Evaluating the Relative Benefits of Water Reuse, Recycling, and Environmental Flows

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California's Water Crisis

- California is water limited and demand for water is increasing
  - Agricultural, municipal, recreational, hydropower production, fisheries, etc.
- Climate change is further stressing water supply and ecosystems
  - Changing rainfall patterns and increasing temperature
  - Extended duration and severity of droughts
- Overallocation of water resources puts a strain on water supply infrastructure and the environment

Lake Orville 2021 (PPIC)

Numerous Policy Drivers that Demand Solutions

- CA Water Action Plan, CA Recycled Water Policy, CA Cannabis Policy, FERC Relicensing, water quality control plans, FloodMAR, Sustainable Groundwater Management Act (SGMA), etc.

CA's Recycled Water Policy

- Established in 2018 by State Water Resources Control Board
- Encourages safe use of recycled water from wastewater sources while protecting public health and the environment

https://www.waterboards.ca.gov/water_issues/programs/recycled_water/policy.html

Water Recycling and Reuse is Critical Part of the Solution

Treated Wastewater

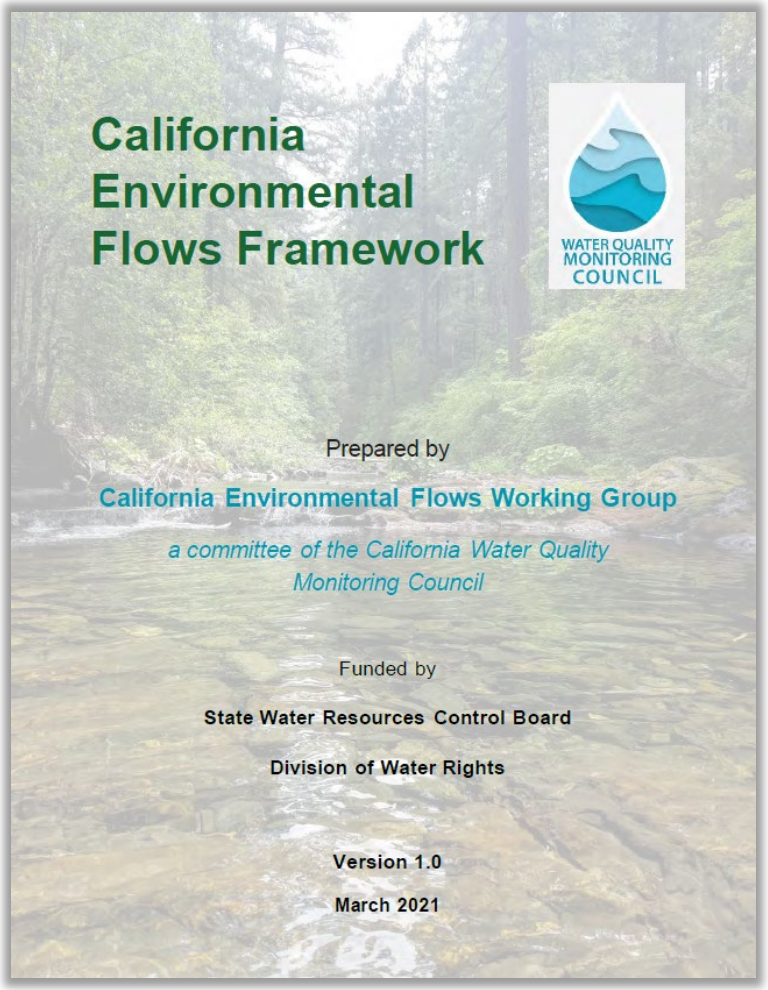
Captured Stormwater

Diversify local water supplies and replenish over-drafted groundwater resources

Reuse Can Create Conflicts with Protection of Aquatic Life and Recreational Beneficial Uses

