CALIFORNIA DEPARTMENT OF WATER RESOURCES

Co-managing for Recharge and Ecosystems:

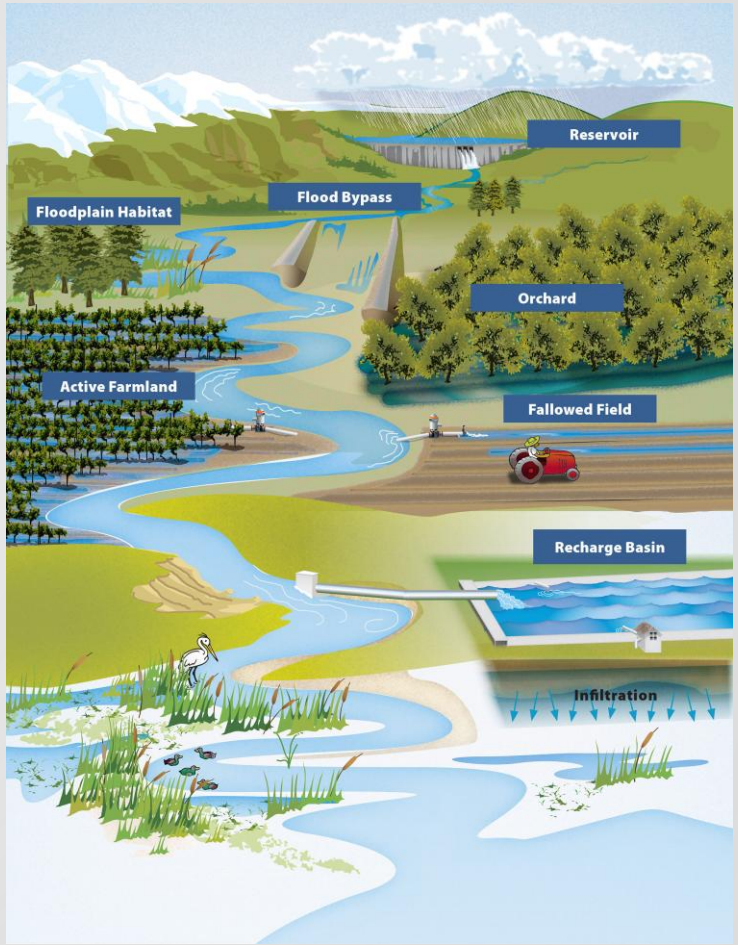
Application of Tools to Inform Flood-MAR Strategies for Sustainable Water Management

2025 CWEMF Annual Meeting

May 13, 2025

Introduction to DWR's Flood-MAR Watersheds Study

- Flood-MAR: Diverting water during floods for managed aquifer recharge
- 5 tributary watersheds to the San Joaquin River
  - Calaveras
  - Stanislaus
  - Tuolumne
  - Merced
  - Upper San Joaquin
- Climate Resiliency - Testing multiple conditions
  - Change in temperature (+1 to +5 C)
  - Change in precipitation (88% to 113%)
- 2 Adaptation Strategies
  - MAR 90/20 (less involved)
  - I-FIRM (more involved, included "Ecosystem Actions")

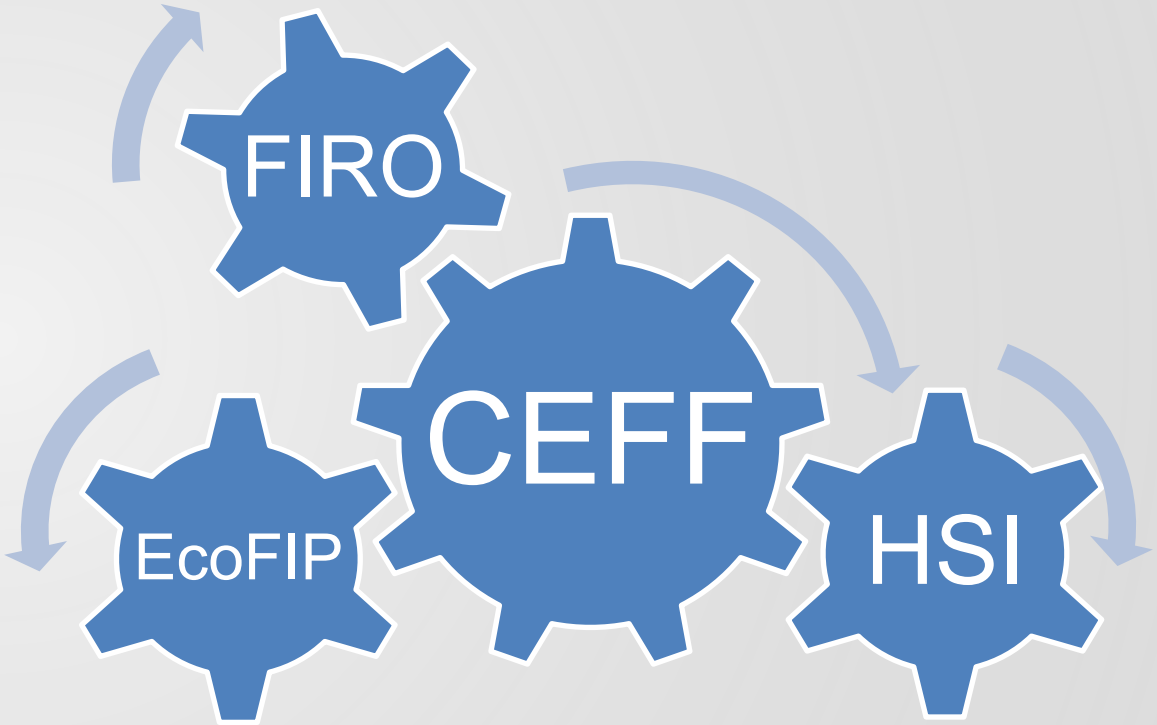


Effects to Biological Communities

- Diverting water
  - Negative Impacts for instream flow dependent communities (i.e., fish)
- Recharge Activities (i.e., off-channel ponding)
  - Positive benefits for waterbirds and potentially for fish (when connected to the river)
- Groundwater Recharge
  - Positive benefits for groundwater dependent communities, stream temperatures, and summer flows

