Real Water for Fish: Improving Instream Flows through Water Accounting, Insights, and Advocacy

A Concurrent Session at the 43rd Annual Salmonid Restoration Conference
Santa Cruz, California, April 29 - May 2, 2025

Session Coordinators: Konrad Fisher, *Water Climate Trust*; Nick Joslin, *Mount Shasta Bioregional Ecology Center*; and Angelina Cook, *California Sportfishing Protection Alliance*

This workshop promotes improved instream flow outcomes through better water accounting, encouraging accountability, and strategic advocacy. Exploring why some approaches to increasing instream flows are more likely to be successful than others, barriers including political realities, potential scientific uncertainties, lack of local knowledge and/or subject matter expertise by funders.

Often misunderstood fundamental concepts including how instream flow studies can lead to instream flow requirements; characteristics of different kinds of water rights, weaknesses in instream flow, and the irrigation efficiency paradox. Presenters provide guidance on what makes a good instream flow project and how to avoid counterproductive pitfalls. Explore why some cost-effective strategies, such as buying irrigated land and permanently retiring water rights, are seldom used. Significant flow benefits may also be achieved through better enforcement of existing laws and regulations, so presenters provide guidance on how to effectively file complaints when violations are observed. Learn which important—yet frequently overlooked—questions should be asked when developing and evaluating instream flow projects.

Presentations

Water Rights 101

An Overview of California Water Law

Matt Clifford, State Director
Lauren Bernadett, CA Water Law & Policy Director

2026 Salmon Restoration Federation Conference
April 28, 2026

Every River
Needs A Champion

TROUT UNLIMITED

Agenda

1. Riparian Rights
2. Appropriative Rights
3. Article X, Section 2
4. Abandonment & Forfeiture
5. Public Trust
6. Groundwater
7. Fish and Game Code § 1602
8. Water Code § 1707 Dedications
9. Forbearance Agreements

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Riparian Rights

- Based in English common law.
- Prevailing system in the eastern U.S.
- Basic principle:
  - Landowners whose property is adjacent to a stream have the right to reasonable and beneficial use of water from the stream.
- Priority: all riparians on a stream have co-equal priority and must share during shortage.
- Usually have priority over appropriative rights.
- Limited to use on riparian land.
- Right to natural streamflow only (not imported or stored water).
- Generally, may not store riparian water.

Appropriative Rights

- Developed during California Gold Rush
- Prevailing system in the western U.S. (drier states)
- Basic principle:
  - Acquire the right by putting water to reasonable and beneficial use, regardless of location.
- Priority: "first in time, first in right"
- The right is quantified.
- May store water if your right allows for it.
- May transfer to another user and/or place (no harm rule).
- Pre-1914 (notice & use) / post-1914 (apply for permit)

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California Constitution, Article X, Section 2

- Added by voter initiative in 1928.
- Direct response to a CA Supreme Court case holding that riparian uses had absolute priority over appropriative uses, even if the riparian's use was unreasonable.
- Requires **all** water use to be **reasonable** and **beneficial**.
  - **Beneficial uses**: domestic, irrigation, municipal, industrial, fish & wildlife, hydropower, frost protection, etc.
  - **Reasonable uses**: fact-dependent, broad source of Water Board authority.
- Prohibits waste and unreasonable uses of water.

Losing a Water Right

Riparian Rights:

- Generally, cannot be lost due to non-use.
- Splitting a parcel: severed parcel no longer has a riparian right.
- Can lose priority in an adjudication.

Appropriative Rights:

- Abandonment/Voluntary: Failure to use the water coupled with intent to abandon the right (act + intent).
- Forfeiture/Involuntary: Failure to use the water for at least 5 years (intent does not matter).

Public Trust

- Rooted in state ownership of water.
    - Water rights are **usufructuary rights**: the state **owns** the water, the water right holder has the right to **use** the water.
- Protects streamflow needed to support public uses of navigation, fishing, and the environment.
- Water Board has continuing jurisdiction over all water rights to protect the public trust.
- Legislature: statutes such as Fish & Game Code § 5937.

Groundwater

- CA law treats groundwater as separate from surface water.
- Common law groundwater doctrine: correlative rights.
  - Landowners overlying an aquifer have equal rights to the water and share equitably in times of shortage (like riparianism for groundwater).
- Sustainable Groundwater Management Act (2014)
  - Comprehensive groundwater regulation.
  - Acknowledges groundwater/surface water connectivity.

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Fish & Game Code § 1602 (LSAAs)

- "An entity shall not substantially divert or obstruct the natural flow of . . . any river, stream, or lake, . . . unless all of the following occur:"
    - [The entity gets a Lake or Streambed Alteration Agreement from CDFW.]
- CDFW may impose reasonable conditions to protect fishery resources.
- CDFW may conduct a site visit.

Water Code δ1707 Dedications

- A water right holder may petition the Water Board to change the purpose of their water right to preserve or enhance "wetlands habitat, fish and wildlife resources, or recreation in, or on, the water."
- May dedicate the amount of water that is actually, reasonably used – no paper water.
- May only dedicate the amount that has been consumptively used in the past.
- Must show no injury to other water users.
- Long permitting process.

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Forbearance Agreements

- Water right holder signs a contract agreeing not to divert for a certain period.
- Forbearance period may be calendar-based or flow-based.
- Not a water rights transaction – no Water Board permitting necessary; no right to object.
- Cannot protect water from other diverters.
- Useful and practical alternative to § 1707 dedications.


Thank you!
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Practical Notes on Instream Flow Methodologies

Chris Shutes
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For SRF Conference

April 28, 2026

Often Unstated Assumptions About Instream Flow Setting

- Instream flow methodologies deal with impaired waters (dams, diversions, or both)
- Flow setting is thus premised on how much water comes out of a system and when
- There are fundamentally opposed default frames of reference regarding instream flow:
  - Water should stay in the stream of river
  - As much water as possible should come out

Regulatory Processes Initiate Flow Setting

- Water rights
- FERC hydropower licensing, other fed. permits
- Endangered Species Act consultation
- Petition or complaint:
  - Endangered Species Act
  - Public Trust
  - CA Fish & Game Code § 5937
- Others (incl. Clean Water Act, Porter-Cologne)

Caveats about this Presentation

- Meant to provide high-level descriptions of the conceptual bases of flow setting methods
- Not encyclopedic or particularly nuanced
- Doesn’t address legal implications
- Doesn’t detail underlying science
- There are many persons more qualified to discuss the technical details of each method (some of them are at this conference)

Unimpaired Flow Is a Key Basis of Comparison in Flow Setting

- Volume
- Timing
- Rate of change
- Seasonality
- Function
- Water temperature
- Other water quality parameters

Water Storage Is a Fundamental Element of Flow Setting

- Interruption of natural storage (snowpack, groundwater, springs) can limit or destroy the viability of riverine systems
- Surface storage (reservoirs) provides a major source for downstream flows even as dams wreak havoc on connectivity, many functions
- Flow setting in systems without surface storage largely a matter of limiting diversions

Key Issues in Flow Setting

- How much storage, diversion?
- Alterations of seasonal flow patterns
- Management goals, often specific species
  - Life stages of management species, incl. migration
  - Limiting factors
- Adaptation (or not) of fish and critters to storage and prior flow regulation
- Riverine and ecosystem processes

Key Methodologies

- Direct fractions of unimpaired flow
- "Building block" approach (key hydrograph elements)
- Functional flow framework (*e.g.*, CEFF)
- Instream Flow Incremental Methodology (IFIM)
  - Habitat modeling
    - PHABSIM
    - Critical riffle
- Individual-Based Models
- Hydrology-based desktop methods (Tennant, etc.)
- Temperature-based flow regime
- Hybrids

Common Element to All Methods: No Silver Bullet

- No method in itself gives THE ANSWER to the best flow regime for any given waterway
- Specific features, social values, and human judgment and are always part of the outcome
- There are, however, flow proposals and regimes that are scientifically indefensible

There Must Be an Adequate Water Budget for Instream Uses

- Conflicts between developmental and instream uses are often framed as conflicts between species
- Reductions in water supply, power generation, and/or storage must be an option, especially in dry water years

Percent- of-Unimpaired Flow Conceptual Bases

- Correlation: history of various diversion levels:
  - "Published results regarding water development in rivers entering the Black Sea, Sea of Azov, Caspian and Mediterranean Seas in Europe and Asia all point to the conclusion that when successive spring and annual water withdrawals exceeded 30% and more than 40-50% of the normal unimpaired flow respectively … [the] ecosystem system [is unable] to restore itself." (Rozengurt et al., 1987)
- Achievement of identified key flow thresholds

Upsides of Percent-of-Unimpaired Flow Methodologies

- Can allow setting an adequate instream flow budget, especially in dry water years
- Works as a systemic and systemwide approach

(Note: these first two reasons are the primary reasons why users of developed water hate it)

- Conceptually simple and easy to understand
- Relatively equitable in many senses
- Unregulated flows overwhelm wet periods

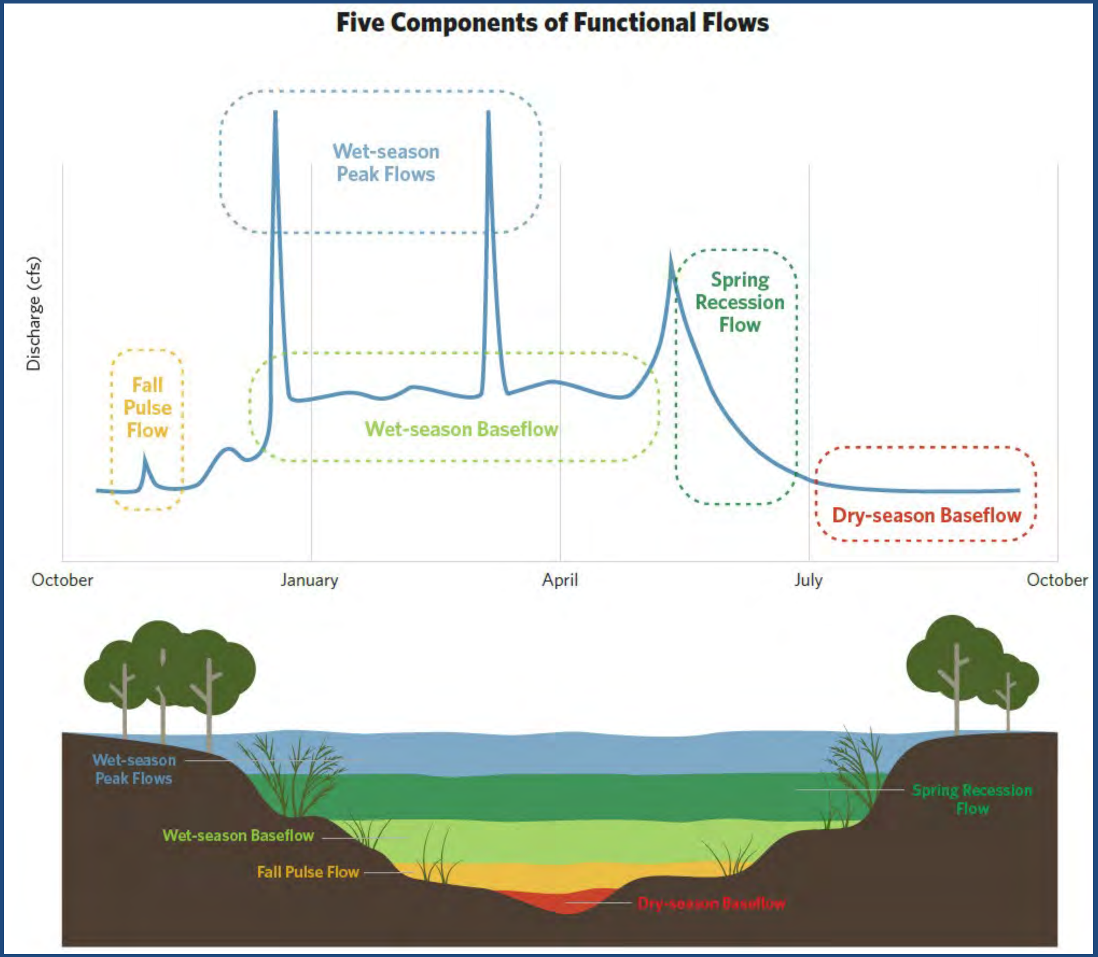
Downsides of Percent-of-Unimpaired Flow Methodologies

- Except in spring-fed systems, tends to set low summer flows in Mediterranean climate
- Compliance at any point hard to measure
- May not capture key life stage needs, require floor values, esp. at low points of hydrograph
- May not meet physical thresholds, esp. in dry years (geomorphic, fish passage, floodplain)
- Limits storage; potential cold-water impacts

