CALIFORNIA DEPARTMENT OF WATER RESOURCES

San Joaquin Basin Watershed Studies

Advancing Sustainable Water Management Through Flood Managed Aquifer Recharge: Insights from the San Joaquin Flood-MAR Watershed Studies

Assessing Climate Vulnerability

May 14th, 2025

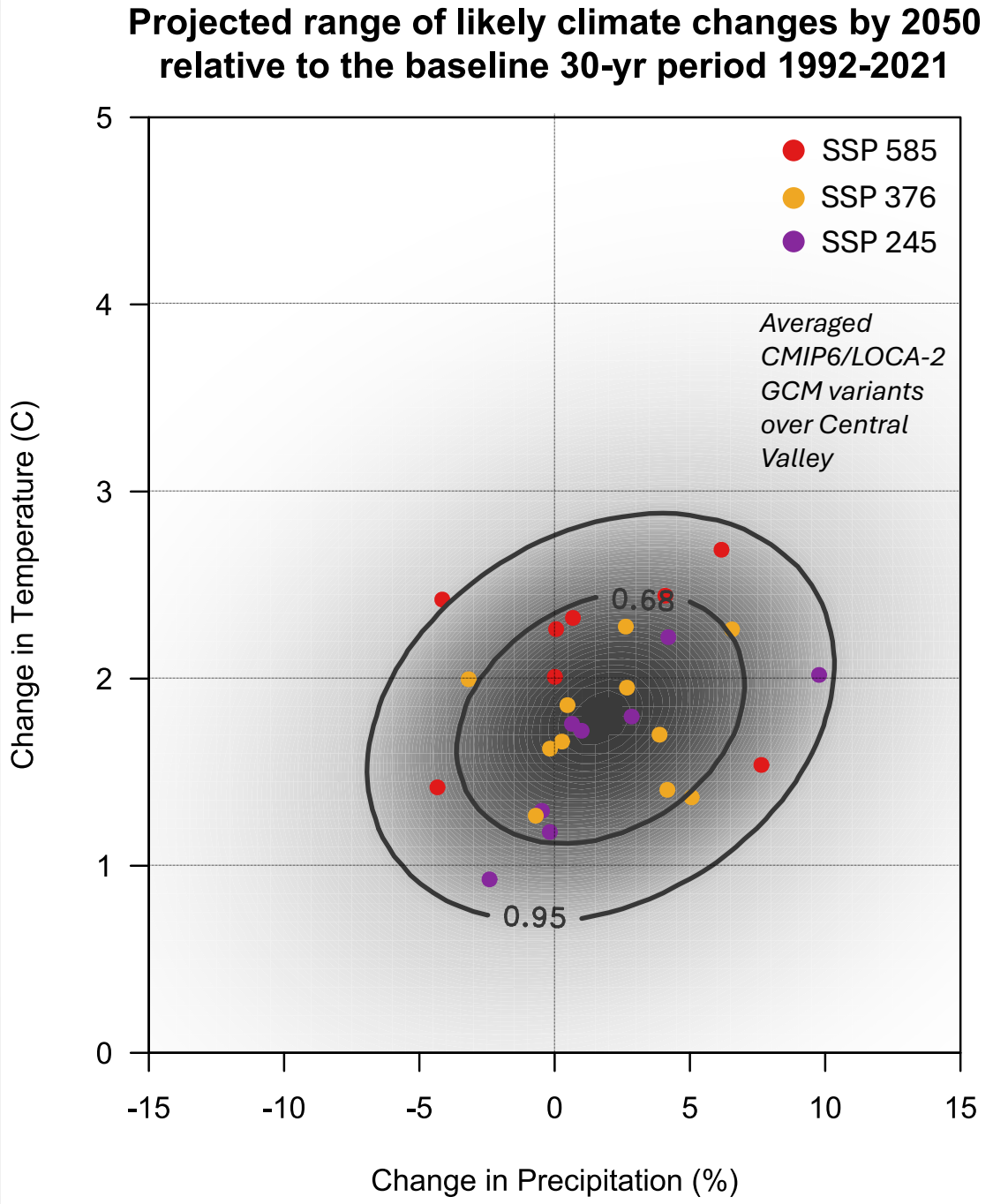
Overview

1) Climate change analysis
2) Major driver: changes in watershed conditions
3) Vulnerability assessment, by sector:
    a. Flood
    b. Water supply
    c. Ecosystems

