
Image Credit: Barbara Wampole

The California Environmental Flows Framework

A data-driven approach to understanding and managing California's most vital resource: water

A Unified Approach for Clear, Scientific Results

The California Environmental Flows Framework (the Framework) **helps managers efficiently develop environmental flow recommendations that balance human and ecosystem needs for water**. The Framework ensures managers have the information they need to make strategic decisions about water allocations that maximize benefits and to consider the likely impact of their choices. On its own, the Framework does not impact any existing water regulations—rather, it is a technical process for gaining essential knowledge that should be used when deciding how to manage California's rivers.

California's Water Management Crisis

To date, it has been impossible to confidently assess what sustainability looks like for California's rivers and streams. Historically, the process of defining ***environmental flows***—the amount of water in rivers and streams necessary to sustain ecosystem health—has been difficult and expensive. Flows in most of California's rivers are currently unprotected and when protections do exist they are often set at static minimum water levels, which fail to account for the essential nature of change in river ecosystems.

As things stand, California's rivers are running dry, water supplies to farms and communities are unreliable and freshwater biodiversity is in precipitous decline. These impacts become only more dire with the intensifying effects of climate change.

Sustainable water management depends on being able to accurately and efficiently determine environmental flows. Based on a groundbreaking synthesis of what we know about how California's rivers function, the Framework was created to offer a transparent, standardized and often significantly less costly process for determining what environmental flows should look like. **This vital information opens up a new path to a sustainable and resilient water future for California.**

Key Objectives

The Framework provides technical guidance so managers can make scientifically defensible flow recommendations. Its key objectives are to:

- **Provide a rapid approach to defining environmental flows for all streams and rivers in California**
- **Standardize, streamline and improve transparency in the way environmental flows are assessed**
- **Provide tools to meet diverse management goals and priorities**
- **Improve coordination and data sharing among management agencies and other stakeholders**
- **Leverage our best scientific understanding to provide the water that ecosystems actually need to thrive**

