

Integrating Watershed Management and System Operations:

Insights from the SWP Adaptation Strategy and San Joaquin Basin Studies

ERIC TSAI & KARANDEV SINGH

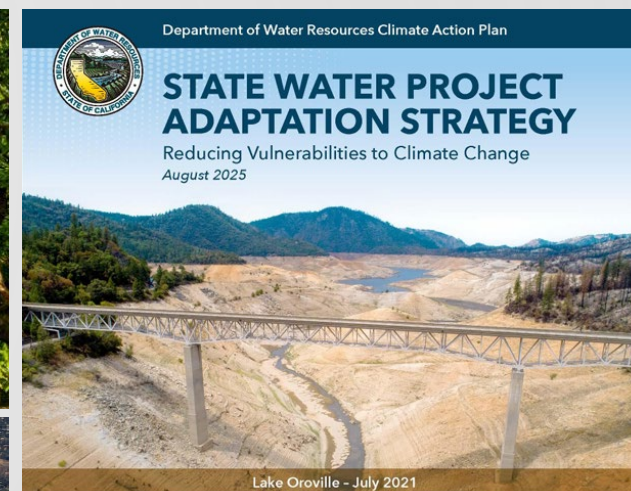
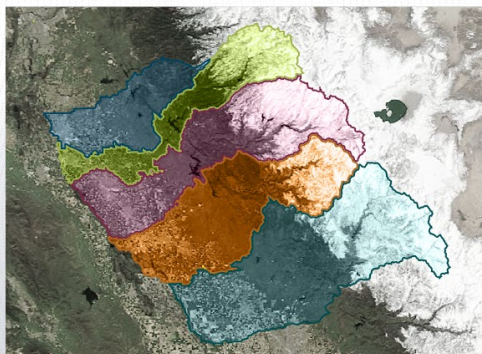
APRIL 20TH, 2026 | CWEMF 2026

San Joaquin Basin Flood-MAR
Watershed Studies

BASINWIDE SUMMARY AND NEXT STEPS

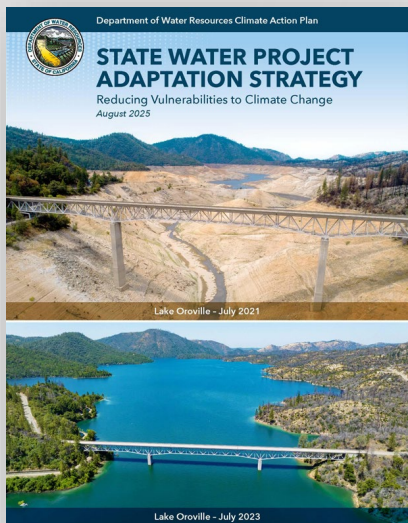
December 2025

CALIFORNIA DEPARTMENT OF WATER RESOURCES



San Joaquin Valley Related Studies

West Side



August 2025

STATE WATER PROJECT ADAPTATION STRATEGY

Evaluates actions that improve climate resilience and delivery capability of the State Water Project

SAN JOAQUIN VALLEY CONVEYANCE STUDY

Identifies San Joaquin Valley conveyance needs and analyzes how recommended actions from the SWP Adaptation Strategy and San Joaquin Basin Watershed Studies would perform together

SAN JOAQUIN BASIN WATERSHED STUDIES

Evaluates the effectiveness of recharge-related adaptation strategies in the eastern San Joaquin Basin

Valley Floor

San Joaquin Valley Conveyance Study



State of California
California Natural Resources Agency



Department of Water Resources
Division of Planning
November 2025

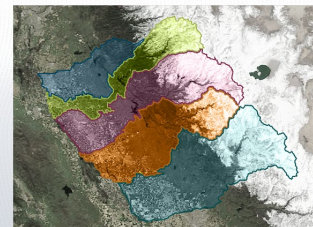
November 2025

East Side

San Joaquin Basin Flood-MAR Watershed Studies

BASINWIDE SUMMARY AND NEXT STEPS
December 2025

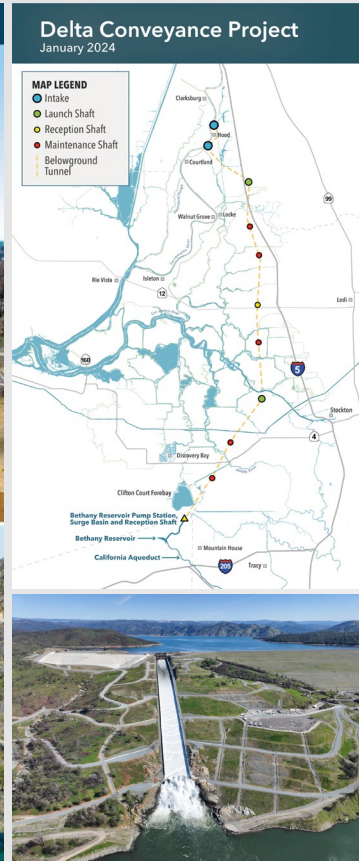
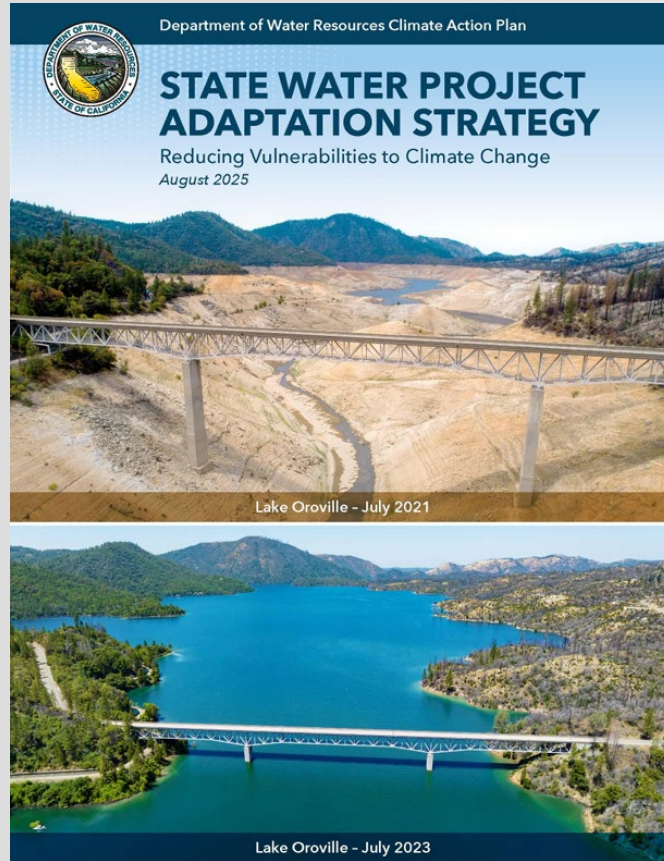
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December 2025