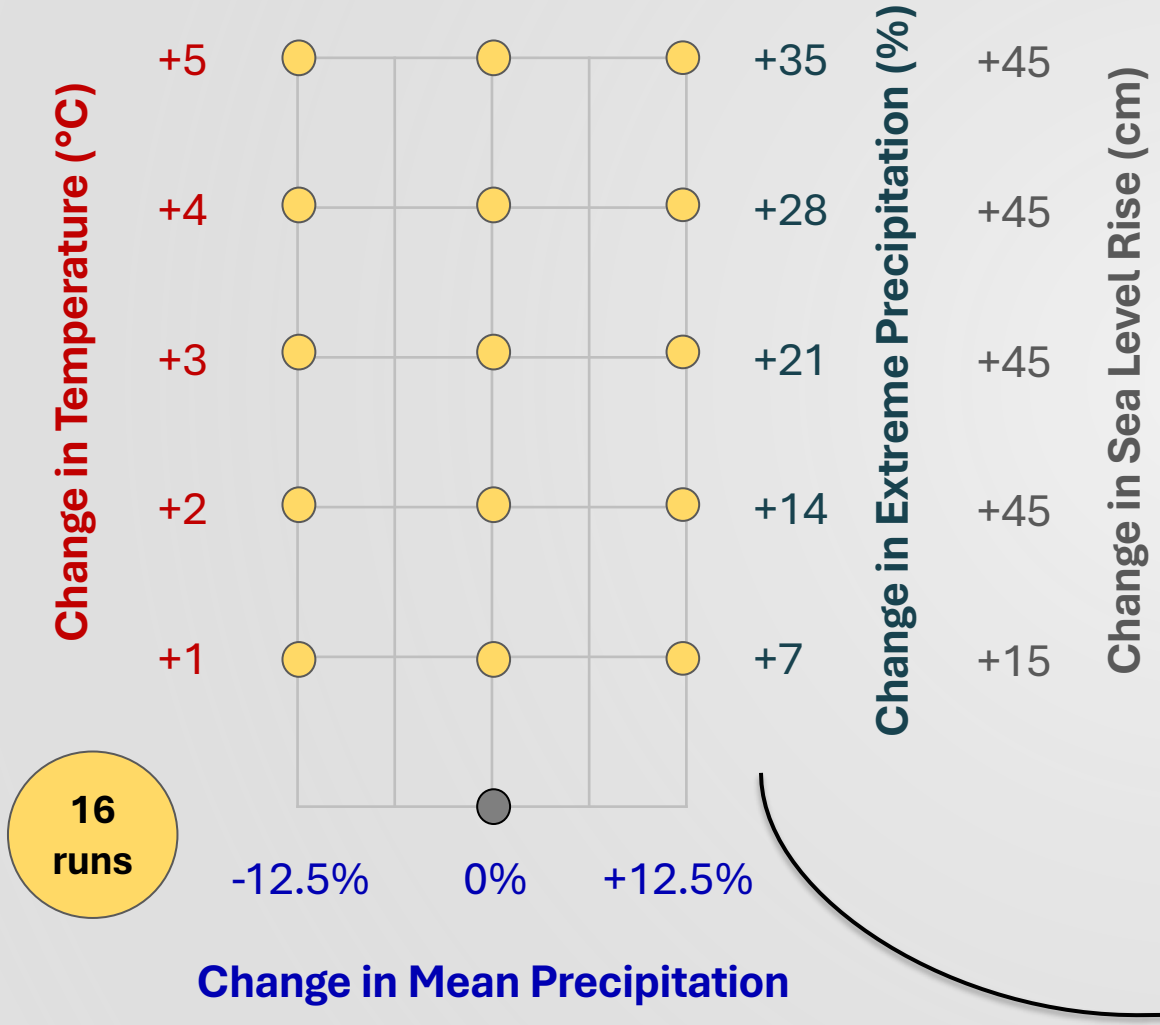
1) Climate change analysis

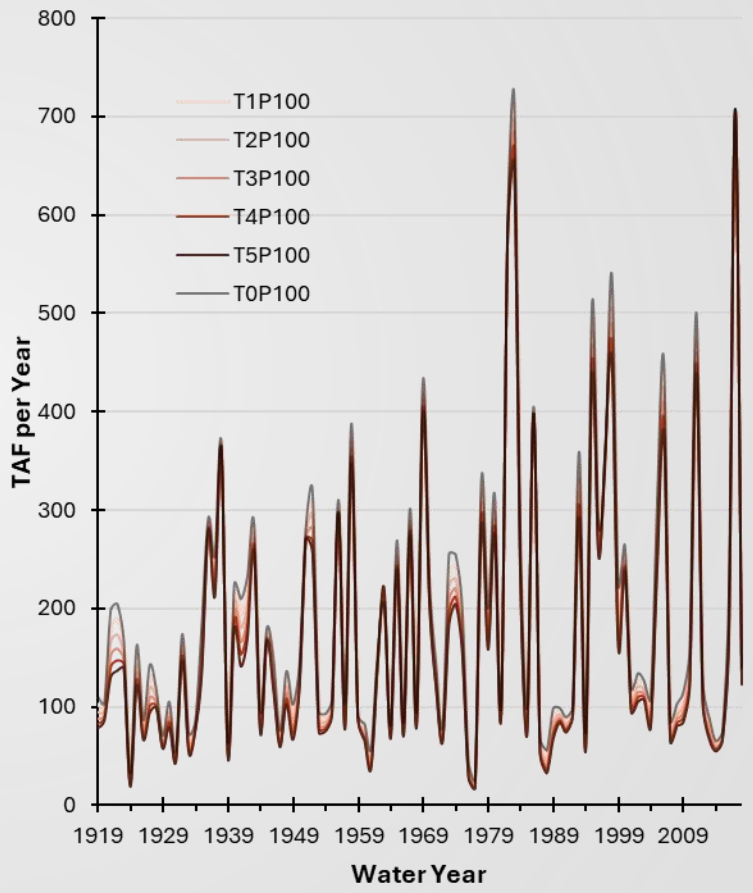
Risk-based climate change analysis

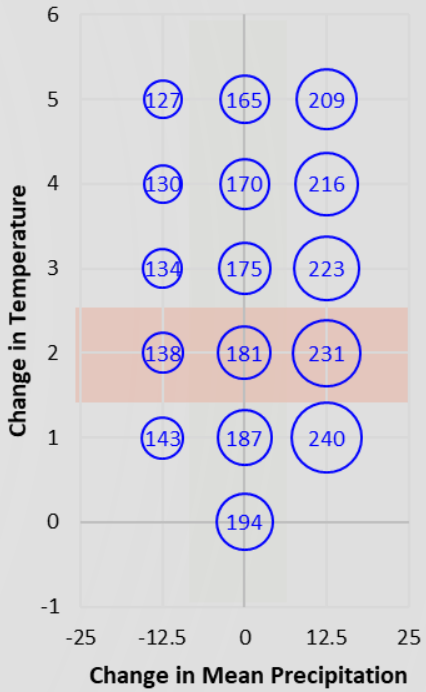
- Probabilistic approach to GCM information
- Combined with system performance response
- Provides risk-based measures of performance



One hundred years of continuous simulation under each climate condition:

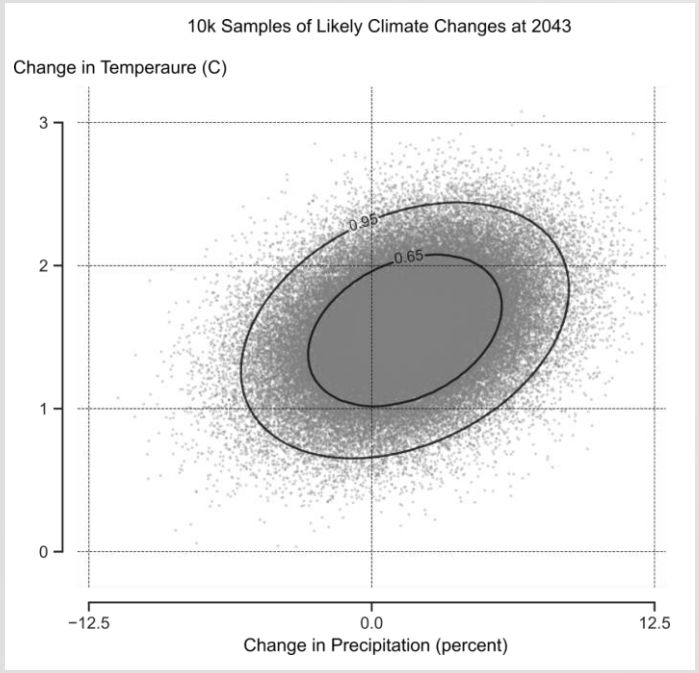


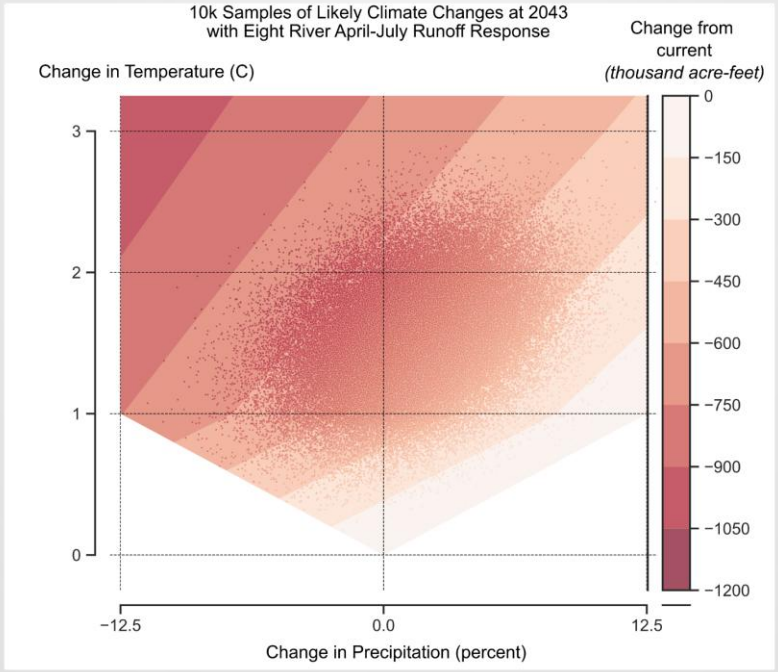


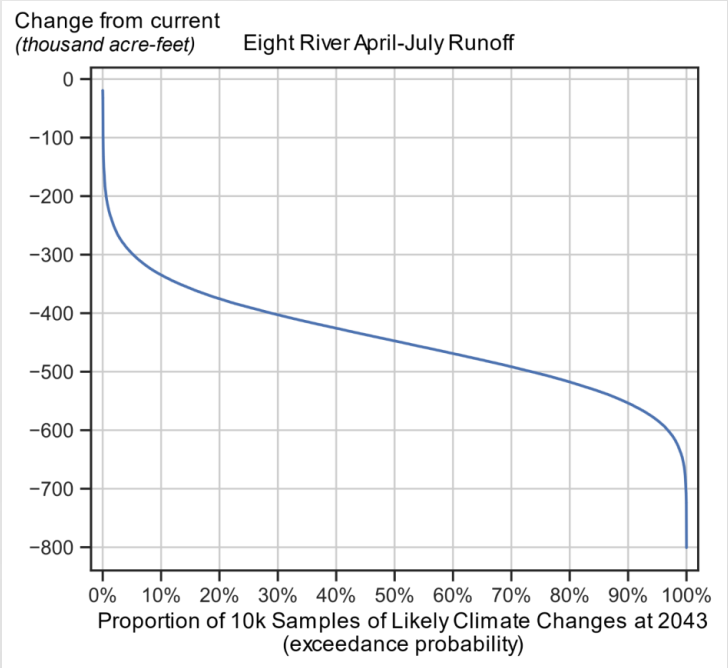


Distribution of system performance outcomes at future time horizon:

Climate Condition Sampling + **System Response Surface** = **CDF of Changes in System Perf.**

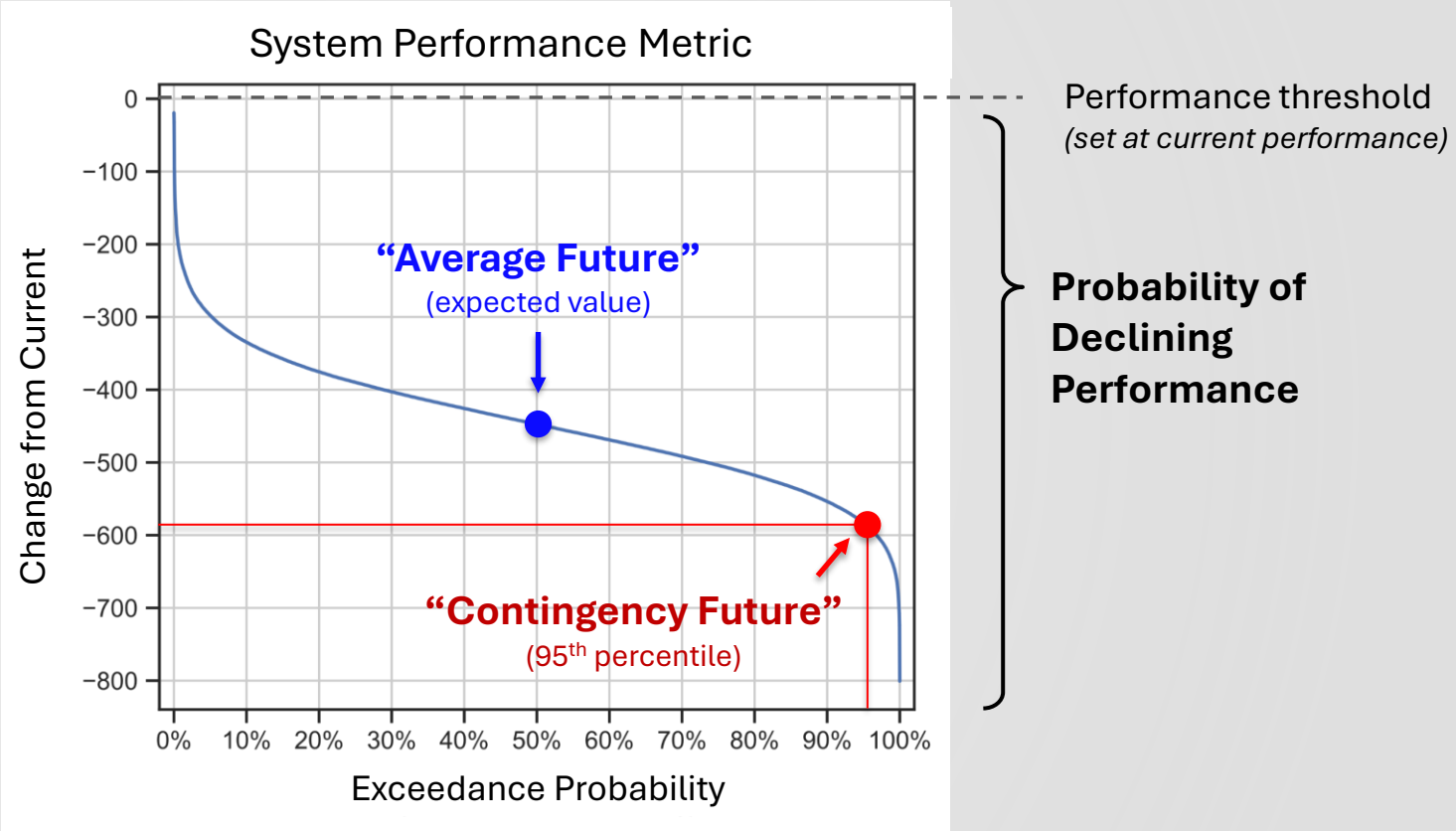






Three risk-based measures of performance

- What to expect
- If worse, by how much (5% chance)?
- Likelihood of being worse (by any amount)



2) Major driver: changes in watershed conditions

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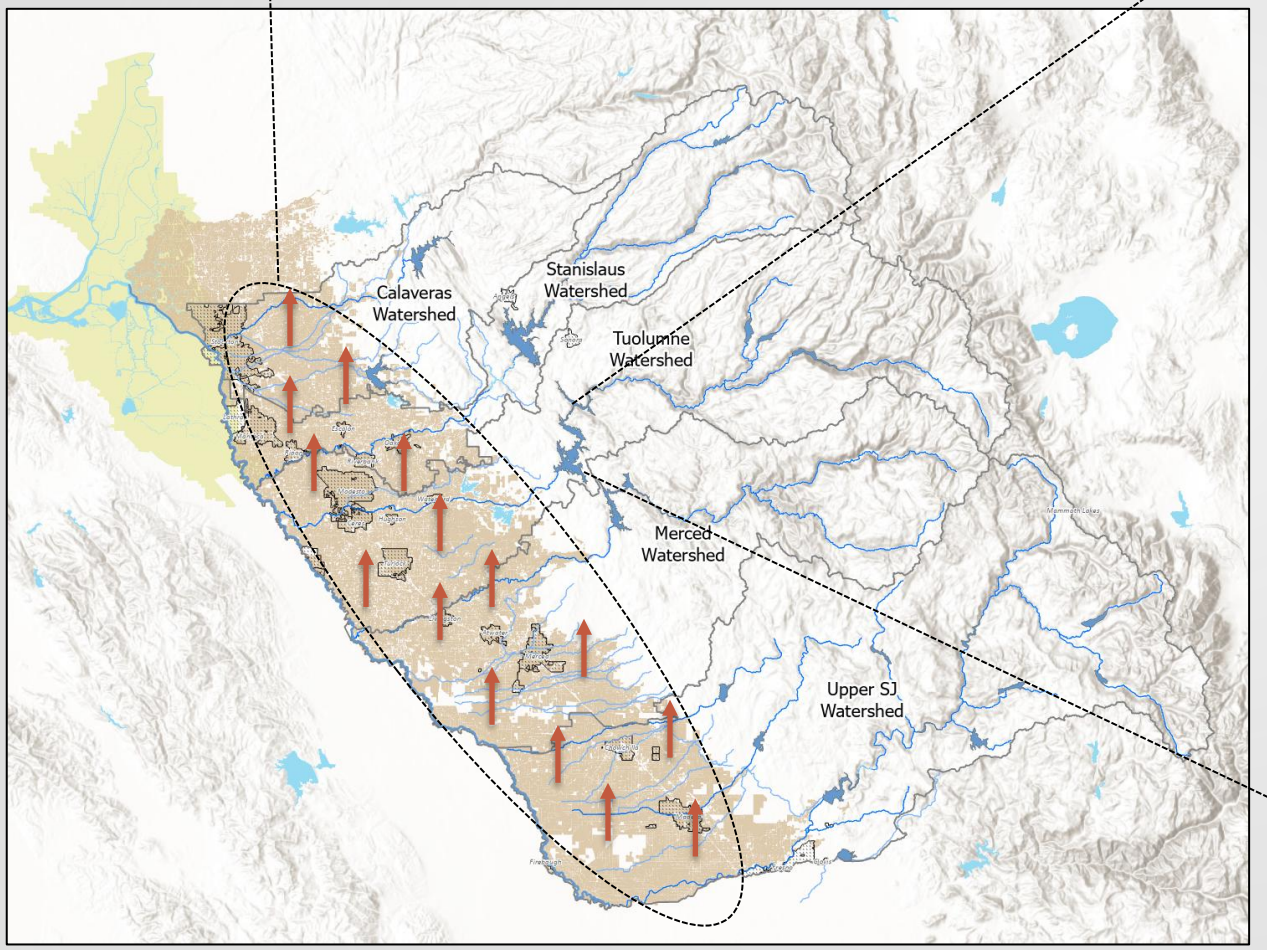
1) Increase in applied water demand