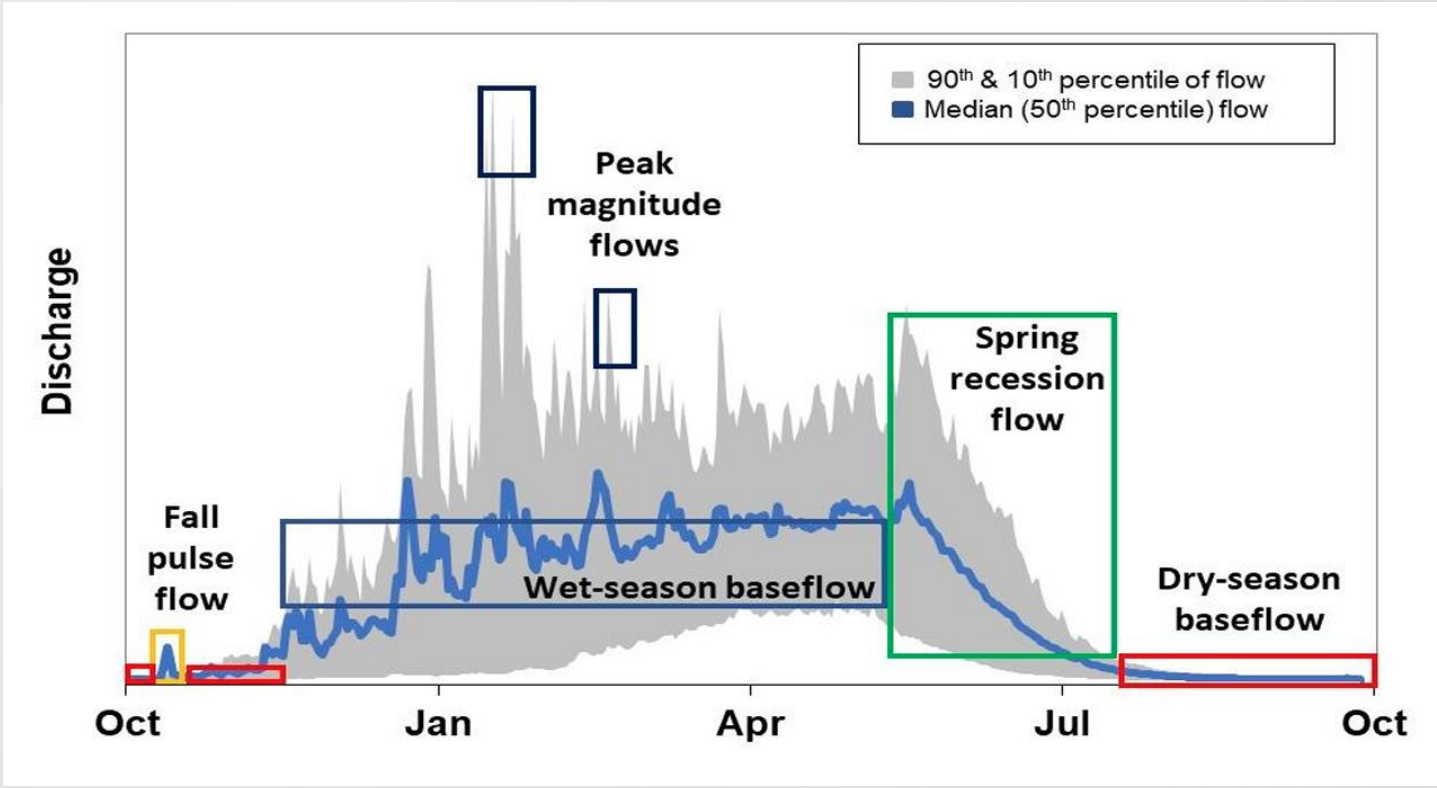
Tools Used to Co-Manage Recharge and Ecosystems

- California Environmental Flows Framework **(CEFF)**
  - Identify “natural” flow regime
- Habitat Suitability Indices **(HSI)**
  - Identify spawning and rearing flow targets
- Ecological Floodplain Inundation Potential **(EcoFIP)**
  - Identify potential inundation flows
- Forecast-Informed Reservoir Operations **(FIRO)**
  - Improve water reliability and enhance benefits from reservoir operations



CEFF Functional Flow Components

Functional Flows are flows which provide ecosystem functions independent of particular species.



Note: hydrograph is theoretical, only for illustrative purposes

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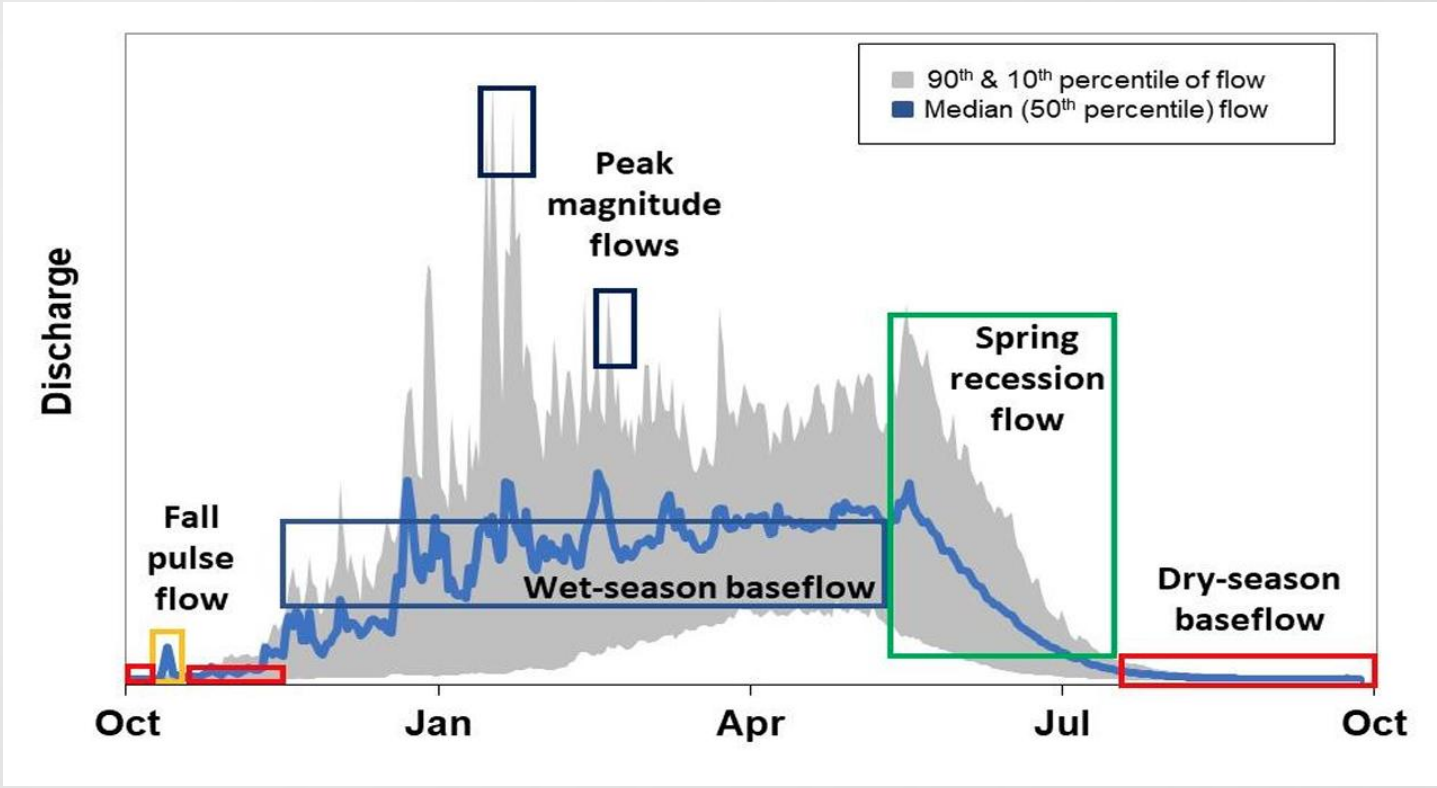