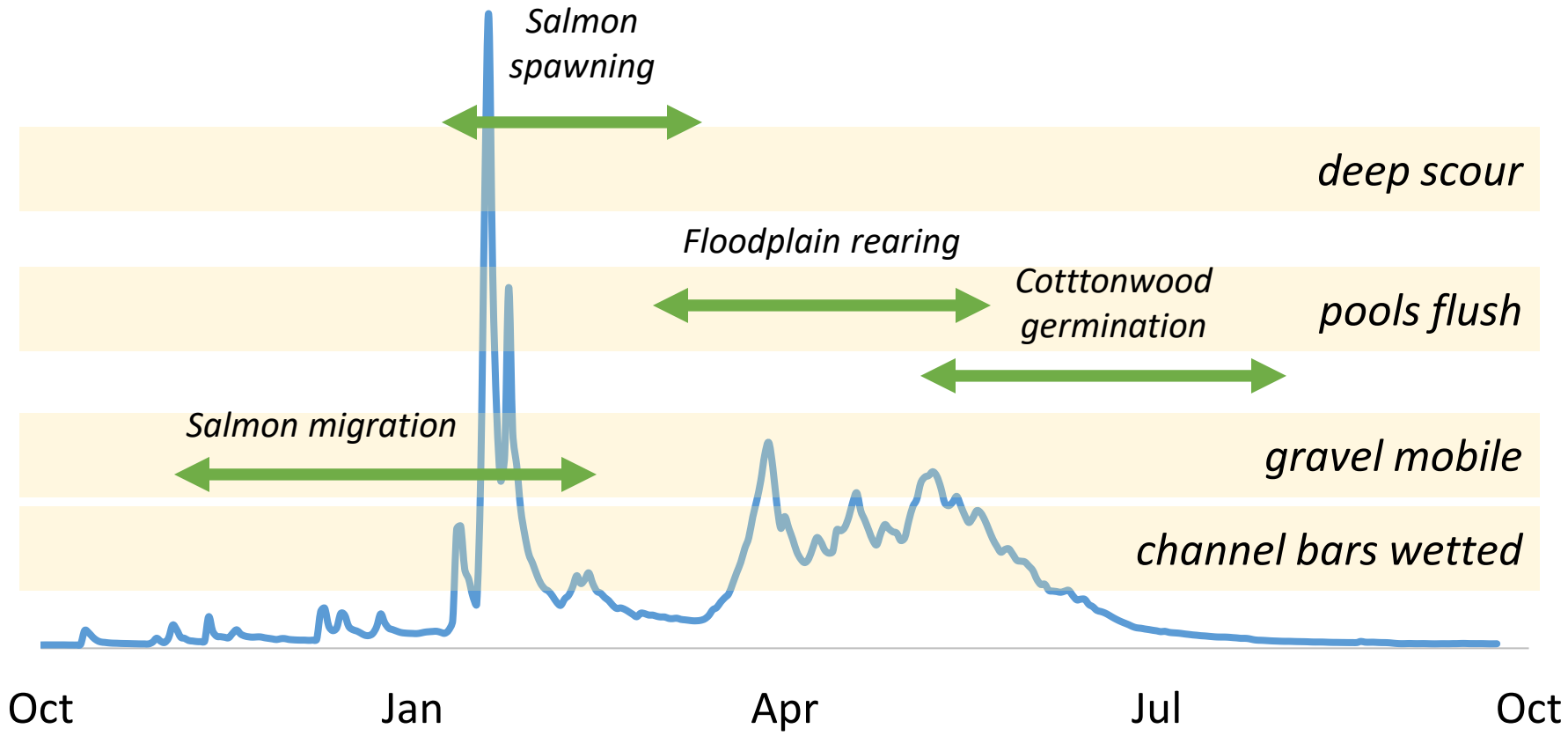
Framework For Solutions

- California Environmental Flows Framework (CEFF) developed with statewide partners:
  - ➢Science-based approach for guiding decisions
  - ➢Determines environmental flows that balance water for humans and the environment
  - ➢Assesses impact of changing flow conditions
  - ➢Explores tradeoffs associated with various management actions
  - ➢Based on a ***Functional Flows Approach***