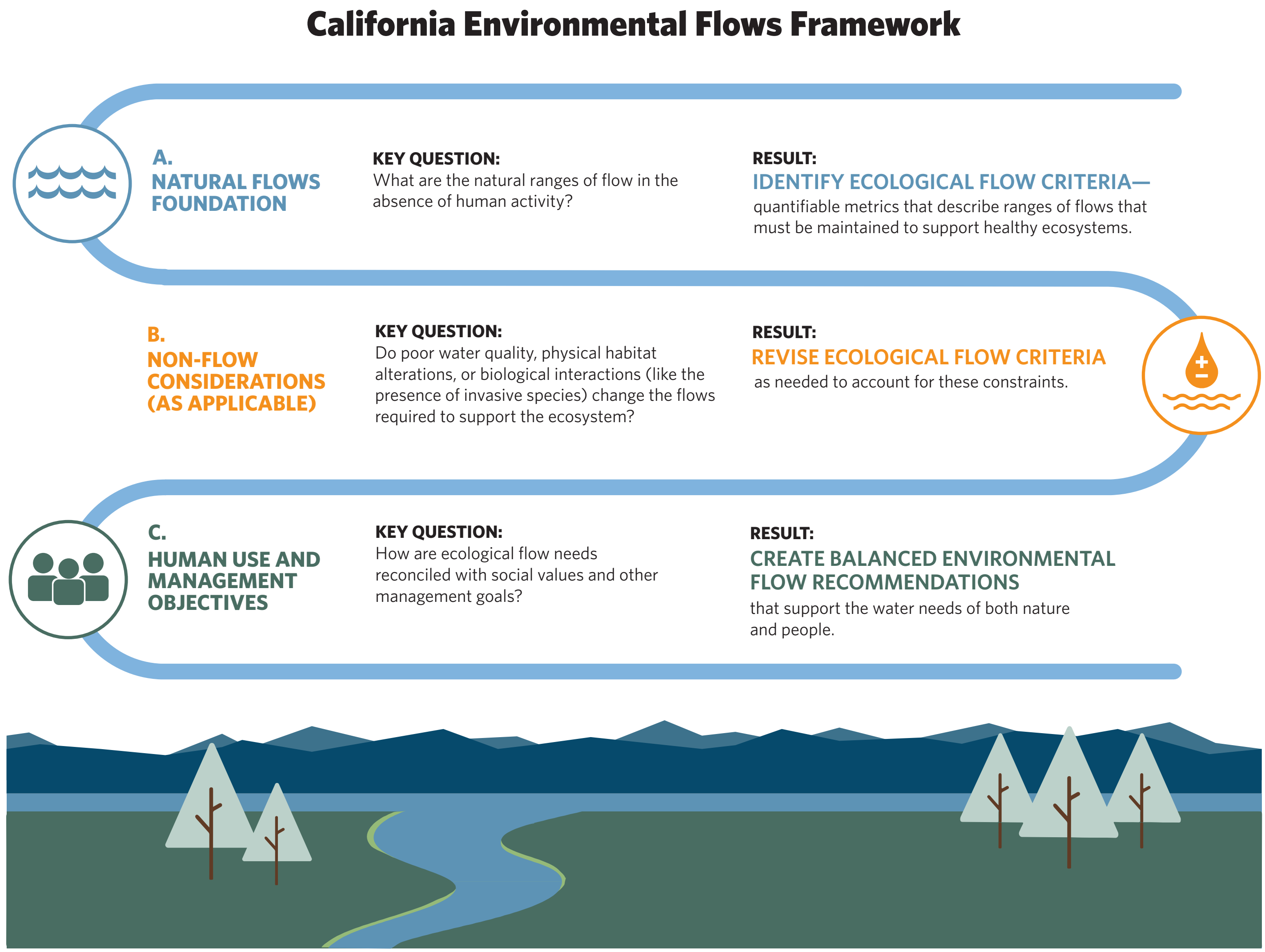


FIGURE 1: An overview of the three parts of the Framework, with the key questions and results of each.

An Overview of The Framework

A) NATURAL FLOWS FOUNDATION

The baseline assessment provides **ecological flow criteria (the range of flows needed to support a healthy ecosystem)** for a study area based on predictions of the natural ranges of flow metrics—i.e. the expected flow patterns in the absence of human activities—for the five different functional flow components (Figure 2). For planning applications, or where non-flow factors are not a concern, the initial ecological flow criteria can be translated into environmental flow recommendations in the final section. In many cases, this will help **avoid resource-intensive, site-specific flow studies.**

It also provides guidance for determining if non-flow impairments such as physical habitat alteration, water quality impairment and biological interactions may make natural ranges for flow metrics less effective in supporting ecosystem functions. If so, users would employ the next section.

B) NON-FLOW CONSIDERATIONS (As Applicable)

Here, users develop conceptual models by compiling information and performing field data collection and quantitative analyses to understand how the five flow components function in the river ecosystem, and **how changes in these flows could affect ecological management goals**. This analysis may result in revisions to the ecological flow criteria that account for physical constraints.

C) HUMAN USE AND MANAGEMENT OBJECTIVES

Finally, the Framework provides guidance on assessing flow alteration to inform management strategies, **balancing ecological and non-ecological management objectives** to develop a final set of environmental flow recommendations. Additional strategies are provided for adaptively managing environmental flows, monitoring outcomes and implementing environmental flow recommendations.

This section represents an evolution from a purely scientific process to an approach that incorporates social values and other management needs, including human uses of water, public health and safety needs, and legal and regulatory requirements.

Results are not prescriptive; rather, **the Framework proposes general principles and best practices that help managers make decisions to balance the water needs of people and the environment.** It is up to water managers and regulatory agencies to set flow criteria to guide water use and projects.

> *"California's water challenges are daunting... we need to harness the best in science, engineering and innovation to prepare for what's ahead and ensure long-term water resilience and ecosystem health."*
>
> **GOV. GAVIN NEWSOM**
> State of California

Understanding Functional Flows

The technical approach of the Framework rests upon the scientific concept of ***functional flows*** – i.e., distinct aspects of a natural flow regime that support stream processes and collectively maintain stream ecosystem health.

This approach does not mandate either the restoration of full natural flows or the maintenance of historical ecosystem conditions. Furthermore, a functional flows approach is not focused on the habitat needs of a particular species. Rather, it is focused on identifying and preserving key ecosystem functions—such as sediment movement, water quality maintenance, and environmental cues for species migration and reproduction—that are necessary to maintain ecosystem health and that are broadly supportive of native freshwater plants and animals, including listed species.

Most California streams have five functional flow components that occur at different times throughout the year: fall pulse flow, wet-season peak flows, wet-season baseflow, spring recession flow and dry-season baseflow.

The Framework provides managers with tools to quantify these different flow components—based on their magnitude, timing, duration, frequency and/or rate of change—to achieve a clear, nuanced understanding of the changes in flow both across seasons and from year to year. Managing for these five functional flow components preserves essential patterns of flow variability within and among seasons.

