PPIC PUBLIC POLICY INSTITUTE OF CALIFORNIA

Source List for *Priorities for California's Water: Thriving with Less*

This document provides background references for the PPIC policy brief, *Priorities for California's Water: Thriving with Less* (November 2022). If you have any questions about the information in the report or these sources, contact us at water@ppic.org.

Continuing Change

- **Conditions have changed, making droughts more intense:**
    - **Warming and others (general trends for California):** Bedsworth, Louise, Dan Cayan, Guido Franco, Leah Fisher, Sonya Ziaja. 2018. *Statewide Summary Report. California's Fourth Climate Change Assessment*. Publication number: SUMCCCA4-2018-013.
    - **Snow (trends for western US):** Siirila-Woodburn, E.R., A. M. Rhoades, B.J. Hatchett et al. 2021. "A low-to-no snow future and its impacts on water resources in the western United States." *Nat Rev Earth Environ* 2, 800–819.
    - **Evaporative demand:** Albano, C. M., J.T. Abatzoglou, D.J. McEvoy, J.L. Huntington,C.G. Morton, M.D. Dettinger, and T.J. Ott. 2022. "A Multidataset Assessment of Climatic Drivers and Uncertainties of Recent Trends in Evaporative Demand across the Continental United States." *Journal of Hydrometeorology*, 23(4), 505-519.
- **An increasingly thirsty atmosphere:** Albano, C. M., J.T. Abatzoglou, D.J. McEvoy, J.L. Huntington,C.G. Morton, M.D. Dettinger, and T.J. Ott. 2022. "A Multidataset Assessment of Climatic Drivers and Uncertainties of Recent Trends in Evaporative Demand across the Continental United States." *Journal of Hydrometeorology*, 23(4), 505-519.
- **All runoff in the Delta watershed was used either upstream of the Delta (85%) or within the Delta (15%):** Gartrell, Greg et al. 2022. *Policy Brief: Tracking Where Water Goes in a Changing Sacramento–San Joaquin Delta*. Public Policy Institute of California.
- **Rock barriers were installed in the Delta to keep salinity at bay:** State Water Resources Control Board. 2021. "DWR Drought Salinity Barrier Projects."
- **Two decades of megadrought in the Colorado River:** Williams, A.P., B.I. Cook, and J.E. Smerdon. 2022. "Rapid intensification of the emerging southwestern North American megadrought in 2020–2021." *Nat. Clim. Chang.* 12, 232–234.
- **Near-term supply cuts are likely:** Department of the Interior. 2022. "Interior Department Announces Actions to Protect Colorado River System, Sets 2023 Operating Conditions for Lake Powell and Lake Mead." *Press Releases*. August 16.
- **Many rivers, lakes, and estuaries are being impacted by declining water quality, including increasing harmful algal blooms:**
    - Jung, Y. "Why toxic algae blooms are on the rise across California — and expected to get worse." San Francisco Chronicle, June 14, 2022.
    - State Water Board website on harmful algal blooms.
- **The state has adopted plans to improve supply reliability—including the governor's new Water Supply Strategy:** *California's Water Supply Strategy - Adapting to a Hotter, Drier Future*. 2022. August.

- **The state negotiating voluntary agreements to meet environmental objectives:** California Natural Resources Agency. n.d. *Voluntary Agreements to Improve Habitat and Flow in the Delta and its Watersheds*.
- **The federal government is prompting Colorado River users to take urgent efforts to reduce demand:** Partlow, Joshua and Karin Brulliard. 2022. "U.S. announces more water cuts as Colorado River hits dire lows." *The Washington Post*. August 16.
- **State-federal cooperation on water management has been increasing for operations of two large water projects:** Fish and Wildlife Service. n.d. *Central Valley Project and California State Water Project Consultation*.
- **The federal Bipartisan Infrastructure Bill has allocated $3.5 billion to improve water infrastructure in California:**
    - The White House. 2021. "White House Releases Updated State Fact Sheets Highlighting the Impact of the Infrastructure Investment and Jobs Act Nationwide." August 4.
    - The White House. 2021. *The Infrastructure Investment and Jobs Act will Deliver for California*.
- **$8 billion for western water infrastructure:** U.S. Congress. House. *Infrastructure Investment and Jobs Act*. HR 2684. 117th Congress. 2021.
- **The Inflation Reduction Act has another $4 billion to support western drought management:**
    - U.S. Congress. *Inflation Reduction Act of 2022*. HR 5376. 117th Congress. 2022.
    - Hager, A. "Feds will spend billions to boost drought-stricken Colorado River system." KUNC, Sept. 23, 2022.
- **Over the past three years the state legislature has authorized more than $8 billion to improve water supply and river and wetland ecosystems:** *California State Budget 2022–23 (Enacted)*.