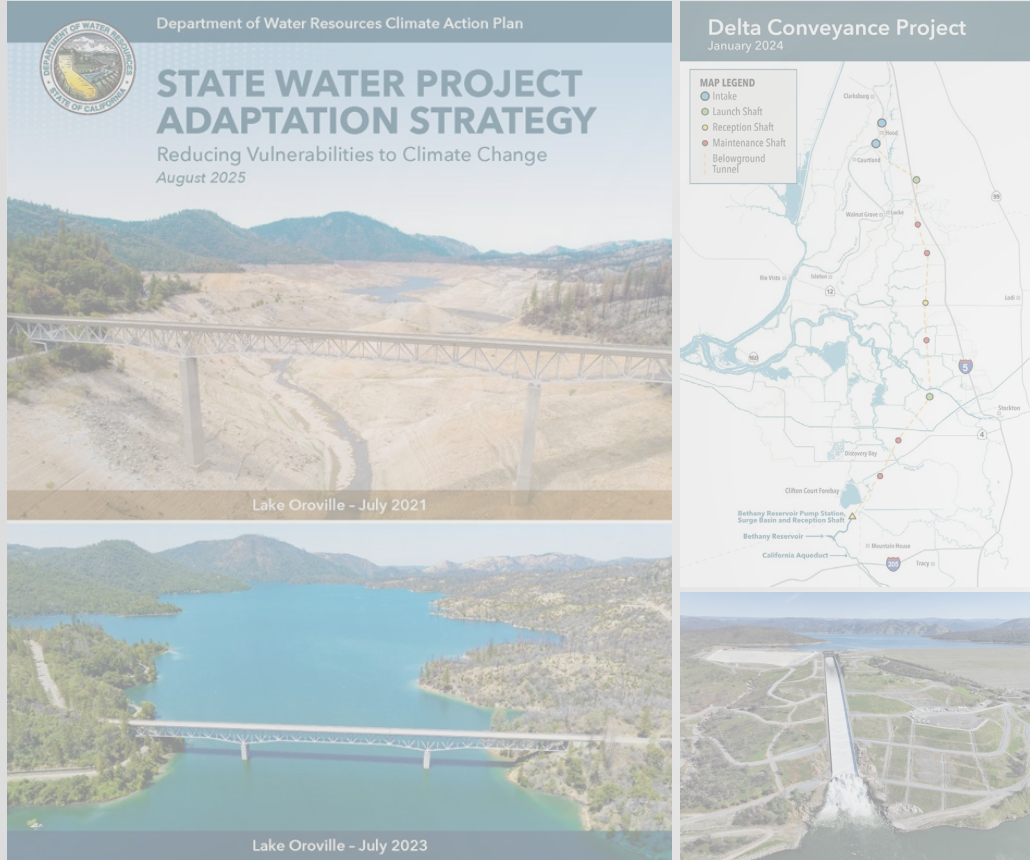
Integrated Analysis



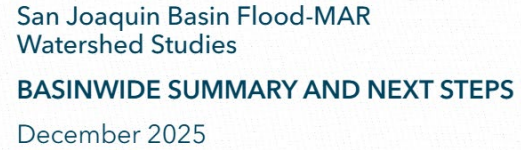
- Delta Conveyance Project
- FIRO at Oroville
- South-of-Delta Storage

- I-FIRM Strategy at Calaveras, Stanislaus, Tuolumne, Merced, and Upper San Joaquin

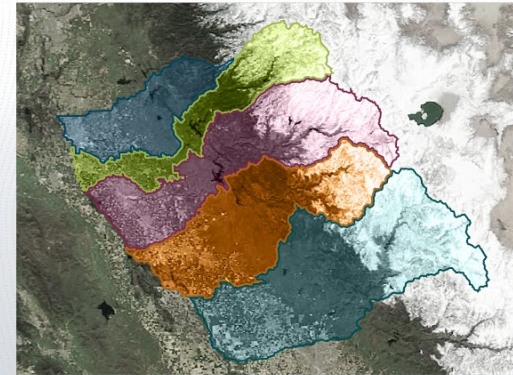
San Joaquin Basin Flood-MAR Watershed Studies



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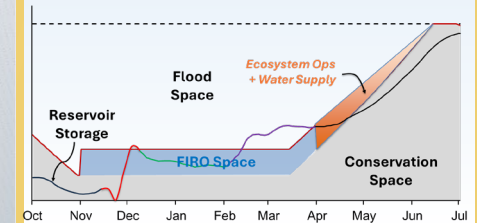
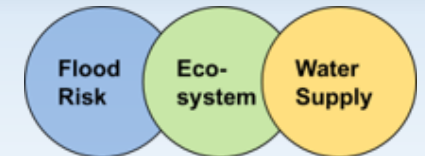
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Reoperate Reservoirs + Recharge Using High Flows



