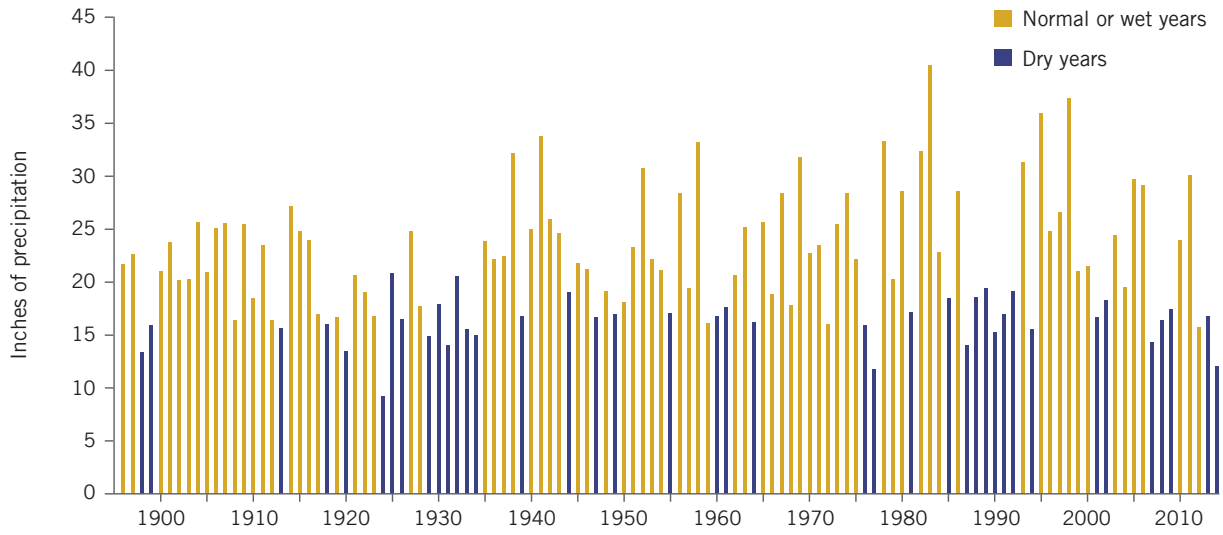
CALIFORNIA FACES GROWING WATER MANAGEMENT CHALLENGES

Water management in California has always been difficult. The state's variable climate is marked by long droughts and severe floods, with stark regional differences in water availability and demand. A vast network of storage and conveyance facilities delivers water from the wetter parts of the state to population and farming centers in the Bay Area, Southern California, and the San Joaquin Valley. This network is now threatened by the physical and biological fragility of the system's hub in the Sacramento–San Joaquin Delta. California is also enduring one of the worst droughts in recorded history, creating far-reaching water management challenges.

Other challenges loom on the horizon. Although per capita water use is declining, population growth is likely to increase urban water demand in some regions. Agricultural demand is becoming less flexible, as farmers are increasing tree crops (especially nuts), which must be watered every year. Conflicts are also growing between human water use and water needed to support fish and other wildlife.

Climate change will play an important, if uncertain, role. California's natural variability is likely to increase, accentuating droughts and floods. Rising air temperatures are expected to significantly reduce the Sierra Nevada snowpack, affecting water storage as well as winter and spring flood flows. Higher water temperatures may make it harder to maintain aquatic habitats for native fish species. Over time, all of these challenges are likely to intensify. Potential solutions involve difficult and sometimes costly trade-offs, as well as inconvenient legal and political changes.

DROUGHTS ARE A RECURRING FEATURE OF CALIFORNIA'S CLIMATE



SOURCE: Western Regional Climate Center.

NOTES: Bars indicate the statewide average precipitation in California based on water year (October–September) since 1896. Dry years are those classified as critical or dry in the Sacramento Valley based on the California Cooperative Snow Survey which takes into account the previous year's precipitation. For 1896–1905 dry years were estimated by comparing precipitation to the rest of the record. The three-year period between October 2011 and September 2014 was the driest on record.

