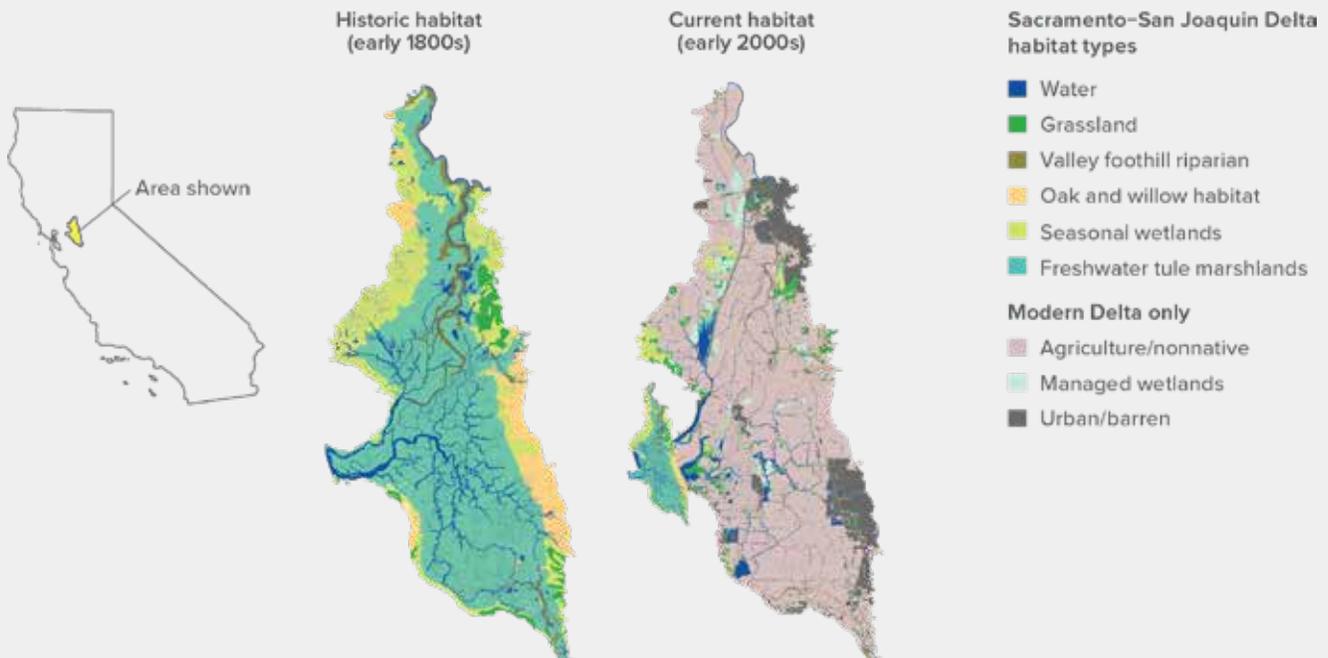


The Delta is California’s greatest water management challenge

The Sacramento–San Joaquin Delta is the terminus of California’s largest watershed and a major water supply hub. The San Francisco Bay and Delta combined form the largest estuary on the US Pacific Coast. The southern Delta exports water to more than 25 million people and 3 million acres of irrigated farmland in the Bay Area, the San Joaquin Valley, and Southern California. This supply’s reliability is declining. Levees that protect Delta farmland and keep saltwater at bay are at risk from rising sea levels, winter floods, sinking farmland, and earthquakes. Changes in the ecosystem harm native species, including salmon and smelt, which are now threatened with extinction. Efforts to protect these species put 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 “coequal goals”—a more reliable water supply for California and improved Delta ecosystem health, plus protection of 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: Adapted from A. Whipple et al., *Sacramento–San Joaquin Delta Historical Ecology Investigation: Exploring Pattern and Process* (San Francisco Estuary Institute and the Aquatic Science Center, 2012).