Applying the Framework

The Framework does not establish new or replace existing regulations or regulatory processes. Instead, it provides guidance that could be useful in developing environmental flow recommendations in both regulatory contexts (e.g., State Water Board regulations or water rights proceedings, FERC licensing) and non-regulatory contexts (e.g., Sustainable Groundwater Management Plans, local cooperative solutions, settlement agreements).

In other words, the Framework may inform other regulatory processes without determining their ultimate outcome.

Five Components of Functional Flows

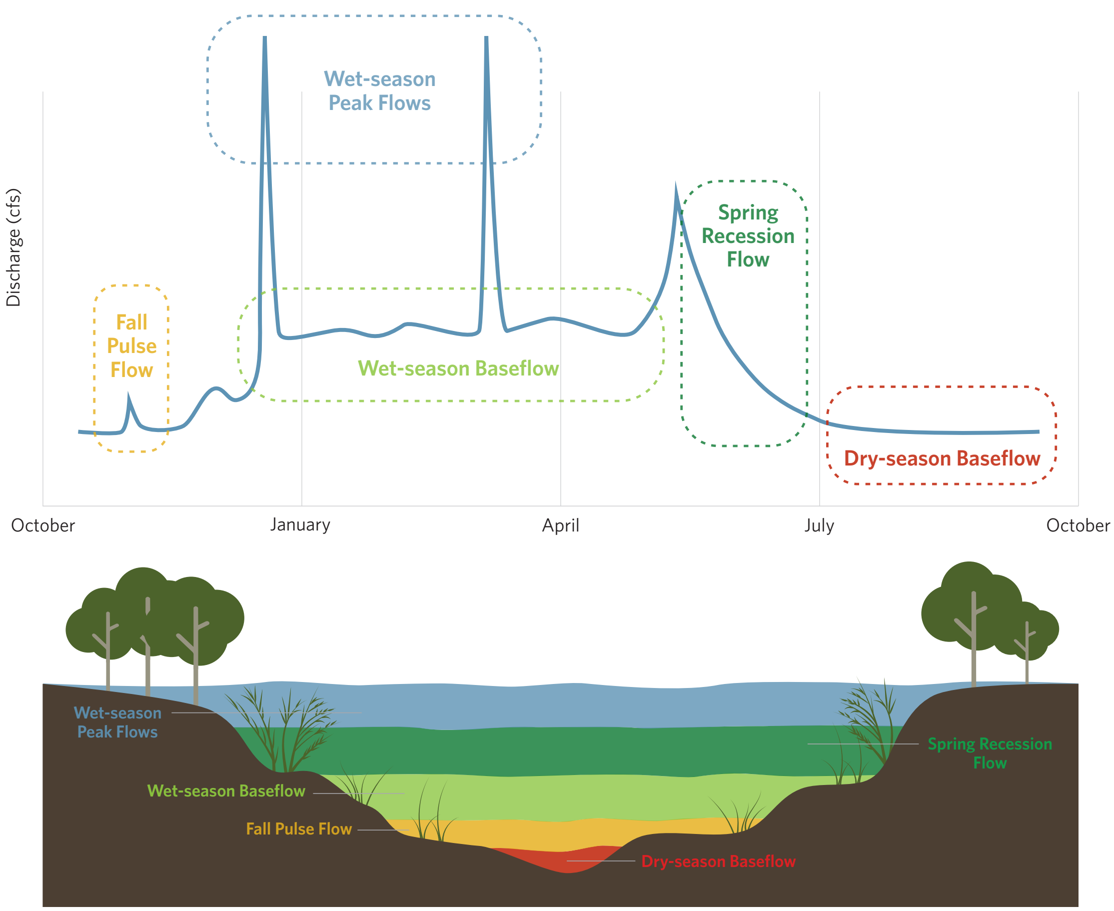


Figure 2. A functional flow regime identifies the water necessary at different times of the year to support healthy ecosystems, taking into account the natural variability of flow levels through the year that are vital for ecosystem health. The generalized hydrograph on top shows how flows change throughout the year, highlighting the five functional flow components. The bottom panel shows how each of the flow components produces a different set of conditions in a river channel, changing the aquatic habitat available.