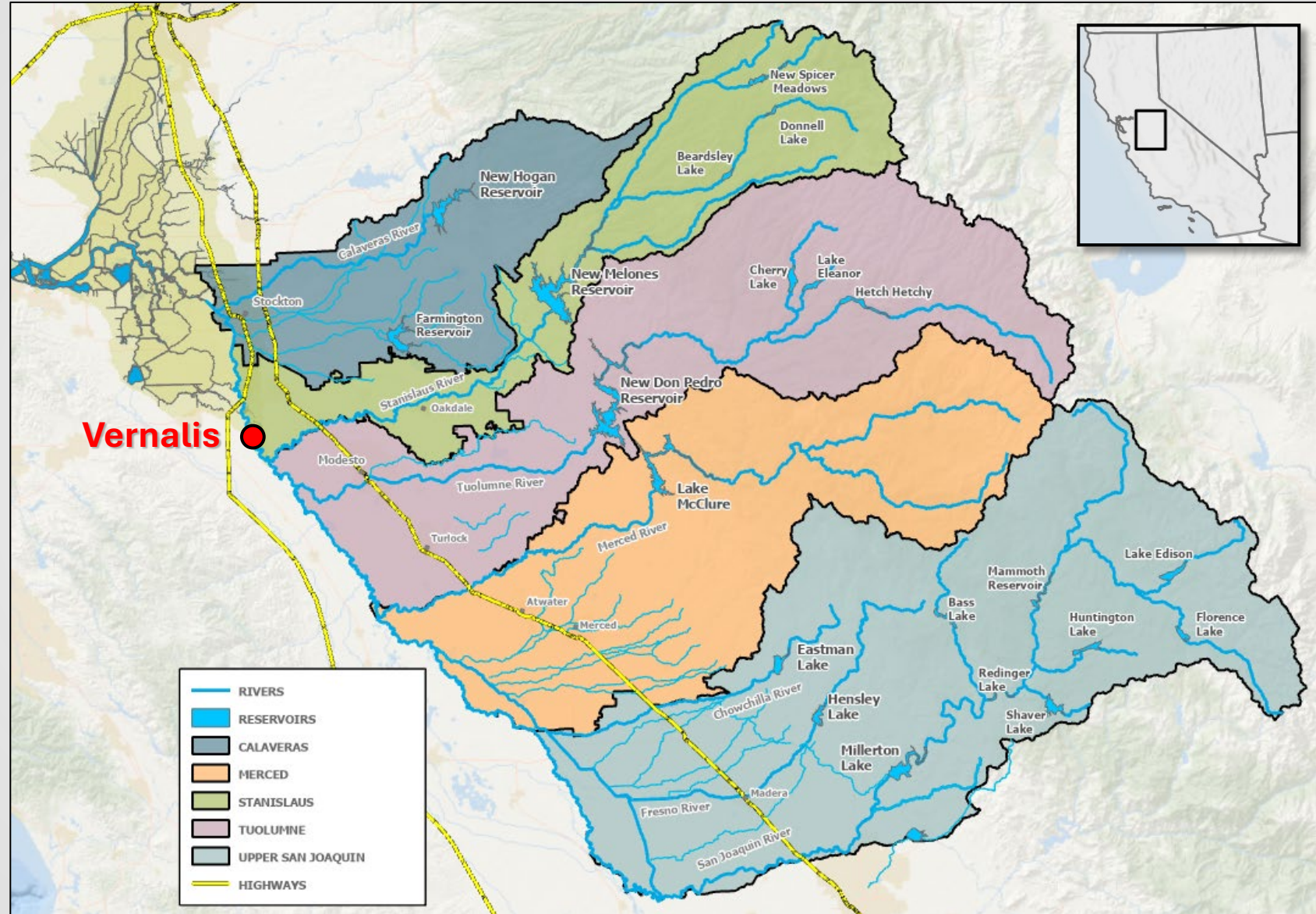
I-FIRM



- I-FIRM Strategy at Calaveras, Stanislaus, Tuolumne, Merced, and Upper San Joaquin

Study Area

- Calaveras
- Stanislaus
- Tuolumne
- Merced
- Upper SJ
 - Chowchilla
 - Fresno
 - San Joaquin