Quick and Dirty Notes on "Building Block" Methods

- Sets a roughly protective base flow
- Adds elements at appropriate times, such as:
  - Fish migration flows
  - Floodplain inundation flows
  - Geomorphic function flows
- Starts from key values or objectives, builds hydrograph
- Desktop approach

Functional Flows Example
CA Environmental Flows Framework



Source:

https://ceff.ucdavis.edu/sites/g/files/dgvnsk5566/files/media/documents/CEFF%20Executive%20Summary_2024_FINAL%20%281%29.pdf

Functional Flows Conceptual Basis
CA Environmental Flows Framework

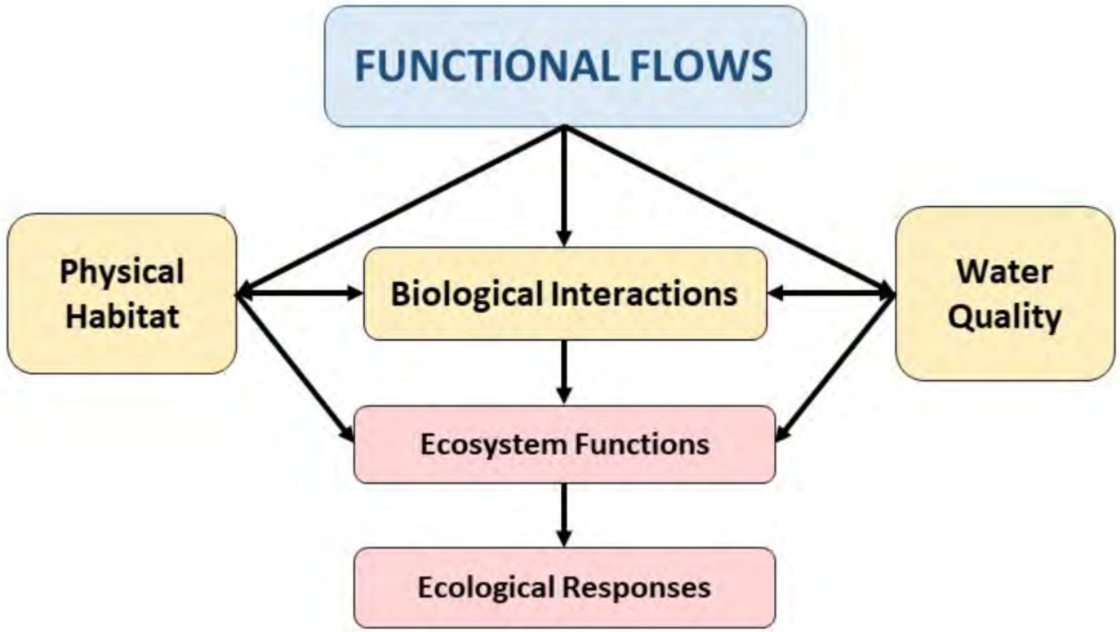


Figure 2. Conceptual basis of the functional flows approach. This approach relies on a priori hypotheses regarding the role of functional flow components and related functional flow metrics in supporting river-dependent species, communities and habitat maintenance processes.

Source: https://ceff.ucdavis.edu/functional-flows-approach

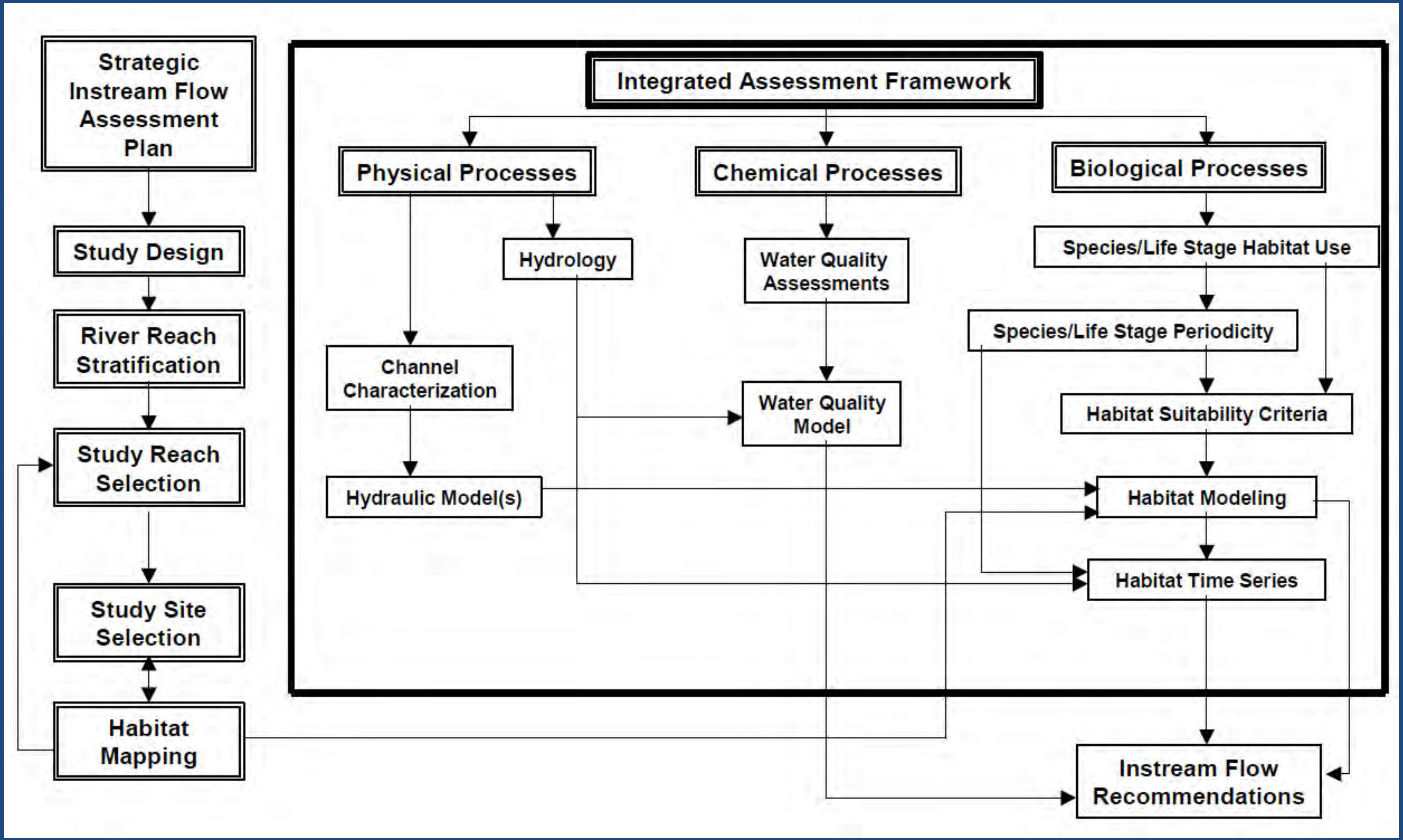
California Environmental Flows Framework

- Focus on key ecosystem functions rather than management for "single species"
- Establish scientifically supported ecological flow criteria
- Develop environmental flow recommendations that consider:
  - Other instream management objectives
  - Other social water uses

Instream Flow Incremental Methodology

- A series of computer-based models which calculate how much fish habitat you gain or lose as you increase or decrease stream flow.
- Based on fish preferences for depth and velocity, cover, substrate, sometimes temps.
- Vary for different species and life stages of fish
- Primary model is **P**hysical **HAB**itat **SIM**ulation
- (Source: Wash St. Dept of Ecology 2010)

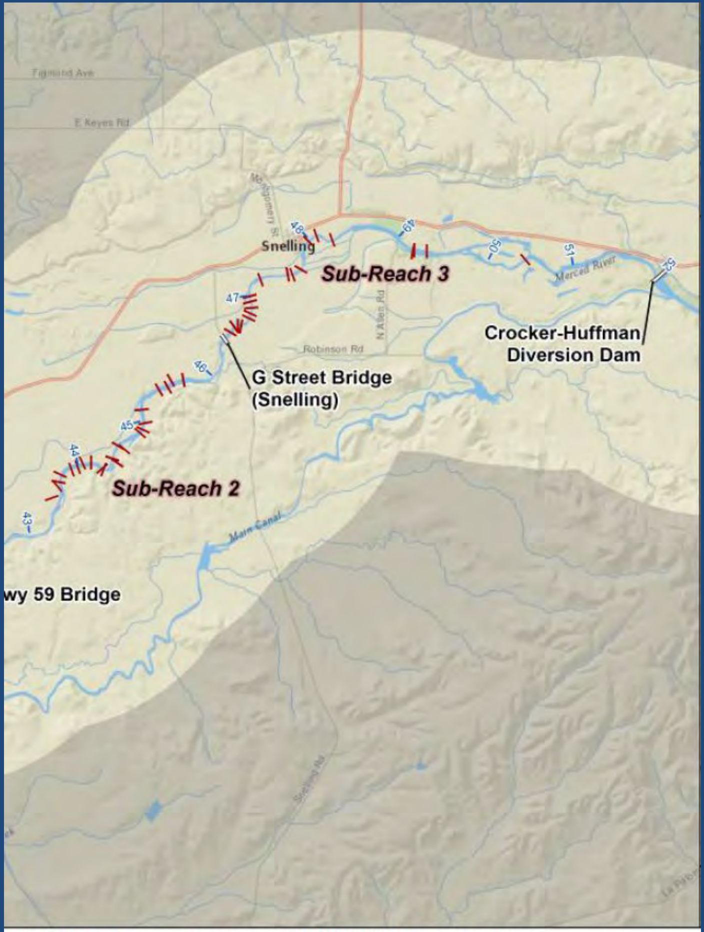
Flow Chart, Modified Instream Flow Incremental Methodology



Source: Hardy and Addley (2003)

PHABSIM: One-Dimensional

- Map river habitat by type
- Select river reaches
- Select 3-5 transects across river per reach
- Measure depth, velocity at different flows
- Observe fish preferences for each or adopt from similar river
- Select curves to define **W**eighted **U**sable **A**rea
- Run models

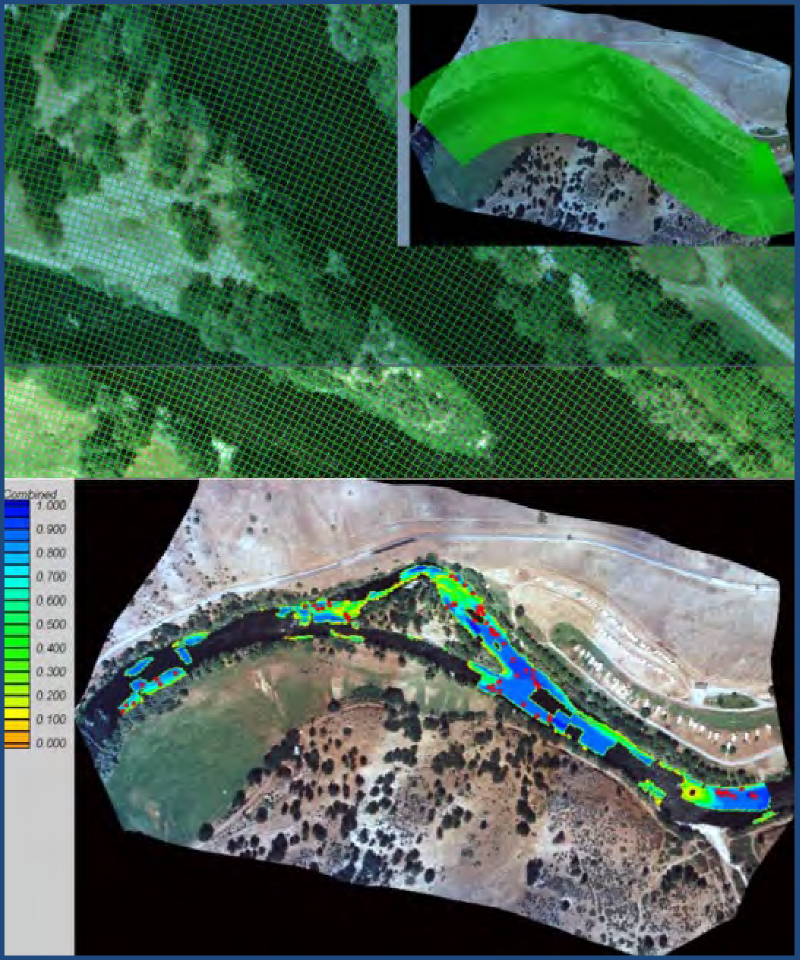


haffer Bridge showing sub-reaches and the PHABSIM transect distribution.

