# Adapting to Chronic Drought in California

## Continuing to Make Craft Beer when Water is Scarce

**California Craft Brewers Association Meeting**
**December 3, 2021**

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UC Davis Emeritus Professor

PPIC PUBLIC POLICY INSTITUTE OF CALIFORNIA

# Outline

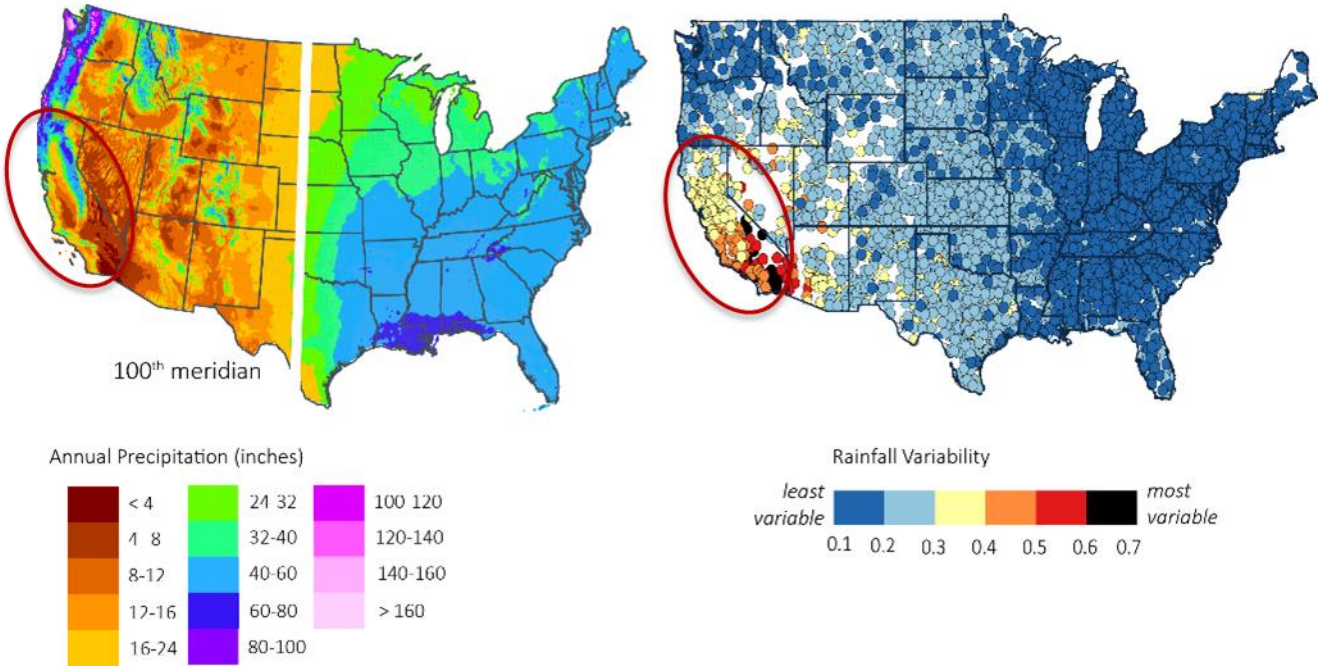
- Challenges of increasing water scarcity
- Looking at the future of supply (a short tutorial)
- The looming threat of wastewater discharge regulations
- Update on water use by the California craft brew industry
- Conclusion: California remains a very good place to brew beer.

# Two drought-related challenges for California craft brewers

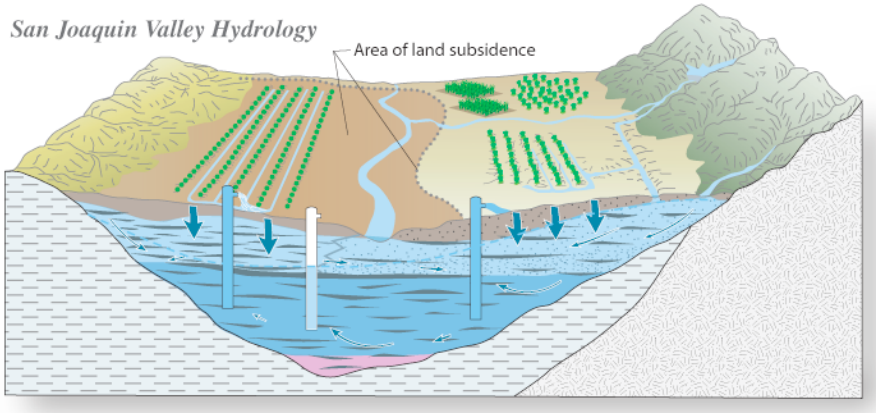
Reliability and Cost of Water Supplies

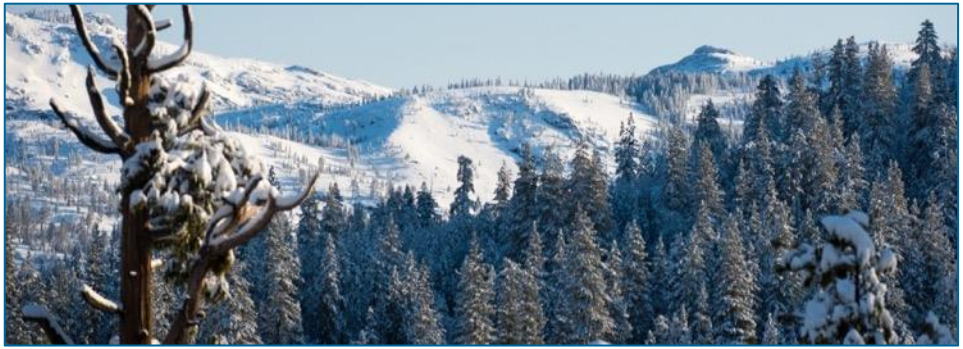
Rising Costs of Wastewater Treatment

# Reminder: Western US is drier, with more variable precipitation—California is most variable



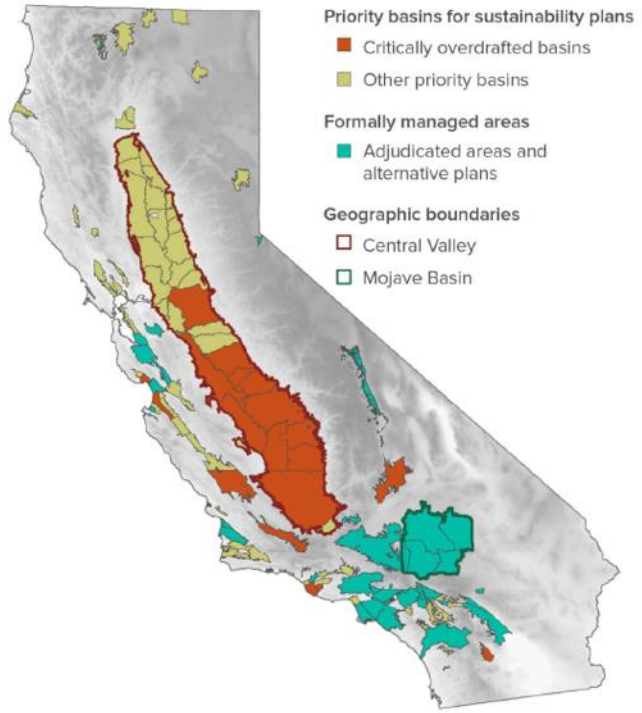
# Management relies heavily upon storage