CALIFORNIA'S LATEST DROUGHT REVEALS STRENGTHS AND WEAKNESSES

The three years between fall 2011 and fall 2014 were the driest since recordkeeping began. Most urban areas have been coping fairly well, thanks to investments to boost resilience since the last major drought from the late 1980s to early 1990s. But the farm sector has been hit hard, fallowing roughly 500,000 acres of cropland. Drinking water wells have gone dry in some rural communities. And environmental water managers have been forced to make difficult trade-offs in allocating scarce flows for fish, birds, and other wildlife. State and federal governments have provided emergency funds to soften the drought's effects on farm communities, drinking water systems, and the environment. If the drought continues into 2015, the state will be faced with very difficult water allocation decisions.

- **California is fortunate to have many options for meeting current and future demands.**
  Expanding traditional supply sources—particularly surface reservoirs and groundwater supplies—is more difficult today than in the past. But there is considerable scope for cost-effective expansion of nontraditional sources—such as recycled wastewater and captured stormwater—and for improving water use efficiency. Water marketing—the sale or leasing of water—plays an important role in increasing efficiency; it allows water to be transferred to growing urban areas and from lower- to higher-revenue crops.

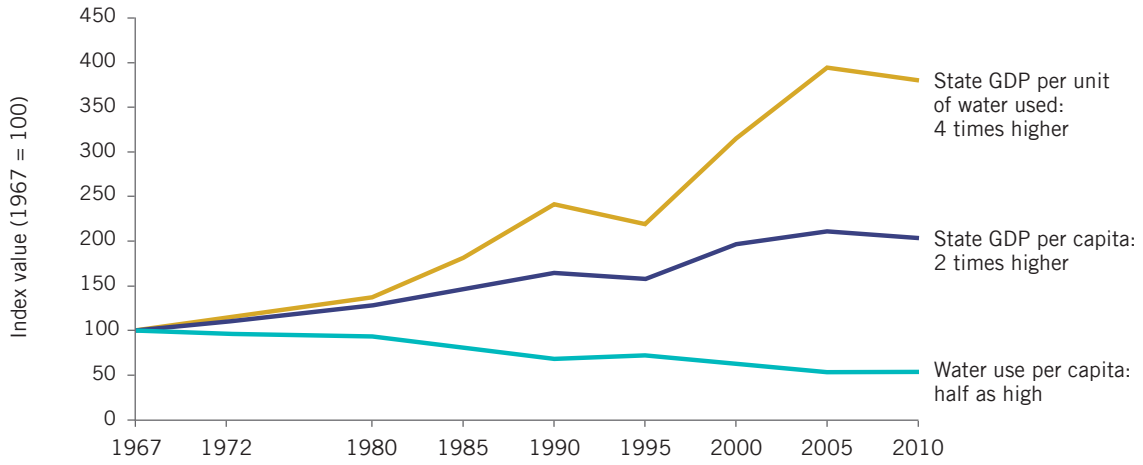
- **Much progress has been made since the drought of the early 1990s.**
  While some small communities have struggled, most urban areas have improved their ability to weather droughts by diversifying supplies. Urban water use efficiency has risen in most areas thanks to new plumbing codes, better technology, and better pricing incentives, and many communities have stored the saved water in local reservoirs and groundwater basins. Regional cooperation is also helping utilities cope with supply emergencies. Water markets have helped to supply water to cities and high-revenue agriculture during droughts and for long-term growth.

- **Better groundwater management will improve supply reliability.**
  Groundwater typically makes up about a third of all water supplies, and much more in dry years, when pumping increases to make up for the lack of rain. But many basins are being used unsustainably, without limits on pumping in normal and wet years, which would allow groundwater levels to recover. In 2014, historic legislation was enacted, giving local agencies the tools and authority to develop and implement sustainable groundwater management plans. This legislation also calls on the state to step in if local agencies fail to act. In some areas, better basin management will also require addressing contamination problems.

- **Surface storage expansion has been very contentious.**
  Increased surface storage could make up for some loss of storage in the snowpack and could also provide more flexibility in managing floodwaters and environmental flows. However, new surface storage has not been proven to provide large new supplies of water, and it will be less valuable if climate change reduces overall precipitation. Large financial and environmental costs also raise concerns. Integrated strategies—increasing storage for dry years in groundwater basins, while allowing surface reservoirs to focus on storing water for seasonal use—may be especially cost-effective. New bond funds approved by voters in November 2014 allocate $2.7 billion to surface and underground storage projects.