Graphic Source: Merced Irrigation District Instream Flow Study (2013)

PHABSIM
Two-dimensional

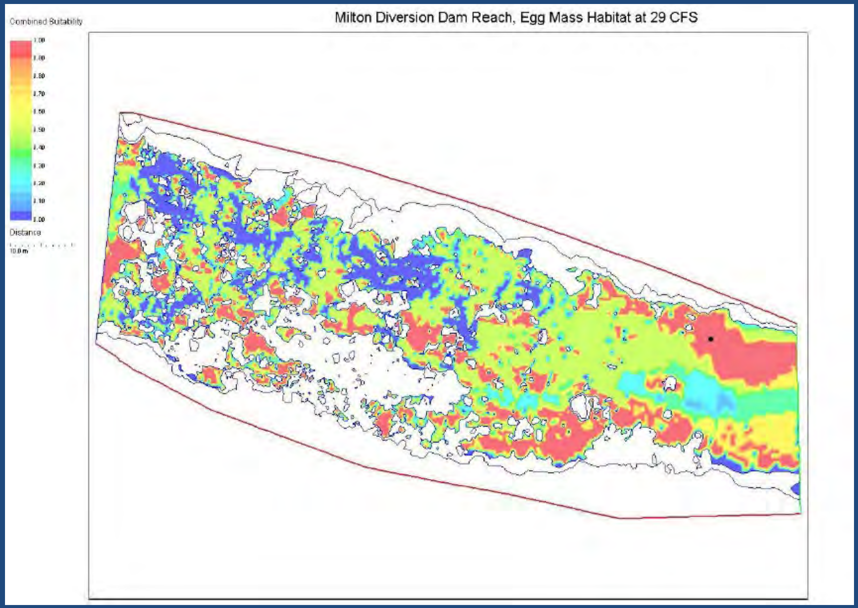
- Two-dimensional model uses “computational mesh” overlaid onto study area (top photo)
- Habitat suitability represented in colors (lower photo)
- Red dots in lower photo show observed spawning



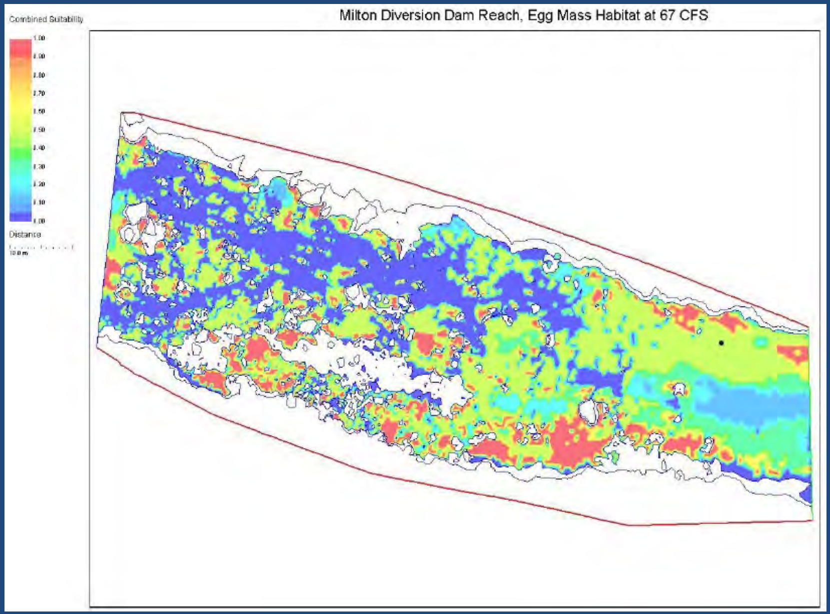
Source: Hardy and Addley, 2003

Two-D PHABSIM Used for Frogs

Foothill Yellow-Legged Frog Egg Mass Suitability at 29 cfs



Foothill Yellow-Legged Frog Egg Mass Suitability at 67 cfs



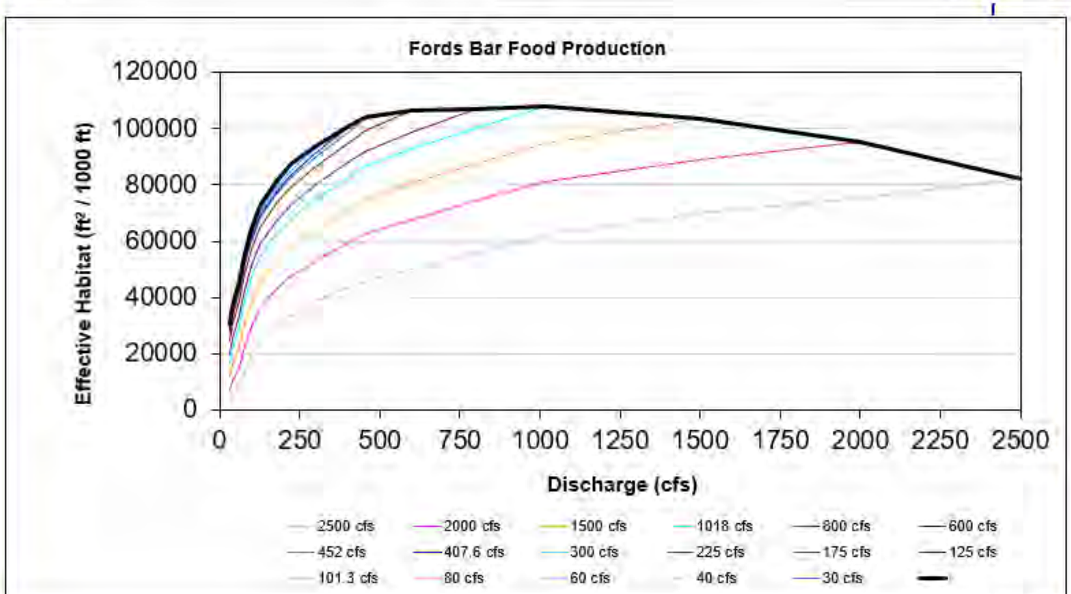
Source: NID, PG&E (2011)

Two-D PHABSIM Used for Peaking Reaches

Source: Middle Fork American relicensing graphics shared in draft with relicensing participants 2010. Upper figure shows loss of function as distance between top daily flow and low daily flow increases. Typical format of quantification.

Figure O-15. Middle Fork American River MF14.1 Effective Food Production Habitat Matrix.

Starting Discharge (cfs)	Ending Discharge (cfs)																	Initial Habitat vs Flow Relationship
	2500	2000	1500	1018	800	600	452	407	300	225	175	125	101	80	60	40	30	
2500 cfs	82078	75359	69776	62262	56087	50125	45857	43702	38740	33765	29679	24269	19538	13730	7722	4545	2991	82078
2000 cfs		95204	89029	80958	74435	67745	62485	59653	53125	47537	42921	36110	29840	22754	15214	10075	7229	95204
1500 cfs			103390	94561	87679	80521	74838	71687	64269	57964	52757	45277	38412	30878	22524	16130	12019	103390
1018 cfs				107696	100096	92600	86482	83084	74980	68155	62509	54447	47017	38860	29565	21977	17005	107696
800 cfs					107013	98431	92093	88533	80072	73036	67171	58926	51346	43003	33328	25361	19976	107013
600 cfs						106258	99025	95302	86446	79204	73224	64848	57162	48698	38772	30516	24884	106258
452 cfs							103990	99247	90064	82633	76597	68134	60383	51856	41834	33422	27649	103990
407.6 cfs								101210	91371	83587	77487	68985	61160	52619	42553	34120	28320	101210
300 cfs									93632	85023	78704	70164	62286	53696	43567	35103	29276	93632
225 cfs										87534	80338	71248	62925	54098	43804	35334	29500	87534
175 cfs											81336	71735	63317	54467	44130	35655	29817	81336
125 cfs												72341	63646	54711	44308	35831	29993	72341
101.3 cfs													64643	55156	44488	35991	30148	64643
80 cfs														55640	44680	36124	30233	55640
60 cfs															45736	36479	30365	45736
40 cfs																36791	30472	36791
30 cfs																	30672	30672



Critical Riffle Flow Study

- Used where migration is limiting factor
- Evaluates passage at critical riffle selected in habitat modeling and transect measurement
- Example: Butte Creek “Lahar Formation” upstream of US Highway 99
- Limited opportunity to augment streamflow
- Limit or disallow diversions during migration

Individual-based Stream Trout Research and Assessment Model (*inSTREAM*)

- "… simulates the behavior, growth, and mortality of individual trout and trout redds in a virtual study site. For each simulated day:"
  - Input daily flow, temperature, and turbidity values
  - Find depth and velocity at daily flow
  - Females may spawn; trout leaves or stays; trout feeds or grows
  - Does fish die? Based on size, predation risk
  - Do redds produce progeny? (Scoured or dewatered?)
  - Output graphics and files updated

Source: PG&E McCloud Tech Memo IBM (July 2009)

Individual-Based Models

- Site selection similar to IFIM
- Create transects within sites, series of “habitat cells” within each (similar to 2-D PHABSIM)
- Many other physical features measured
- Hydraulics simulated using PHABSIM
- Water temperature measured
- Observation of actual fish
- Survival of different trout species predicted, highly dependent on juvenile survival

Tennant Method

- Desktop exercise; requires no fieldwork.
- Based on percentage of Mean Annual Discharge
- "Low-flow" and "High-flow" (Apr-Sep) seasons
- Generally considers 60% or above for each season as "outstanding"
- Devised for high elevation trout streams
- Similar hydrology-based methods from other rivers: Hoppe, New England, Northern Great Plains, Washington. *See* Hardy & Addley 2003

Temperature-Based Flow Setting

- Temperature is limiting factor in many reaches
- Flows in key months must meet target temps
- May use in combination with other methods
- Tailwaters create both need and opportunity:
  - Blockage of fish passage to upstream cold reaches
  - Reservoir stratification, cold water pool
  - Greatest flow need in summer, opp. of unimpaired
  - Some unimpaired spring-fed systems adequate, but reduced summer flows don’t support key life stages

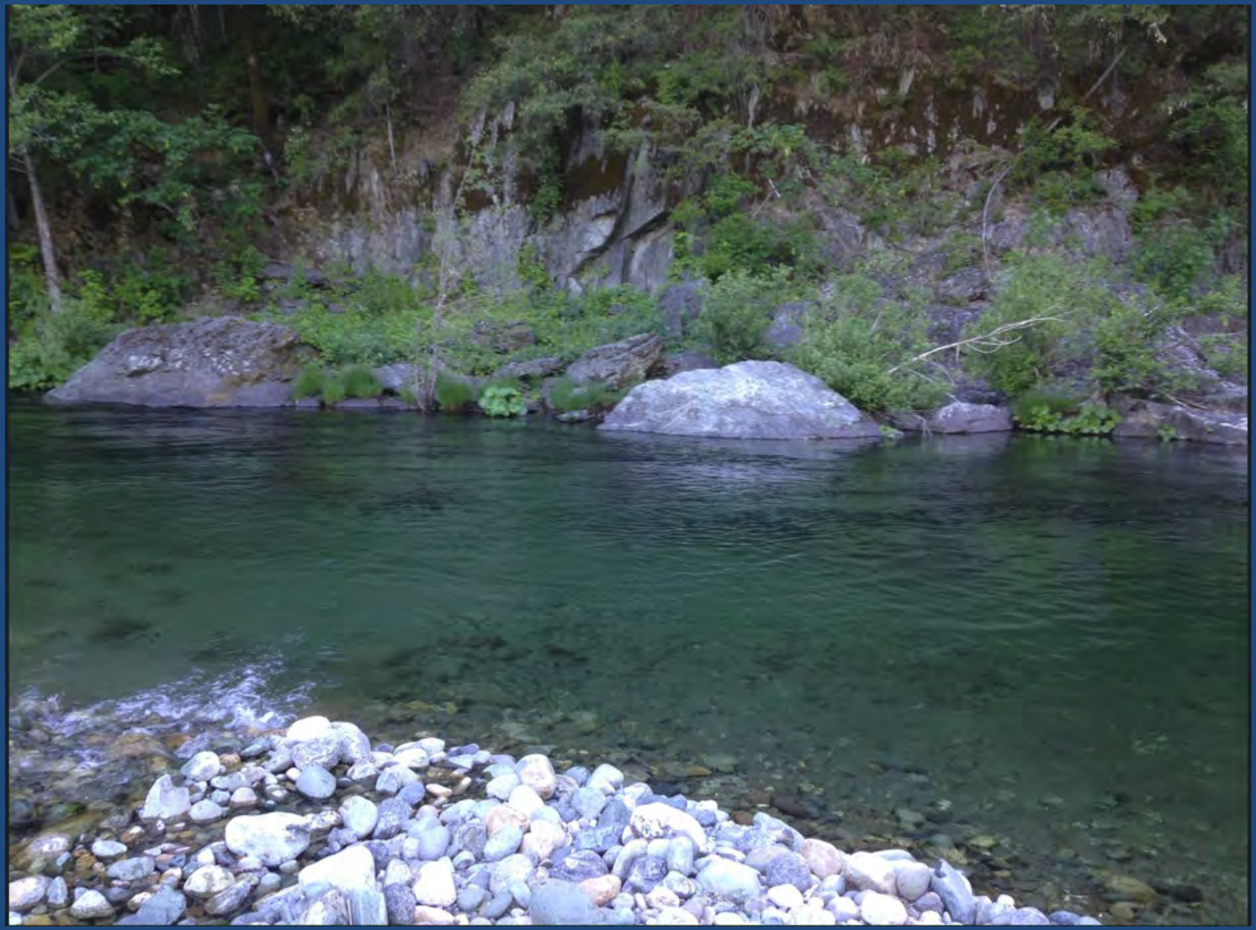
Temperature-Based Flow Setting: Well-Known Examples and Types