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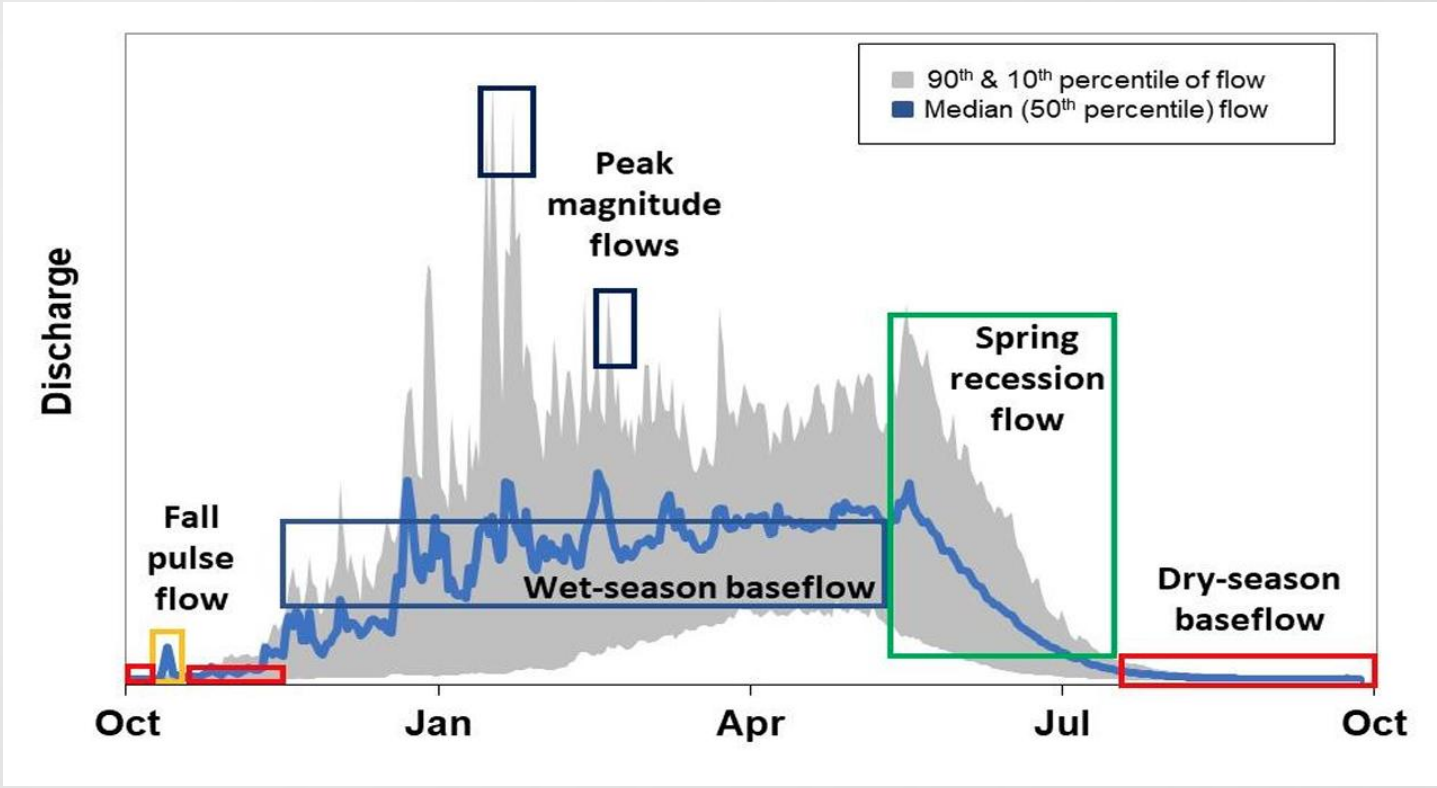
- Winter Baseflow – Provide sustained spawning and rearing habitat, maintain water quality
- Winter Peak Events – Nutrient Cycling and Bed mobilization



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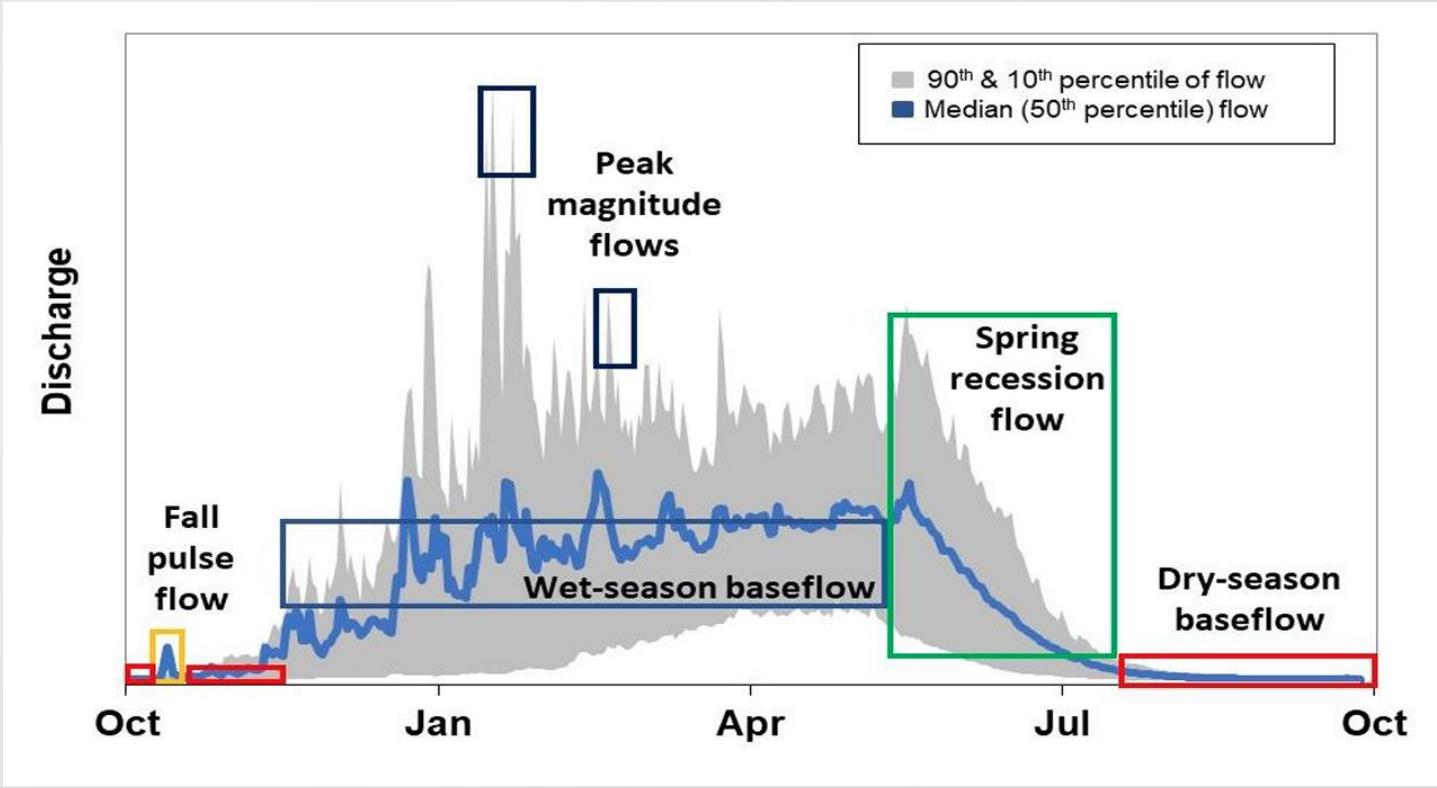
- Spring Recession Flow – Salmonid Rearing and Emigration