The Delta is changed and changing

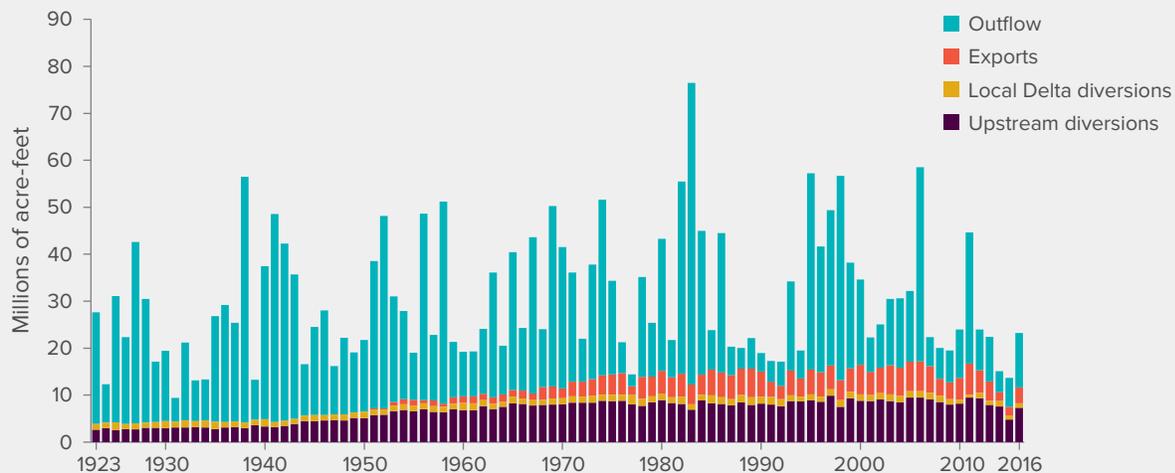
Today’s Delta is dramatically different from the one that existed before its lands, waterways, and upstream watersheds were developed. It continues to change in ways that make achieving the Delta Reform Act’s goals difficult.

- **Land reclamation for farming transformed the Delta landscape.** Some 1,100 miles of levees have converted 700,000 acres of tidal marsh into “islands” of farmland. Farming caused peat-rich soils to oxidize and land to sink. Today, many islands are 10 to 25 feet below sea level. This causes drainage problems and increases pressure on levees, making flooding more likely and costly.

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

The Delta watershed is California’s largest source of water for farms and urban areas. Since 2000, approximately one-third of total watershed runoff has been diverted upstream. In-Delta uses account for 4 percent, Central Valley Project and California State Water Project exports 18 percent. On average, 47 percent of runoff flows out of the Delta and into the San Francisco Bay—but this share varies greatly with the volume of precipitation.

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



SOURCES: Updated from Delta Vision Blue Ribbon Task Force, *Our Vision for the California Delta*, Figure 7b (2007). For 2007–16, estimates are from G. Gartrell et al., *A New Approach to Accounting for Environmental Water: Insights from the Sacramento–San Joaquin Delta* (PPIC, 2017).

- **Delta outflow serves many purposes.**

Some outflow is required to repel seawater from the Delta so that water there remains fresh enough for exports and local cities and farms. Regulations to protect endangered fish create additional requirements. Since 2008—the most recent update to these regulations—42 percent of outflow was needed to maintain water quality for exports and local diversions, and another 21 percent for the ecosystem. The remaining 38 percent occurs principally during winter storms when flow exceeds the capacity of diversions. All outflow improves water quality and habitat throughout the estuary.

- **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 endangered species acts. Multiple factors account for the decline of native fishes: loss of habitat, changes in flow volume and timing, changes in water quality, and unfavorable hatchery and fishing practices. In addition, many alien species have invaded the estuary, altering the environment and competing with or preying on native species.

- **Water supplies and the Delta economy are at increasing risk.**

Climate change and other factors are reducing the reliability of water supplies and increasing flood risks for local communities. Warming and more variable precipitation change the timing and magnitude of flows into the Delta, increase salinity and harmful algal blooms, and make it more difficult to manage habitat for native species. This will increase pressure to release water from upstream reservoirs to protect Delta water quality. Changes in flood flows and rising sea levels will also increase risk of levee failure—threatening farms and communities, as well as water supply. Levees also risk failing from a large earthquake.