- Sacramento River below Shasta, Keswick reservoirs (summer temp, winter-run salmon)
- Trinity River (summer temps for coho)
- McCloud River (summer temps for Chinook)
- Not only fish; also, water quality, other:
  - Dissolved oxygen, algal blooms
  - Ceratonova Shasta, other pathogens
  - May reduce flows to extend frog breeding, growth

In the End, It's a Negotiation (at a Table, in EIR/EIS, in a Courtroom)

- There are almost always site-specific factors
- So, know your watershed! Ops model helps!!
- Different entities use flow setting methods to support outcomes that meet their interests
- Methodologies provide quantification
- There are no silver bullets
- The negotiation is as much art, law, politics, and economics as it is science

Thank you!



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Instream Flow Requirements on the Scott and Shasta Rivers: A Case Study in River Advocacy

Real Wet Water for Fish: Improving Instream Flows through Water Accounting, Accountability, and Advocacy

Nat Kane

Environmental Law Foundation

April 28, 2026

Scott River

Source: USGS via
Wikipedia

Scott River

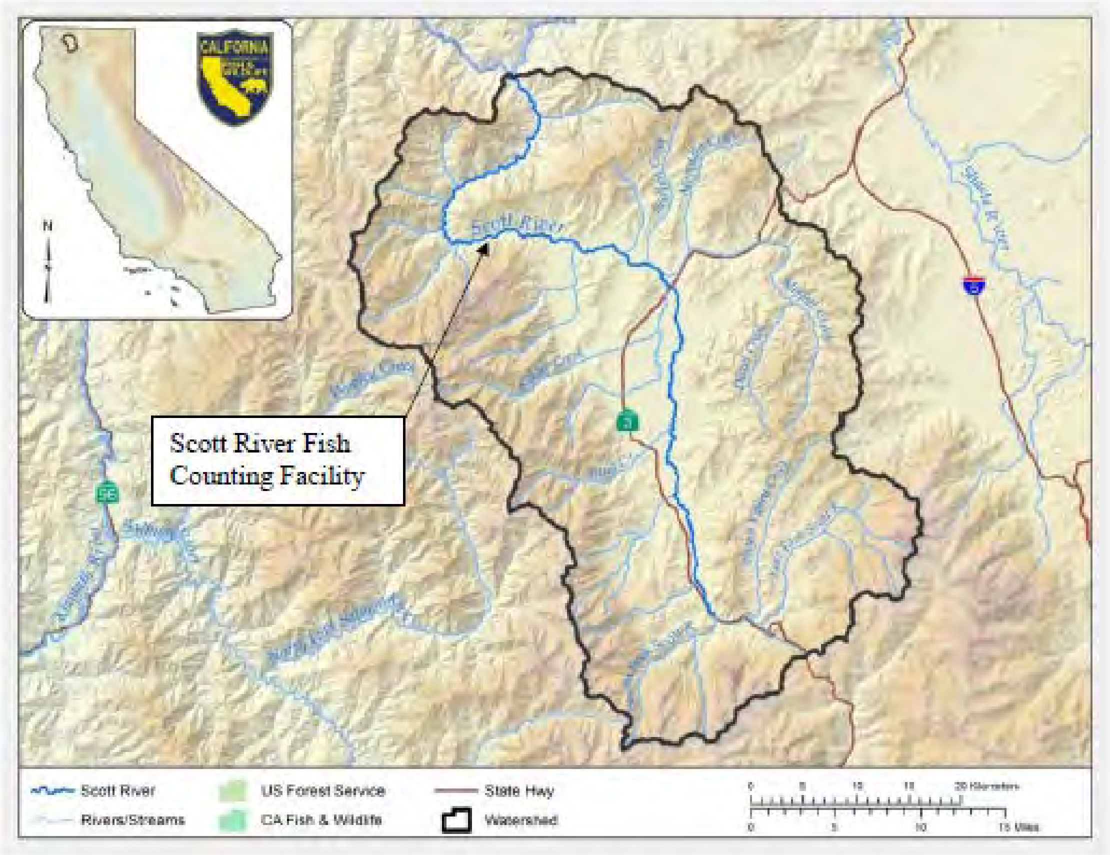
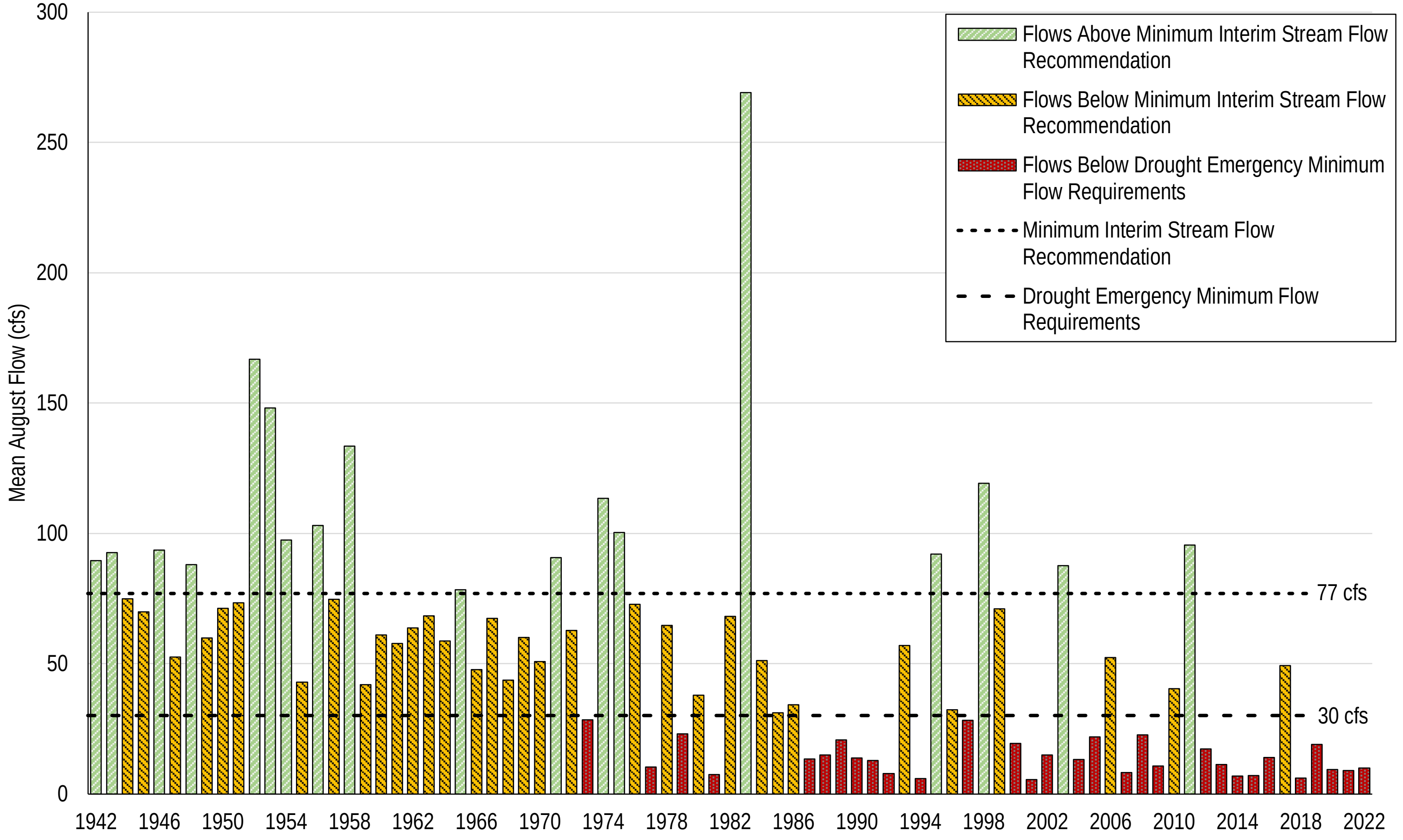


Figure 1. Location of the Scott River, tributary to the Klamath River, Siskiyou County, California.

Source: CDFW

Trend in Mean August Flows, 1942-2022



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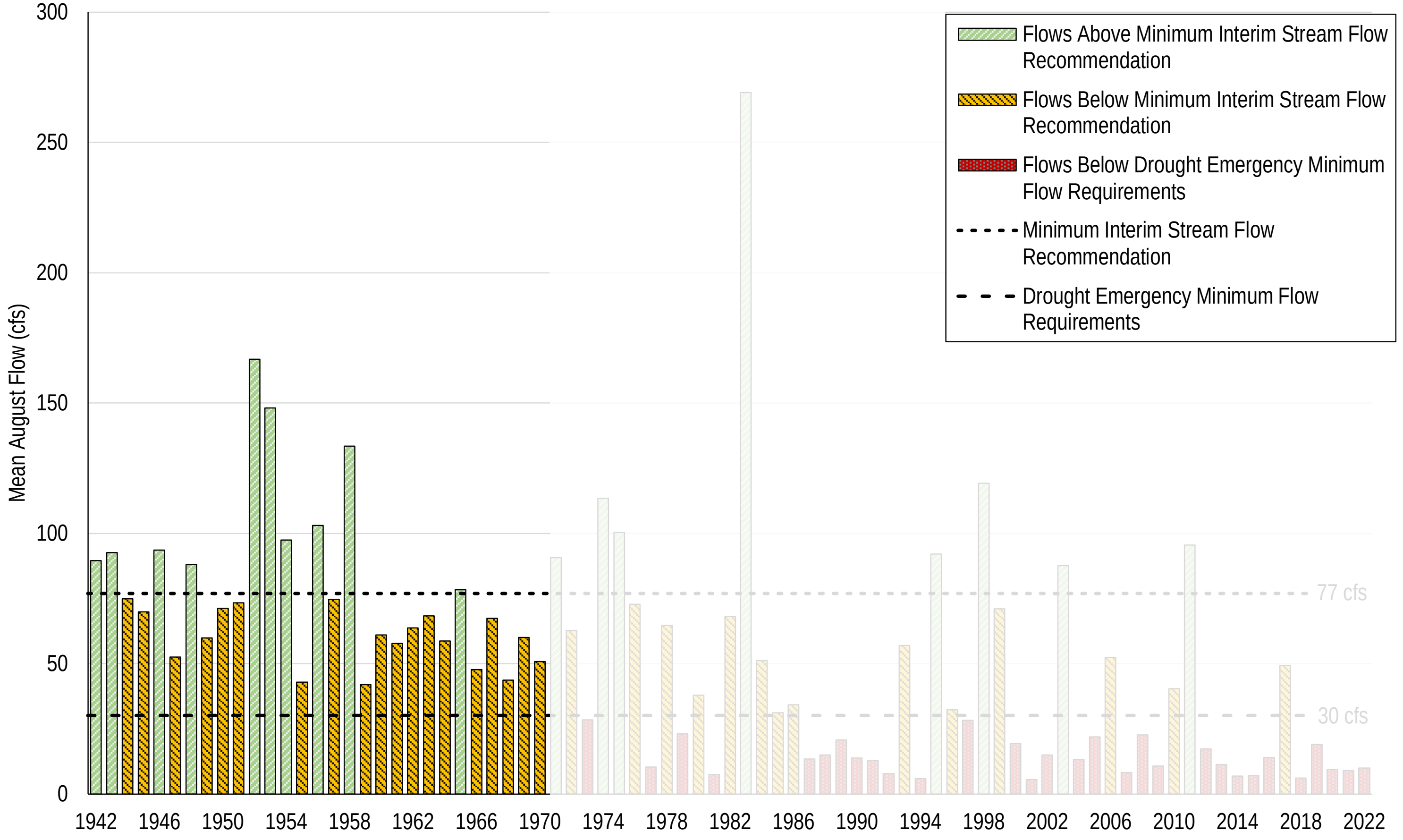