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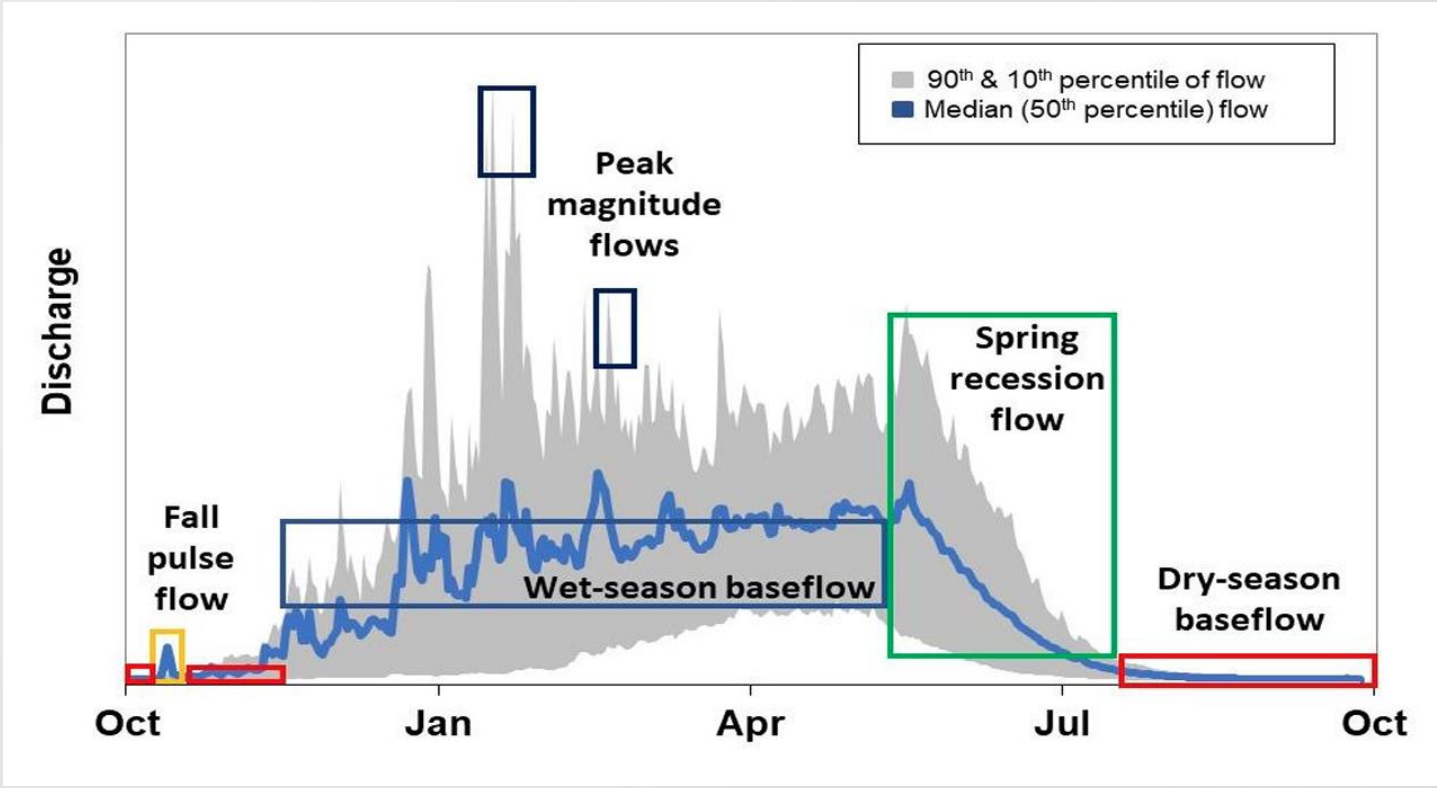
- Winter Baseflow – Provide sustained spawning and rearing habitat, maintain water quality
- Winter Peak Events – Nutrient Cycling and Bed mobilization
- Spring Recession Flow – Salmonid Rearing and Emigration
- Summer Baseflow – Maintenance of resident fish populations and water quality



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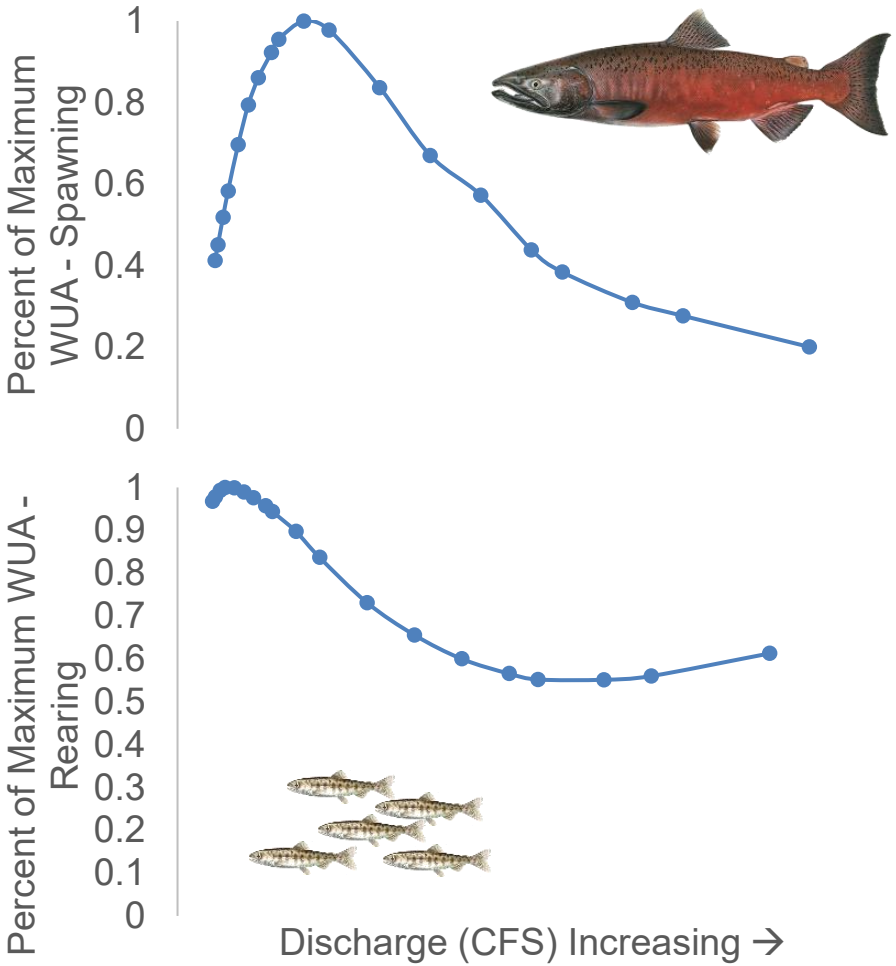
Habitat Suitability Curves