Water for Communities

- **The state's communities are using roughly the same amount of water as in the late 1980s, despite growing by more than 10 million residents:** Hanak, E. and J. Mount. 2019. *Water Use in California*. Public Policy Institute of California. Municipal and industrial water use in 2018 was approximately 7.1 million acre-feet (from DWR).
- **Per-capita water use has declined over time:** Mitchell, D., E. Hanak, K. Baerenklau, A. Escriva-Bou, H. McCann, K. Schwabe, and M. Pérez-Urdiales. 2017. *Building Drought Resilience in California's Cities and Suburbs*. Public Policy Institute of California.
- **Efforts to encourage such reductions have varied across the state during the current drought:** Escriva-Bou et al. 2022. "How Are California's Cities Managing the Drought?" *PPIC Blog*. October 31.
- **Utilities have made great strides in investing in water supply infrastructure:** Mitchell, D., E. Hanak, K. Baerenklau, A. Escriva-Bou, H. McCann, K. Schwabe, and M. Pérez-Urdiales. 2017. *Building Drought Resilience in California's Cities and Suburbs*. Public Policy Institute of California.
- **Smaller, rural utilities are often isolated and more vulnerable to impacts such as dry wells and poor water quality:** Chappelle, C., J. Collins, and E. Hanak. 2021. *Access to Safe Drinking Water in California*. Public Policy Institute of California.
- **Over the past two years numerous small water systems have faced shortages . . . :**
    - Adalian, D. 2022. "South Valley in water crisis as systems fail." *Our Valley Voice*. August 4.
    - Montalvo, M. 2021. "An entire California town is without running water — in a heat wave." *CalMatters*. August 3.
    - Vad, J. 2022. "Even emergency water suppliers are close to tapped out as more valley towns go dry." *SJVWater*. July 19.
    - Vad, J. 2022. "Second Tulare County town goes dry as water tables plummet in drought." *SJVWater*, July 18.
- **. . . and more than 2,000 domestic wells have gone dry:** Department of Water Resources. "Has your well gone dry?" *Dry Well Reporting system*.
- **Groundwater sustainability agencies now have a responsibility to mitigate the impacts of groundwater overdraft on rural drinking-water wells, but these efforts are still in early stages:** Hanak, E. and a. Escriva-Bou. 2022. "Testimony: Implementing SGMA at Ground Zero—Challenges and Opportunities for the San Joaquin Valley." *PPIC Blog*. February 15.

- **Utility consolidation and connection with other water systems can help in many places:** Bardeen, S. "Consolidating Small Water Systems Is a Springboard to Water Justice." *PPIC Blog*. November 15.
- **…as can support for upgrades of domestic wells:** Escriva-Bou, A. and R. Pauloo. "Commentary: How Better Data Can Help California Avoid a Drinking Water Crisis." *PPIC Blog*. June 14.
- **…and joint investments in new supplies:** Ayres, A. et al. 2021. *Groundwater and Urban Growth in the San Joaquin Valley*. Public Policy Institute of California.
- **Addressing affordability concerns for low-income Californians is an ongoing priority in both urban and rural settings:** Chappelle, C. and E. Hanak. 2021. *Water Affordability in California*. Public Policy Institute of California.