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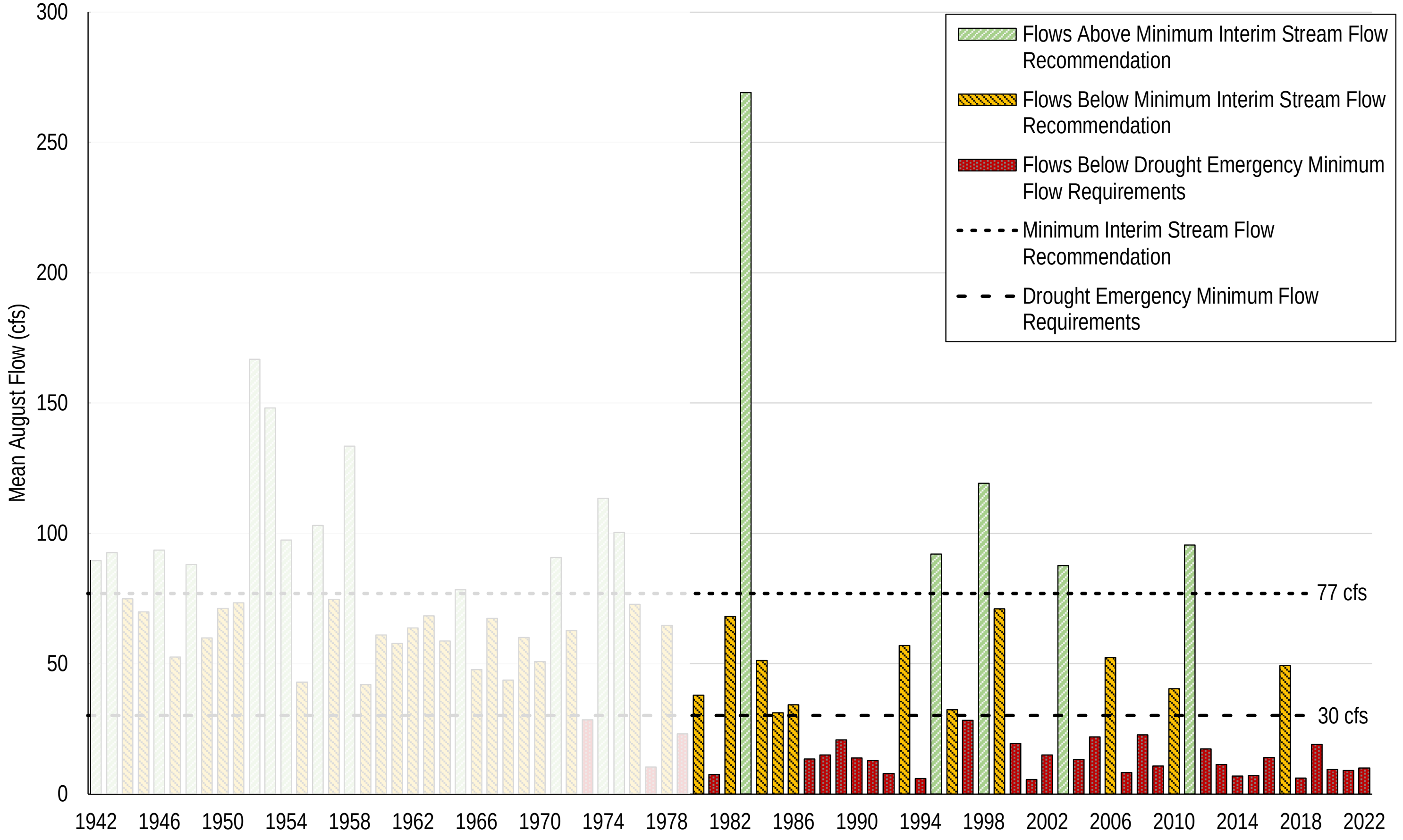

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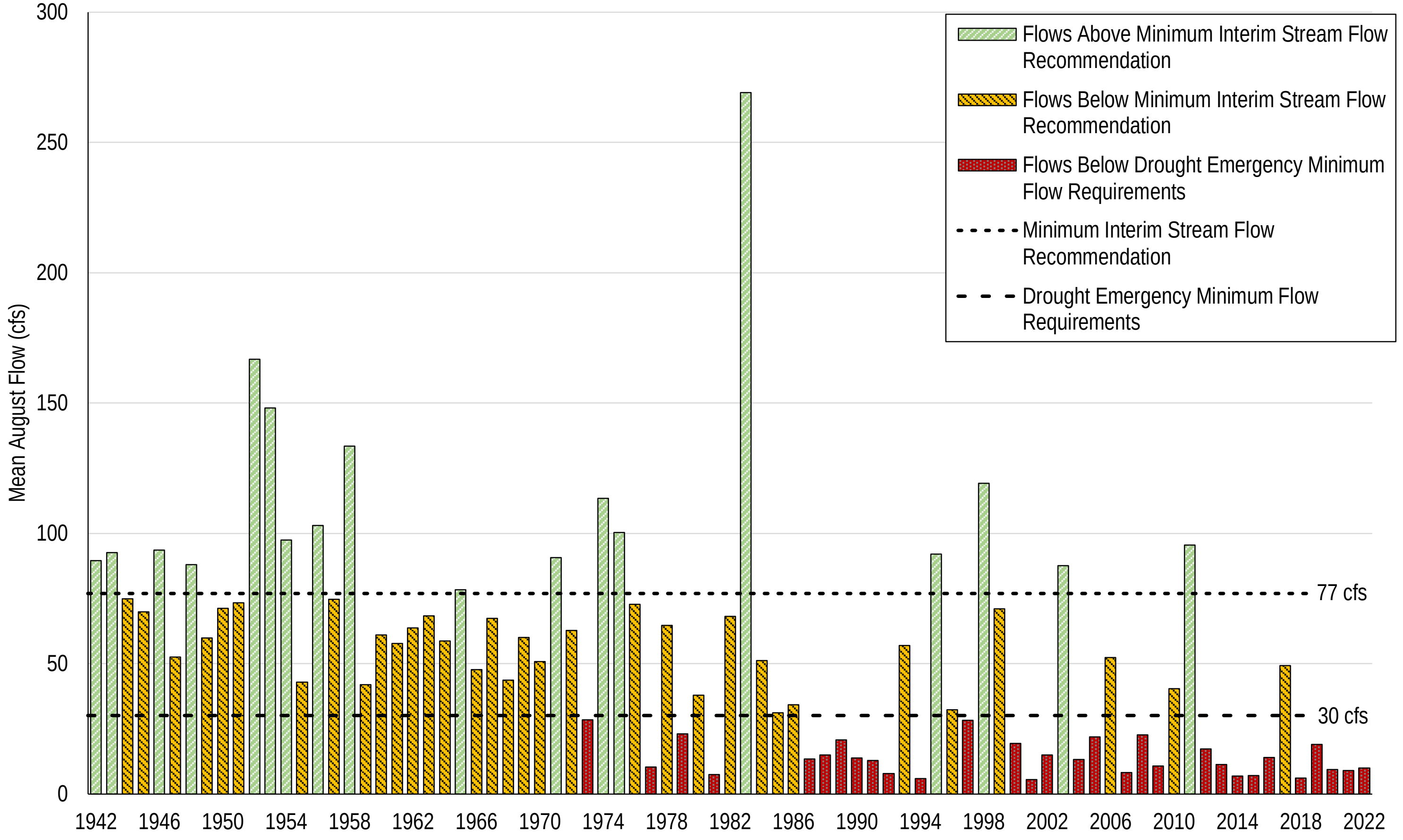

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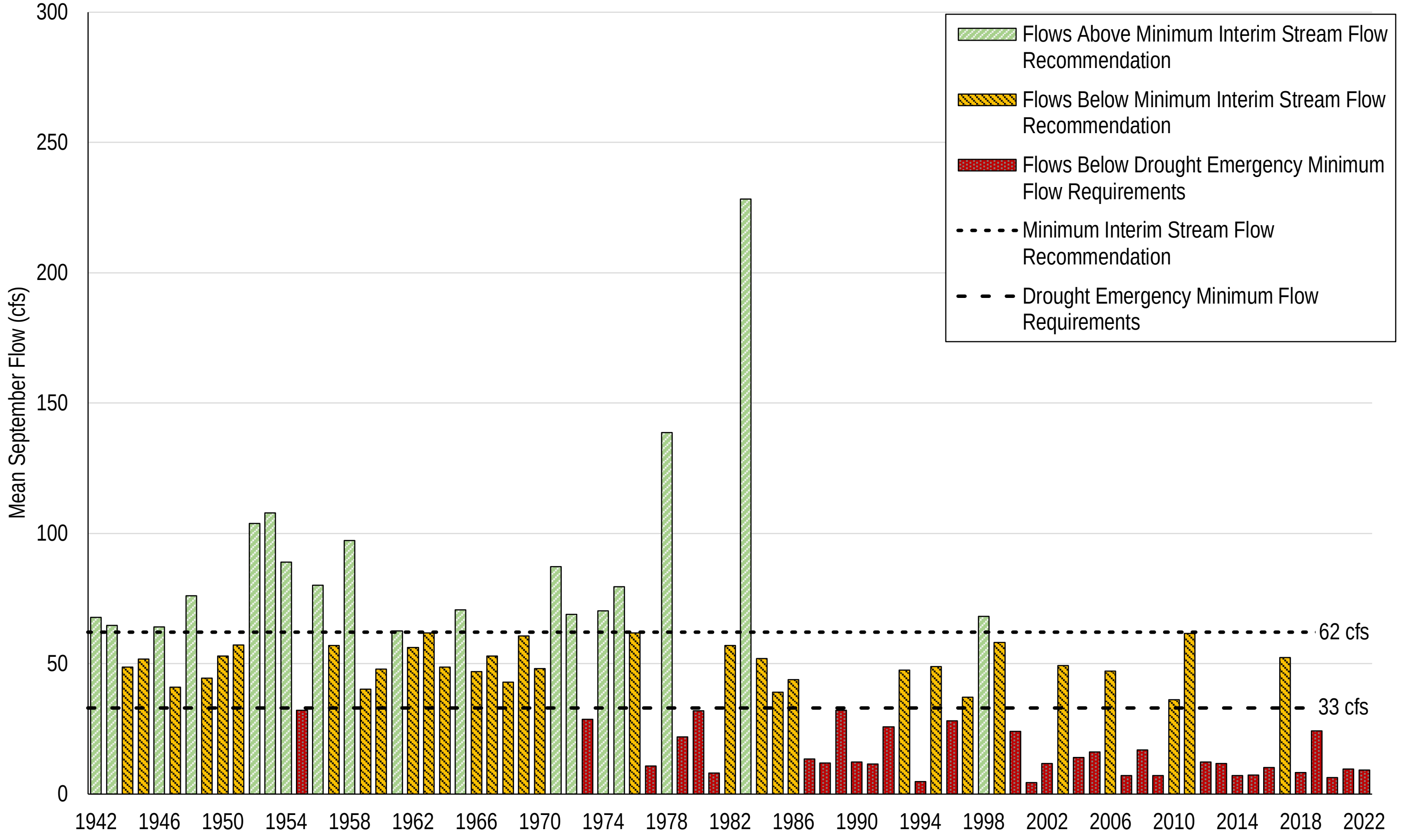