The Framework In Action

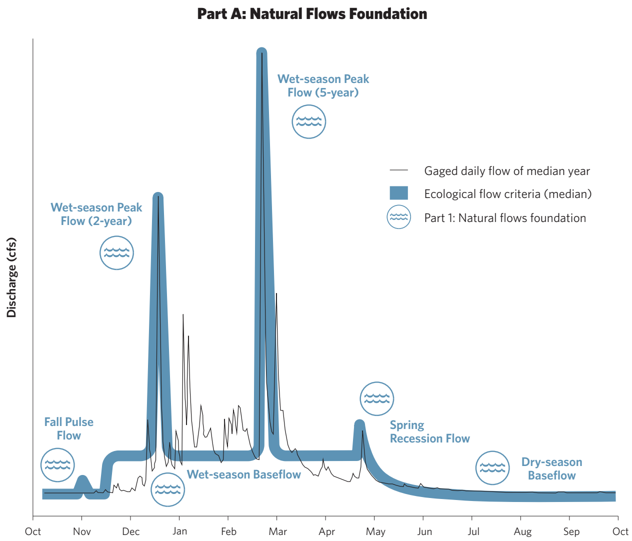


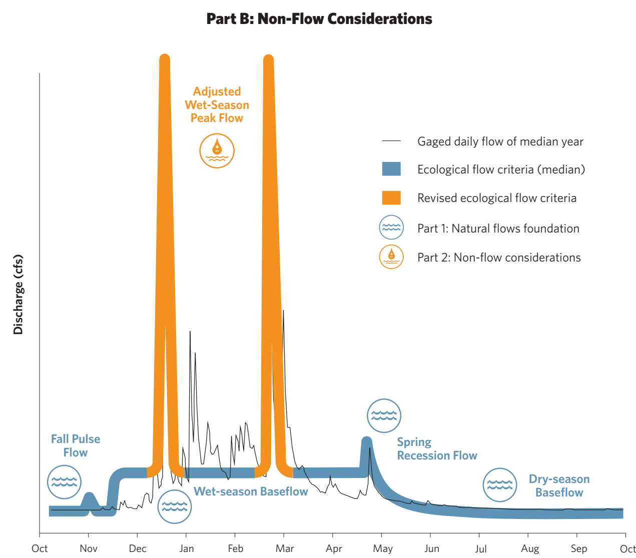
FIGURE 3. NATURAL FLOWS FOUNDATION This hypothetical example shows the outcome of Part A. It establishes ecological flow criteria that takes into account the variation in water levels that occur naturally, reflected in the five functional flow components. This variation is needed throughout the year to support the ecological functions of this watershed.

Differences between ecological flow criteria and median year flows reveal when this ecosystem might have more or less water than it requires to function.

FIGURE 4. NON-FLOW CONSIDERATIONS In our hypothetical, the riverbed channel is incised and leveed. This physical alteration prompted us to use Part B of the Framework to determine if changes needed to be made to the ecological criteria in Part A.

In order for wet-season peak flows to fully support the ecosystem, they need to inundate the surrounding floodplains. In Part B we learned that an increased volume of water is needed for peak flows to perform this function in the incised and leveed channel. The ecological flow criteria was revised to reflect this.

Part B reveals that a greater volume of water than usually flows in a median year is needed for this altered watershed to support the ecosystem.



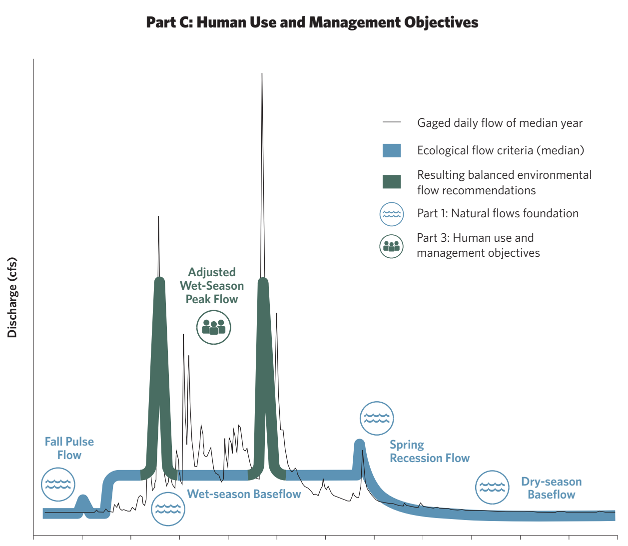


FIGURE 5. HUMAN USE AND MANAGEMENT OBJECTIVES Part C of the Framework suggests best practices for managers developing environmental flow recommendations that account for the issues raised in Parts A and B as well as sociopolitical considerations.

In our hypothetical, there is a concern that the wet-season peak flows identified in Part B could cause flooding of nearby communities. Furthermore, the water needed to achieve these flows is not usually present within the watershed.

To address these concerns, the Framework leads us to consider restoration within the channel that would create floodplain access at a lower flow. With restoration, we can achieve the necessary ecological support with a smaller flow of water and low risk to nearby communities.