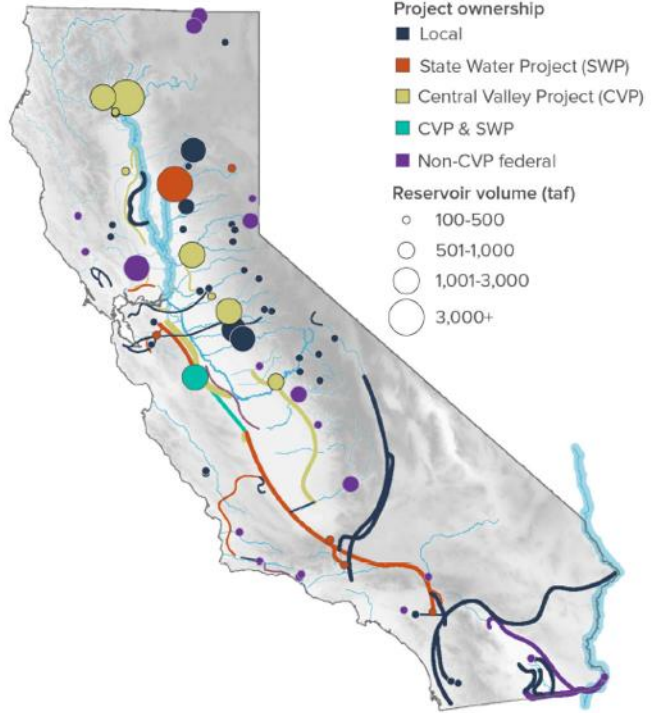



# And a “water grid”

A) California’s main groundwater basins




B) California’s main surface water grid

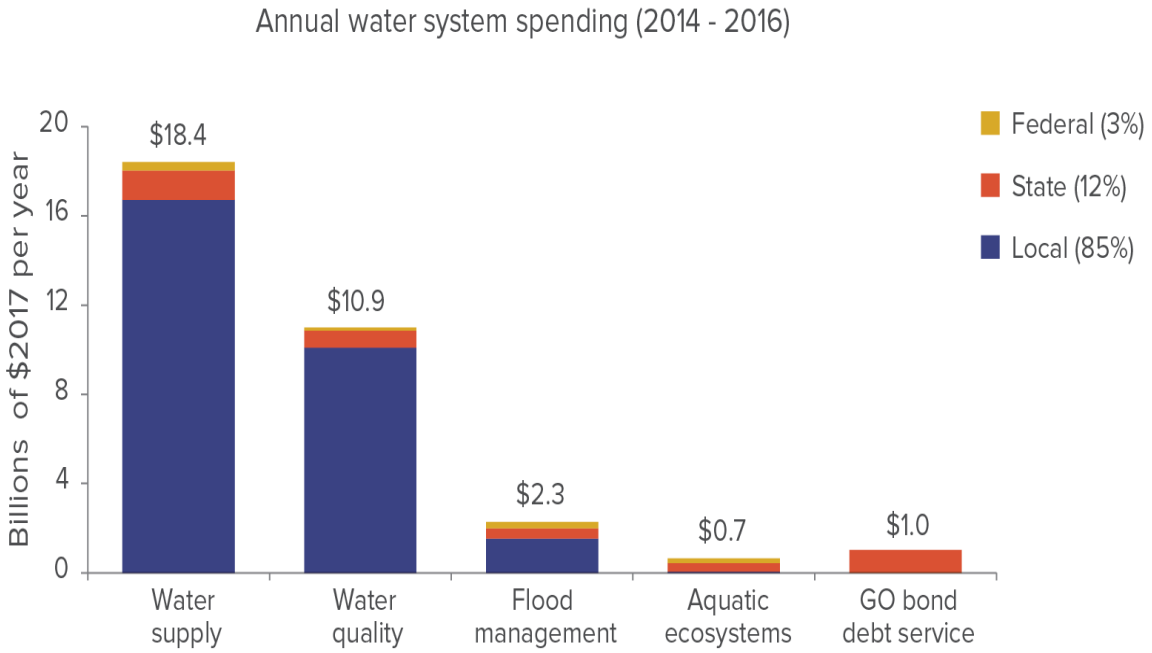


# And allocation, trading, environmental regulation

- Century-old water rights system specifically designed for scarcity
- Growing but still small water markets and trading
- Clean Water Acts, Endangered Species Acts, etc.


# And reliable funding

- Reliable sources of funding are crucial
- Ratepayers the most abundant source
- But there are many fiscal orphans
  - Poor rural communities
  - Flood protection
  - Ecosystems



# Looking out over the horizon

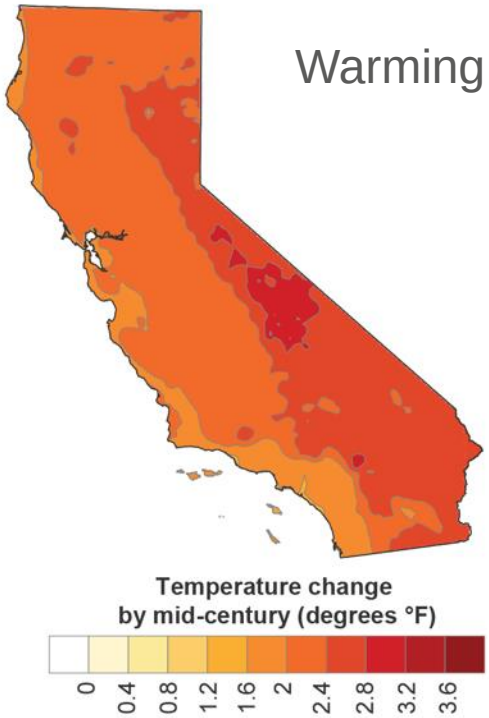
# Five climate pressures impact water scarcity