- **Supplies are becoming more limited, but the potential to adapt is strong.**
  Despite little expansion of the state's major water infrastructure since the early 1970s, California's economy has prospered. From 1967 to 2005, per capita water use declined by half, real per capita state gross domestic product (GDP) doubled, and the economic value of each unit of water increased fourfold. These trends—temporarily slowed by the recent recession—reflect the increased efficiency of water use in all sectors as well as a decline in the relative importance of agriculture, which accounts for roughly 80 percent of human water use but only 1 to 2 percent of state GDP.

THE ECONOMIC EFFICIENCY OF WATER USE CONTINUES TO RISE



SOURCE: E. Hanak et al., *Water and the California Economy* (PPIC, 2012), updated to 2010 with data from the California Department of Water Resources, the California Department of Finance, and the U.S. Bureau of Economic Analysis.

NOTE: State GDP is adjusted for inflation. Water use estimates are for applied use in the agricultural and urban sectors.

INSTABILITY IN THE DELTA IS A MAJOR CHALLENGE

As the fragile hub of California's water supply, the Delta poses serious risks to the economies of the Bay Area, Southern California, and the San Joaquin Valley. Sea level rise and earthquakes threaten the weak Delta levees. The collapse of native fish populations has led to cutbacks in pumping from the southern Delta. The Delta's physical deterioration will not be delayed by political indecision: the state faces inevitable, fundamental change in this region.

- **Moving water beneath the Delta could reduce both ecosystem and economic risks.**
  The current system relies on pulling water directly through Delta channels to the pumps. A new management plan, known as the Bay Delta Conservation Plan, is being formulated by local, state, and federal water agencies. These agencies are considering the construction of two tunnels to tap some water upstream on the Sacramento River and move it underneath the Delta to the pumps. This change could be good for the environment: fewer native fish would be trapped in the pumps, and it would be easier to restore more natural flows within the Delta. The state's economy could also benefit from improved water quality and water supply reliability.

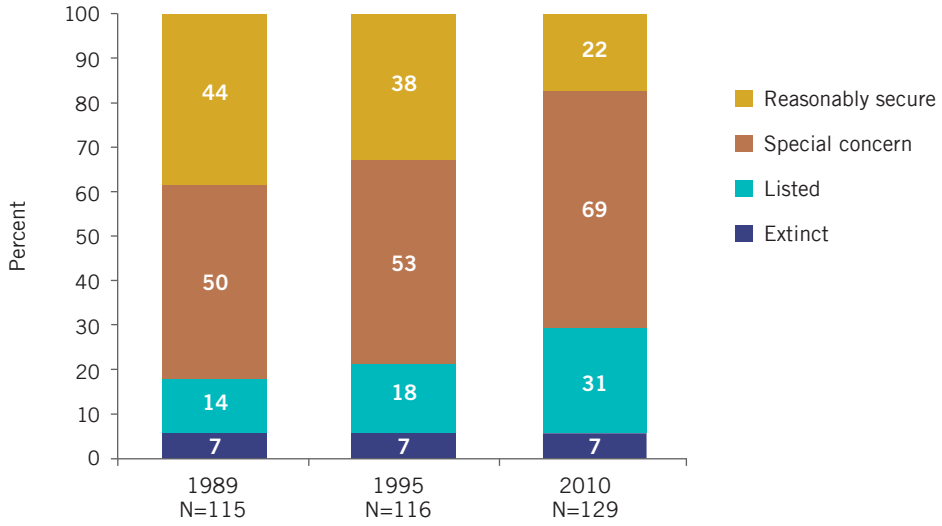
- **Governance and finance solutions are needed—so is attention to the Delta economy.**
  To ensure that the tunnels are managed for environmental benefits, the project should include performance-based limits on water diversions from the Delta. Water users have said they will pay for the new conveyance infrastructure, but the current price tag raises affordability questions for farmers. The plan also assumes state and federal taxpayers will pay for the large ecosystem investments, and it will be challenging to raise these funds. Funds will also be needed to support the Delta economy, because many of the region's islands are at high risk of inundation.