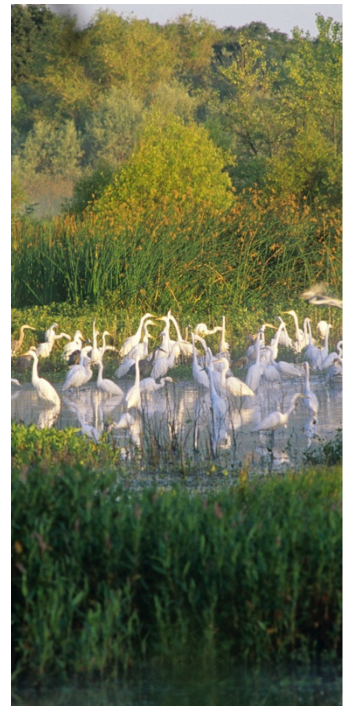
In the output of Part C, these adjusted wet-season peak flows are incorporated into our final, balanced environmental flow recommendation. However, this balanced flow still represents a sacrifice of ecological function; even with channel modification and restoration, this river's ecological functions are reduced because of lowered channel capacity and smaller size. Acknowledging these tradeoffs is an important part of the Framework.

Strategic Opportunities

Employing the Framework allows managers to confidently:

- Protect nature by understanding how much water is needed in a river or stream to support ecosystem health
- Shape a given water budget to optimize the positive impacts of the environmental water allocation
- Make strategic decisions that take into account the likely impact on the environment of different water allocation choices
- Prevent further freshwater biodiversity loss by supporting landscape-scale environmental flow protections
- Maximize benefits to people and nature by targeted improvements in flow

In our rapidly changing climate, it is critical that we better manage our water for both nature and people. The California Environmental Flows Framework gives managers the tools to better protect the future of our state's most important resource.



Case Studies

The Framework is a relatively new process, but it's starting to be applied throughout the state.

Lower Cosumnes River

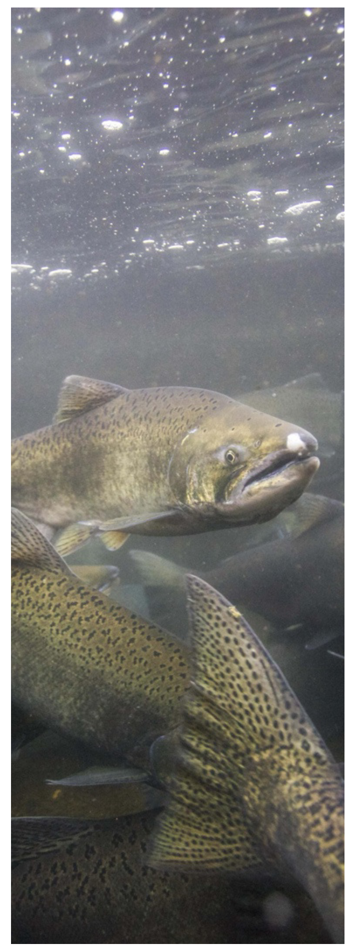
The lower Cosumnes River in the Central Valley supports a Chinook salmon run, hundreds of species of migratory birds and diverse groundwater-dependent ecosystems, as well as the largest remaining Central Valley riparian forest. In addition, the lower watershed supports thousands of acres of productive agricultural land and several communities. The Framework was used to gain additional knowledge of surface water hydrology and determine ecological flow criteria to inform the development of instream flow targets to support salmon, steelhead, riparian habitat and more ecological objectives.

San Juan Hydrologic Unit

Local watershed managers identified flow alteration and stream erosion as the highest priority water quality concerns for the San Juan Hydrologic Unit in South Orange County. The unit supports a combination of willow and riparian scrub communities, federally listed bird species and fish species of special concern. The Framework was applied to prioritize where to focus flow management efforts and to determine ecological flow needs that consider altered channel morphology and how to support key species.

Little Shasta River

Historically one of the most productive salmon streams in California, the mainstem Shasta River and its tributaries have experienced more than a century of aquatic and riparian habitat degradation. Historical adjudication of water rights did not consider the quality and quantity of water necessary to support native fishes. As a result, surface water allocations prioritize agricultural and other human water use, with limited water remaining to support ecological functions. The Framework was applied to determine ecological flow criteria in order to better understand how much streamflow is needed and when, guiding efforts in streamflow enhancement to restore instream habitat and recover native species.



Top: Egrets at the Consumnes River. © Mary Ann Griggs **Bottom:** Chinook salmon. © TNC.