Water for Agriculture

- **California accounting for 12 percent of agricultural production, including more than 70 percent of the nation's fruits and nuts with annual revenues of more than $50 billion in 2021:** U.S. Department of Agriculture. Cash receipts by commodity State ranking. *Economic Research Service*.
- **Agriculture sector employs more than 420,000 people:** Escriva-Bou, A. et al. 2022. *Policy Brief: Drought and California's Agriculture*. Public Policy Institute of California.
- **Last year farmers fallowed about 400,000 acres (about 6% of 2018 acreage):** Escriva-Bou, A. et al. 2022. *Policy Brief: Drought and California's Agriculture*. Public Policy Institute of California.
- **SGMA is designed to bring overpumping to an end by the early 2040s:** California Department of Water Resources. n.d. *California's Groundwater and Sustainable Groundwater Management Act*.
- **The San Joaquin Valley has been overdrafting groundwater by close to 2 million acre-feet annually:** Escriva-Bou, A. 2019. *Technical Appendix A: Updated Assessment of the San Joaquin Valley's Water Balance* to *Water and the Future of the San Joaquin Valley*. Public Policy Institute of California.
- **At least 500,000 acres of land will likely need to come out of intensively irrigated production:** Hanak, E. et al. 2019. *Water and the Future of the San Joaquin Valley*. Public Policy Institute of California.
- **Farmers in Imperial County are being called on to reduce their use:** Becker, R. 2022. "California offers to reduce imports of Colorado River water." *CalMatters*. October 5.
- **Water trading to put water on the most productive lands and groundwater banking to manage risks:** Ayres, A. E. Hanak, B. Gray, G. Sencan, E. Bruno, A. Escriva-Bou, and G. Gartrell. 2021. *Improving California's Water Market*. Public Policy Institute of California.
- **Augment supplies through partnerships with urban areas:** Escriva-Bou, A., G. Sencan, E. Hanak, and R. Wilkinson. 2020. *Water Partnerships between Cities and Farms in Southern California and the San Joaquin Valley*. Public Policy Institute of California.
- **Encouraging growers to shift to other uses can reduce the economic and environmental costs of land fallowing, like increased dust:** Ayres, A., J. Kwon, and J. Collins. 2022. *Land Transitions and Dust in the San Joaquin Valley*. Public Policy Institute of California.
- **Encouraging growers to shift to . . .**
    - **Dryland or water-limited farming:** Peterson, C., C. Pittelkow, and Mark Lundy. 2022. *Exploring the Potential for Water-Limited Agriculture in the San Joaquin Valley*. Public Policy Institute of California.
    - **Grazing:** Peterson, C. 2022. "Could Rangeland Return to the Central Valley?" *PPIC Blog*. March 28.
    - **Wildlife habitat:** Hanak, E., C. Peterson and Abby Hart. 2022. "SGMA Could Bolster Habitat Restoration in the San Joaquin Valley." *PPIC Blog*. February 22.
    - **Solar farms:** Ayres, A. et al. 2022. *Solar Energy and Groundwater in the San Joaquin Valley: How Policy Alignment Can Support the Regional Economy*. Public Policy Institute of California.
- **The closest behind California in agricultural production is Iowa, with $35 billion in production in 2021:** U.S. Department of Agriculture. Cash receipts by commodity State ranking. *Economic Research Service*.