Current Climate

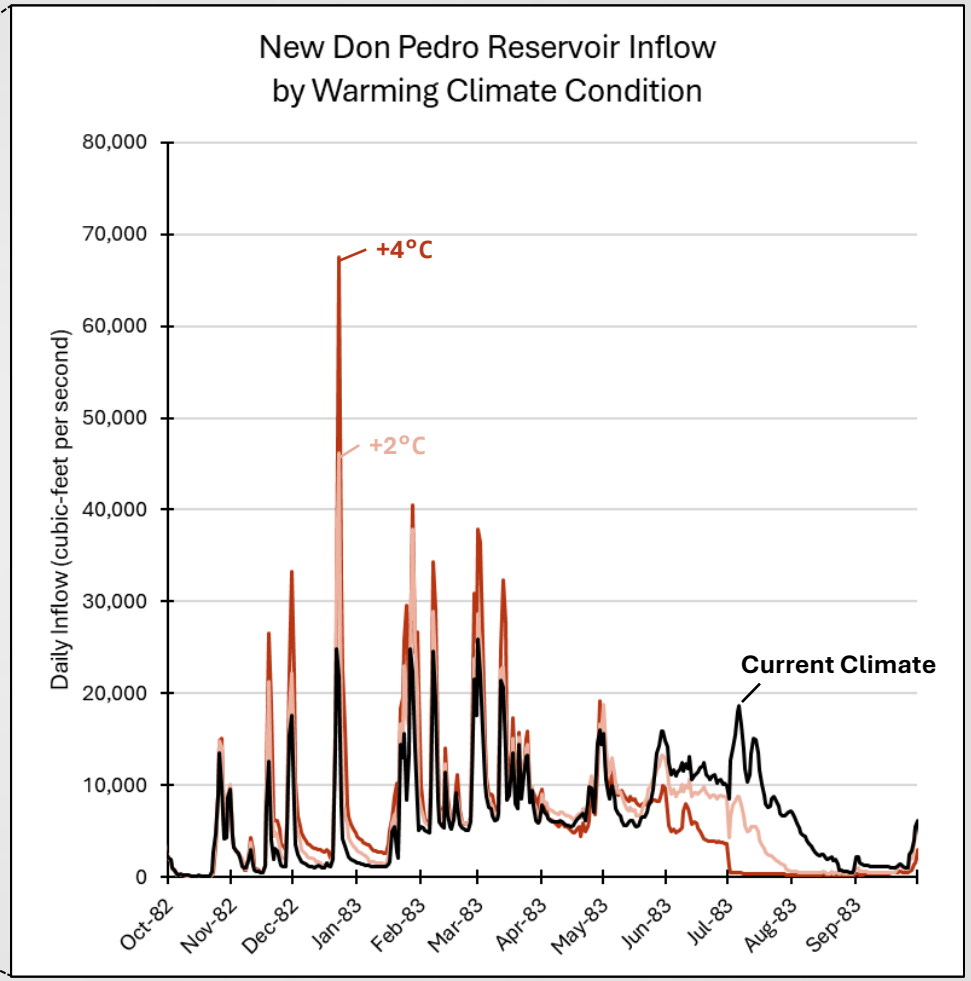
4,640 taf/y

Increase per °C:

≈ +120 taf/y (+2.5%)



2) Transition of snow → rain dominated



Current climate:	35%	65%	*Proportion of annual inflow*
+2°C:	50%	50%	
+4°C:	62%	38%	

3) Vulnerability assessment, by sector:

   a. Water supply

   b. Flood risk

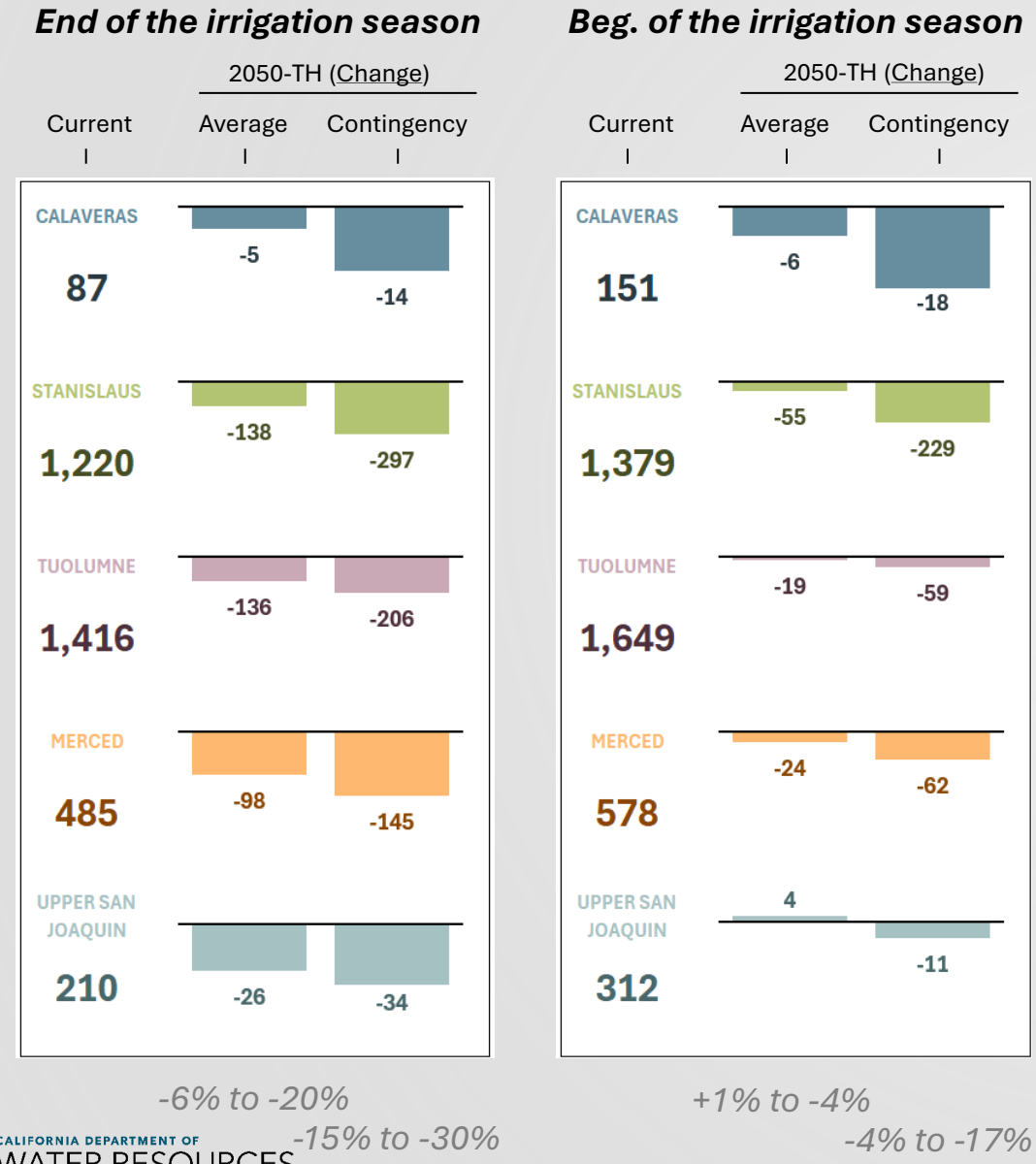
   c. Ecosystems

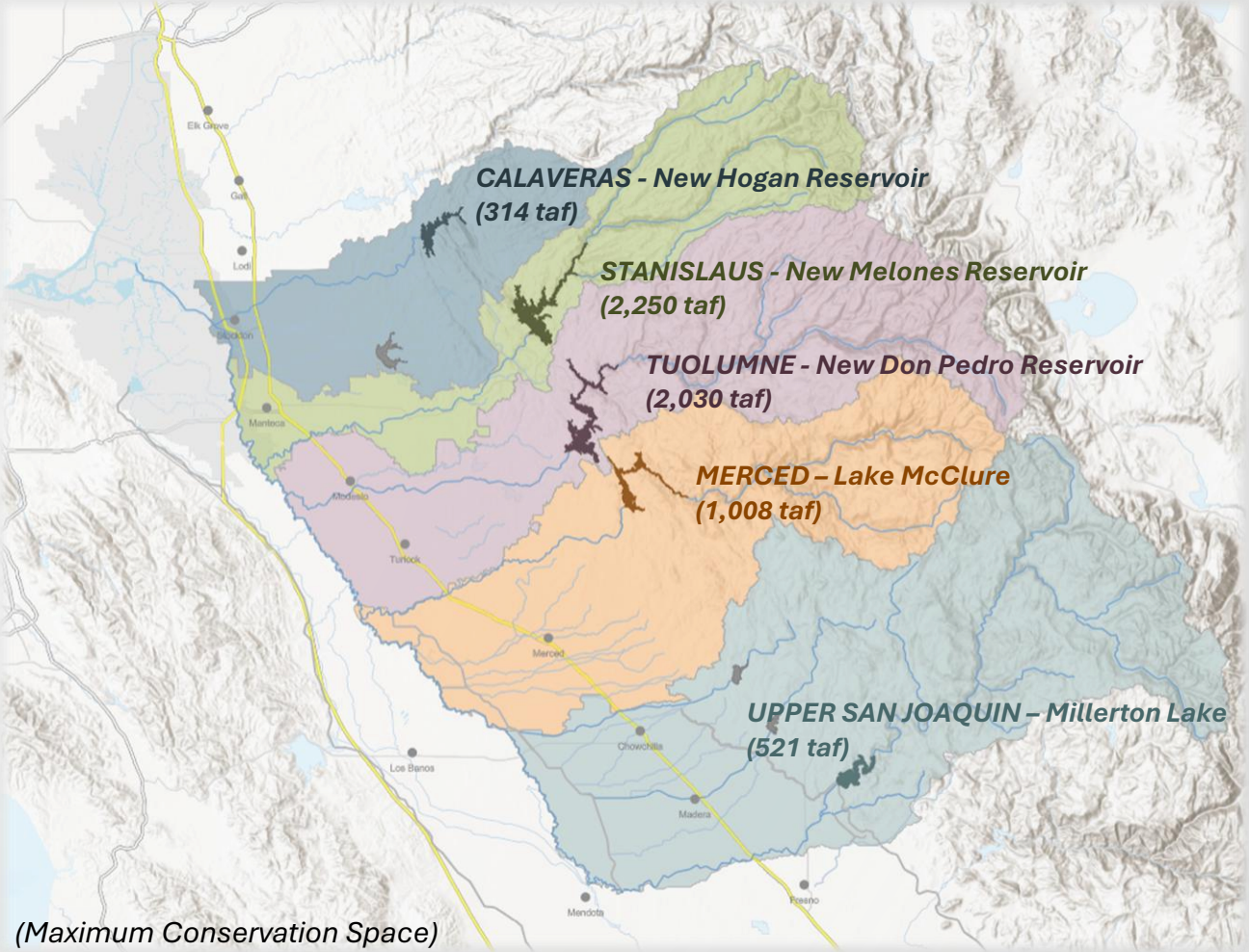
Each watershed is different:

Primary Reservoir	Average Annual Reservoir Inflow	Conservation Pool		Average Annual Applied Water Demand	
New Hogan	144 taf	314 taf	**2.2x**	544 taf	**3.8x**
New Melones	1,114 taf	2,250 taf	**2.0x**	535 taf	**0.5x**
New Don Pedro	1,672 taf	2,030 taf	**1.2x**	1,097 taf	**0.7x**
Lake McClure	953 taf	1,008 taf	**1.0x**	998 taf	**1.0x**
Lake Millerton	1,633 taf	521 taf	**0.3x**	1,465 taf	**0.9x**

Vulnerability: Water Supply – Reservoir Storage

Average annual reservoir storage (taf)