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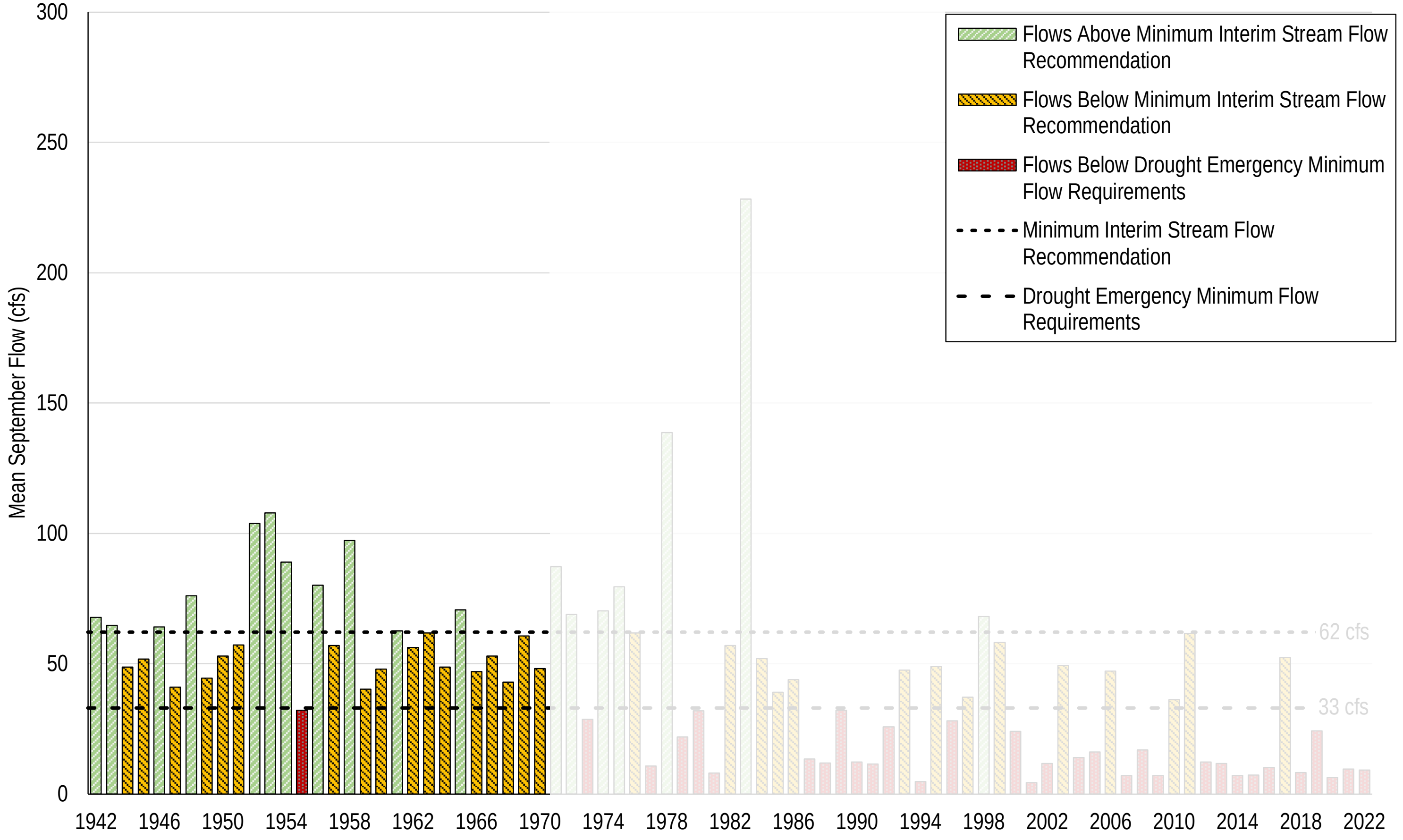

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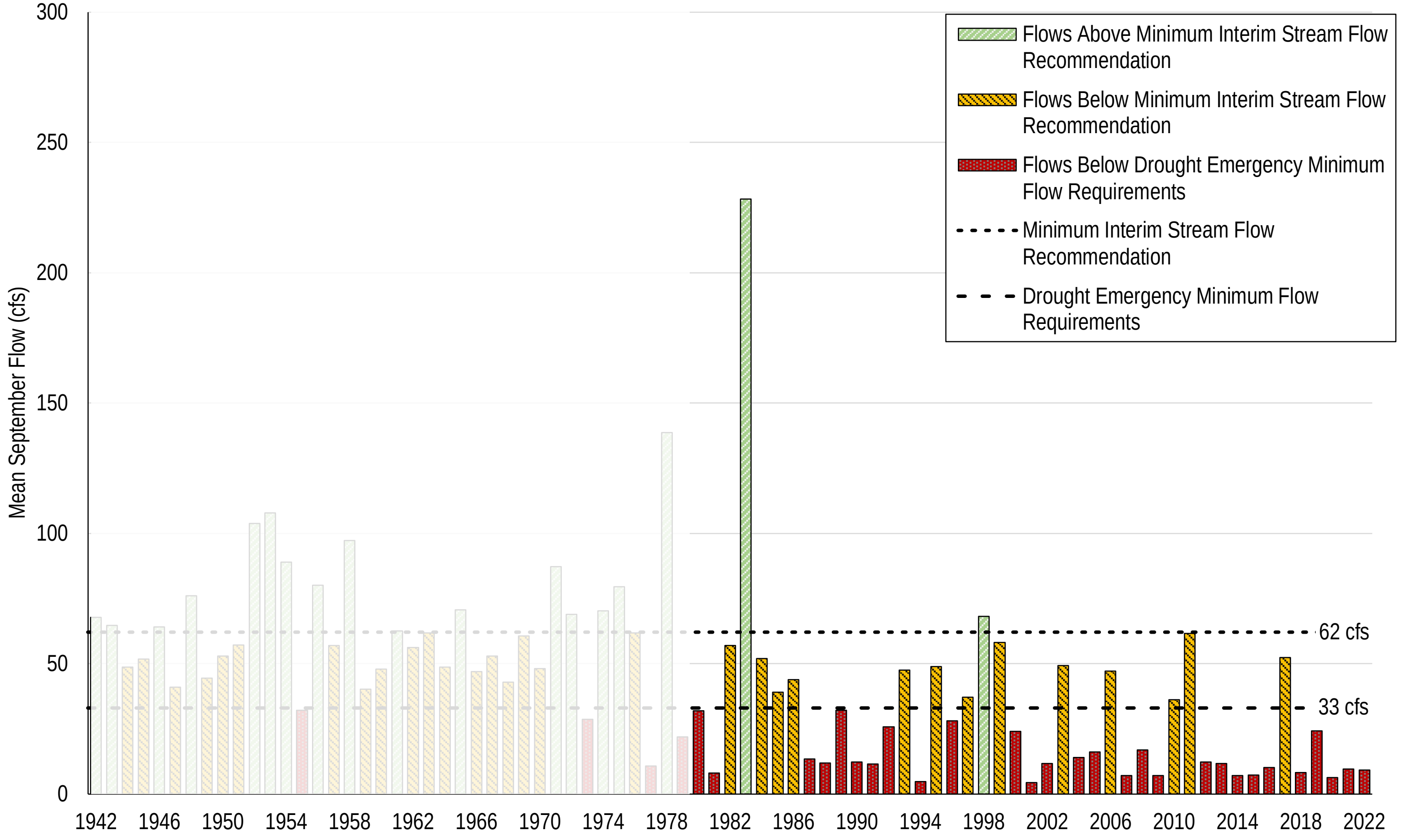
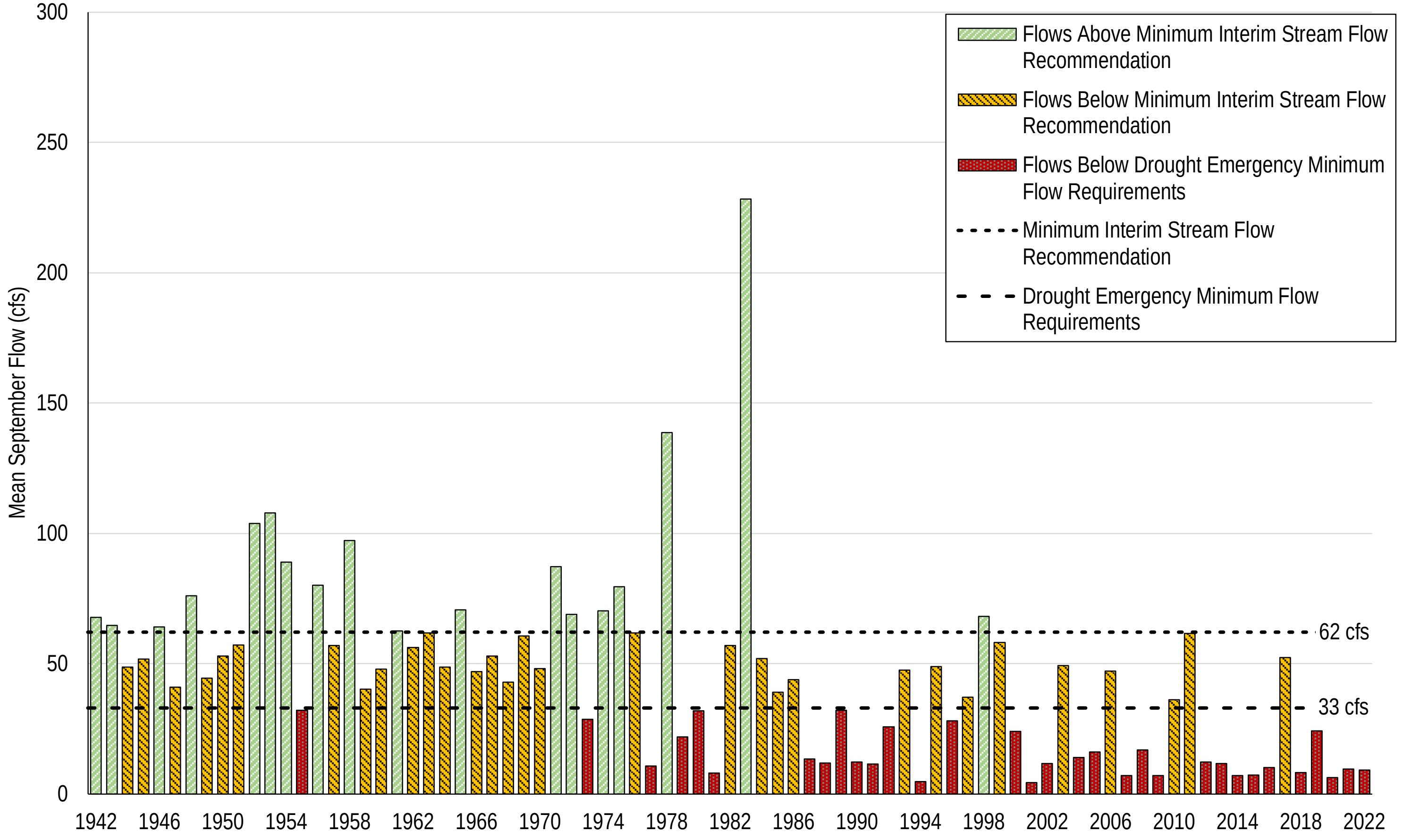
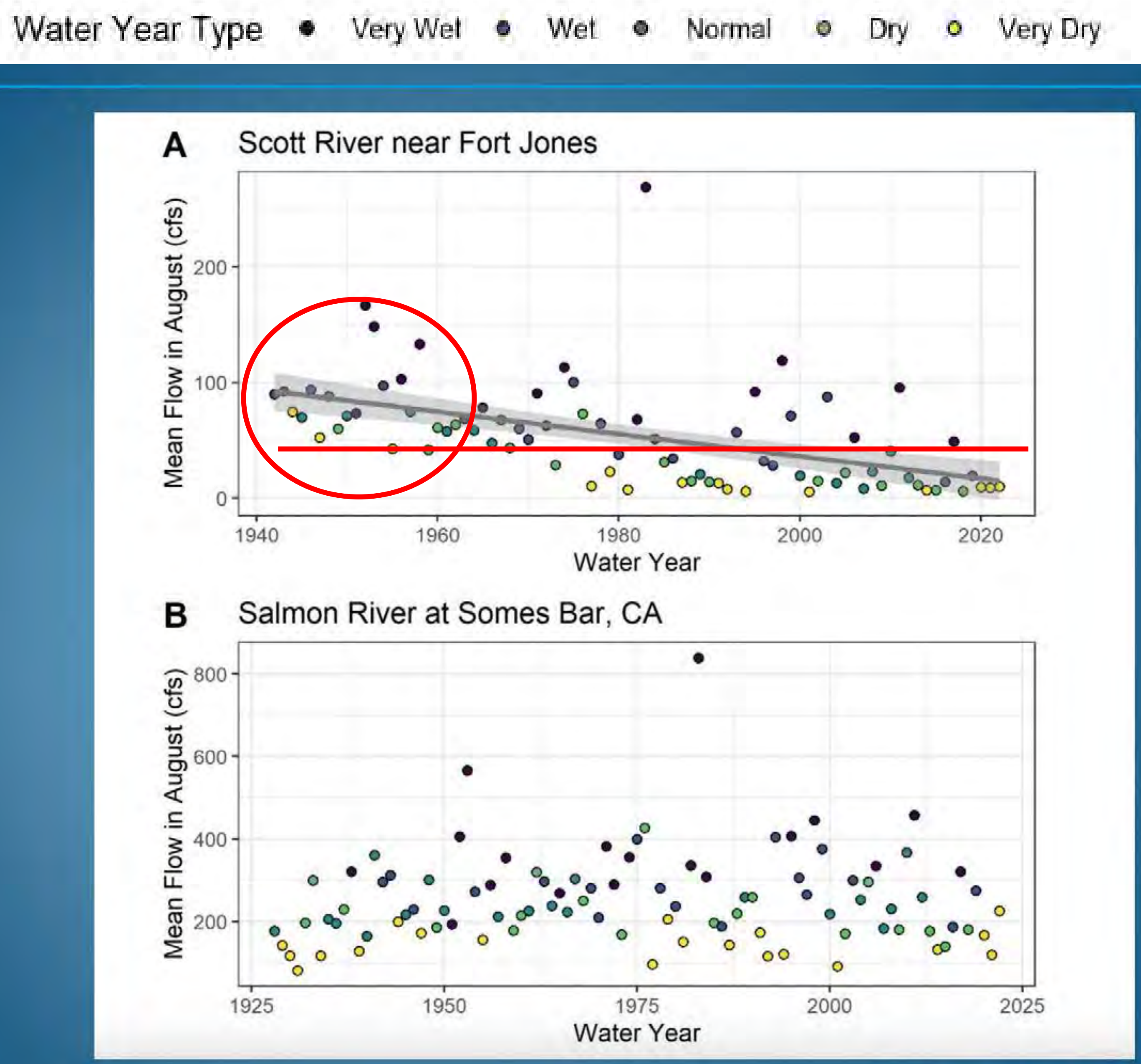