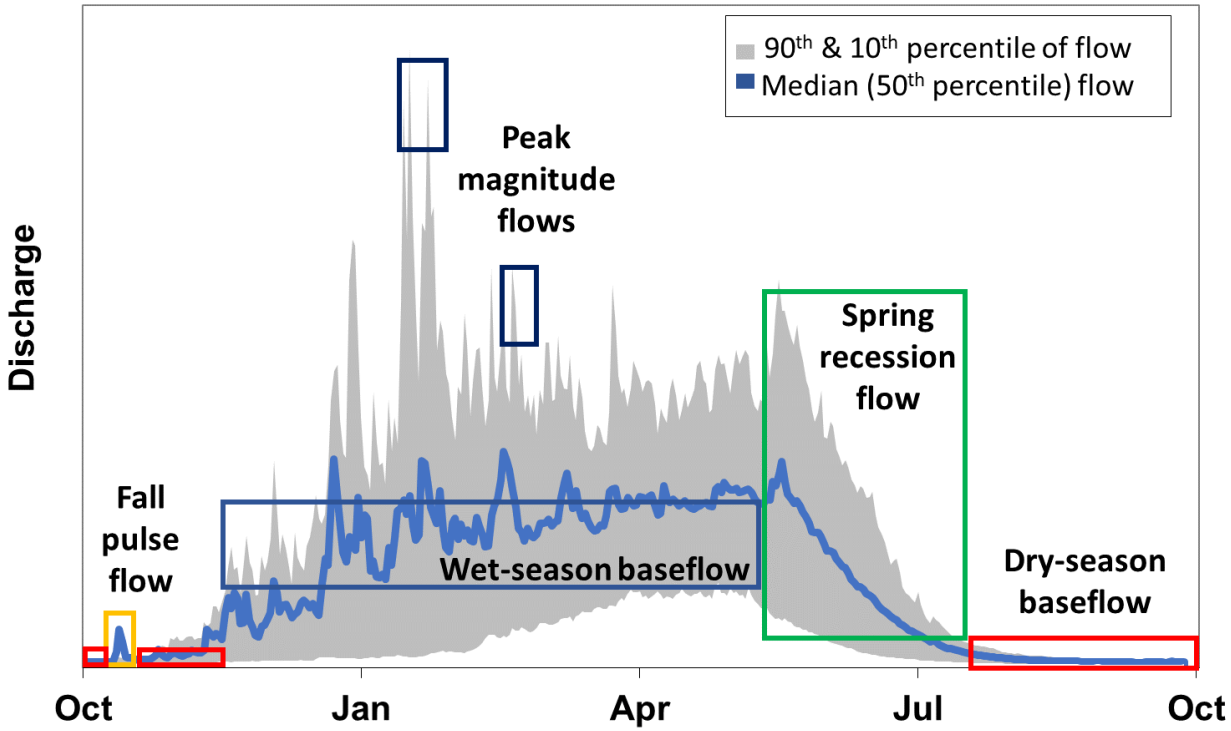
https://ceff.ucdavis.edu/

Functional Flows



modified from Yarnell et al. 2010, 2015 *BioScience*

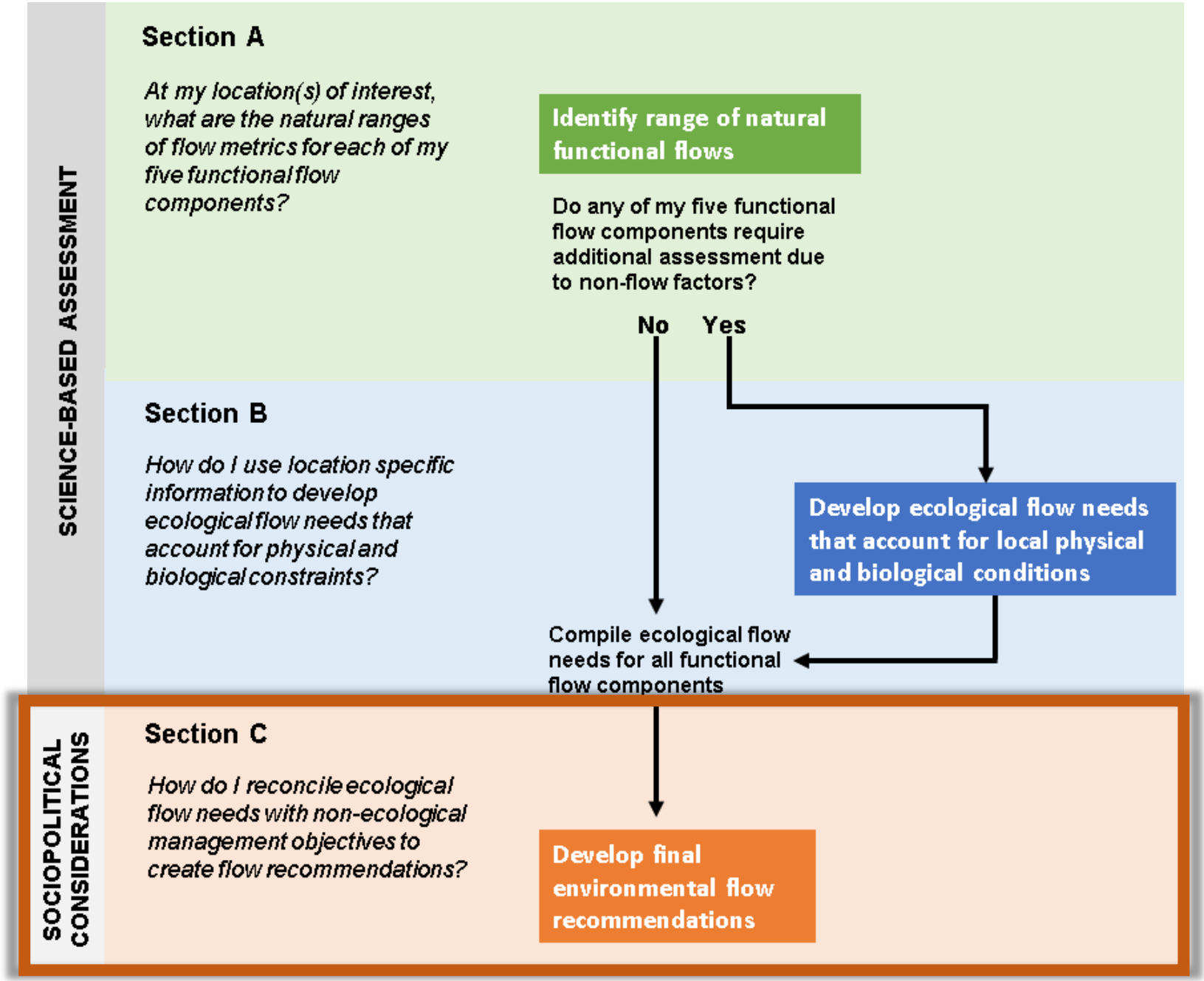
Functional Flow Metrics



Metrics quantify flow components

Flow Component	Flow Metrics
Fall pulse flow	Magnitude (cfs)
	Timing (date)
	Duration (days)
Wet-season base flow	Magnitude (cfs)
	Timing (date)
	Duration (days)