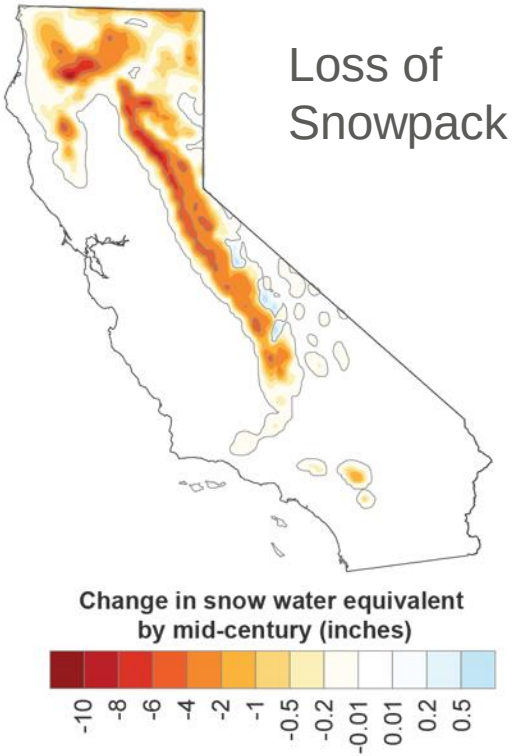


# California is warming and snowpack is changing

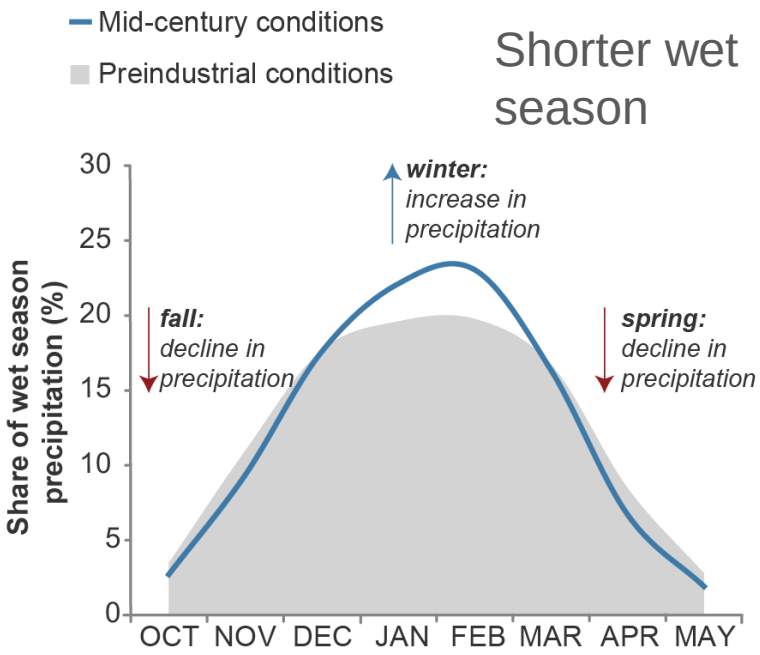
Warming

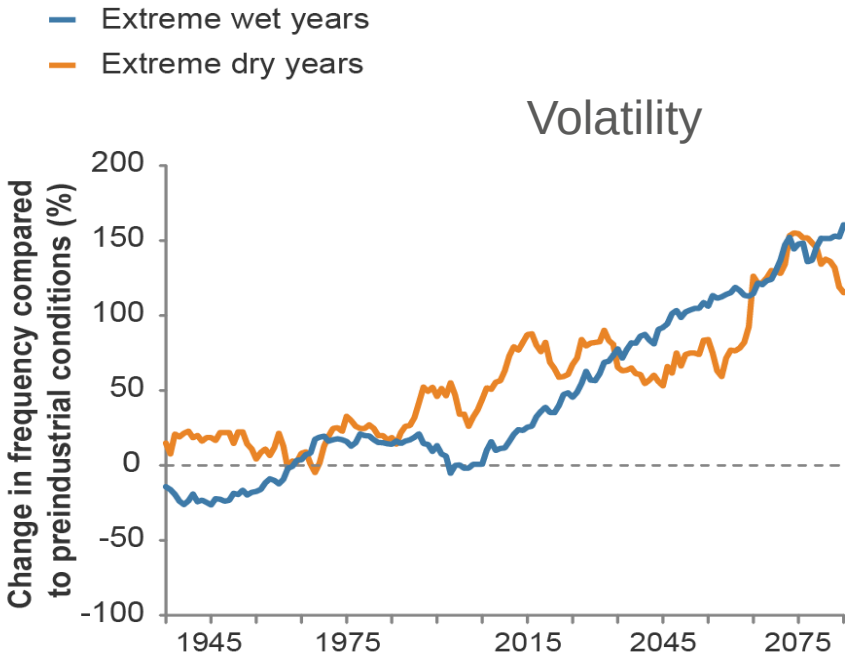



Loss of Snowpack

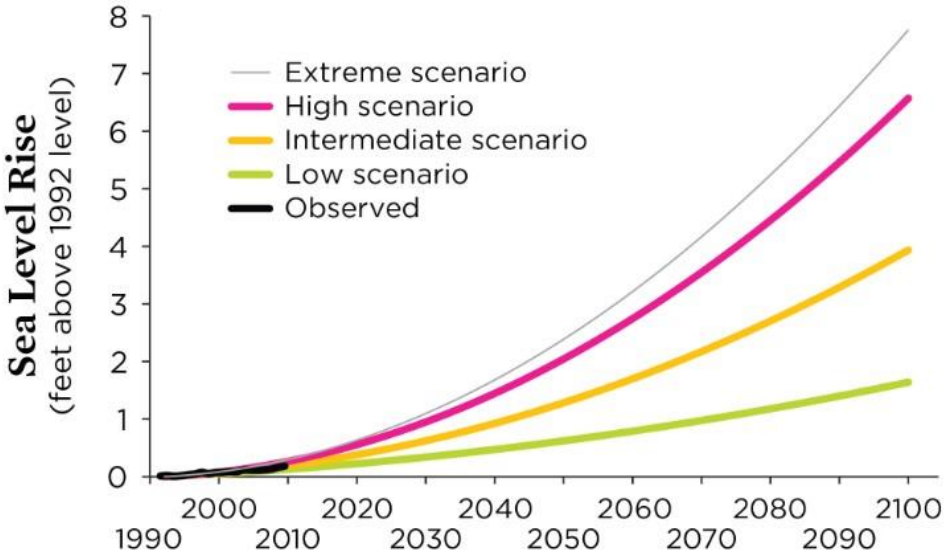


# Shorter wet season and increasing volatility



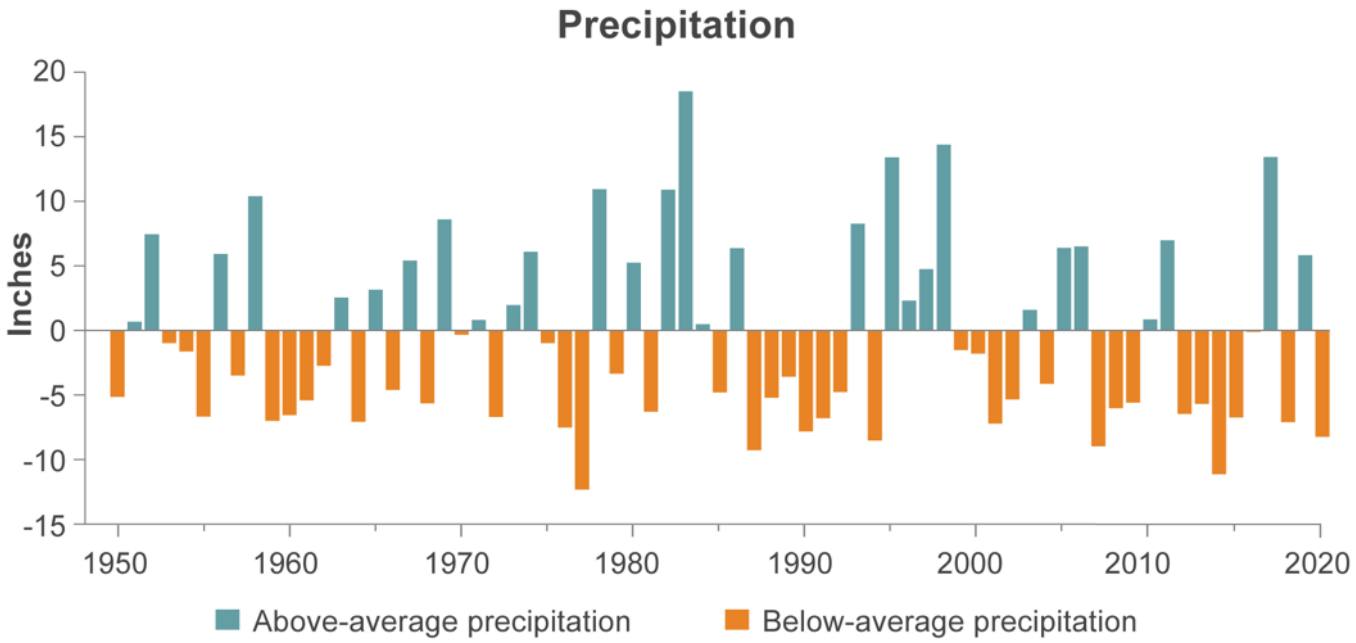
# Continued sea level rise





**Sea level rise impacts coastal aquifers and Delta**

# Climate Change: Are we in a megadrought?




Source: Climate Tracker, Western Regional Climate Center

