought, state regulators relaxed standards to allow increased exports, and proposed federal legislation would go further in this direction. Since 2006, federal, state, and local agencies that use Delta exports have been exploring a longer-term solution involving new water conveyance infrastructure and ecosystem improvements. The latest version of this proposal—put forth in 2015—is called California Water Fix.

- **California Water Fix is ambitious ...**

Most Delta exports are now drawn through the Delta's channels from the Sacramento River to large pumps in the southern Delta. California Water Fix would move water directly from the Sacramento River to the pumps through two tunnels. A complementary effort—California EcoRestore—has a near-term goal of restoring 30,000 acres of tidal marsh and floodplain habitat within and adjacent to the Delta.

- **... and involves many uncertainties.**

California Water Fix—together with California EcoRestore—is likely to improve water supply reliability. But it is uncertain how future climatic, ecosystem, and regulatory conditions will affect program goals. For example, it is unknown whether the proposed ecosystem improvements will substantially benefit native fish populations. To succeed, both programs will require ongoing flexibility, experimentation, and refinement.

- **Costs are high, with no clear funding for the ecosystem.**

Tunnel construction costs of approximately \$17 billion are to be paid by urban and farm customers who use Delta exports rather than by taxpayers. The first phase of California EcoRestore will cost \$300 million—also borne by water users. But there is no clear mechanism for funding longer-term ecosystem improvements and related science and monitoring. Proposition 1—the state bond approved by voters in November 2014—provides less than \$140 million for the Delta ecosystem.

## Improving Delta levees is another big challenge

The Delta's 1,100 miles of levees support the local economy and the current system of water exports. High costs to upgrade levees as well as low land values and limited state and federal funding create tough choices on how and where to invest.

- **Economic justification and funds to improve all Delta levees are insufficient.**

According to recent state estimates, more than \$12 billion in flood investments are needed in the five Delta counties. This includes levees in the inner Delta, where few people live, and urban areas such as West Sacramento and Stockton, where large populations are vulnerable. The entire region faces a sizable funding gap. Furthermore, costs of upgrading many of the Delta's agricultural levees exceed the economic value of the land they protect, and only some Delta levees are needed to keep Delta waters fresh.

- **Limited state funds need to be prioritized.**

State bonds approved in 2006 dedicated nearly \$600 million to Delta levees. Proposition 1 earmarks another \$295 million. The Delta Stewardship Council is now setting priorities for using these funds.

## Looking ahead

If Californians put off difficult decisions about the Delta, then the Delta's growing population, changing climate, and changing ecosystem will make it even harder to find solutions. Five areas need immediate attention.

**Make a strategic decision on water supplies.** In taking action to ensure future water supplies, the state must decide whether to move forward with California Water Fix; adopt a scaled-back version of the plan with reduced export capacity, costs, and other impacts; or prepare for large permanent reductions in Delta water exports. The last alternative would force cities in the Bay Area and Southern California to turn to more expensive sources of water. In the southern Central Valley, it would reduce farming and make it harder to achieve sustainable groundwater management.

**Ensure robust scientific support.** Scientific and technical support for managing the Delta has been underfunded and poorly organized. To improve decision making and reduce controversy and litigation, the state and federal governments should make substantial, sustained investments in more integrated scientific work, as outlined in the new Delta Science Plan.

**Reverse the decline of native fishes.** California has compelling social and economic reasons to reverse the decline of Delta fish populations, including avoiding regulatory costs. Because the science is uncertain, bold experiments are needed in habitat restoration, flow changes, and management of fisheries and invasive species. Agencies will need to adjust flow management and take other actions as scientific understanding improves. This work requires reliable funding.

**Set priorities for state levee funding.** California needs a transparent and effective plan for investing limited state funds in Delta levees. Priority should go to investments that provide broad social, economic, and environmental benefits for the Delta region. Some funds should be set aside to support economic transitions in places where levees cannot be sustained.

**Incorporate long-term change into all aspects of planning.** The state should consistently take into account the significant effects on the Delta of climate change, rising sea level, shrinking sediment supply, introductions of new species, and other changes over the long term. Adaptation strategies are needed for improving water supply, managing ecosystems and species, and prioritizing levee maintenance.

## CONTACT A PPIC EXPERT

Jeffrey Mount      Caitrin Chappelle      Brian Gray  
mount@ppic.org      chappelle@ppic.org      gray@ppic.org

Ellen Hanak      Jay Lund  
hanak@ppic.org      jrlund@ucdavis.edu

## CONTACT THE RESEARCH NETWORK

James Cloern, jecloern@usgs.gov  
William Fleenor, wefleenor@ucdavis.edu  
Wim Kimmerer, kimmerer@sfsu.edu  
Peter Moyle, pbmoyle@ucdavis.edu

## READ MORE

- CLIMATE CHANGE AND WATER
- THE COLORADO RIVER
- ENERGY AND WATER
- MANAGING DROUGHTS
- PAYING FOR WATER
- PREPARING FOR FLOODS
- PROTECTING HEADWATERS
- THE SACRAMENTO–SAN JOAQUIN DELTA
- STORING WATER
- WATER FOR CITIES
- WATER FOR THE ENVIRONMENT
- WATER FOR FARMS

*This series is supported by funding from a diverse group of sponsors.*

The PPIC Water Policy Center spurs innovative water management solutions that support a healthy economy, environment, and society—now and for future generations.

The Public Policy Institute of California is dedicated to informing and improving public policy in California through independent, objective, nonpartisan research. We are a public charity. We do not take or support positions on any ballot measure or on any local, state, or federal legislation, nor do we endorse, support, or oppose any political parties or candidates for public office. Research publications reflect the views of the authors and do not necessarily reflect the views of our funders or of the staff, officers, advisory councils, or board of directors of the Public Policy Institute of California.

Public Policy Institute of California  
500 Washington Street, Suite 600  
San Francisco, CA 94111  
T 415.291.4400 F 415.291.4401  
**PPIC.ORG/WATER**

PPIC Sacramento Center  
Senator Office Building  
1121 L Street, Suite 801  
Sacramento, CA 95814  
T 916.440.1120 F 916.440.1121



**PPIC**

PUBLIC POLICY  
INSTITUTE OF CALIFORNIA