CALIFORNIA MUST IMPROVE MANAGEMENT OF AQUATIC ECOSYSTEMS

Beyond the Delta, the demand for environmental water, healthy watersheds, and clean beaches has been increasing and is likely to grow. However, the state faces major challenges in meeting some environmental goals, especially during droughts.

- **Native fish species are in decline.**
  Populations of native fish species—an important indicator of overall ecosystem health—are declining across the state, despite several decades of well-intentioned efforts and expense. These declines heighten conflicts with other water management goals because they lead to increasingly tight and costly restrictions on water supply, wastewater, and flood protection projects.

CALIFORNIA'S NATIVE FISHES ARE IN TROUBLE



SOURCE: P. B. Moyle, J. Katz, and R. M. Quiñones, "Rapid Decline of California's Native Inland Fishes: A Status Assessment," *Biological Conservation* 144: 2414–23 (2011).

NOTES: "Extinct" = extirpated from California; "listed" = threatened or endangered under state or federal endangered species acts; "special concern" = in decline and could qualify for listing in the future; "reasonably secure" = widespread and abundant according to current knowledge. N = number of known species.

- **Ecosystem-based approaches can help.**
  Environmental management is often "siloed," with each agency and each project addressing particular issues in specific locations—water quality, wetlands, flows, habitat—with no integrated vision of how to contribute to the overall improvement of ecological conditions. Coordinated, flexible approaches that seek to improve environmental performance for entire watersheds would be much more effective in protecting native species—and would enable California to allocate its dollars (and environmental water) more wisely.

CALIFORNIA HAS ONLY JUST BEGUN TO ADDRESS EXTREME FLOOD RISKS

Sacramento has the highest flood risk of any major U.S. city, and many other areas in the Central Valley, the Bay Area, and Southern California are at extreme risk of river flooding. Coastal areas also face flood risk from extreme high tides. These risks are expected to grow with climate change and sea level rise. Although the state has recently increased investments in flood control infrastructure, more work is needed to keep development out of harm's way.

- **Local governments and residents have few incentives to limit flood risk exposure.**
  Federal land-use regulations only restrict new development in areas of extreme flood risk (susceptible to a "100-year flood"). State legislation enacted in 2007 requires that local governments within the Central Valley provide double that level of protection for new homes, but the weaker federal standards still apply elsewhere. Federal law also requires many individuals living in areas of extreme flood risk (in California, 4 percent of the population) to carry flood insurance. But another 17 percent of Californians live in areas with significant flood risk, and few of these residents are insured.

- **Policies do not adequately account for increasing risks from climate change and sea level rise.**
  Federal regulations do not require communities to consider future conditions when approving development. State law requires cities and counties to consider sea level rise and climate change in hazard mitigation planning but not to reduce development in areas likely to be at higher risk in the future.