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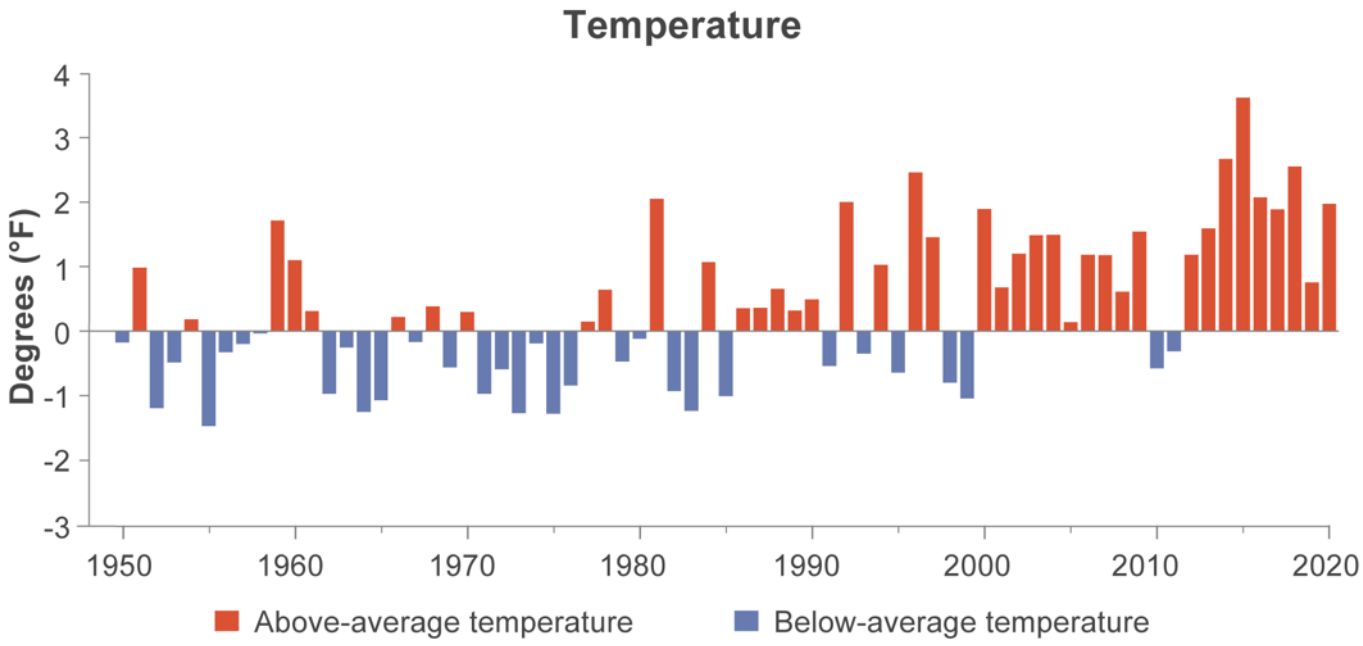
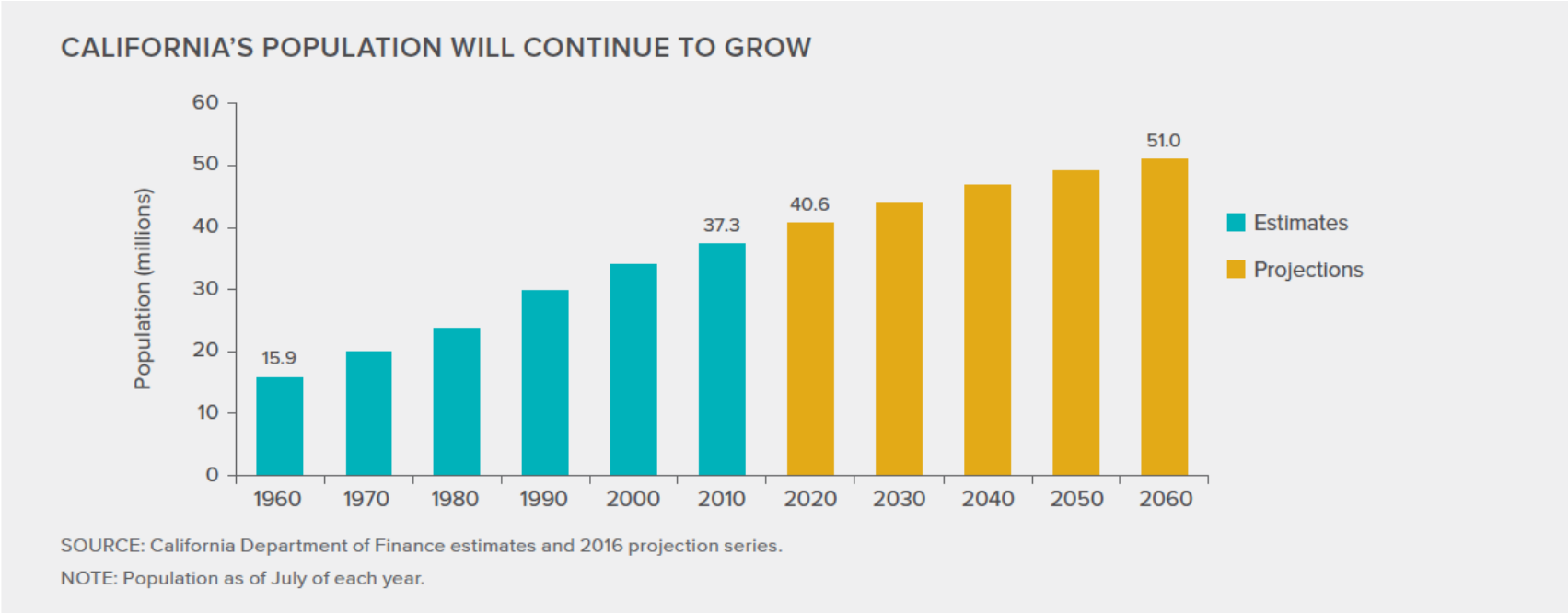



Source: Climate Tracker, Western Regional Climate Center

# Will population growth will create more pressure?





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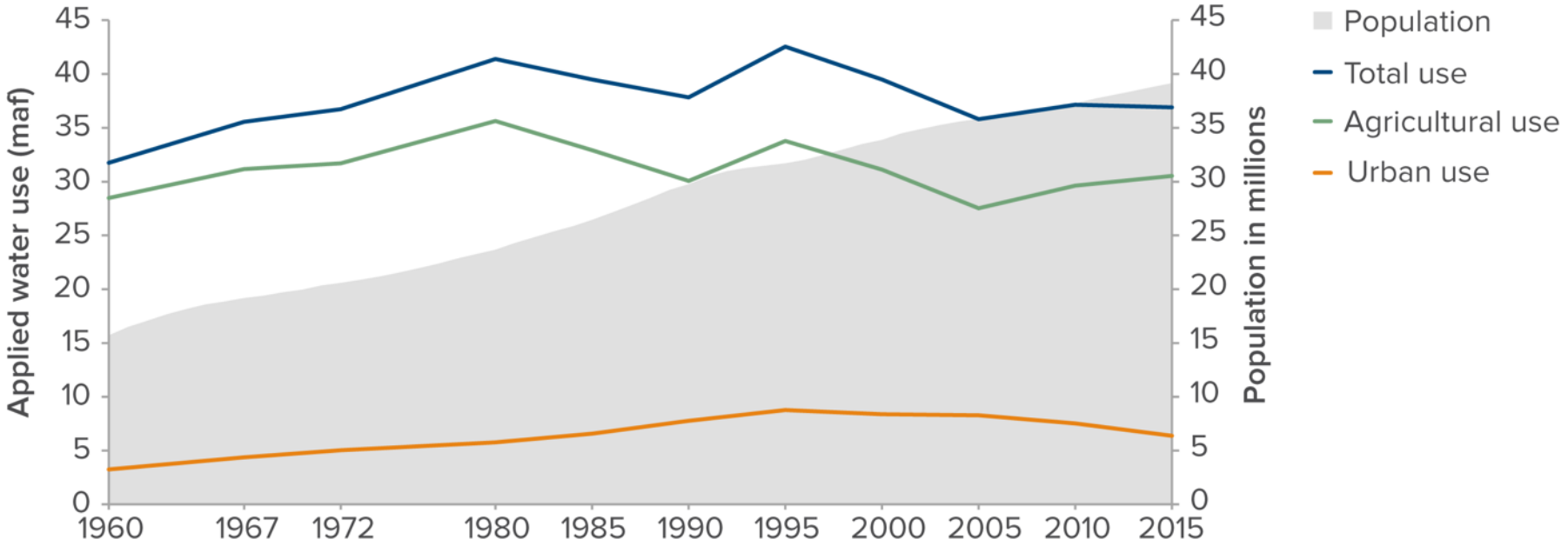
# Yes, but even with growth, we can adapt…