Wet-season peak flow	Magnitude (cfs)
	Duration (days)
	Frequency
Spring recession flow	Magnitude (cfs)
	Timing (date)
	Duration (days)
	Rate of change (%)
Dry-season base flow	Magnitude (cfs)
	Timing (date)
	Duration (days)

California Environmental Flows Framework (CEFF)



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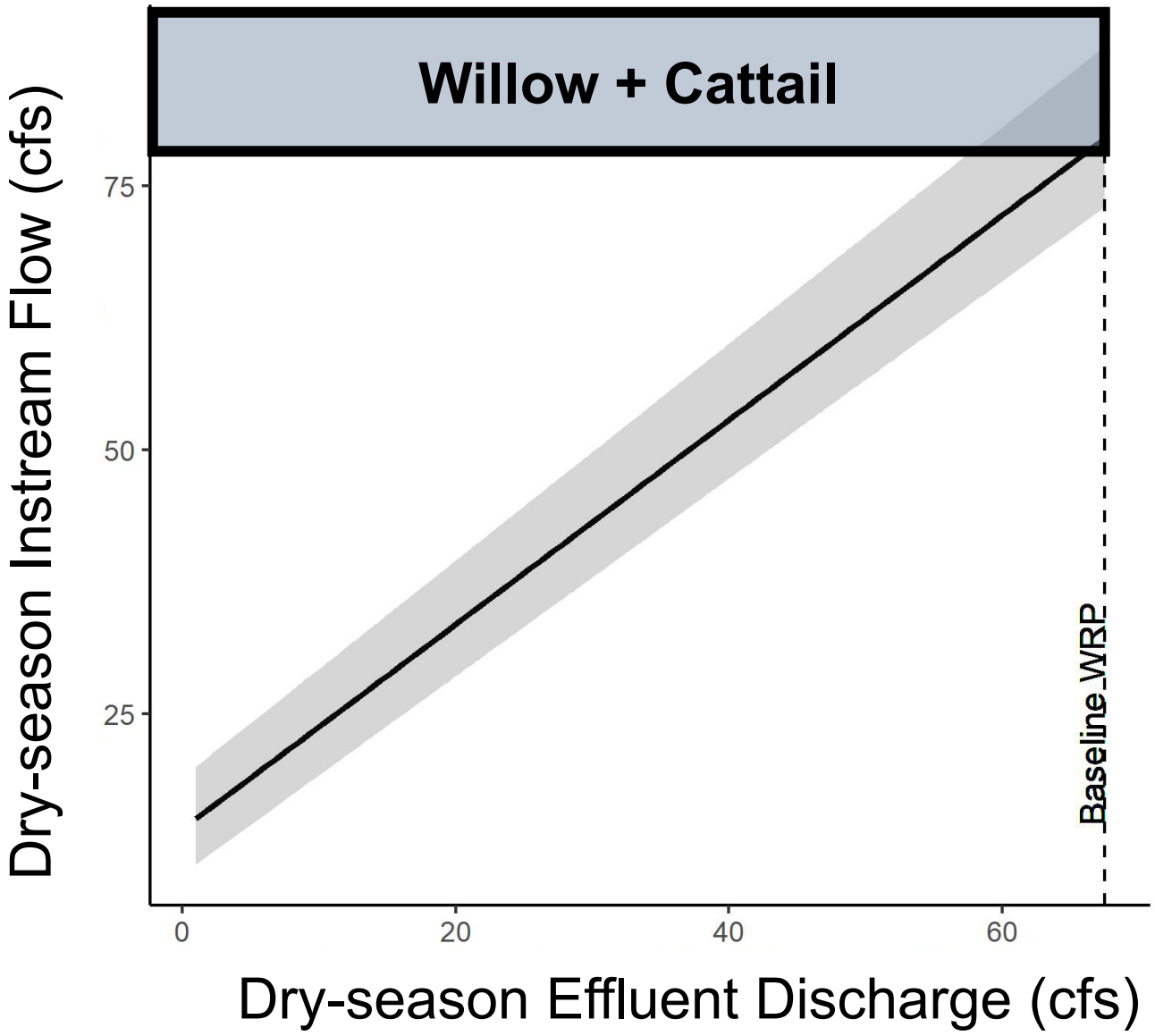
CEFF Adopted by State Agencies