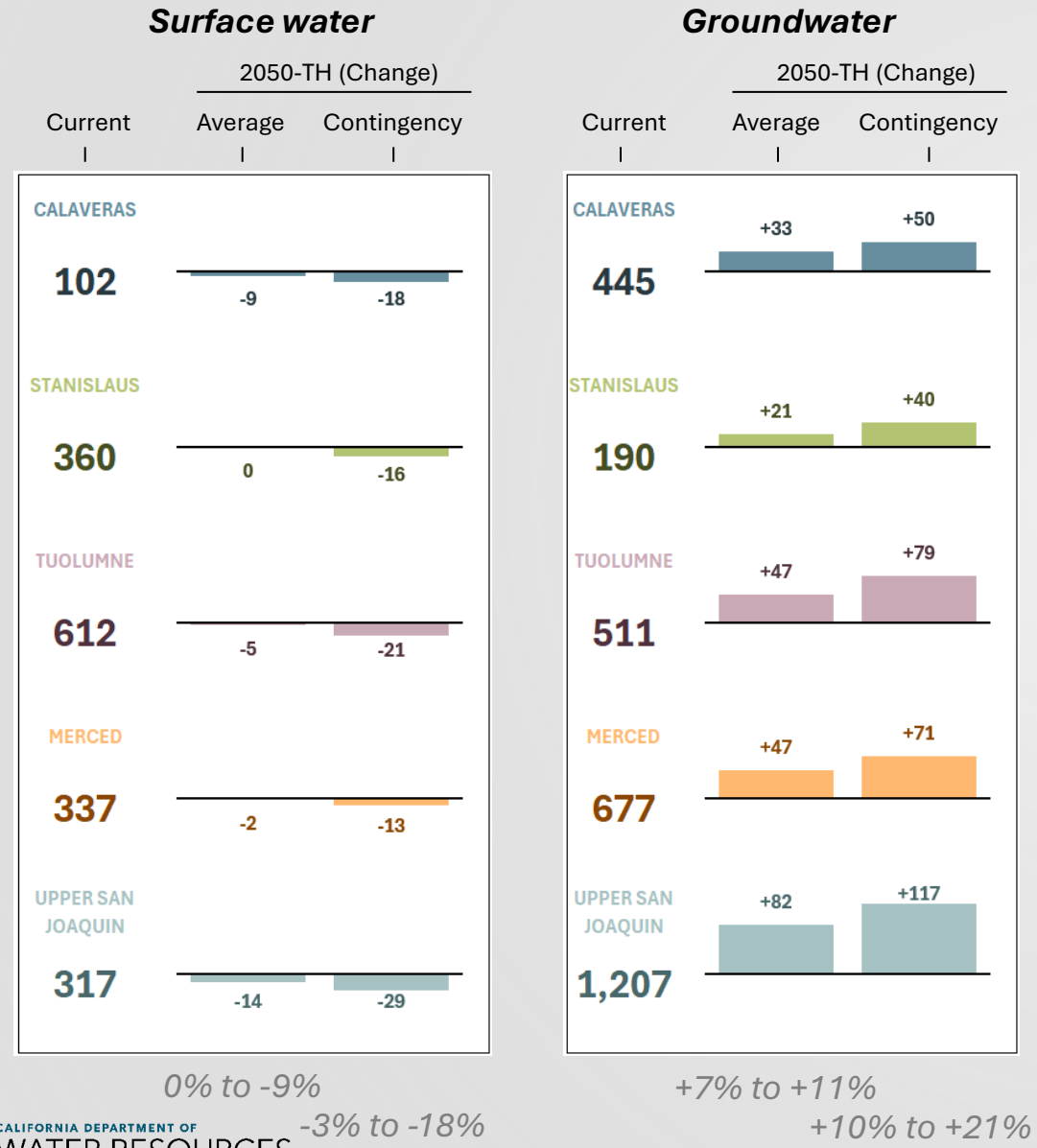


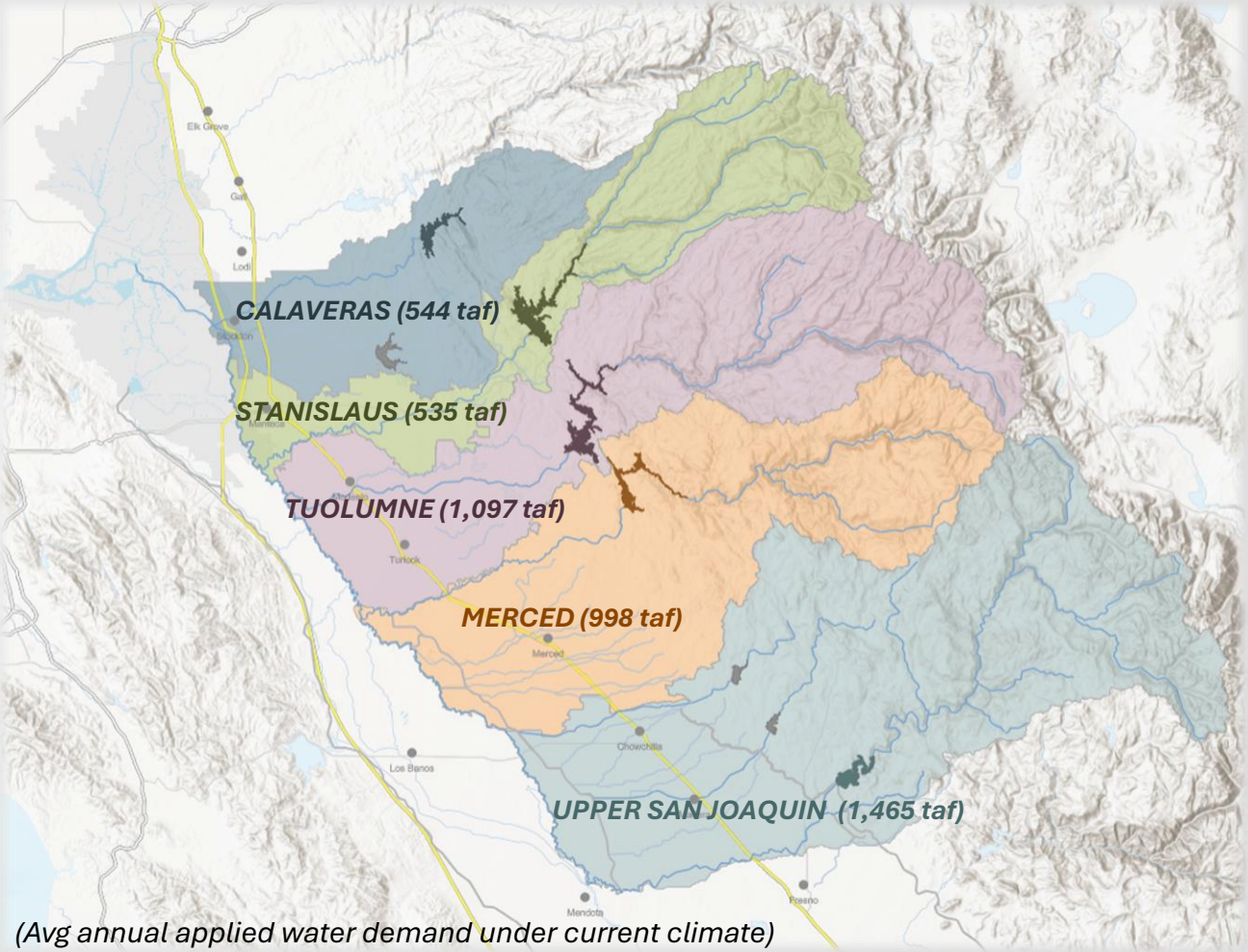


(Maximum Conservation Space)

Vulnerability: Water Supply – Applied Water

Average annual applied water (taf)

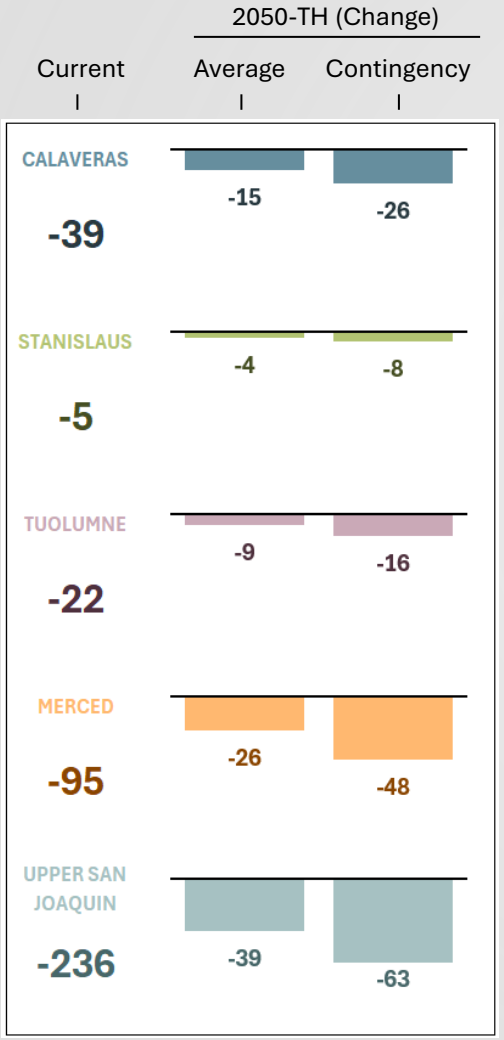




(Avg annual applied water demand under current climate)