- Based off previously completed studies in specific study areas (e.g. PHABSIM)
- Identify flows which provide the highest suitability



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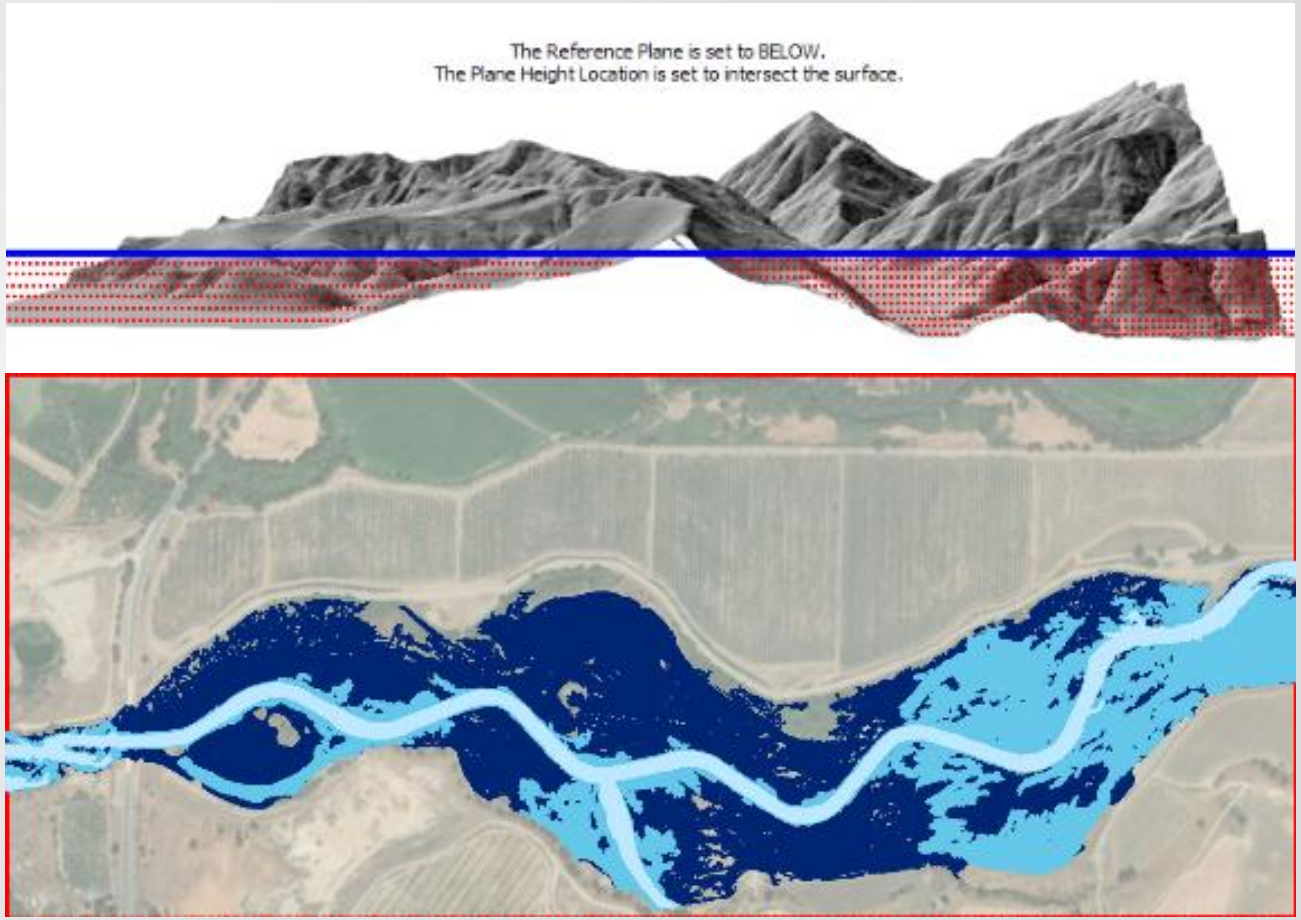
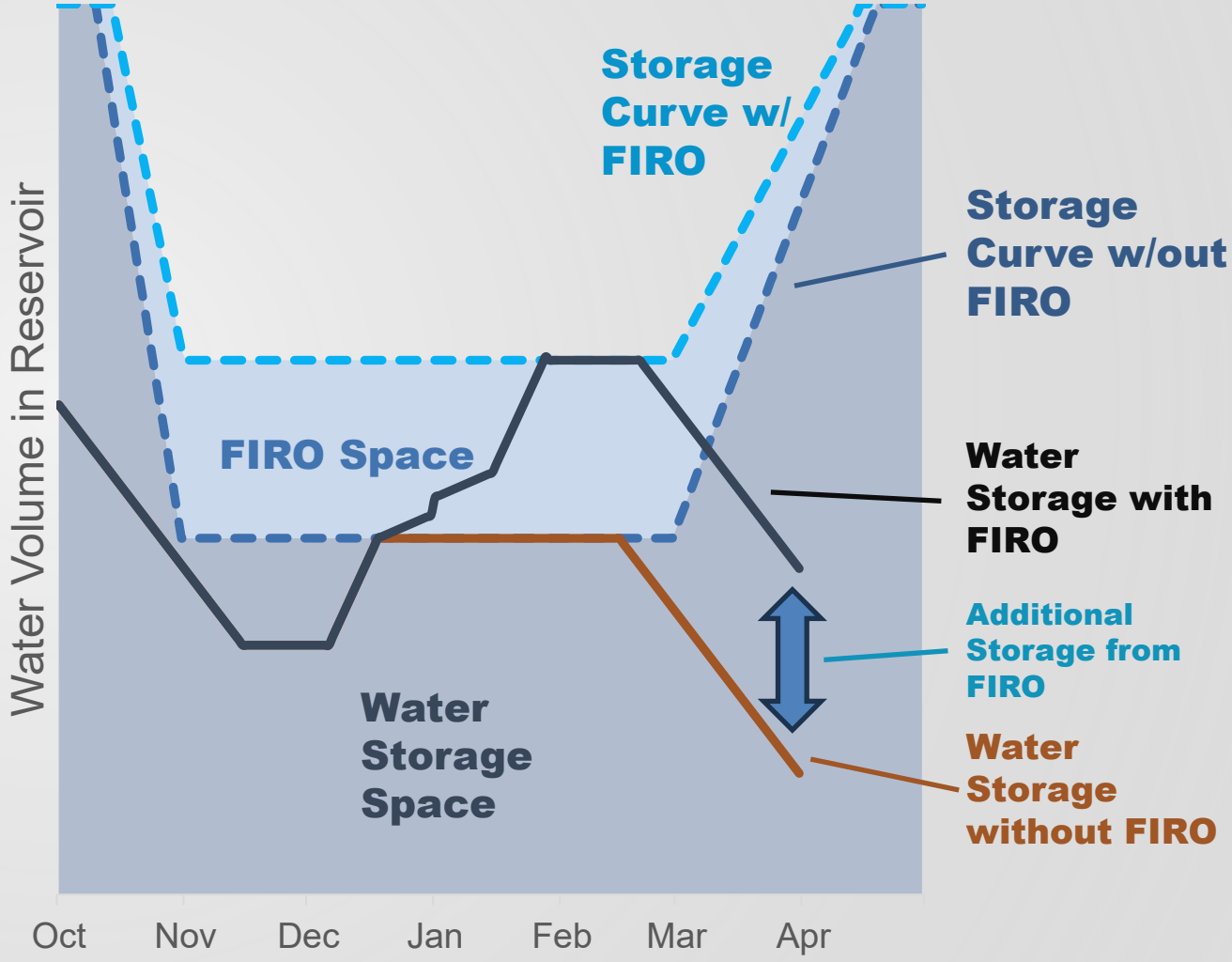
Floodplain Inundation Potential