- ✓Instream Flow Program
- ✓CA Water Action Plan
- ✓Cannabis Cultivation Policy
- ✓CA Recycled Water Policy

Tools for Ecological Tradeoffs

- Evaluate tradeoffs between water management actions and instream flows needed to support ecology



Need Tools and Approaches to Assess Economic and Socio-Cultural Tradeoffs

- Most environmental flow studies lack non-biophysical considerations

- Need tools to help managers balance ecological, economic, and socio-cultural tradeoffs for more holistic water resource management

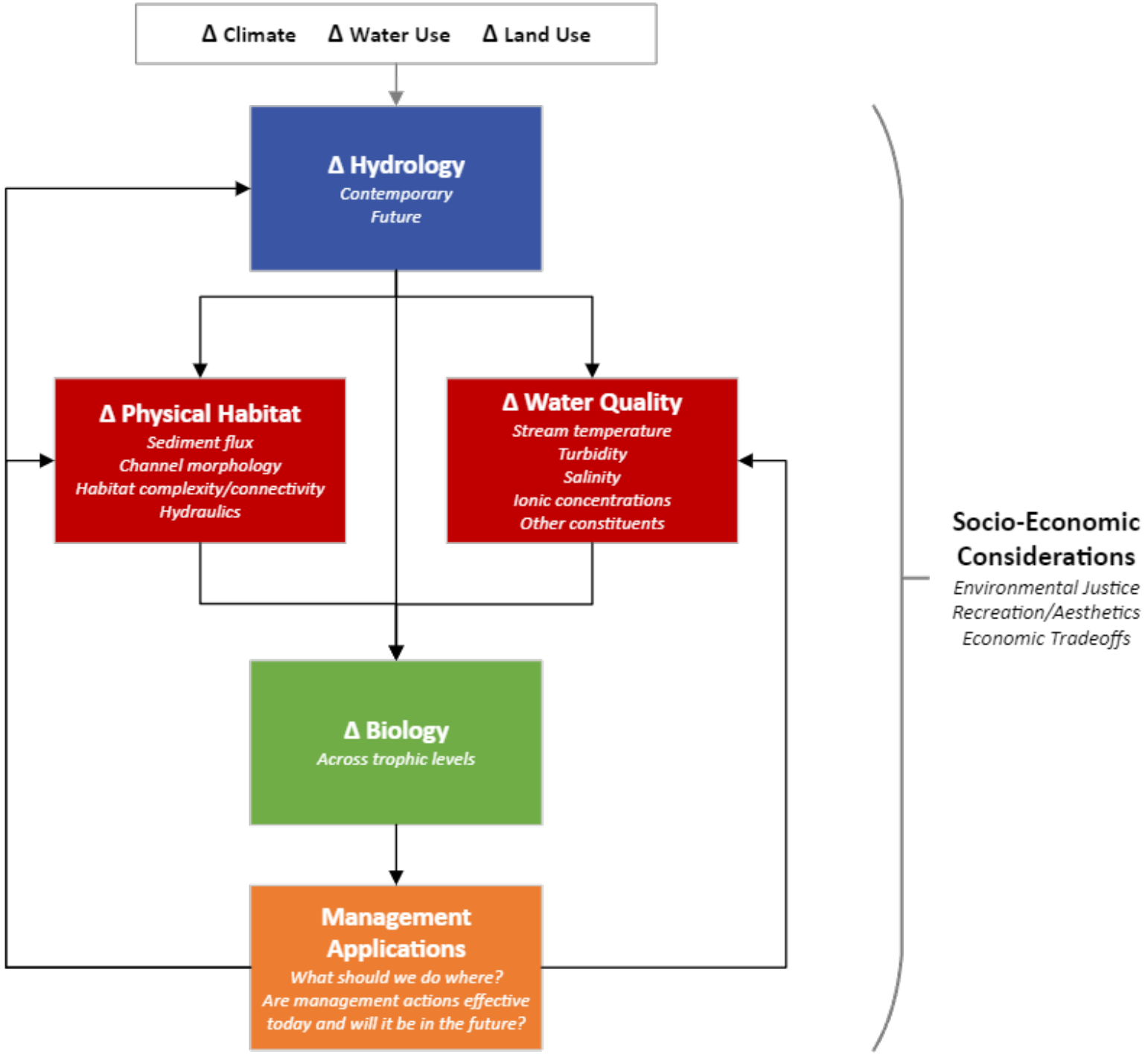
CSU WATER / SCCWRP Collaboration

- Shed light on how to integrate social-cultural, economic, and environmental factors to balance water for human uses and the environment
  - ➢Develop tools that consider economic and socio-cultural tradeoffs
  - ➢Create approach that seeks to balance tradeoffs for more stable and resilient water supply
  - ➢Illustrate the use of the toolkit within CEFF in a real-world example