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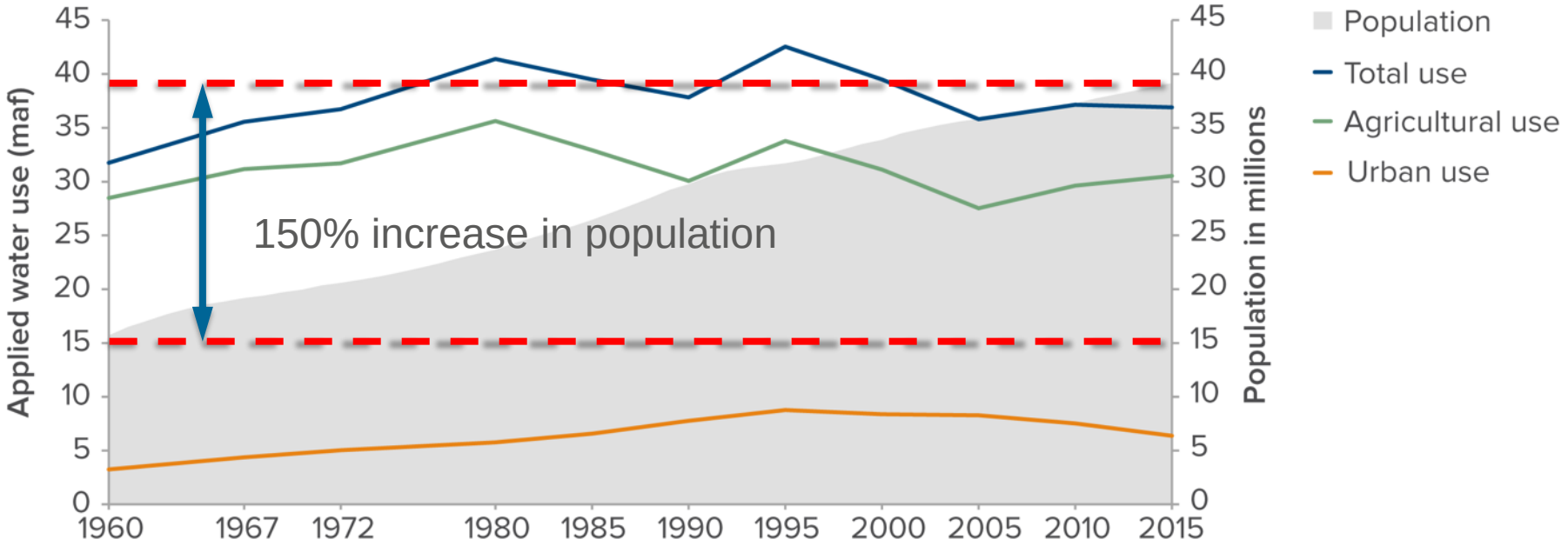
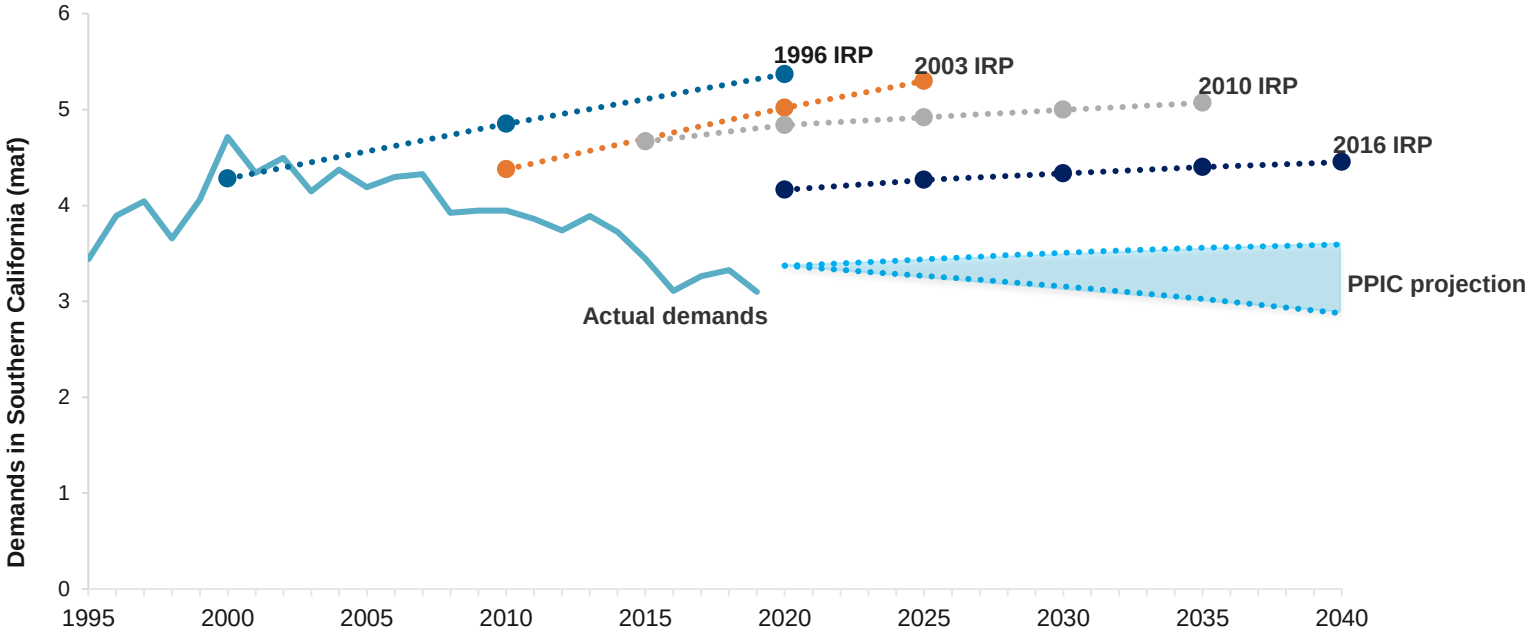
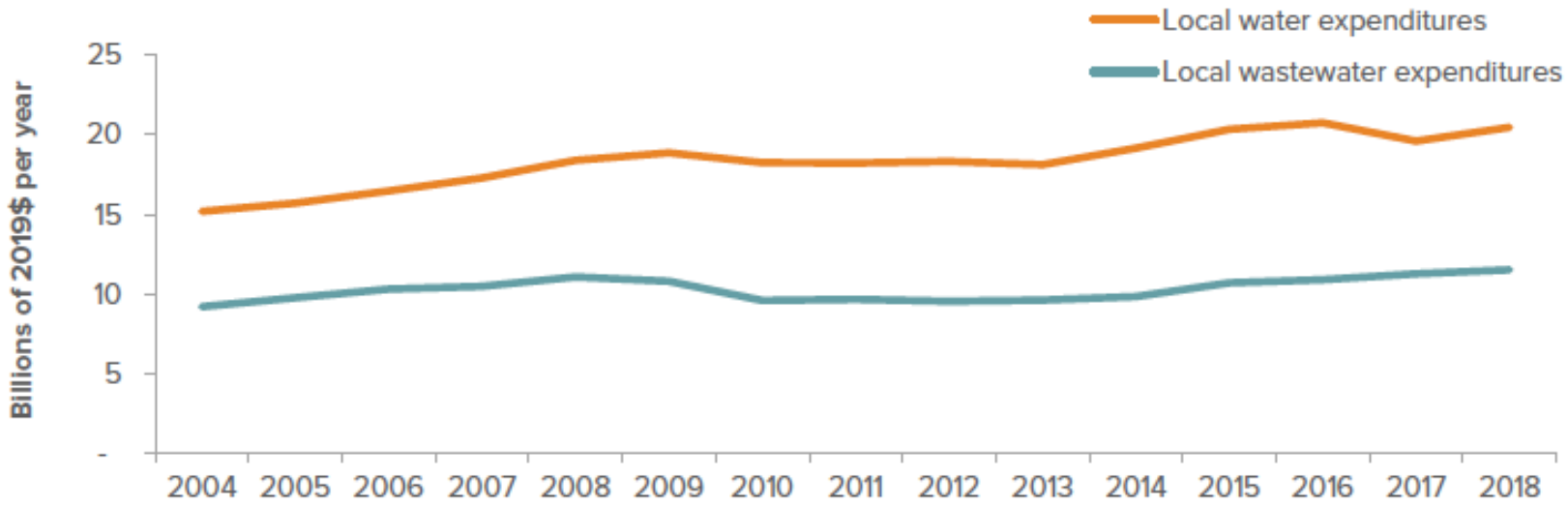