Flood-MAR Adaptation Strategies

+ Reoperate Reservoirs

Recharge Using High Flows



MAR-90/20

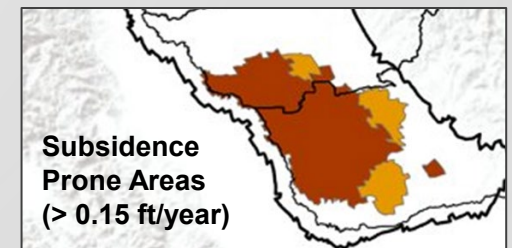
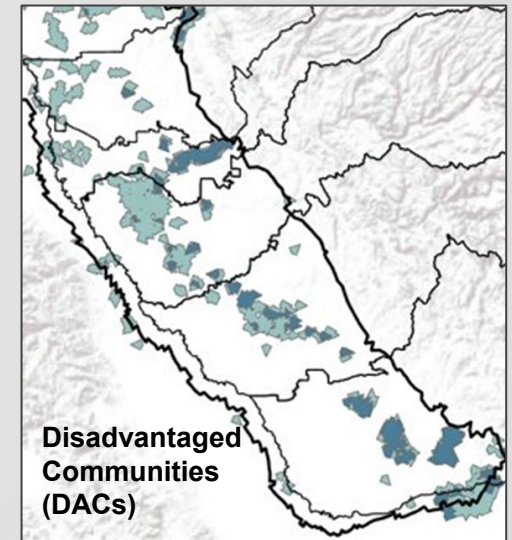
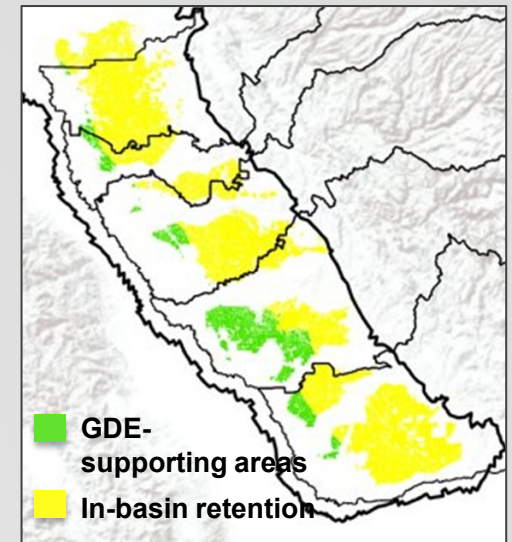
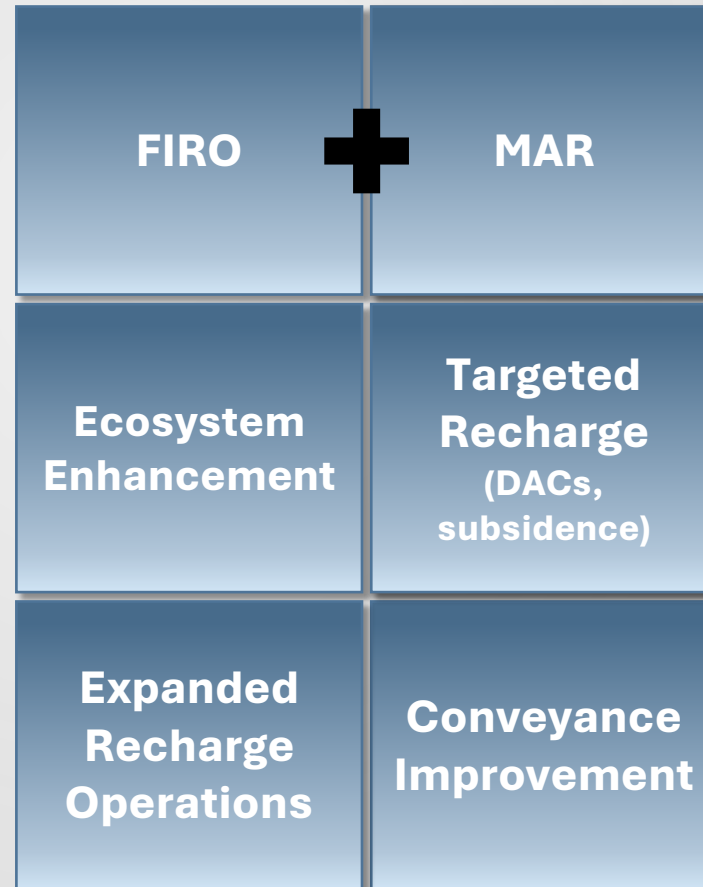
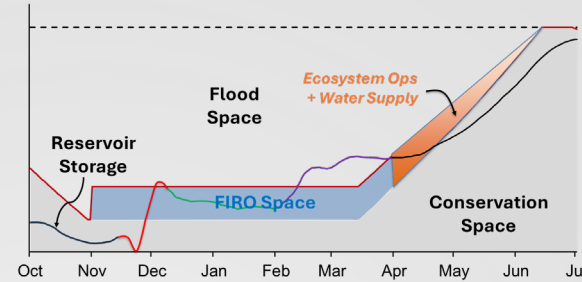
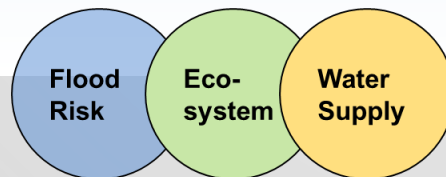
Skim high flows

*Derived from SWRCB
Streamlined Permitting
guidance*

I-FIRM

*Strategic integration of
FIRO, recharge, and enhanced
ecosystem management*

*Expanded recharge window,
capacity and access*



Flood

- 30–60% reduced peak flood flows in Calaveras, Tuolumne, and Merced watersheds
- Lowers peak flood flows in San Joaquin River at Vernalis by ~54,000 cfs

Water Supply

- 410 TAF annual applied recharge, on average
- 2/5 of the recharge stays in the ground; 3/5 of it return to stream
- Improved groundwater conditions elevate groundwater levels basinwide
- Recharge only mitigates against climate-induced change in groundwater storage, but does nothing to reverse current groundwater storage deficit

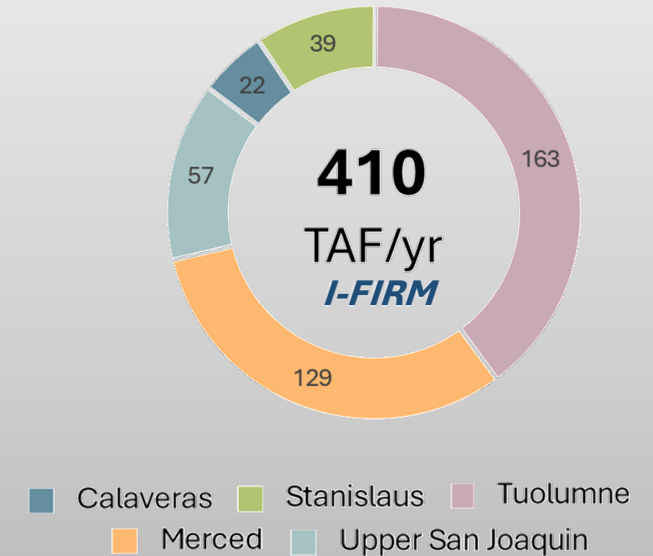
Environmental

- Enhanced instream spawning and rearing salmonid habitat, shorebird habitat, and better quality off-channel rearing habitat through environmental pulse flows