- Combine 1-D hydraulic models (CVFED, FEMA, local Habitat Studies) to create interpolated water surface elevations for a range of discharges
- Intersect the water surface elevation with Digital Elevation Models restricted to the 100-yr flood zone.
- Find the discharge which inundates ≥ 0.1 acres of off-channel habitat by at least 1 foot
  - Baseline: Wet-Season Baseflow channel

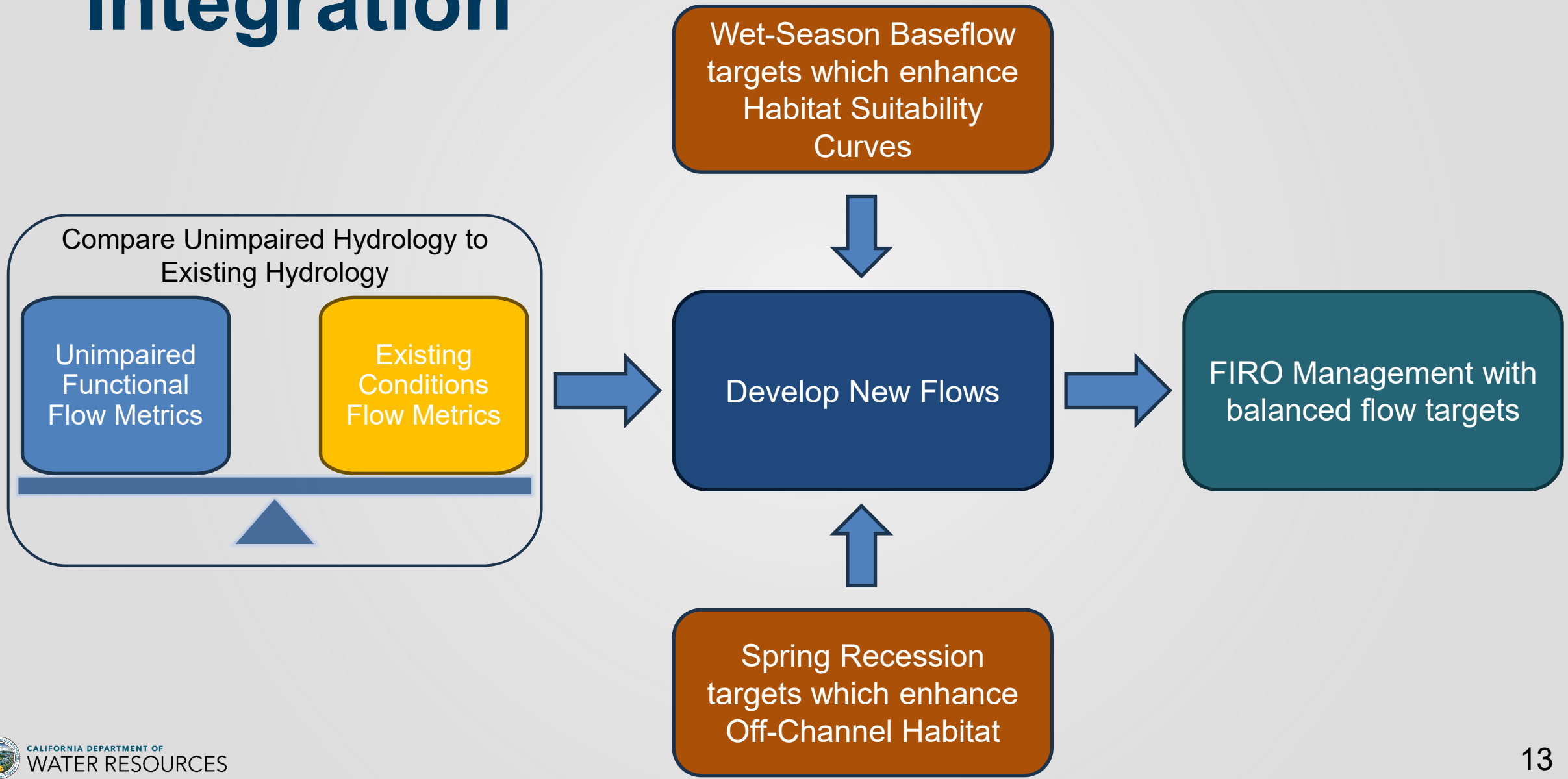


Forecast-Informed Reservoir Operations

- Uses improvements in weather and water forecasts to more effectively manage reservoirs
- Allows managers to retain or release water from reservoirs with more flexibility
  - FIRO space provides a flexible buffer, allowing managers to store more water during winter than previously allowed