# Regional water demands and demand projections have been falling (example: Southern California)



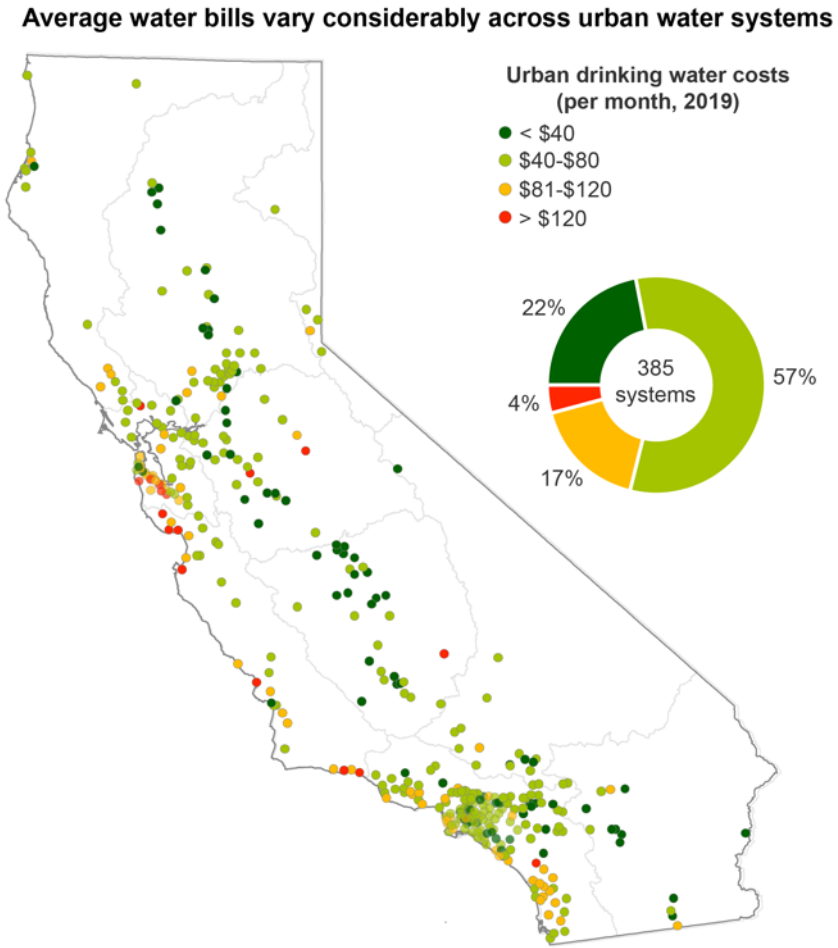
# Even with ability to adapt, costs will continue to rise

Local agencies are spending more to operate and maintain their systems



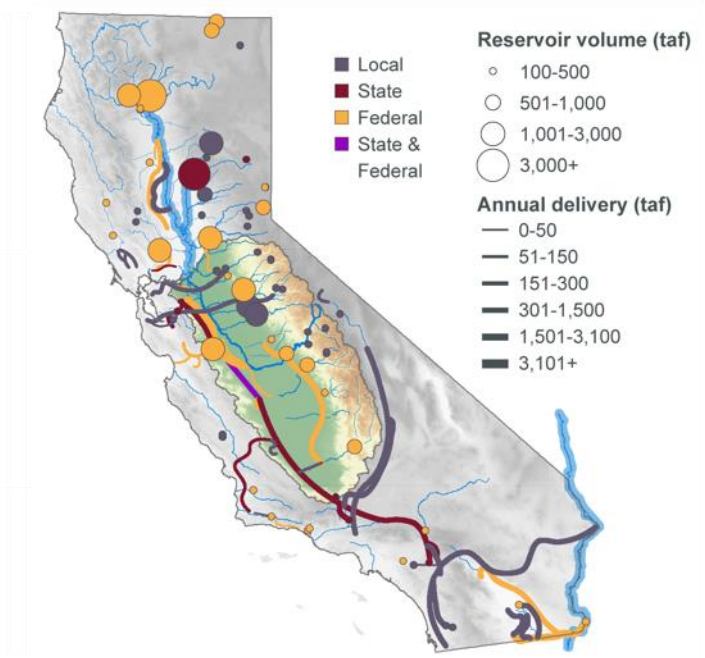

**Source:** Author estimates using data from the California State Controller's Office.

# Location Matters: Costs will vary depending on region



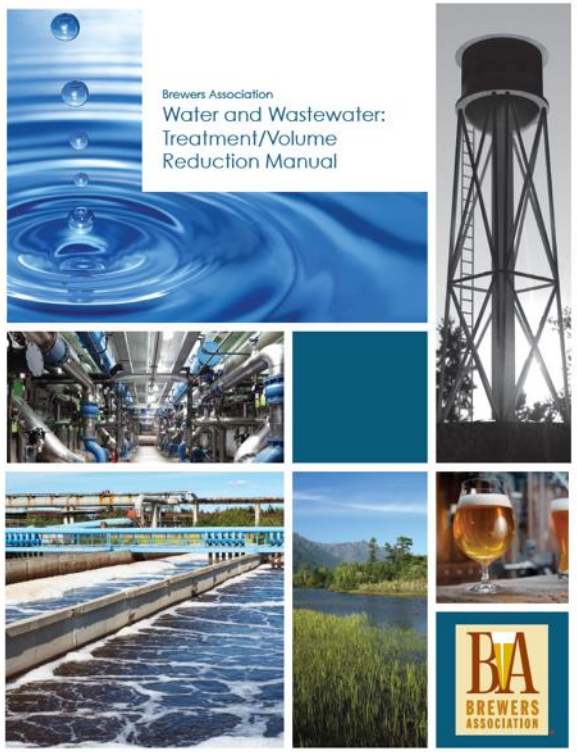
# Key Takeaways about Future Supplies

1) Locations that can tap into the statewide grid are likely to have the most secure supplies
2) Groundwater-only is high risk
3) Urban areas with a diverse portfolio of sources are best
4) Climate change, aging infrastructure will increase scarcity and related costs
5) But based on experience there will be useful adaptation



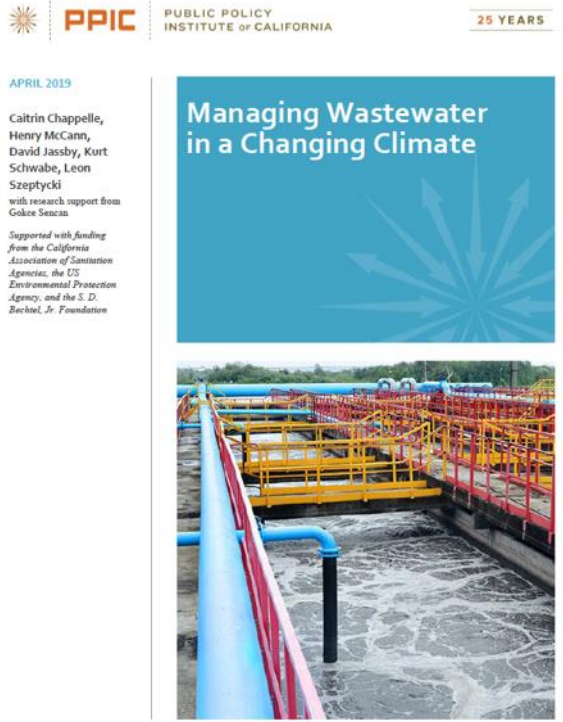
# Wastewater treatment challenges

- Significant current costs associated with:
  - TSS
  - BOD
  - Total discharge
- Every indication that these costs will increase in the future
- And there are likely to be some surprises