Balancing water supply and ecosystem goals is a major challenge

California has struggled for decades to find a balance between diverting Delta water and letting it flow through the estuary to support the ecosystem and meet state and federal regulations to protect endangered fishes. Since 2006, agencies that use Delta exports have been exploring a longer-term solution involving new water conveyance infrastructure and ecosystem improvements. California Water Fix (put forth in 2015) is the latest version of this proposal.

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

Large pumps in the southern Delta export water to the state's two major water delivery systems—the Central Valley Project and California State Water Project. California Water Fix would divert some of it from the Sacramento River north of the Delta into two tunnels, bypassing the Delta. California EcoRestore is an effort to meet permitting requirements for the projects. It aims to restore 30,000 acres of tidal marsh and floodplain habitat within and adjacent to the Delta by 2020.

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

Water Fix is likely to improve water supply quality and reliability and EcoRestore will create some habitat. But how future climatic, ecosystem, and regulatory conditions will affect program goals is uncertain. For example, it is unknown whether Water Fix or the proposed ecosystem improvements will substantially benefit native fish. Both programs require ongoing flexibility, experimentation, and refinement.

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

Urban and farm customers, not taxpayers, will foot the approximately \$20 billion tunnel construction costs. EcoRestore's first phase will cost \$300 million—also borne by water users. Recent state bonds provide important near-term support for ecosystems in the Delta and its watershed. But no clear mechanism exists to fund longer-term improvements and the science and monitoring needed to measure progress and steer future improvements.

- **... and new water quality regulations may impact both efforts.**

The State Water Board will have to grant a permit for the new Water Fix facilities. The board is also updating flow and water quality standards for the Delta and its watershed, which could increase the outflow required to support the ecosystem. Both proceedings may affect the construction and operation of Water Fix and the implementation of EcoRestore.

Improving Delta levees is another big challenge

The Delta's levees support the current water export system; critical roads, pipelines, and power lines; and the local economy. The high cost of upgrading levees and the low land values of areas they protect coupled with limited state and federal funding create tough choices on how and where to invest.

- **The region faces a sizable levee funding gap.**

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

- **Limited state funds should be prioritized.**

State bonds approved in 2006 dedicated nearly \$600 million to Delta levees, and more recent bonds earmark another \$350 million. In 2017 the Delta Stewardship Council set priorities for investing state funds in these levees. The highest priorities will be levees that protect urban areas, critical infrastructure, and ecosystem restoration projects or areas with high potential for habitat restoration.

Looking ahead

If Californians put off difficult decisions regarding the Delta, the region's growing population, rising and warming waters, and changing ecosystem will make it even harder to find solutions. Five areas need immediate attention.

Make a strategic decision on water supplies. The state must decide whether to move forward with California Water Fix or prepare for reductions in Delta water export reliability. The latter alternative would force cities in the Bay Area and Southern California to turn to more expensive water sources. In the San Joaquin Valley, the no Water Fix approach would reduce farming and make it harder to manage groundwater sustainably. And the value of new state investments in water storage capacity would diminish without the ability to reliably convey water across the Delta.

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. More complete water accounting is also needed to support management and inform policy.

Manage the Delta as an ecosystem. To improve environmental outcomes, the state and federal governments should shift from a focus on managing outflows for endangered fish species to an ecosystem-based approach. This entails managing river flows, tidal flows, and landscapes together to improve habitat for a broad array of fish and wildlife. Efforts should be concentrated in the northern Delta and Suisun Marsh, and they should include strategies for reducing harmful algal blooms. An ecosystem water budget for the Delta, which would allocate a portion of water to the ecosystem, could enable more flexible and effective management.

Implement a priority-based levee improvement program. The Delta Plan's priorities for levee investments are likely to yield the greatest reduction in economic and environmental risk, while using state funds most efficiently. The Department of Water Resources should follow these priorities in allocating state resources.

Incorporate long-term change into all aspects of planning. The state should prepare for significant changes in the Delta from rising sea level, climate warming, declining sediment supply, invasions of new species, and other changes.

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