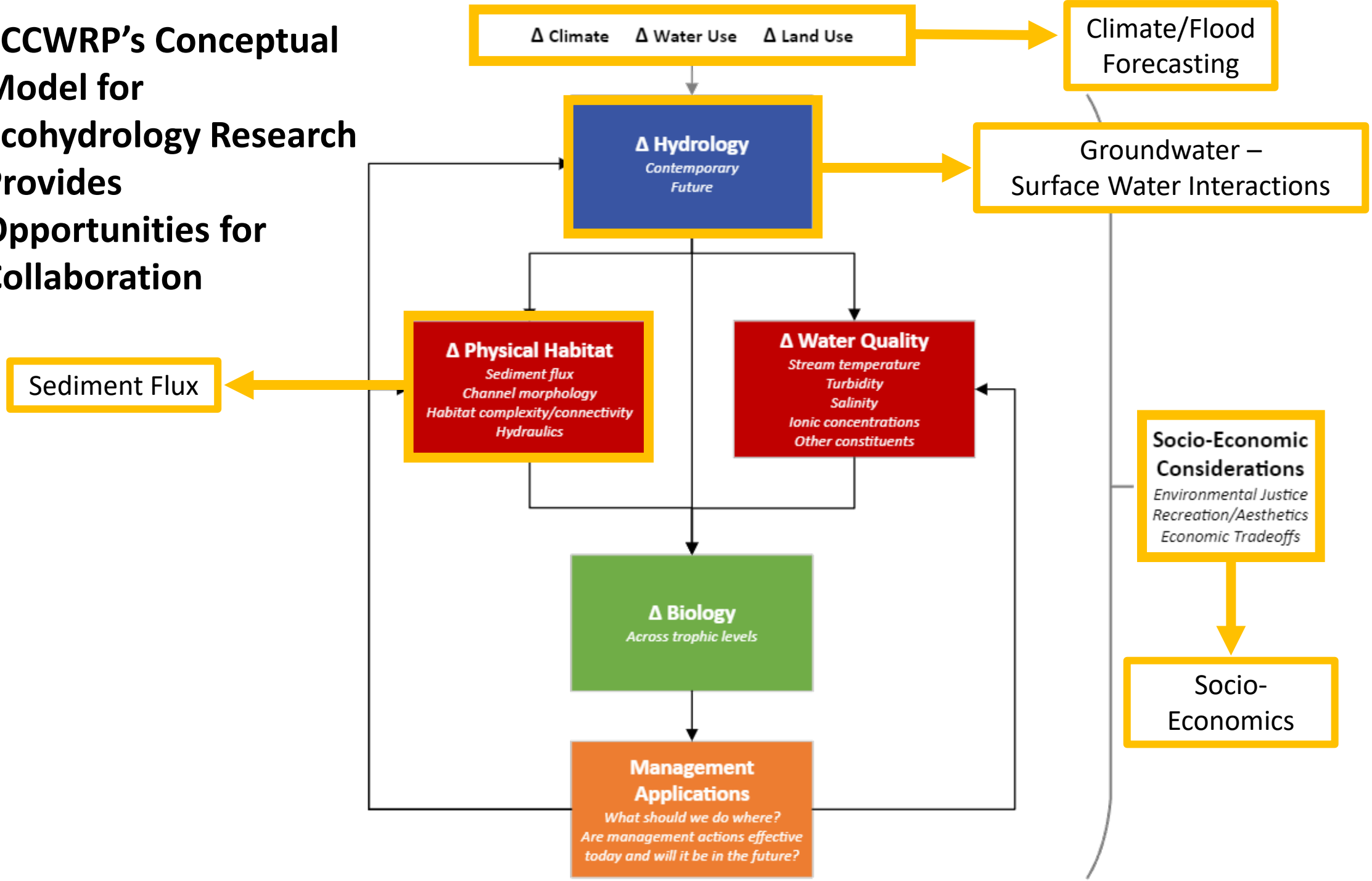
CSU The California State University

SCCWRP Established 1969

SCCWRP's Conceptual Model for Ecohydrology Research



SCCWRP's Conceptual Model for Ecohydrology Research Provides Opportunities for Collaboration