Trend in Mean September Flows, 1942-2022





Kelson et al., 2022

Number of Days with Flow at Ft. Jones below 40 cfs

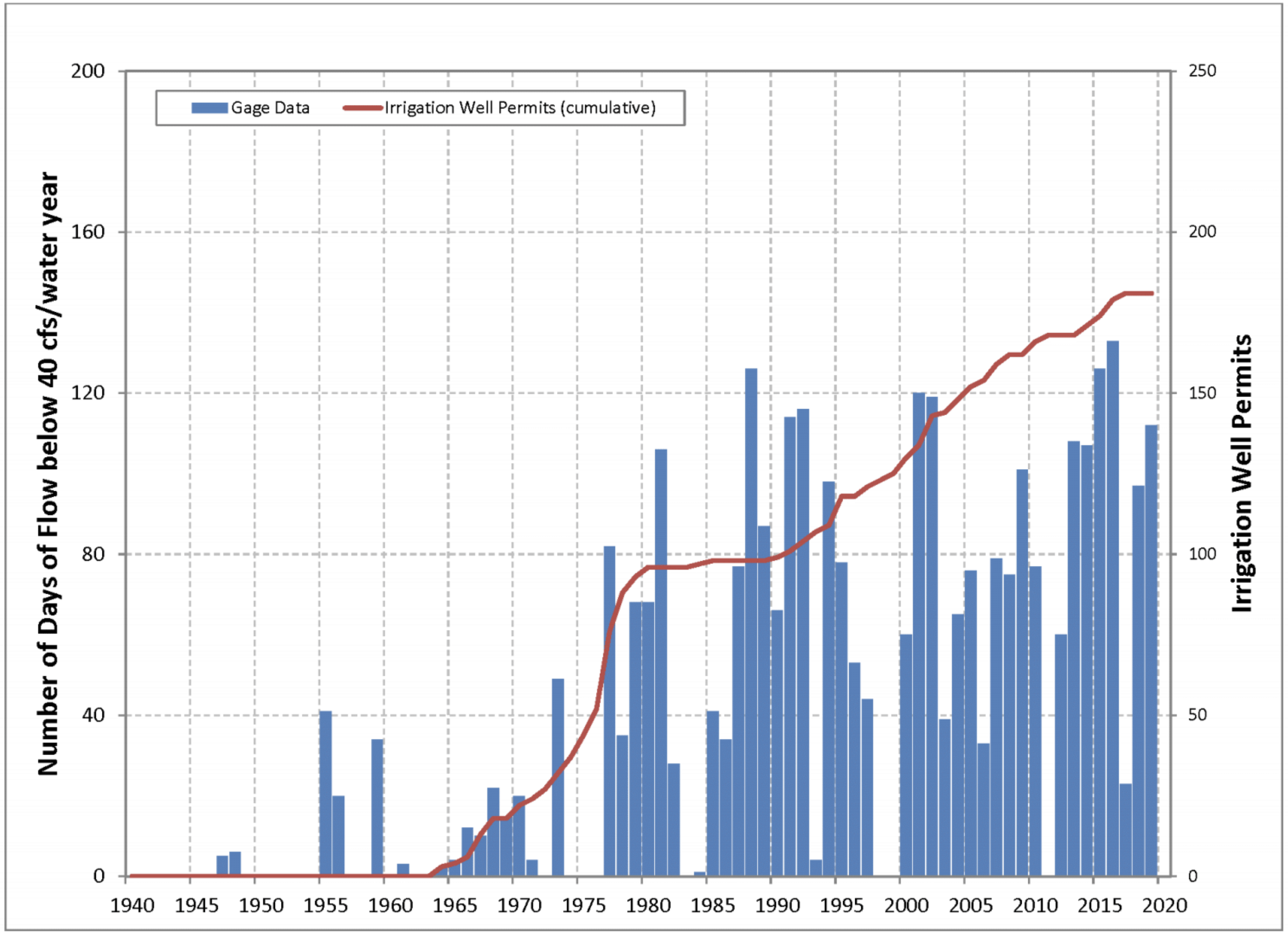
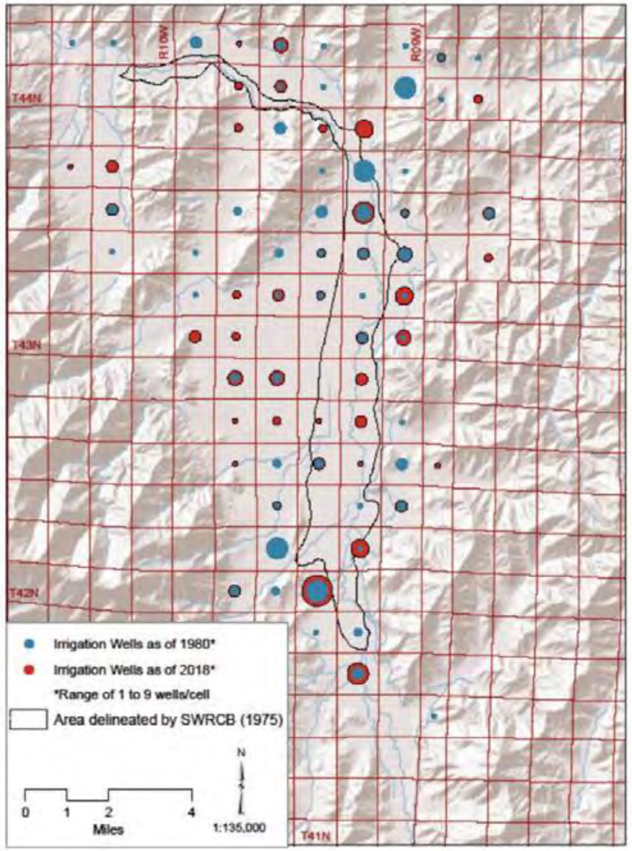


Figure 3: Number of Days with Flow near Ft. Jones below 40 cfs

Wells Drilled beyond Zone of Adjudication

- Pumping is not measured
- New irrigation wells may be drilled outside of "interconnected" zone
- Numbers of wells suggest increased groundwater diversions over time
    - 99 irrigation wells in 1979;
    - 130 irrigation wells in 1999;
    - 172 irrigation wells in 2010.
    - 181 irrigation wells in 2018
- Groundwater use offsets late-season surface water shortage and extends growing season during dry years



Irrigation Wells in the Scott River Valley

Flow Effects on Salmonid Recovery

Source: CDFW

Chinook Staging at Scott Mouth

Source: CSPA

Coho: Recovery and Depensation

- NMFS 2014
- Recovery Goal: 6500 Spawners
- Depensation Level 250

Coho

California Department of Fish and Wildlife

Final Report 05/2/2022

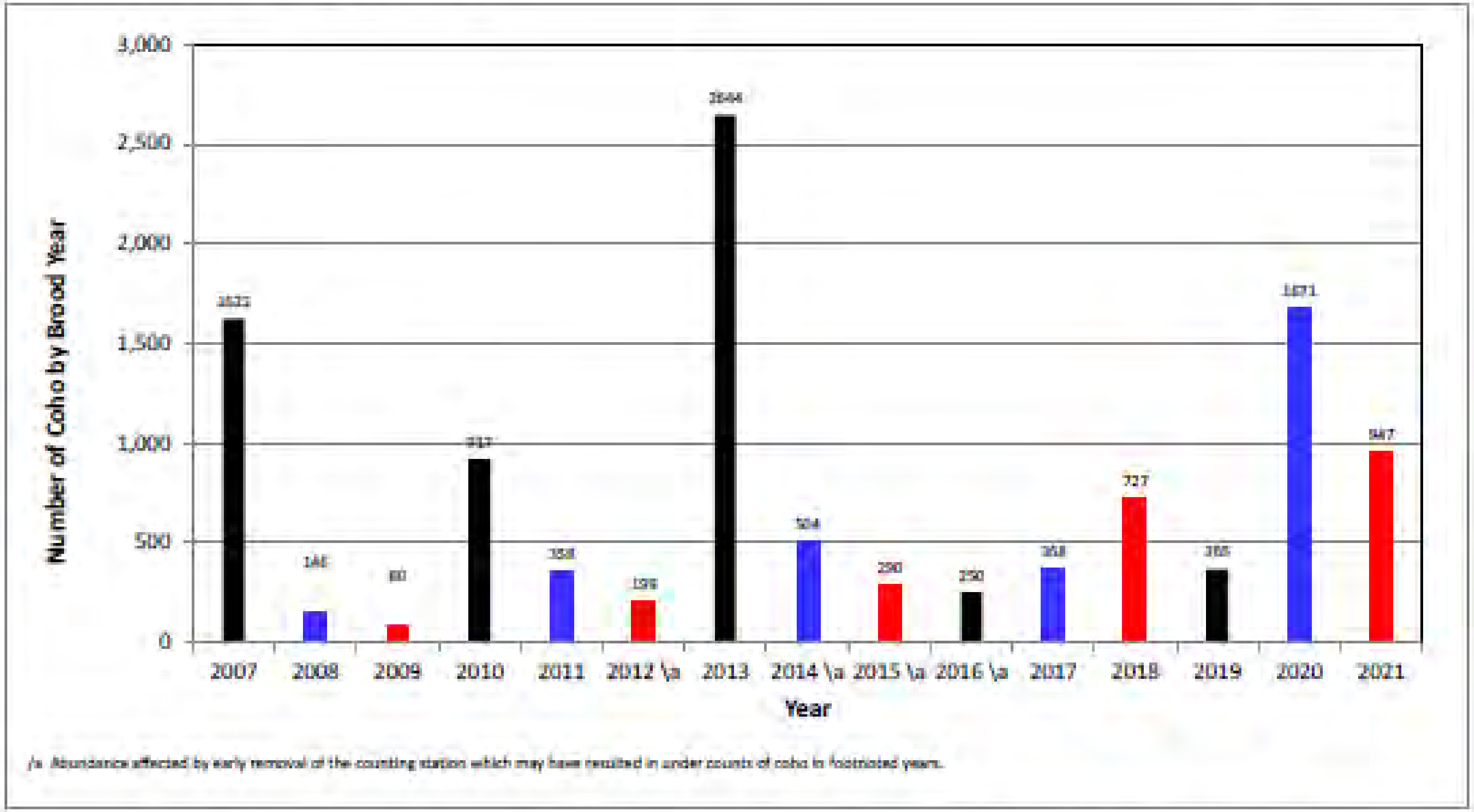
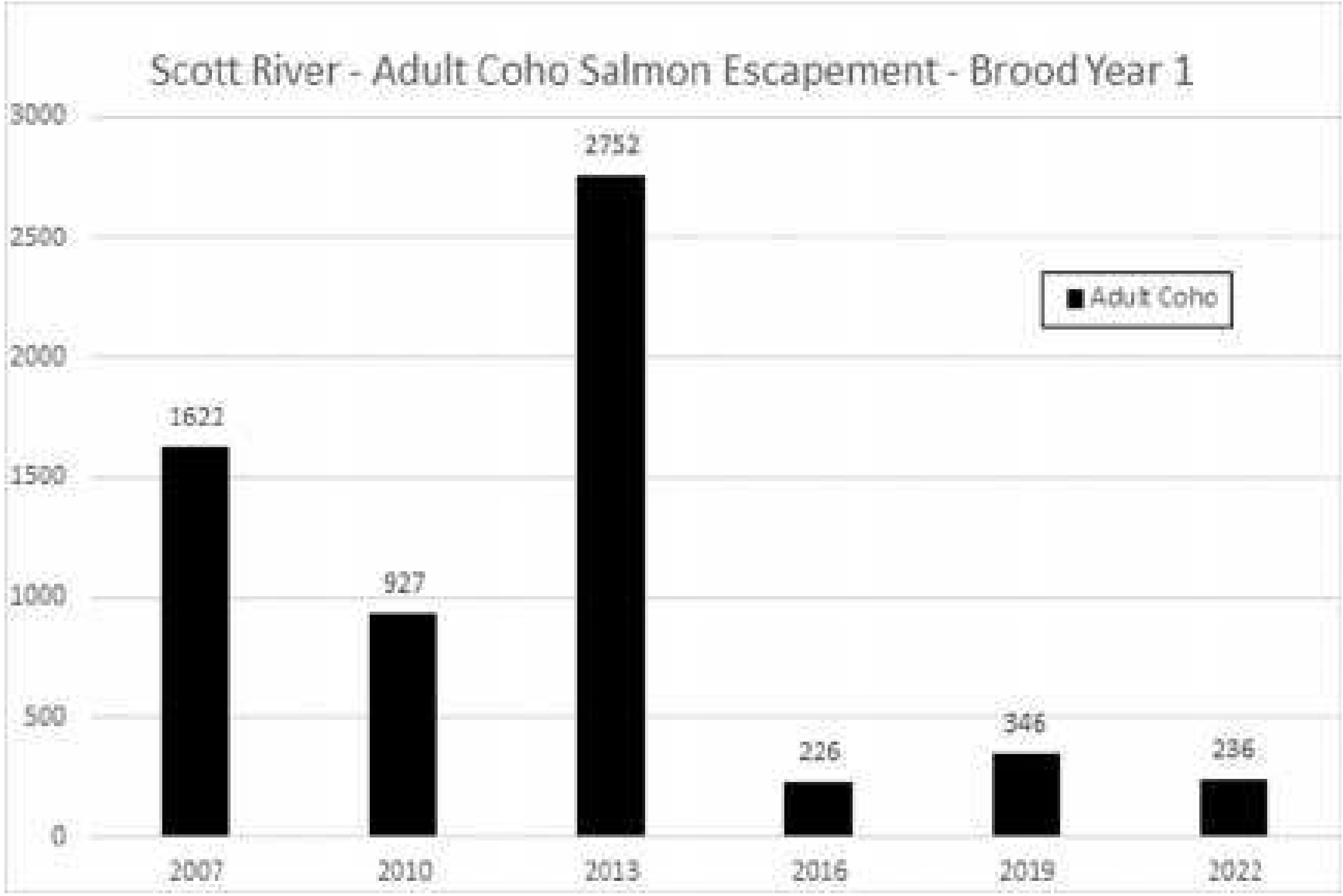