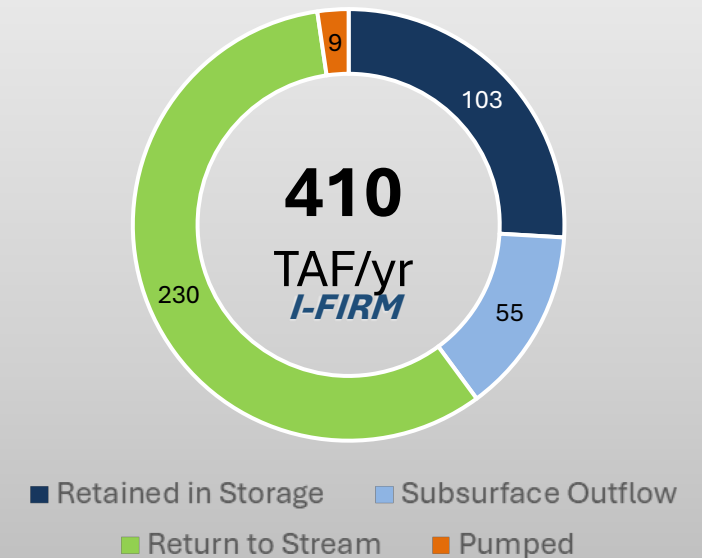
Equity

- Strategic recharge opportunities for vulnerable communities

Average Annual Applied Recharge



Fate of Applied Recharge

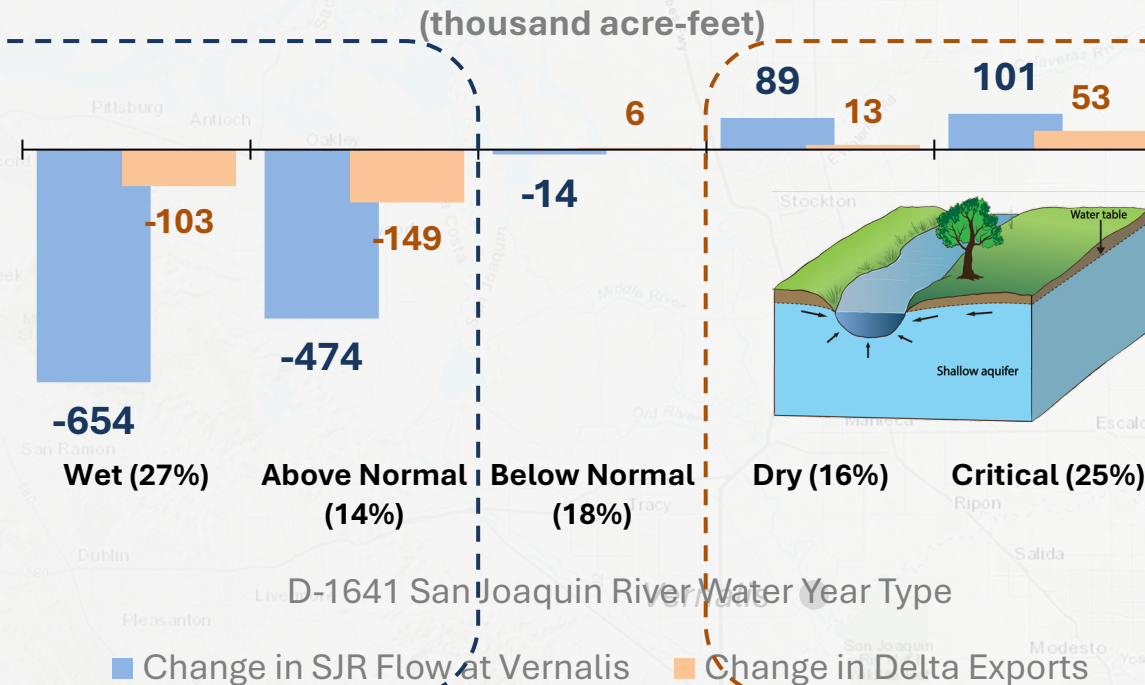


Recharge diversions upstream don't translate directly to reduction in San Joaquin River flow.

	Upstream Recharge Diversion	Change in SJR Flow at Vernalis	Change in Delta Exports
I-FIRM	394 TAF per Year	-206 (52%) TAF per Year	-32 (8%) TAF per Year

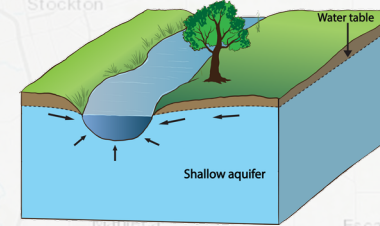
Wetter Periods

- Reduced flows due to upstream diversions
- Including periods when Delta is in Excess with Restriction
- Negatively impacts OMR flows → **Limits Delta Exports**



Drier Periods

- Higher baseflows due to improved groundwater conditions
- Reduced COA responsibility and relaxed export-related constraints → **Additional Delta Exports**



Results are from the +2°C climate condition.

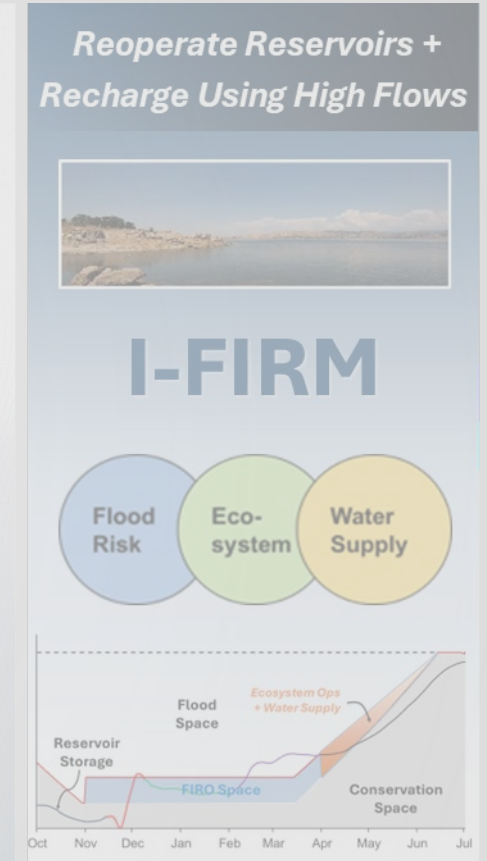
State Water Project Adaptation Strategy



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- I-FIRM Strategy at Calaveras, Stanislaus, Tuolumne, Merced, and Upper San Joaquin