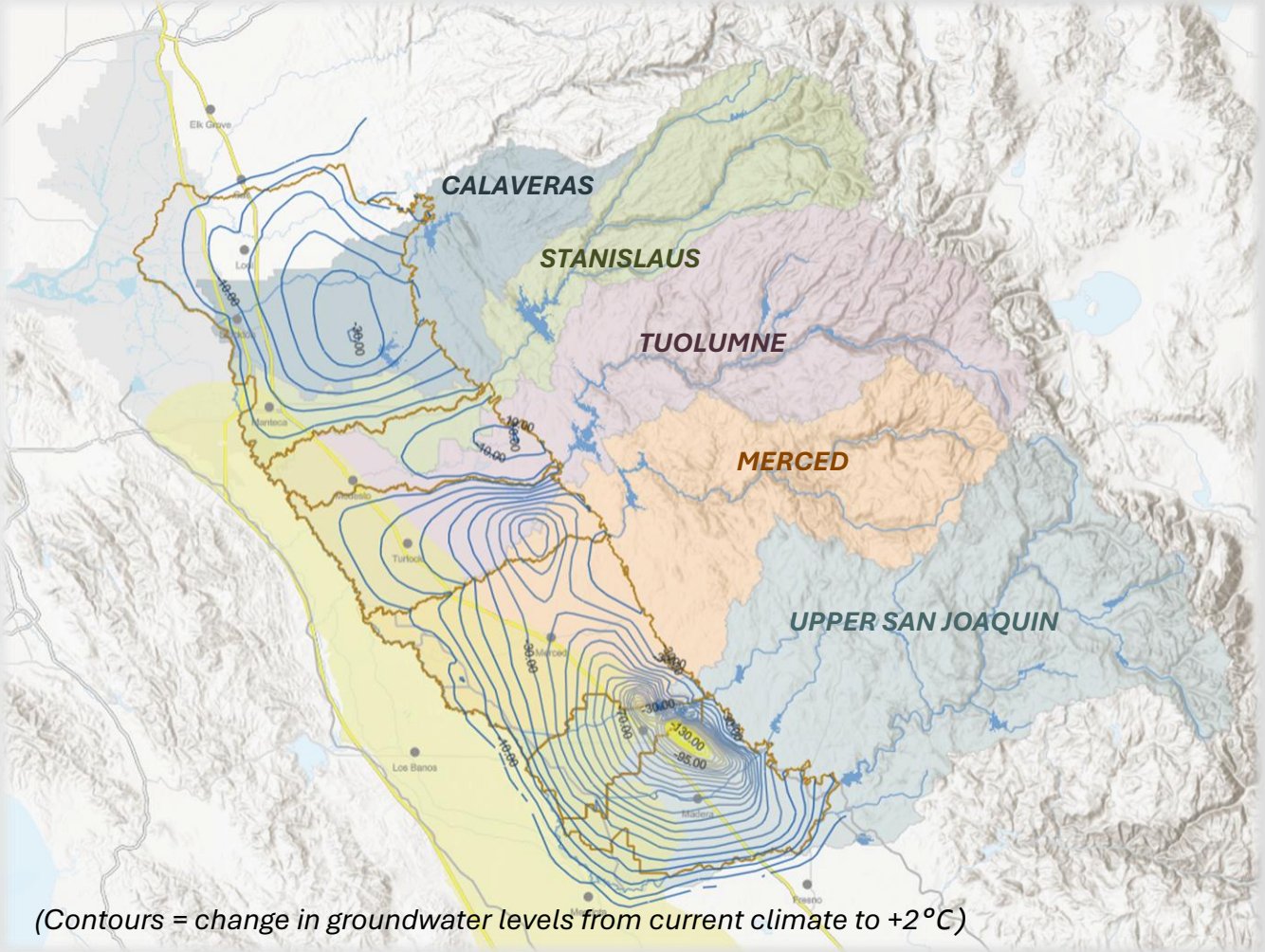
Vulnerability: Water Supply – Groundwater

Average annual change in groundwater storage (taf)



1.2x to 1.9x

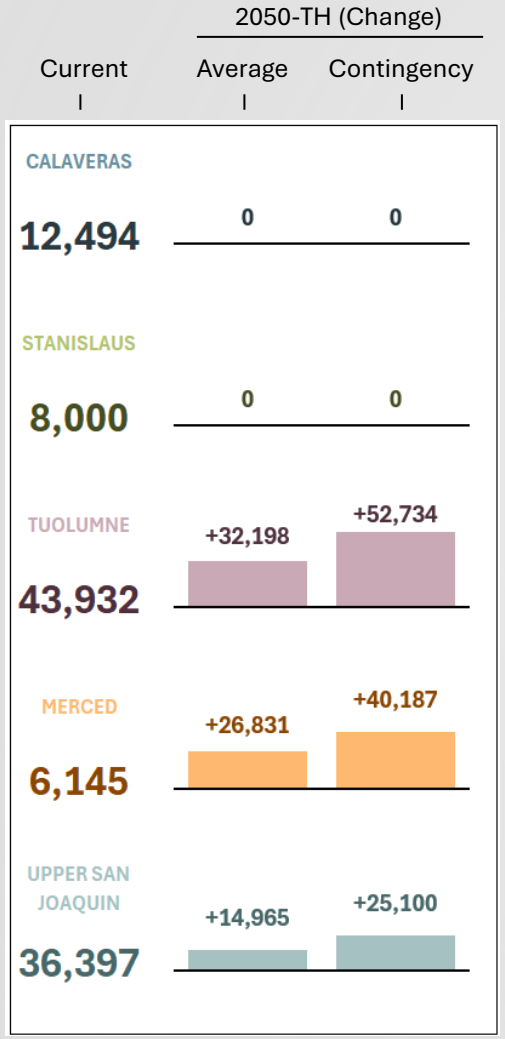
1.3x to 2.5x



(Contours = change in groundwater levels from current climate to +2°C)