We Look Forward to Working Together

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EXTRA SLIDES

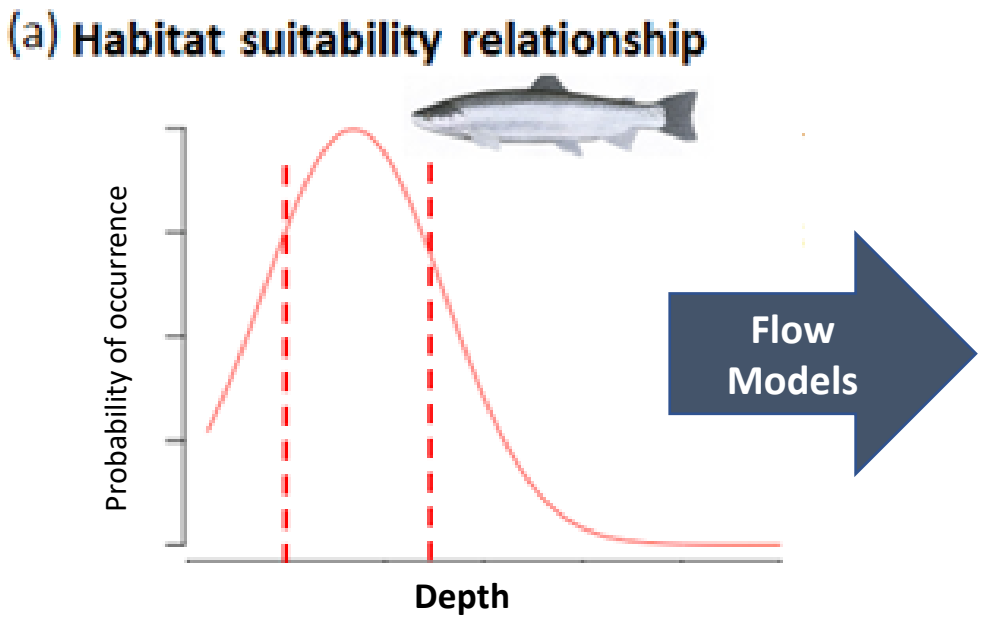
CEFF Applications Focus on Ecological Tradeoffs