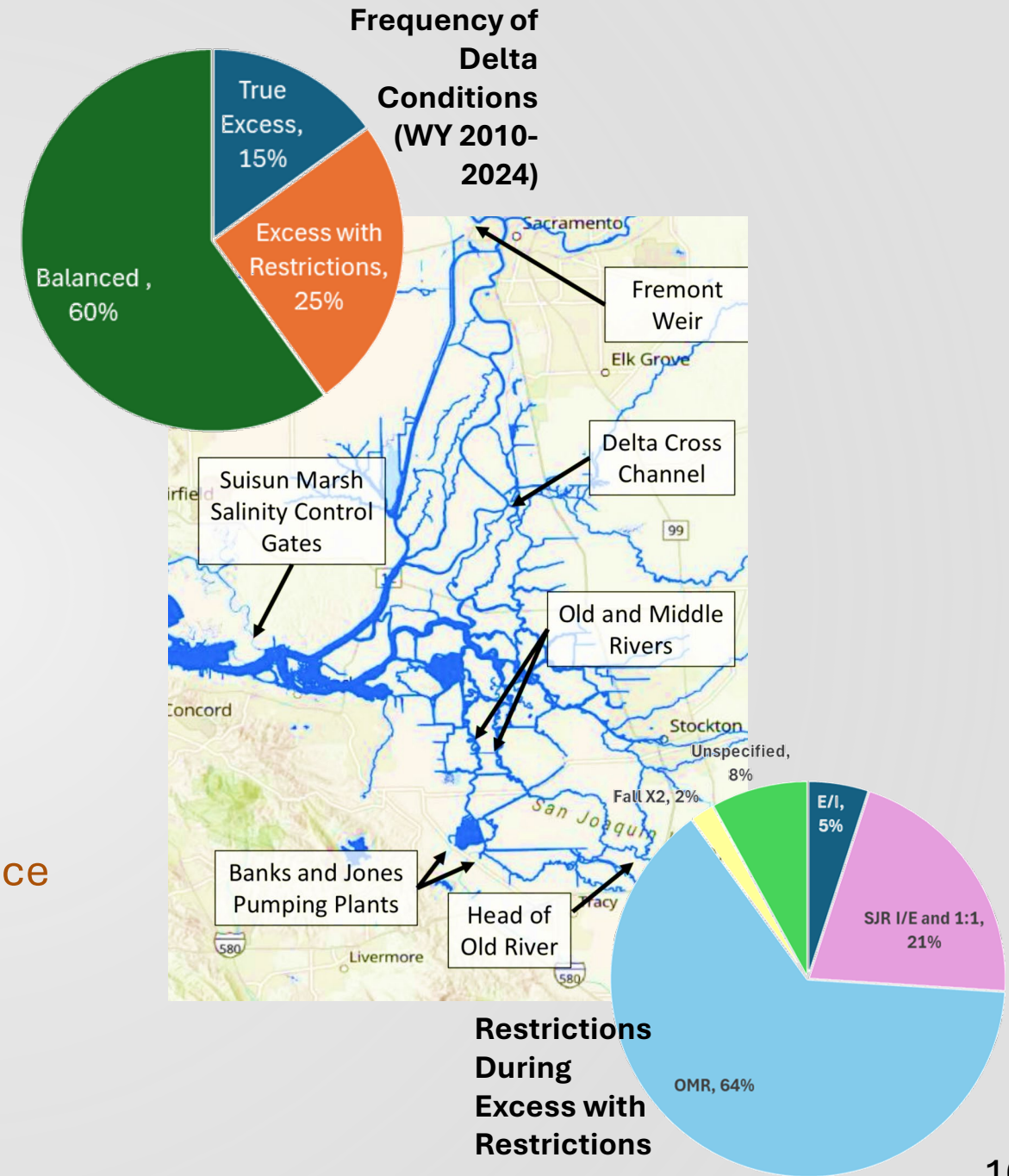


Water Supply

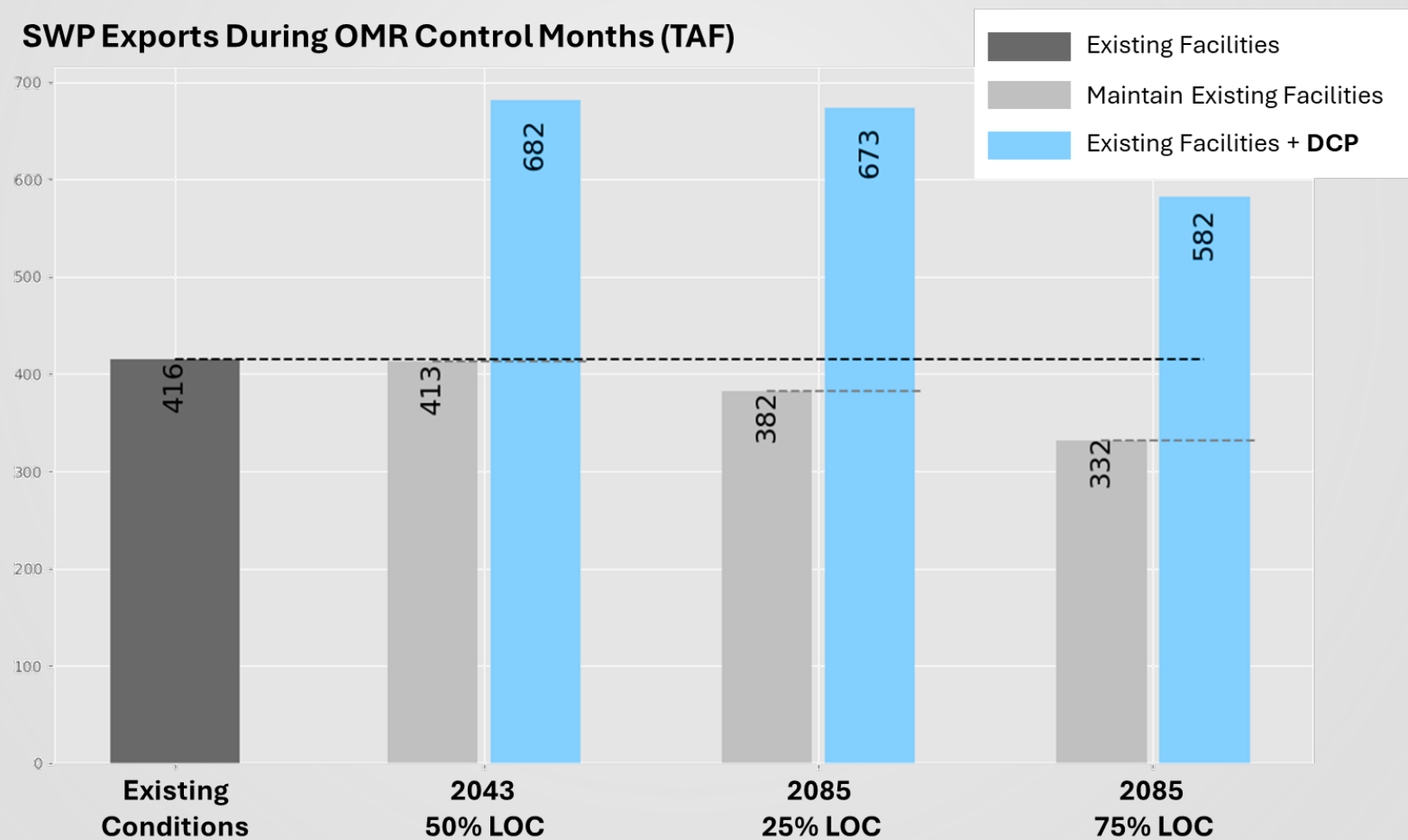
- More than 500 TAF/yr increase in SWP exports
- Effective strategic water reserve for droughts