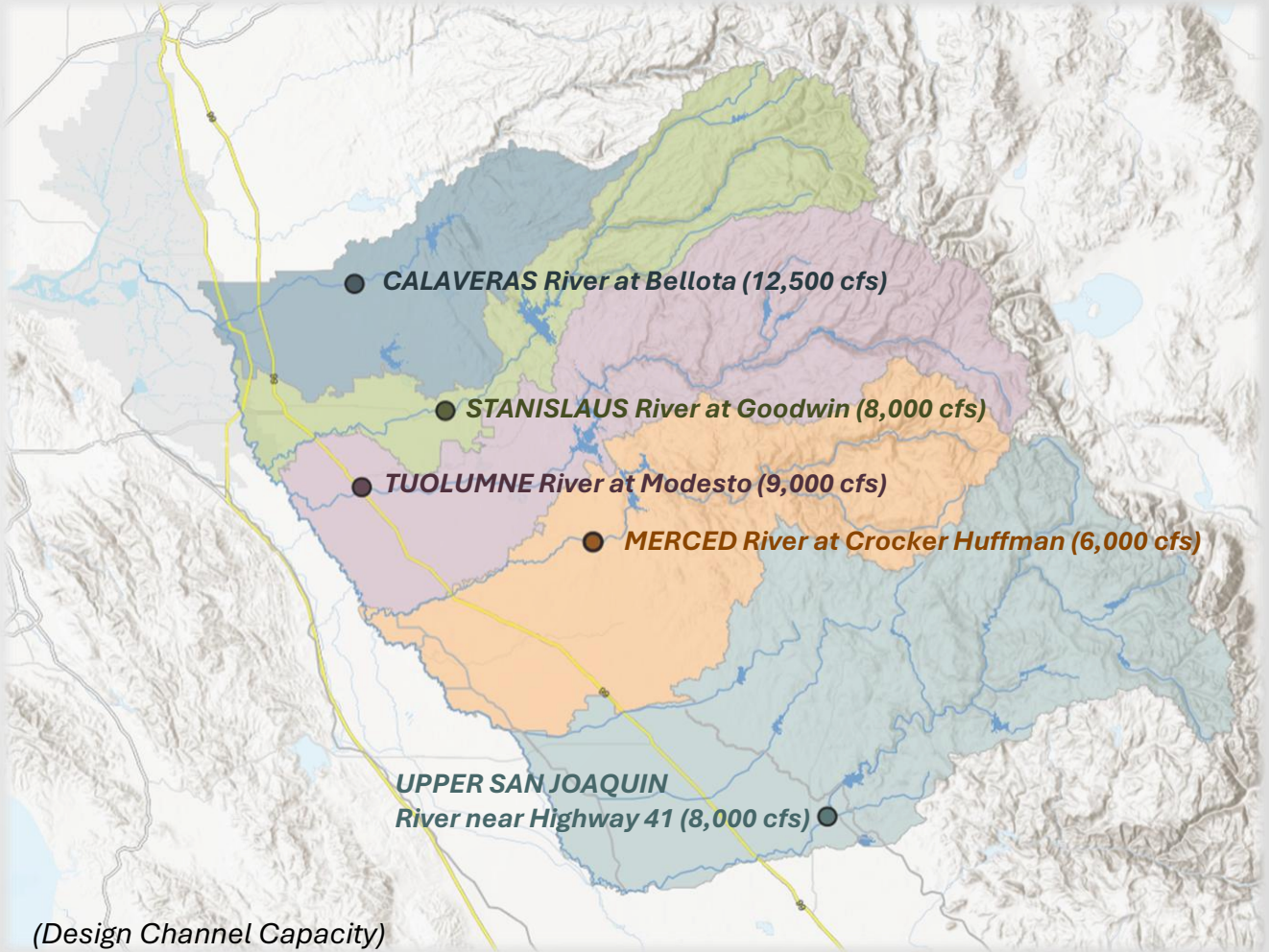
Vulnerability: Flood Risk

Maximum flow over 100 years (cfs)



up to 5.4x

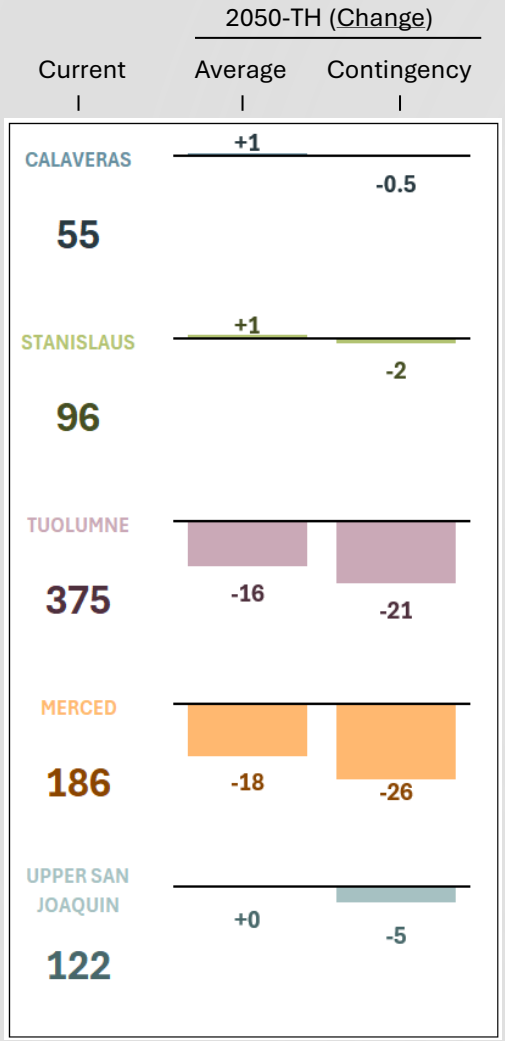
up to 7.5x



(Design Channel Capacity)

Vulnerability: Ecosystems – Salmonid Habitat

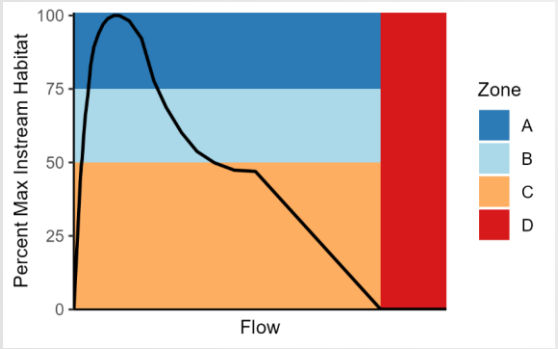
Average annual instream spawning (acre-days per linear mile)



+1% to -10%

-1% to -14%

Conceptual flow-habitat curves.

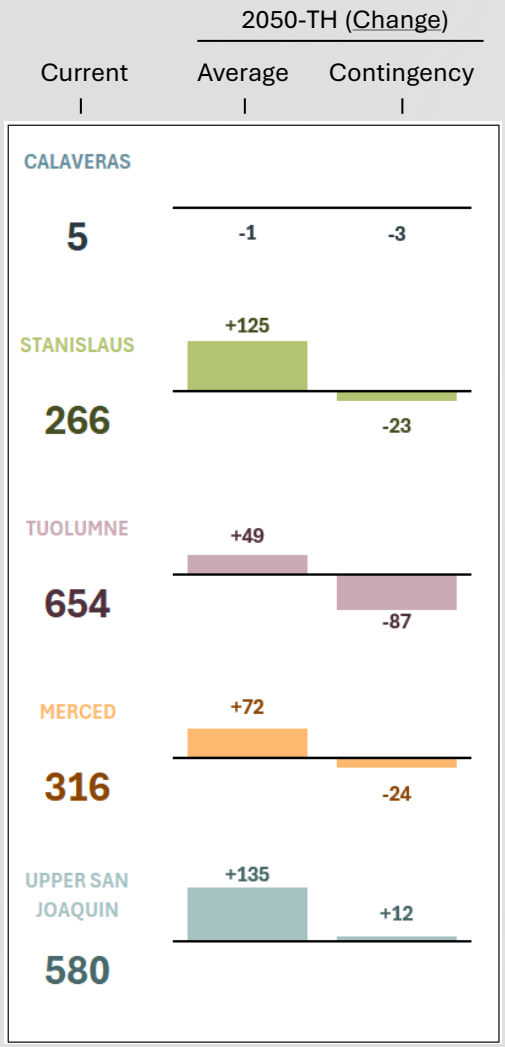


(Evaluated Reach Lengths)

Note: potential impacts on salmonids of changes in instream temperatures are not assessed in the study

Vulnerability: Ecosystems – Salmonid Habitat

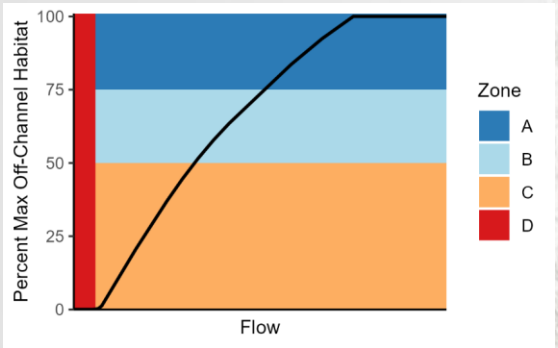
Average annual potential off-stream rearing (acre-days per linear mile)



+47% to -14%

+2% to -62%

Conceptual flow-habitat curves.



Note: potential impacts on salmonids of changes in instream temperatures are not assessed in the study

Takeaways

1) Risk-based approach provides decision support for watershed-scale climate change planning

2) Similar patterns of vulnerability emerge across watersheds, but magnitude of change is unique

3) Climate change risk to declining water supply and increasing flood risk are high, while ecosystem effects are more complex and mixed.