LA River Flows Study

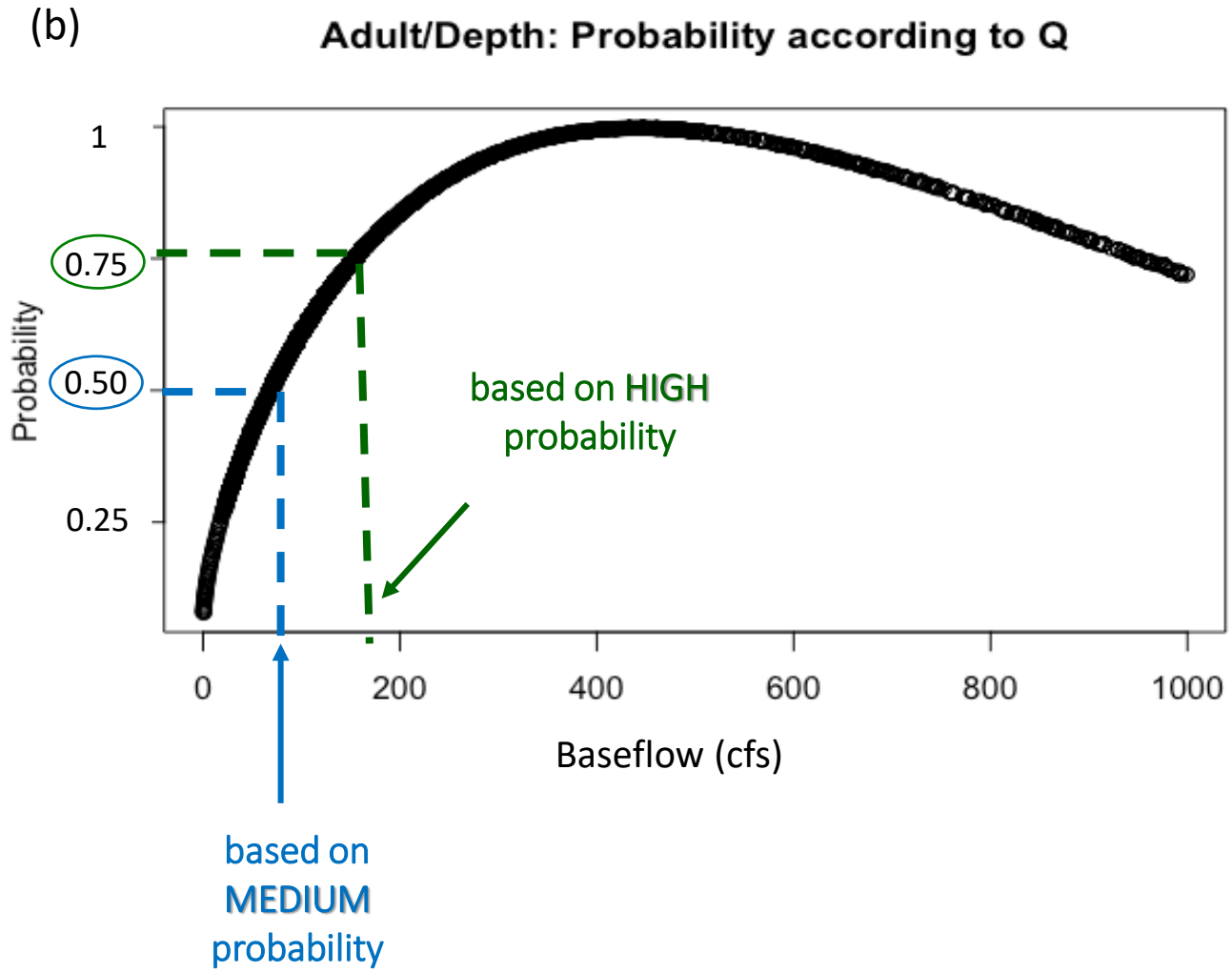
North Coast Cannabis Policy

Primary focus on ecological tradeoffs, with limited effort on economic and social tradeoffs of allocating flows for other uses

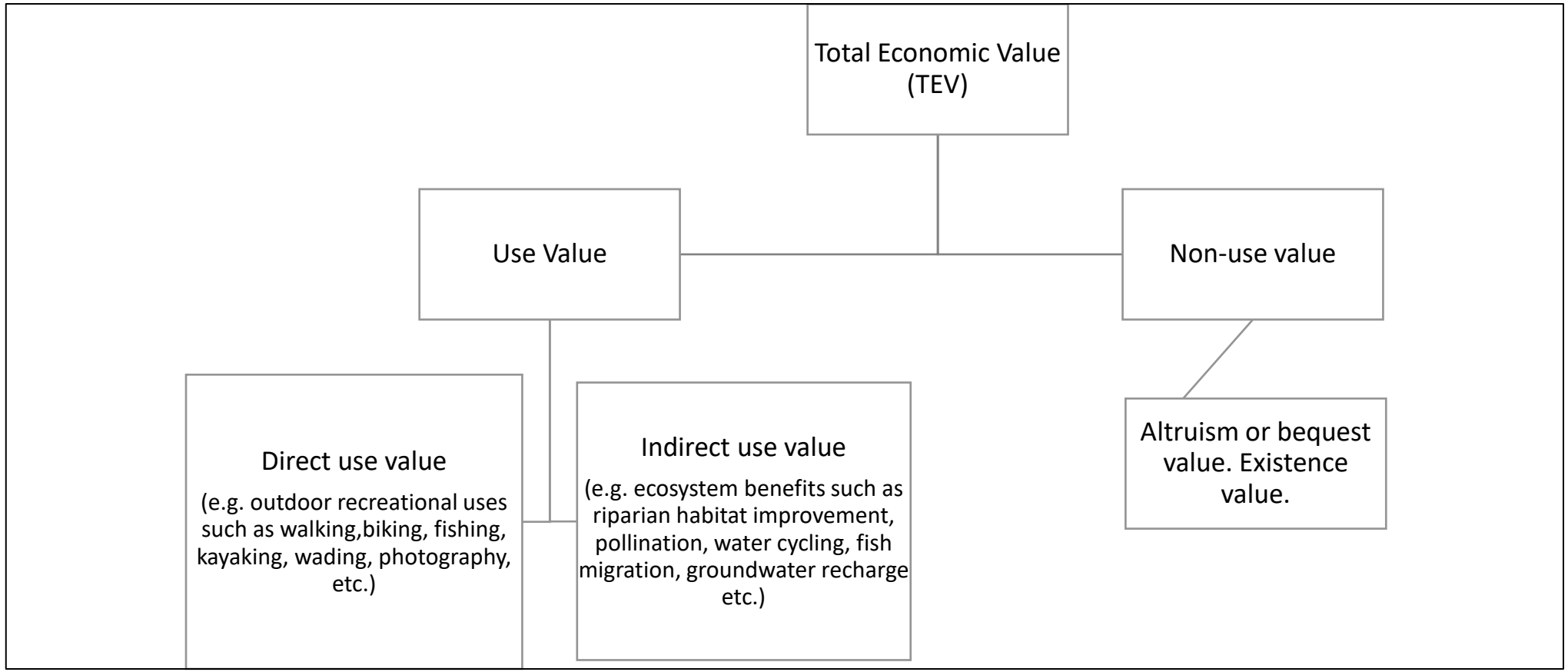
Process for Determining Flow Ranges



Flow Models



Measuring Economic Benefits from Changes in LA River Flows



Source: Adapted from Boyer and Polasky (2004)

Other Considerations for Tradeoff Analysis