Delta Operations

- Regulations related to reverse flows on Old and Middle River (OMR), and San Joaquin River Inflow Export (SJR I/E) ratio are the most frequent constraints on Delta exports during Excess with Restrictions conditions
- Changes in San Joaquin River flows directly influence the OMR and SJR I/E export constraints



Delta Conveyance Project provides the flexibility to divert water using north Delta diversions during high-flow vents without causing OMR reverse flows.



Department of Water Resources Climate Action Plan



STATE WATER PROJECT ADAPTATION STRATEGY

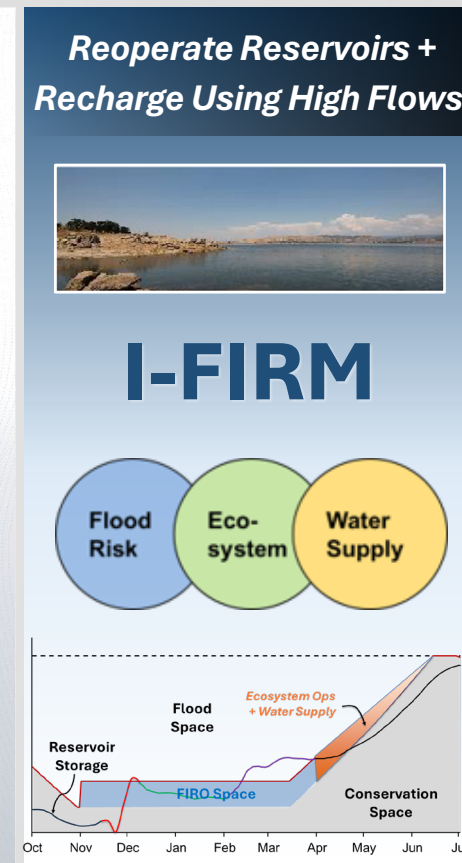
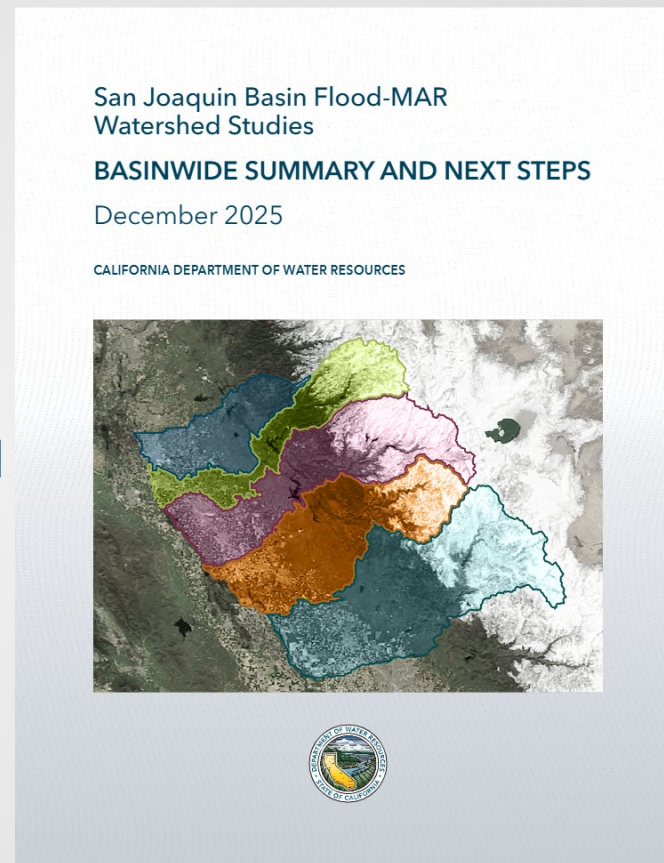
Reducing Vulnerabilities to Climate Change
August 2025