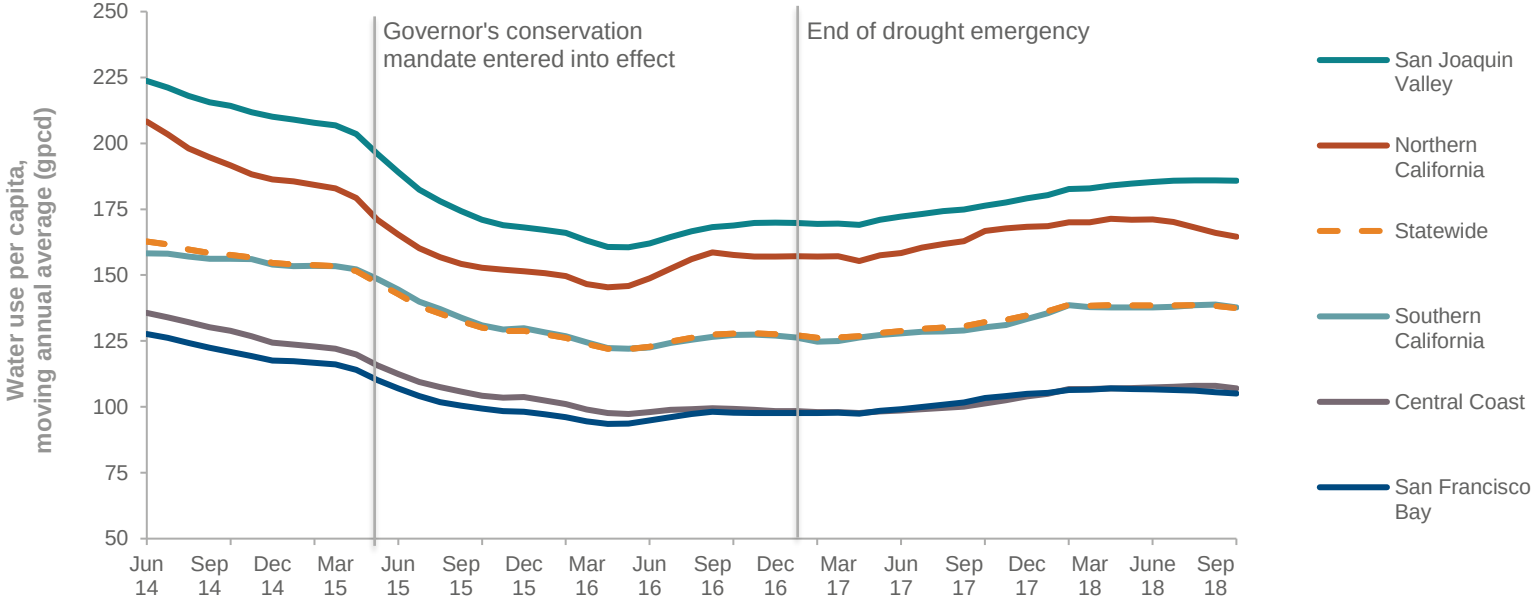
# Wastewater treatment challenges

- Increasing demand for recycled water
- Increasing concentration of waste streams
- Changing  water quality standards, including contaminants of emerging concerns
- Increasing demand for environmental flows
- Aging infrastructure and changing climate (rising sea level)



# Urban water use during drought

## Scarcity translates to conservation and reduced wastewater streams



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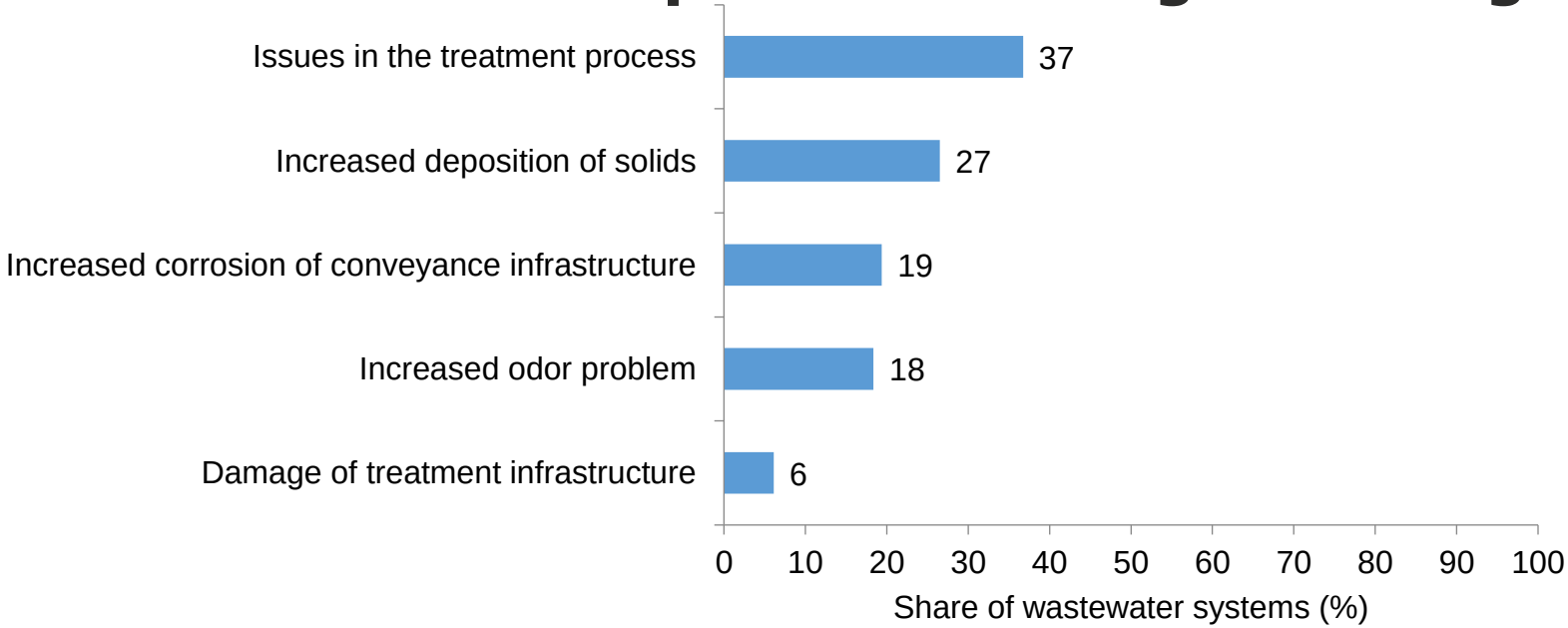
# Wastewater agencies experienced problems with infrastructure and operations during the drought