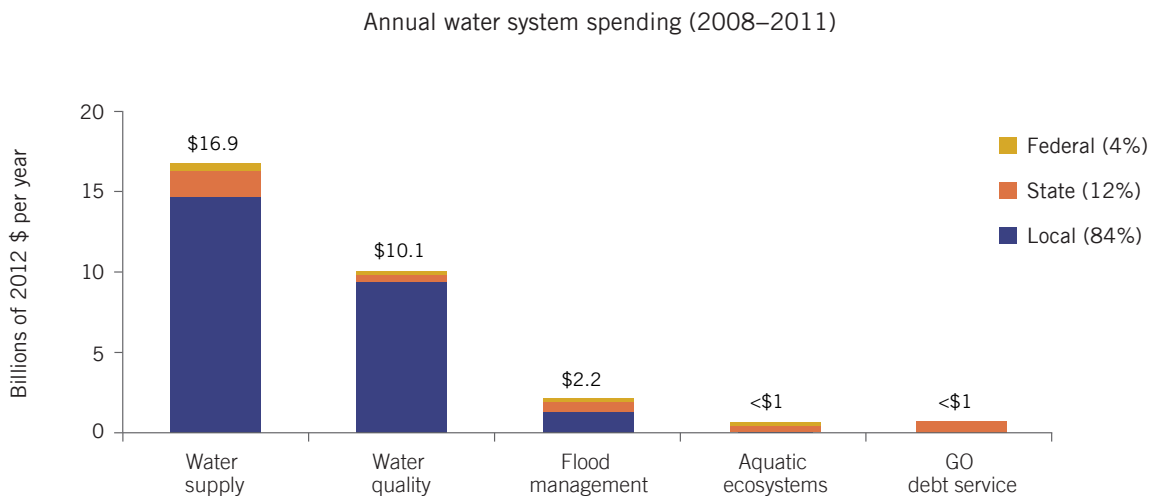
CALIFORNIANS MUST DECIDE HOW TO FILL FUNDING GAPS

California faces critical funding gaps in five key areas: provision of safe drinking water in small, disadvantaged communities; flood protection; management of stormwater and other polluted runoff; aquatic ecosystem management; and integrated water management. These gaps total $2 billion to $3 billion a year. And although urban water and wastewater utilities are doing reasonably well at raising the funds to provide safe and reliable service, looming legal uncertainty and rising costs threaten these agencies as well.

- **State bonds provide valuable support …**
  Californians pay for the vast majority of water system expenditures through their monthly water and wastewater bills, but since 2000 the sector has been relying more heavily on state general obligation (GO) bonds. These bonds—reimbursed with general tax dollars—have helped local water agencies fund some innovative projects, such as water recycling and groundwater banking, and they have been essential for some flood protection, stormwater, and ecosystem management projects, which do not have adequate alternative funding sources. Yet even with the passage of a new $7.5 billion bond in November 2014, other funds are needed; bonds provide at most $1 billion per year, and they do not address all critical gaps.

- **… but California needs to go beyond bonds to fill gaps.**
  Three constitutional reforms approved by voters since the late 1970s—Propositions 13, 218, and 26—have improved transparency but also severely limited the ability of local agencies to raise funds to meet critical water sector needs. For robust solutions, California will have to better align its funding laws with the goals of modern water management. This may include legislation that introduces new special taxes and regulatory fees for water and voter-approved adjustments to the state constitution that maintain transparency while increasing flexibility for local agencies, which are responsible for most water investments.

LOCAL AGENCIES RAISE MOST OF THE MONEY SPENT ON THE WATER SECTOR



SOURCE: E. Hanak et al., *Paying for Water in California* (PPIC, 2014), Table 1.

LOOKING AHEAD

California has the tools to help secure a safe and reliable water supply, improve conditions for aquatic species, and reduce flood risks. Water managers have made significant progress toward these goals. But the challenges are increasing with population growth and climate change. Increased momentum toward policy reform—coupled with new investments—is essential to the state's future. Some changes will be politically difficult. The following issues require sustained attention.

Preparing for droughts. California should learn from the current drought to be better prepared for the next one. The state must improve management of water rights, water transfers, ecosystems, and interagency coordination. And agencies should periodically test drought preparedness through "dry run" exercises, similar to system tests for flood and earthquake emergencies.

The Delta. The proposed new tunnels have the potential to safeguard the Delta's environment while maintaining water supply reliability. But this solution requires solid policies on governance, finance, and mitigation for Delta landowners and residents, as well as a well-organized and well-funded science program to adapt and refine ecosystem management under changing conditions.

Ecosystem protection. Beyond the Delta, a more comprehensive, coordinated, and proactive approach is needed to support California's aquatic ecosystems and the species that depend on them.

Water efficiency. Better pricing policies—such as tiered water rates with higher prices for greater use—can heighten incentives to conserve while allowing local water suppliers to balance their budgets.

Groundwater management. The new groundwater legislation will require sustainable management of most basins in California. But implementation will be challenging, especially for agricultural regions that rely heavily on groundwater.

Flood risk exposure. To reduce risks to new development, floodplain mapping should account for climate change and increasing flood risks. The state should pursue more multi-benefit projects that expand floodplain habitat, simultaneously improving flood protection and ecosystem conditions.

Funding. Even with new bond funds, California will need to find ways to pay for rising water infrastructure costs and to fill critical gaps in drinking water quality, flood protection, stormwater management, aquatic habitat, and integrated water management. Legal reforms are needed to enable local and state agencies to fill these gaps.

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