Lake Oroville - July 2021



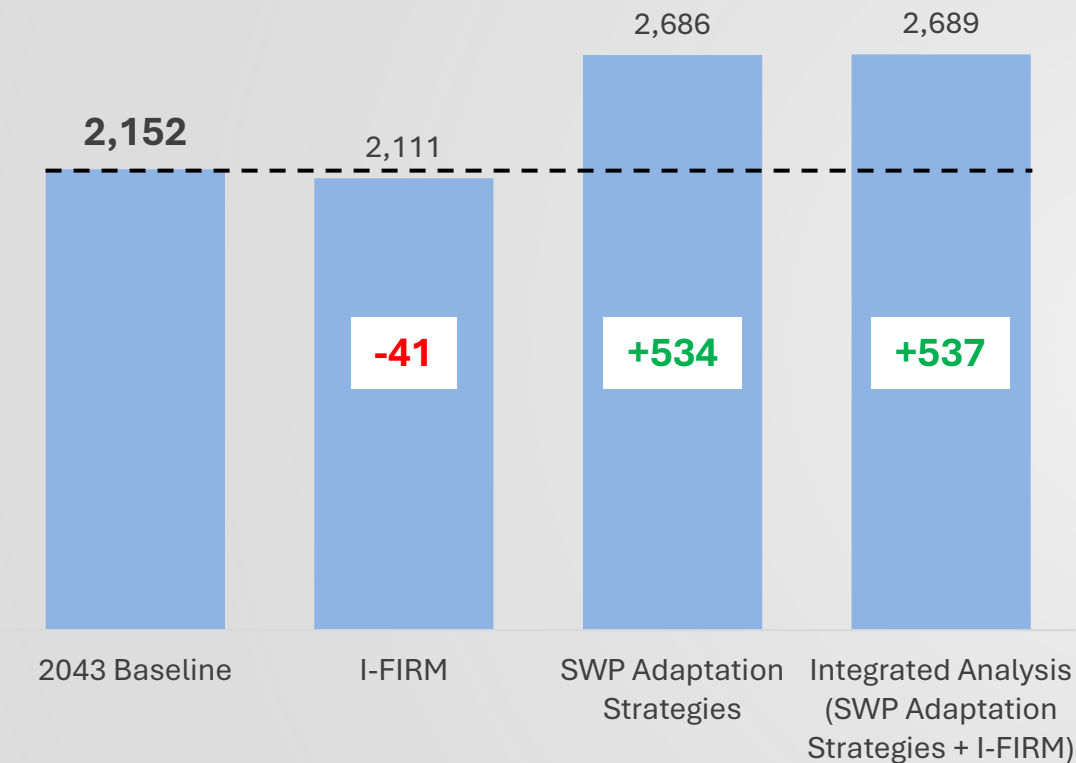
Lake Oroville - July 2025



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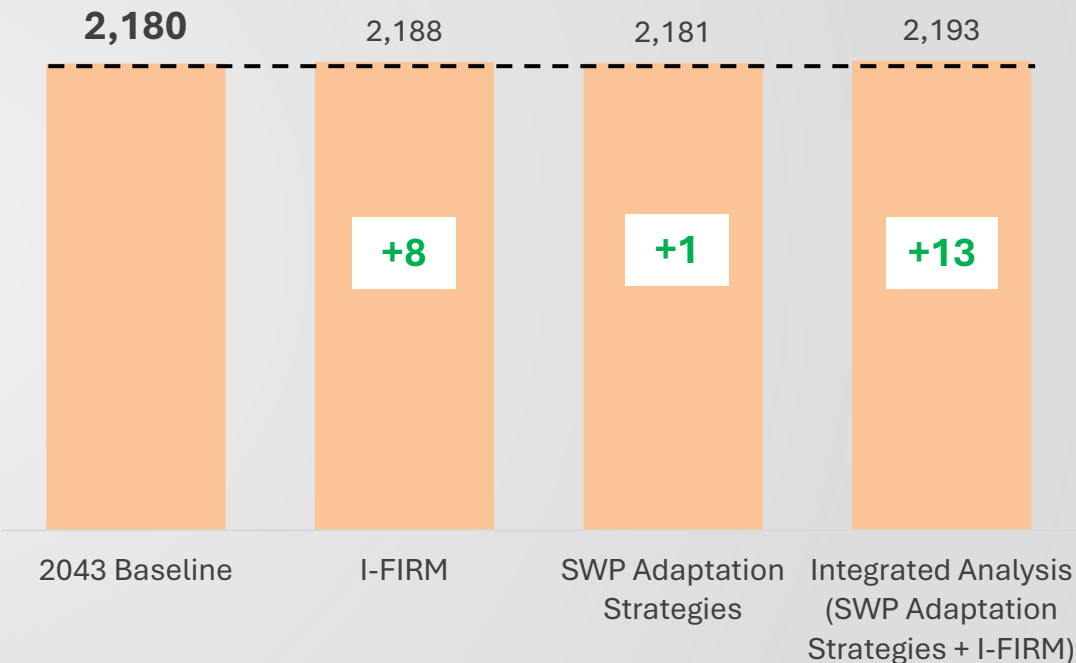
Long-term effects on Project Exports

Average Annual SWP Exports



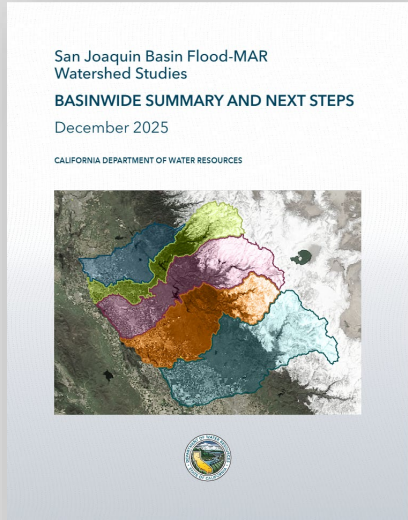
Integrated Scenario eliminates net reduction in SWP exports from the I-FIRM Strategy.

Average Annual CVP Exports

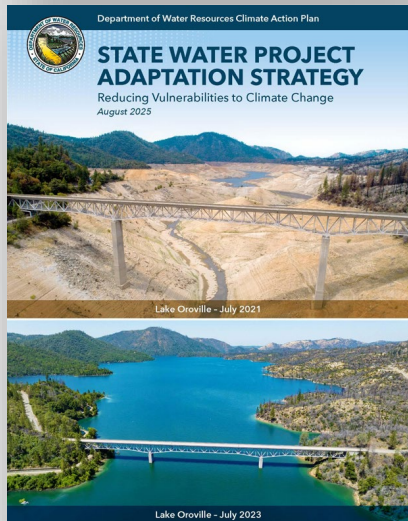


CVP exports show more modest effects.

Closing Observations



- Integrated strategies can provide a broad range of robust benefits and should be explored together to maximize synergies and understand tradeoffs
- Effective implementation will require unprecedented levels of collaboration/coordination across local, State, and federal agencies
- Significant demand management will still be needed in the San Joaquin Valley to bring groundwater basins into sustainability



[SJ Watershed Studies \(water.ca.gov/watershedstudies\)](https://water.ca.gov/watershedstudies)

[State Water Project Adaptation Strategy Report \(August 2025\)](#)