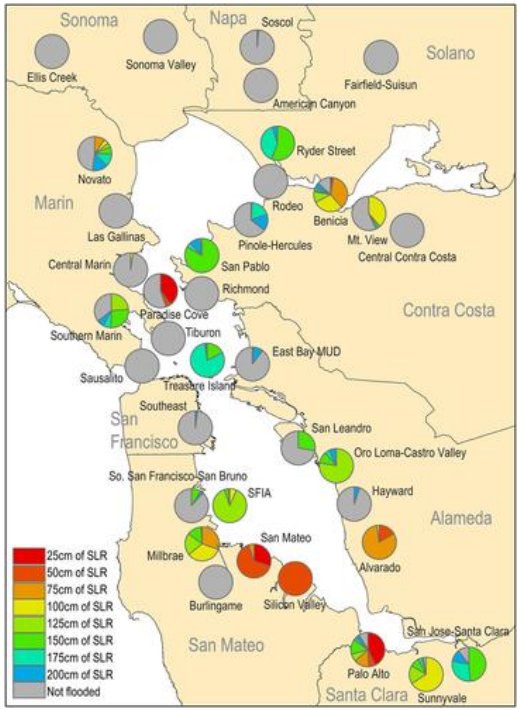



N = 98

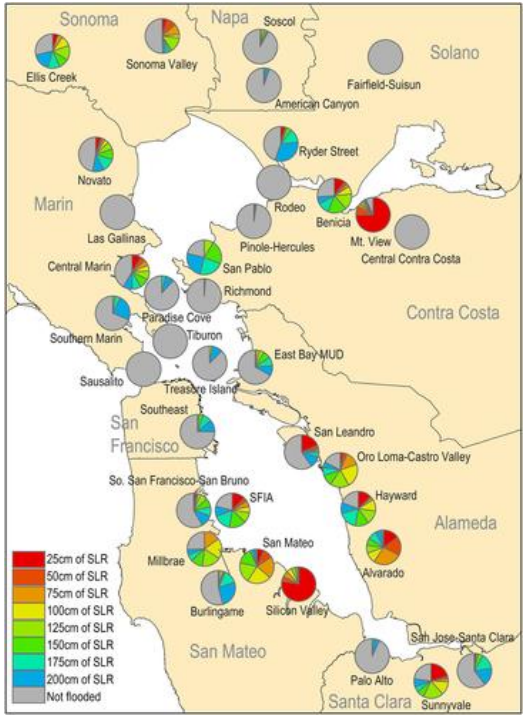
This all occurred when demand for recycled wastewater was rapidly increasing

# Sea level rise a major problem for treatment plants: Example of potential flooding in SF Bay Area

**Treatment Plants at Risk from Ocean Flooding**




**Treatment Plants at Risk from Groundwater Flooding**




Source: Hummel et al., 2018

**Typical Ranges Of Brewery Untreated "End-Of-Pipe" Wastewater Effluent**

| PARAMETER | TYPICAL RANGE |
|---|---|
| Water to beer ratio | 4 - 10 liter/liter |
| Wastewater to beer ratio | 1. 3 - 2 liter/liter lower than water to beer ratio |
| Biochemical Oxygen Demand (BOD) | 600 - 5,000 ppm |
| Chemical Oxygen Demand (COD) | 1,800 – 5,500 ppm |
| Nitrogen | 30 - 100 ppm |
| Phosphorus | 30 - 100 ppm |
| pH | 3 - 12 |
| Total Suspended Solids (TSS) | 200 – 1,500 ppm |

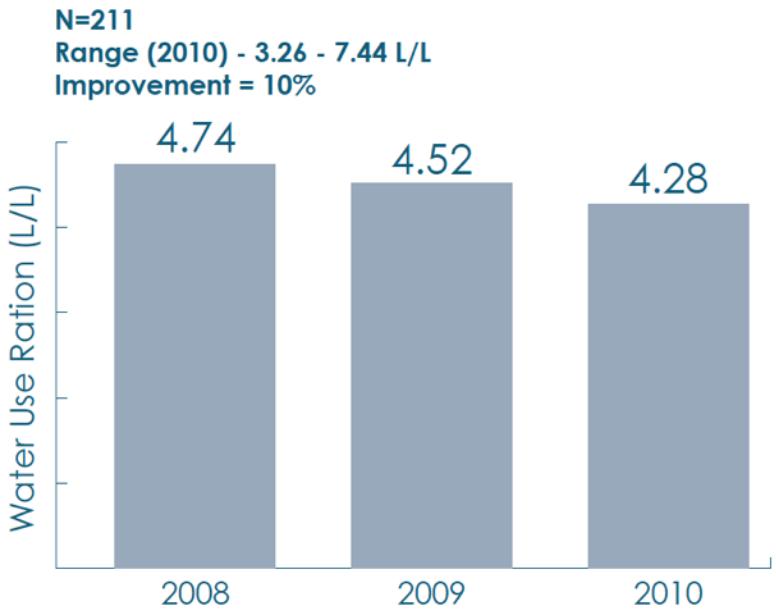
Source: Brewer's Association

- Larger, newer facilities better able to handle wastewater load
- Expect increasing costs for treatment due to higher facility costs and new regs
- Build into planning that growth will eventually lead to increased demand for on-site treatment of BOD, TSS and total discharge
- Recycling helps with sustainability goals, but…

# Finally, how much water are you using?

- Important to understand ”applied” vs “consumptive” or “net” use
- Assume for every 5 bbl water, 1 bbl beer, 3 bbl discharge.
- Net on-site water use is < 2 bbl water/1 bbl beer
- Really matters where it goes from there
- And how much “product” gets recycled  back into system (?)

BIER Water Use Ratios

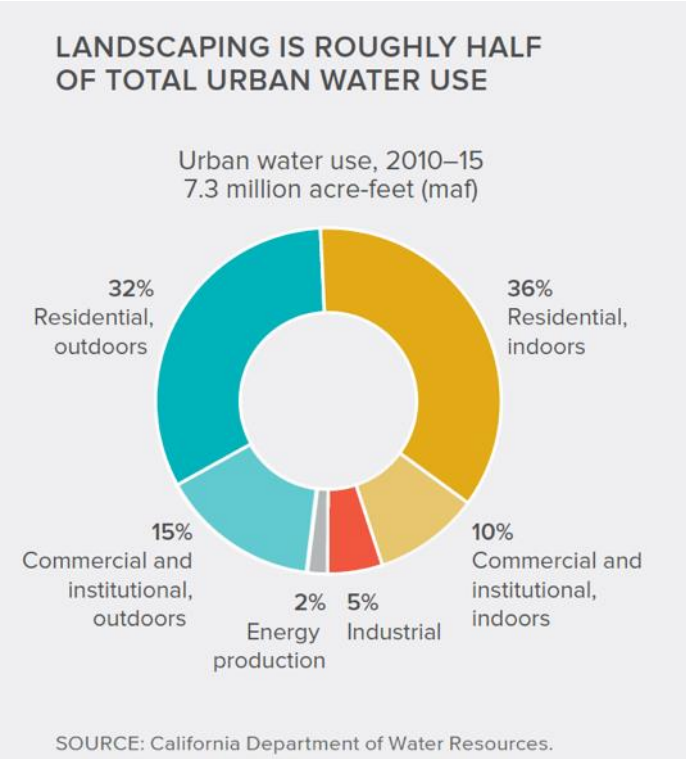


# Finally, how much are you using?

- According to Tom M., **3.7 M** barrels produced in 2020
- Applied water use: 18.5 M bbl
- Assume 7.4 M bbl onsite net usage
- Assume 11.1 M bbl of wastewater discharge.  Some net, some reused.
- *It all depends on where you are. Also whether you recycle on-site.*

# How do you compare with other applied use?

- Some useful comparisons:
  - Less than .04% of almond industry (USDA figures)
  - .2% of total urban commercial water use
  - annual water use of 10,000 southern Californians (150 gal/day) or about 1/4th of City of Davis' water use



# Finally, how do you compare?

**BUT** if you count hops and barley

- According to Tom M, 55 lbs of barley and 1.3 lbs hops/barrel = 104,000 tons
- Yields/acre = 1 ton; water use = 2 acre-ft/acre (UC Extension)
- 208,000 acre-feet of water to grow hops and barley
- When combined with use on-site, enough water for 1.23 million southern Californians.*

*all but a small fraction imported to California

# Summary of Takeaways

- 1) Do your homework on supply. Grid-connected, large, diversified urban areas do the best. Small, groundwater-dependent rural areas the worst.
- 2) Plan on escalating costs for water and wastewater treatment, including a mandate for on-site treatment.
- 3) Your industry uses a LOT of water for hops and barley (imported), but a very small amount for production.

# Thanks.  No, really, I mean it.  Thanks.

# About these slides

These slides were created to accompany a presentation. They do not include full documentation of sources, data samples, methods, and interpretations. To avoid misinterpretations, please contact:

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Thank you for your interest in this work.