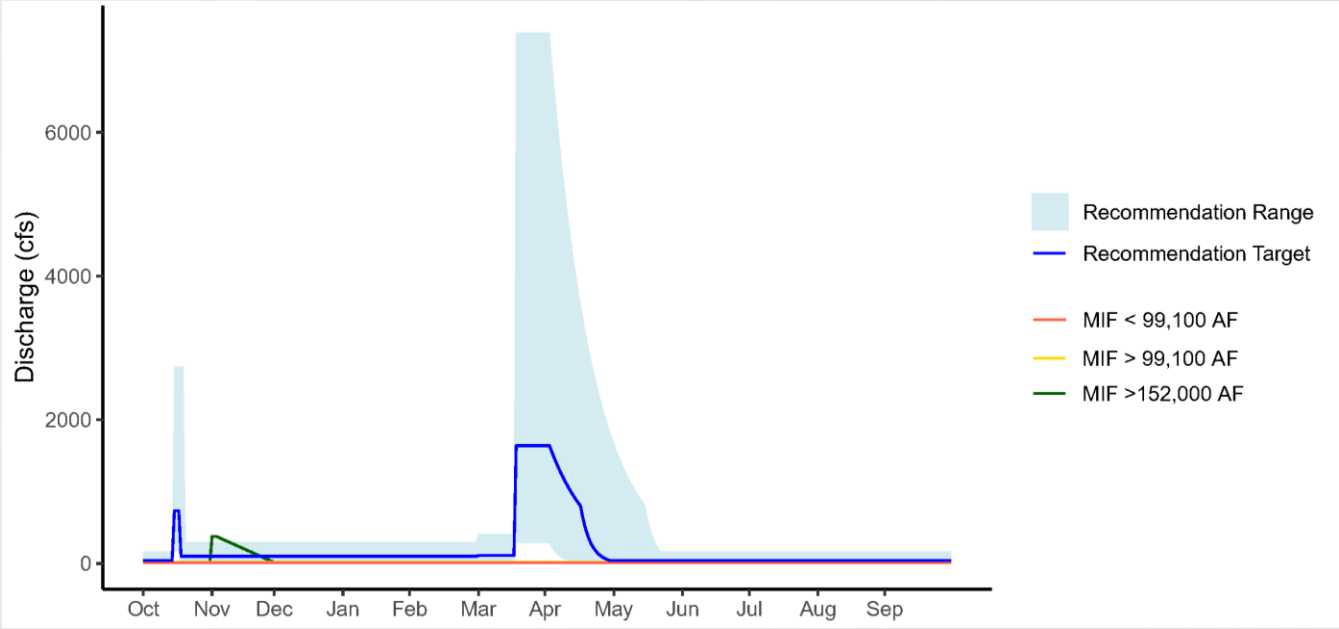


Integration



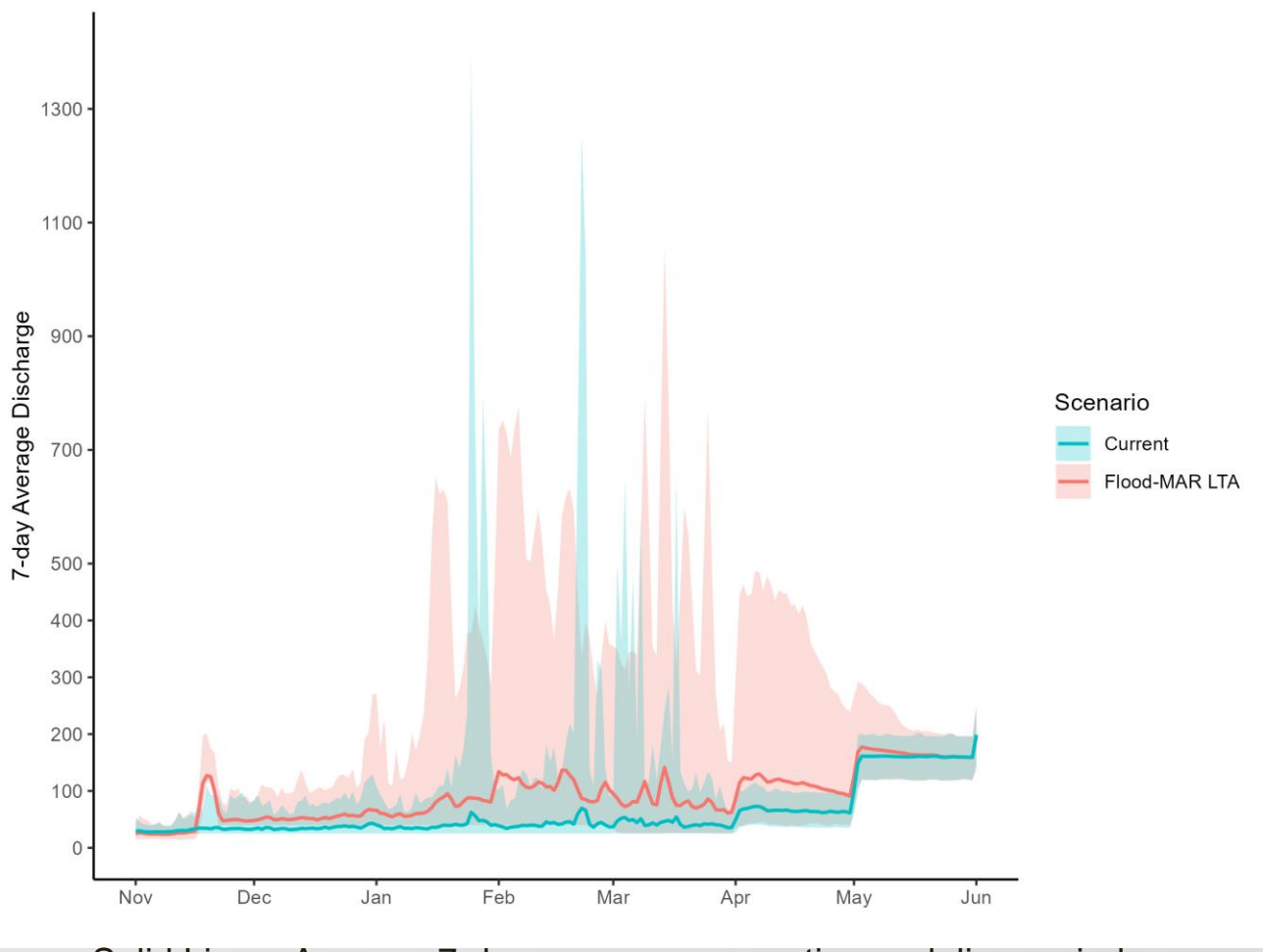
Example Case Study: The Calaveras River

- Inundation Threshold: 100 – 200 cfs
- Optimal Spawning (January – March) flow: 100 cfs
- Optimal Rearing (March – May) flow: 110
- Required minimum instream flow
  - 20 cfs year-round if reservoir capacity > 99,100 AF
  - 10 cfs if reservoir capacity < 99,100 AF
  - If storage exceeds 152,000 AF on Nov 15 -> Fall release implemented
- Operational flood capacity limits
  - <7,000 cfs at Bellota weir to protect infrastructure



Example Case Study: The Calaveras River

- New Hogan storage is extremely limited
  - Unable to implement all CEFF and ecosystem flow targets
- Manage storage to provide a fall pulse event in mid-November
  - If fall-pulse supplied, protect spawning and rearing by increasing wet-season baseflows to target (100 – 110 cfs)
  - If fall-pulse not supplied, wet-season baseflow reduced to minimum flow targets (20 -35 cfs)
- If storage exists at end of March, provide for a single winter peak flow with spring recession flow



Solid Line = Average 7-day-average over entire modeling period; Ribbon = 10th to 90th percentile of the 7-day-average over the entire modeling period

