Establishing Environmental Flows for California Streams

Eric Stein
Southern California Coastal Water Research Project
What Do We Know About the Status of Flows Statewide?

• First comprehensive study recently published
  – Statistical analysis of gauged locations

• 95% of gauged locations have at least some altered flows; 11% have pervasive alteration
  – Depletion of high flows
  – Augmentation of low flows
  – Reduction in seasonal variability

• Results NOT related to any ecological endpoints

Need an approach to define “flow impairment”
Low Bioassessment Scores Tend to Occur Where Hydrology is Altered
Statewide Needs for Environmental Flows

• Set instream flow standards to protect biological communities
  – Process for selecting appropriate ecological endpoints

• Assess vulnerability of streams to future changes in flow conditions
  – Prioritize areas for restoration/management

• Evaluate/inform management actions
  – e.g., reservoir operations, water withdrawals
What are Environmental Flows?

The magnitude, timing, duration, rate of change, and frequency of flows and associated water levels necessary to sustain the biological composition, ecological function, and habitat processes within a water body and its margins.
The mission of the California Environmental Flows Workgroup is to advance the science of environmental flows assessment and its application for supporting management decisions aimed at balancing natural resource needs with consumptive water uses.

**Technical Products**
- Analytical frameworks
- Classification systems
- Assessment tools
- Modeling approaches and models
- Databases
- Statistical analysis of patterns and relationships

**Implementation Products**
- Guidance for environmental flow criteria
- Appropriate application of tools, databases and models
- Prioritize knowledge gaps for funding
- Interpretation tools
- Communication approaches
- Ways to reconcile different approaches
CA Environmental Flows Workgroup Members

**Technical Participants**
- University of California, Davis
- University of California, Berkeley
- University of California Agriculture and Natural Resources
- Utah State University
- Southern California Coastal Water Research Project
- The Nature Conservancy
- California Trout
- US Geological Survey

**Agency Members**
- State Water Board - Water Quality
- State Water Board - Water Rights
- Department of Water Resources
- California Department of Fish and Wildlife
- US Fish and Wildlife Service
- US Forest Service
- US Geological Survey
- Regional Water Quality Control Boards
- Bureau of Reclamation
- NOAA Fisheries
Ecological Flow Criteria

Statewide rapid approach for setting flow criteria: comprehensive & coarse

Regional, local or site specific flow criteria: specific & objective-based

Databases + guidelines + tools + information accessible to the public

Ecological Flow Criteria
Ecological Flow Criteria

Statewide rapid approach for setting flow criteria: comprehensive & coarse

Provide tools to establish “flow criteria” ranges for any stream reach in California
- Define a natural stream classification
- Develop dimensionless reference hydrographs
- Estimate functional flow metrics
- Predict flow metrics at all stream segments
- Flow metric ranges at locations of interest
CEFF Tier 1

Hydrologic Classification

Stream classes

Dimensionless Reference Hydrographs

Functional flow components

Functional Flows Calculator

<table>
<thead>
<tr>
<th>Flow Characteristics</th>
<th>Fall Flush</th>
<th>Winter Floods</th>
<th>Spring Recession</th>
<th>Summer Baseflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Timing</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Duration</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate of Change</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Catchment Properties

Rainfall Patterns

Geology

Soil Properties

Lane et al., 2018 in revision
Purpose:
To characterize comparable seasonal and inter-annual flow patterns for each stream class.

Methods:
For each reference gage in a stream class, divide daily flow values by water year average annual flow. Calculate nondimensional flow percentiles for each date across all gauges and years.
Sub-annual aspects of the natural flow regime expected to support key ecosystem functions

Winter High Flows
First Fall Flush
Spring Transition
Summer Baseflow

Yarnell et al. 2015
Functional Flow Metrics

Metrics not related to any specific organism.

Metrics relate to general health based on reference conditions.
Water Year Type

Stream Class: Low-volume Snowmelt and Rain
Functional Flow Component: Spring Transition
Functional Flow Metrics: Start timing, magnitude

Start Date: May 11 – May 27
Start Magnitude: 2,028 – 4,880 cfs

Timing

Magnitude

Dry

Wet

Avg.
How Do I Use These Numbers?

SF American River  
2013 water year

Stream Class: Low-volume Snowmelt and Rain
Functional Flow Component: Spring Transition
Functional Flow Metrics: Start timing, magnitude

At my site, where do I fall compared to reference ranges?

For this reach in this year, the flows are too low and start too early

Hydropower Effects

Apr 1 << too early
1,250 cfs << too low

Start Date: May 11 – May 27
Start Magnitude: 2,028 – 4,880 cfs
How Do I Use These Numbers?

SF American River

Stream Class: Low-volume Snowmelt and Rain
Functional Flow Component: Fall Flush

Hydropower Effects

Start Date: Oct 5 – Nov 22
Peak Magnitude: 422 – 857 cfs

Oct 13 == meets target
796 cfs == meets target

At my site, where do I fall compared to reference ranges?

For this reach in this year, the flows achieve functional flow targets
Ecological Flow Criteria

Regional, local or site specific flow criteria:
*specific & objective-based*

TIER 2

California Environmental Flows Framework (CEEF) – Tier 2

Provide a framework for developing watershed or regional flow criteria based on local needs/issues

- Define context and objectives:
  - spatial-temporal scale, ecological endpoints, hydrologic conditions, water management system
- Characterize and compile data
- Select appropriate E-flow method
- Consider Policy and Management Needs:
  - balance objectives, implementation, monitoring, adaptive management
Incorporate Local Data

Hydrology

Geomorphology  Ecology

Reach scale environmental flow methods

Flow targets
Tier 2 Products 
by late 2020

• Baseline characterization of hydrologic alteration
• Geomorphic classification – flow, form function approach
• List of ecological endpoints for each stream class
• Flow-ecology relationships and suggested metrics
  – Will NOT produce specific criteria
• Guidance document for how to produce regional or watershed scale flow criteria
• Case study examples
S. CA (Tier 2) Case Study:
Criteria related to wastewater and stormwater management
LAR Case Study: Overall Objective

Develop and implement an approach to balance reuse of treated wastewater with protecting beneficial uses affected by treated wastewater discharges

✓ Prototype for consideration of establishing environmental flows in urban (effluent dominated) systems

✓ Case study for implementation of Tier 2 of statewide framework

Potential Participants
State Water Board
LA Regional Water Board
City of Los Angeles
LA County Public Works
LA County Sanitation Districts
City of Burbank
City of Glendale
UCLA
Colorado School of Mines
Outcomes/Products

• Evaluation of risks & benefits to key ecological endpoints associated with flow modification

• Set of acceptable ranges for flow/depth and wetted area to protect beneficial uses
  – Representative of all ecologically relevant flows

• Process of evaluating tradeoffs in management actions
  – Balance “restoration” vs. “flow management”

These products will provide the information necessary for Division of Water Rights to develop a LA River Instream Flow Policy
Questions

Eric Stein
erics@sccwrp.org
www.sccwrp.org