Water for the Environment

- **California's freshwater biodiversity has been declining for decades:** Moyle, P.B., R.M. Quiñones, and J.V. Katz. 2015. *Fish Species of Special Concern in California*. California Department of Fish and Wildlife.
- **Reduced runoff and increases in temperature are making matters worse:** Mount, J. et al. 2017. *Managing California's Freshwater Ecosystems: Lessons from the 2012–16 Drought*. Public Policy Institute of California.
- **These factors have likely played a major role in the decline of the Sacramento–San Joaquin Delta:**
    - Mahardja, B. et al. 2021. "Resistance and resilience of pelagic and littoral fishes to drought in the San Francisco Estuary." *Ecological Applications*.
    - Bashevkin, S. et al. 2022. *Synthesis of data and studies related to the effect of climate change on the ecosystems and biota of the Upper San Francisco Estuary*. Interagency Ecological Program.
- **Drought can lead to fundamental changes in ecosystem conditions as water quality declines:** Pottinger, L. 2016. "How Green Is My Water?" *PPIC Blog*. August 2.
- **More than 80 percent of native freshwater fishes are in decline:** Leidy, R.A. and P.B. Moyle. 2020. "Keeping up with the status of freshwater fishes: A California (USA) perspective." *Conservation Science and Practice*.
- **Almost half the runs of steelhead and salmon are facing extinction by the end of the century:** Lusardi, R., P. Moyle, P. Samuel, and J. Katz. 2017. "The Future of California's Unique Salmon and Trout: Good News, Bad News." *California WaterBlog*.
- **Healthy ecosystems serving as important natural infrastructure to . . .**
    - **Manage floods:** Pottinger, L. 2019. "Reducing Flood Risk in the Central Valley." *PPIC Blog*. November 19.
    - **Recharge groundwater:** California Department of Water Resources. 2022. "Going with the Flow: How Aquifer Recharge Reduces Flood Risk." *DWR Updates*.
    - **Improve water quality:** Cheng, F.Y., K.J. Van Meter, D.K. Byrnes, and N.B. Basu. 2020. "Maximizing US nitrate removal through wetland protection and restoration." *Nature*.
- **Ecosystem-based management integrates the environment into all phases of decision-making:** Mount, J. et al. 2019. *A Path Forward for California's Freshwater Ecosystems*. Public Policy Institute of California.
- **Making this work may require establishing assets for the environment:** Mount, J., et al. 2017. *Managing California's Freshwater Ecosystems: Lessons from the 2012–16 Drought*. Public Policy Institute of California.
- **Allocating environmental water as "functional flows" to get the most ecosystem benefit:** Grantham, T., J. Mount, S. Yarnell, and E.D. Stein. 2020. *Making the Most of Water for the Environment: A Functional Flows Approach for California's Rivers*. Public Policy Institute of California.
- **Reservoir storage space that can be flexibly used to adapt to changing conditions:** Null, S., J. mount, B. Gray, K. Dybala, G. Sencan, A. Sturrock, B. Thompson, and H.B. Zeff. 2022. *Storing Water for the Environment*. Public Policy Institute of California.
- **Funding to restore physical habitat:** Hanak, E. and G. Sencan. 2022. "Water Trading Can Help California's Struggling Freshwater Ecosystems." *PPIC Blog*. April 4.
- **Accelerating the pace and scale of physical habitat improvements through more nimble permitting is vital:** Grenier, L., S. Panlasigui, C. Pickett, G. Sencan. 2021. *Advancing Ecosystem Restoration with Smarter Permitting*. Public Policy Institute of California.
- **This year's statewide Programmatic Biological Opinion for restoration programs is a major step in the right direction:** U.S. Fish and Wildlife Service. 2022. "Aquatic restoration projects made easier in California thanks to new statewide consultation available to federal agencies." *Press Release*. September 15.
- **The extensive portfolio of actions provided in the governor's Water Supply Strategy left the environment out:** *California's Water Supply Strategy - Adapting to a Hotter, Drier Future*. 2022. August.

Wet-year Strategy

- **Climate models do not project a California that is in a permanent state of drought:** State of California. *Key Findings*. California's Fourth Climate Change Assessment.
- **Drought intensity and storm intensity are both increasing:** Swain, D.L., B. Langenbrunner, J.D. Neelin, and A. Hall. 2018. "Increasing precipitation volatility in twenty-first-century California." *Nature Climate Change*.
- **Flood-managed aquifer recharge on farms is gaining considerable momentum:**
    - California Department of Water Resources. 2022. "Going with the Flow: How Aquifer Recharge Reduces Flood Risk." *DWR Updates*.
    - Sustainable Conversation. n.d. *Refilling Our Underground Savings Account*.
    - Marr, J., D. Dhillon, D. Arrate, S. Stygar, and R. Maendly. 2018. *FLOOD-MAR: Using Flood Water for Managed Aquifer Recharge to Support Sustainable Water Resources*. California Department of Water Resources.
- **The seven Proposition 1 Water Supply Infrastructure Program projects are all focused on storing water during wet periods:** Sencan, G. and J. Mount. 2022. "The Environmental Benefits of the Water Storage Investment Program." *PPIC Blog*. September 26.
- **Cities—particularly in the South Coast—are developing new stormwater capture systems:** Escriva-Bou, A., G. Sencan, E. Hanak, and R. Wilkinson. 2020. *Water Partnerships between Cities and Farms in Southern California and the San Joaquin Valley*. Public Policy Institute of California.
- **Reservoir operators are using new forecasting models to better manage the trade-offs between flood protection and water supply during storms:** Center for Western Weather and Water Extremes. n.d. *Forecast Informed Reservoir Operations*.
- **California already has some very good models for how to do this through existing groundwater banks:** Ayres, A. E. Hanak, B. Gray, G. Sencan, E. Bruno, A. Escriva-Bou, and G. Gartrell. 2021. *Improving California's Water Market*. Public Policy Institute of California.
- **Modeling suggests that extreme regional floods are becoming more likely:** Huang, X. and D. Swain. 2022. "Climate change is increasing the risk of a California megaflood." *Science Advances*.