Example Case Study: The Calaveras River

- New Hogan storage is extremely limited
  - Unable to achieve target/maximum flows for
- Manage storage to provide a fall pulse event in mid-November
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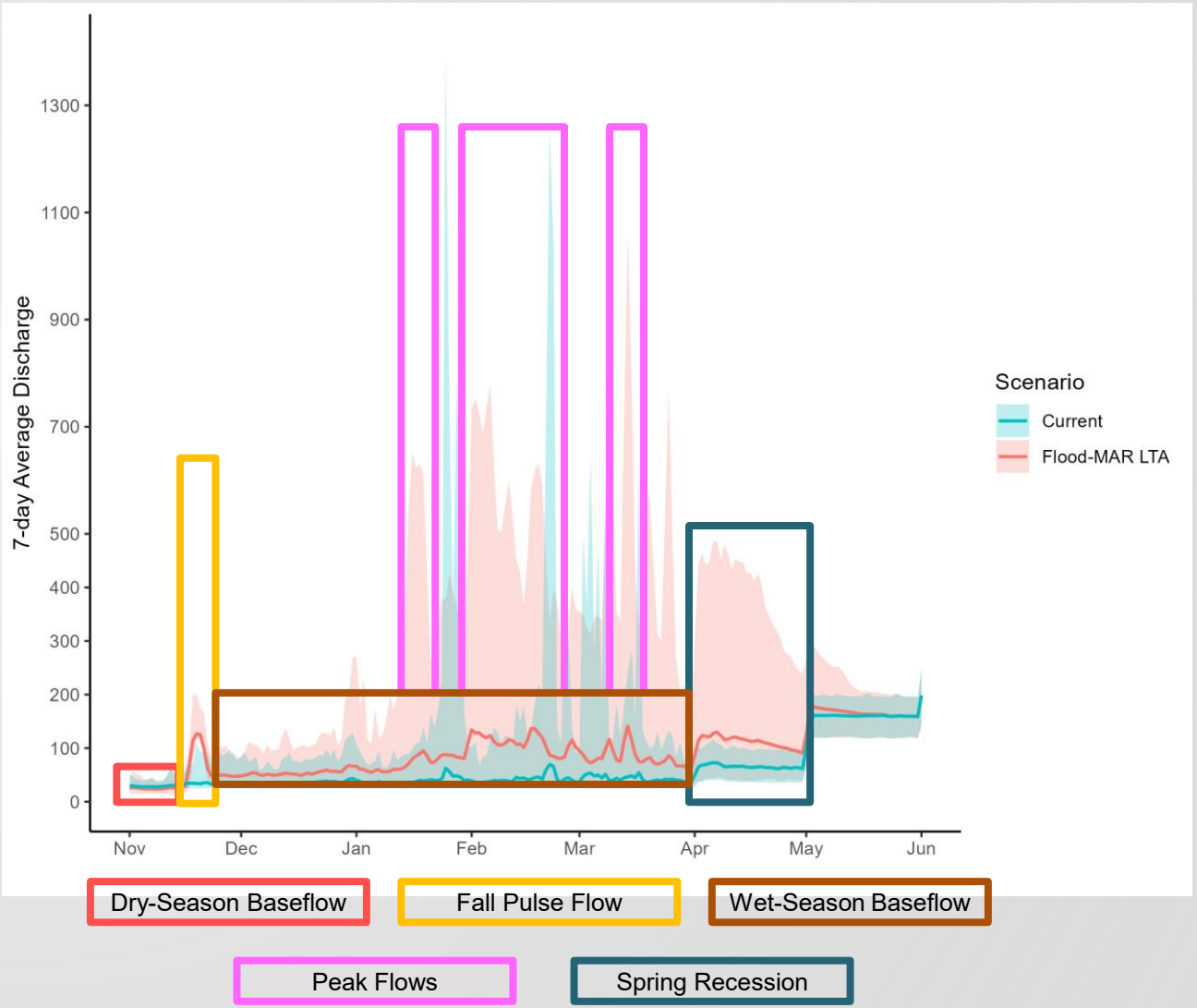
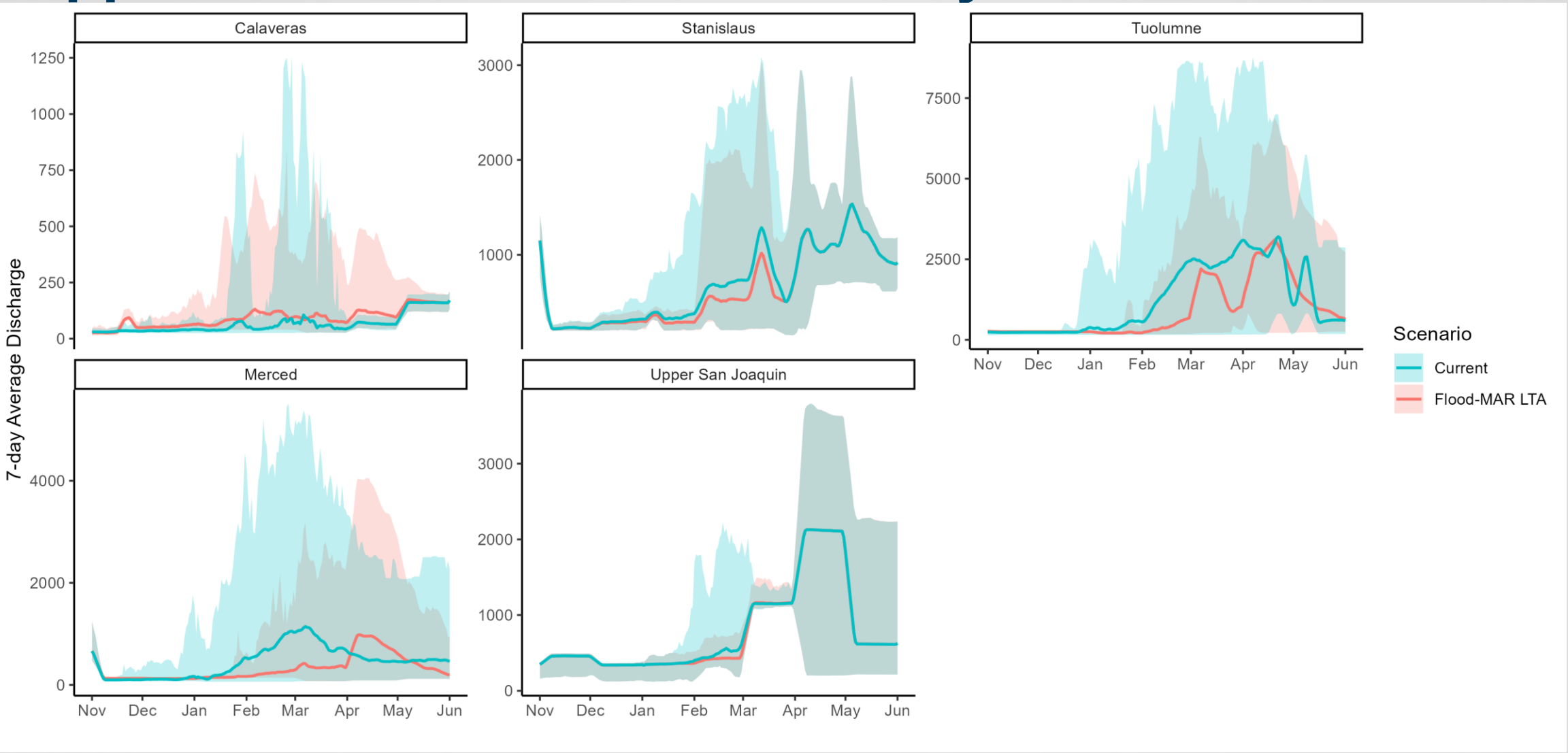


Application to all 5 Central Valley Watersheds



Key Take-Aways

- Co-management of diversions for recharge and providing ecological benefits is possible for MAR projects
- Designed flows ≠ Restoration of “natural” flows
  - Co-management of water for recharge and water for ecological resources
- Pairing designed flows with additional restoration activities such as floodplain reconnection and enhancement, gravel augmentation, etc. can yield additional benefits.

DEPARTMENT OF WATER RESOURCES · STATE OF CALIFORNIA

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Woodard & Curran

ESA

cbec eco engineering

Sustainable Conservation

CHOWCHILLA WATER DISTRICT

Friant WATER AUTHORITY

MADERA IRRIGATION DISTRICT

theEARTH GENOME
REVEALING THE POSSIBLE

BUREAU OF RECLAMATION

MID Modesto Irrigation District
The Power to Grow