Figure 19. Estimated escapement by Brood Year of adult and grilse Coho Salmon (age 2 [year-1] and age 3 [year]) salmon returning to the Scott River from 2007 to 2021. Individual brood years are represented by different colors.

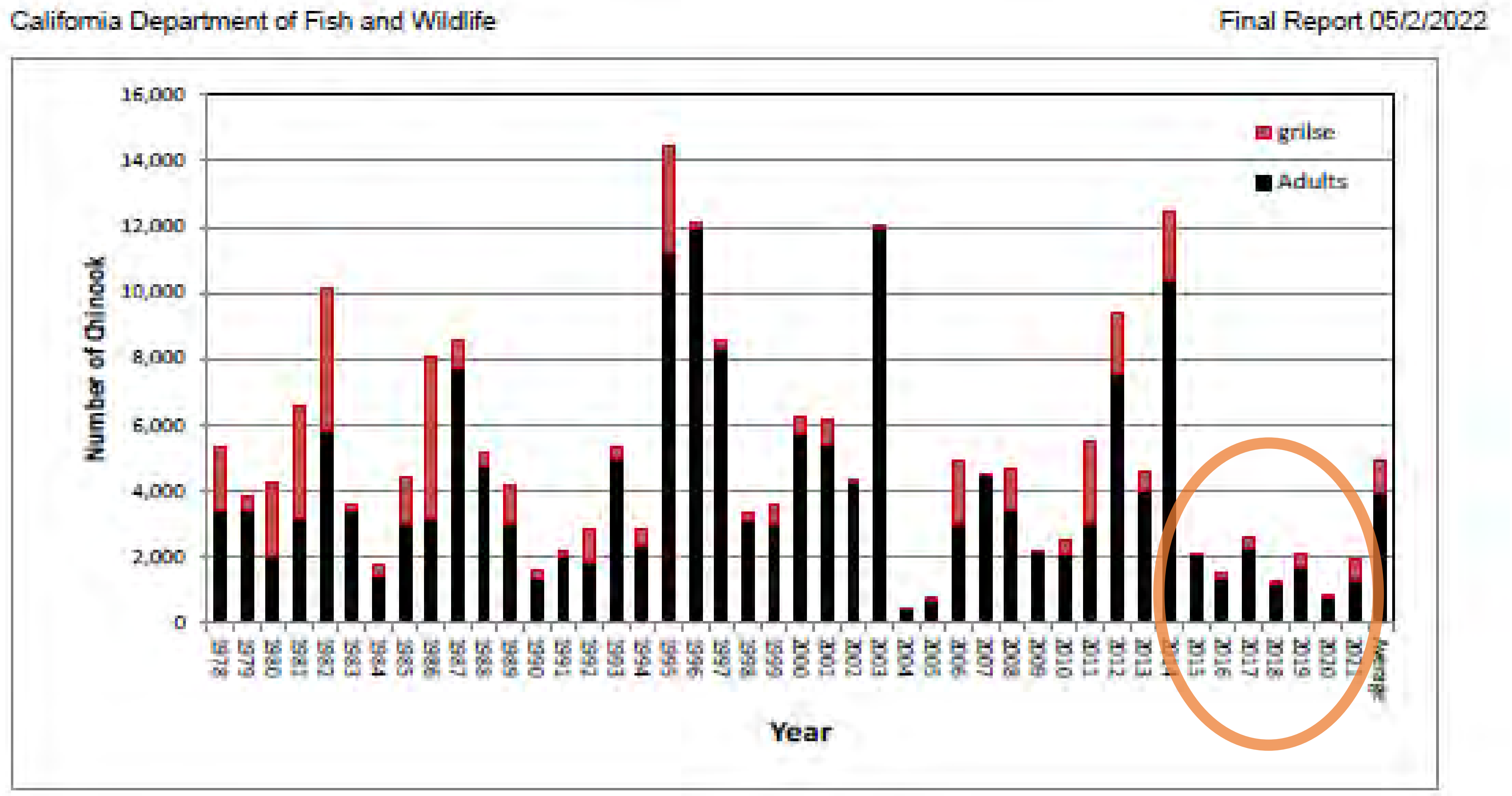
Source: CDFW

Coho: Brood Year 1



Source: SRWC

Chinook



Source: CDFW

Need For Regulation

- Adjudication
- Clean Water Act/TMDL
- Non-Regulatory Notices of Unavailability
- SGMA
- Emergency Regs

Legal Authority

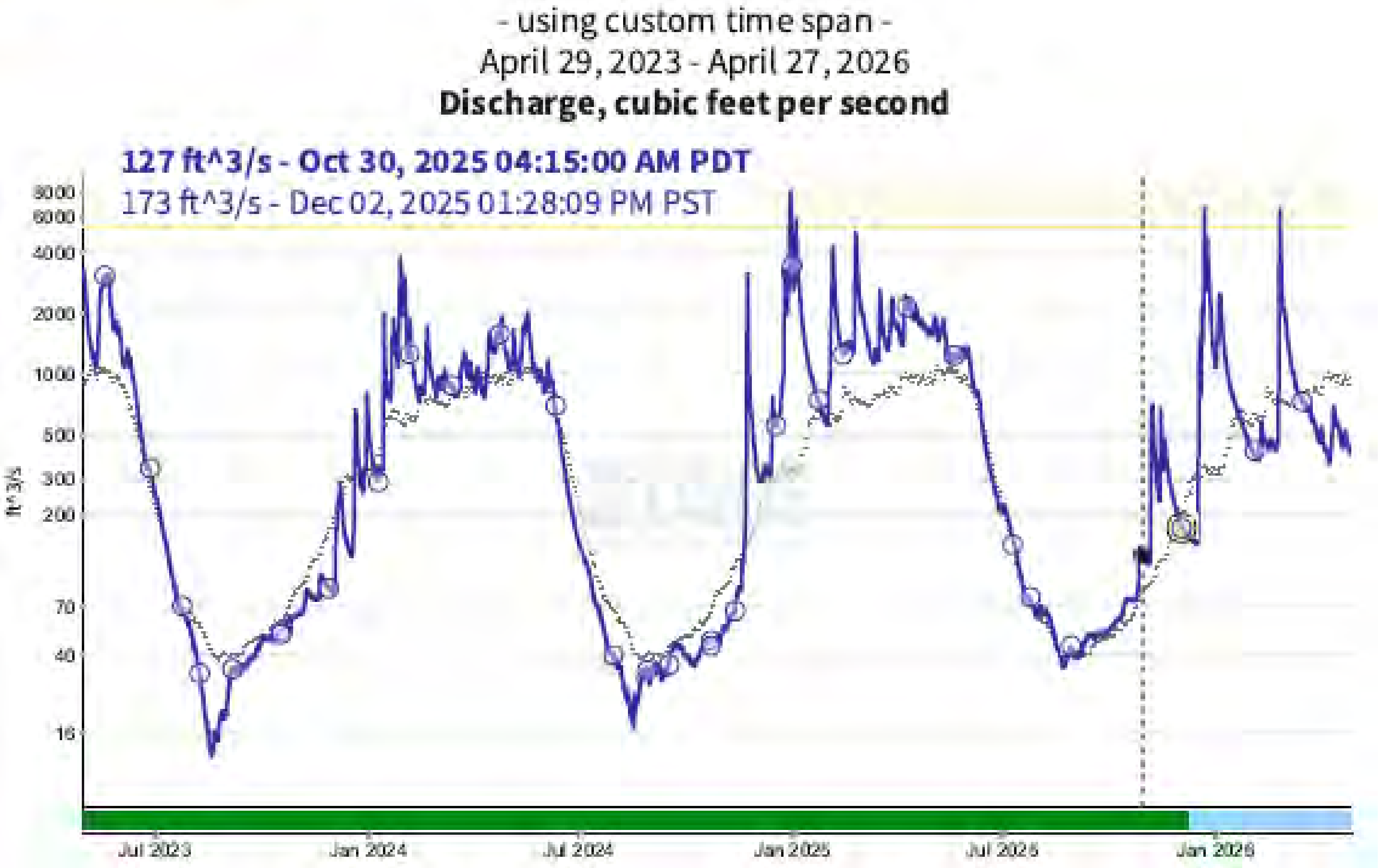
- Regulatory:
  - Constitution, Article X section 2
  - Water Code sections 174, 186, 275, 1058
  - Waste and Unreasonable Use Authority
  - Public Trust Doctrine

2023 Request for Action

- Establish minimum flows based on CDFW's 2017 Flow Criteria, with consideration of higher minimums as hydrologically appropriate;
- Include mandatory monitoring and information reporting to demonstrate compliance and refine modeling;
- Include mandatory groundwater pumping limitations—both within and without the adjudicated zone—sufficient to preserve adequately high groundwater levels to maintain stream connection during the summer and fall;
- Maintain the Emergency Regulation's prohibition on inefficient livestock watering.

Scott R NR Fort Jones CA - USGS-11519500

Subscribe to WaterAlert



What’s Next?

- A.B. 263: 5-year clock
- Regulatory Process
  - Scientific and Economic reports
  - Models
  - Policy Options
- Hope?

Instream Flows on the Scott and Shasta Rivers: A Case Study in River Advocacy

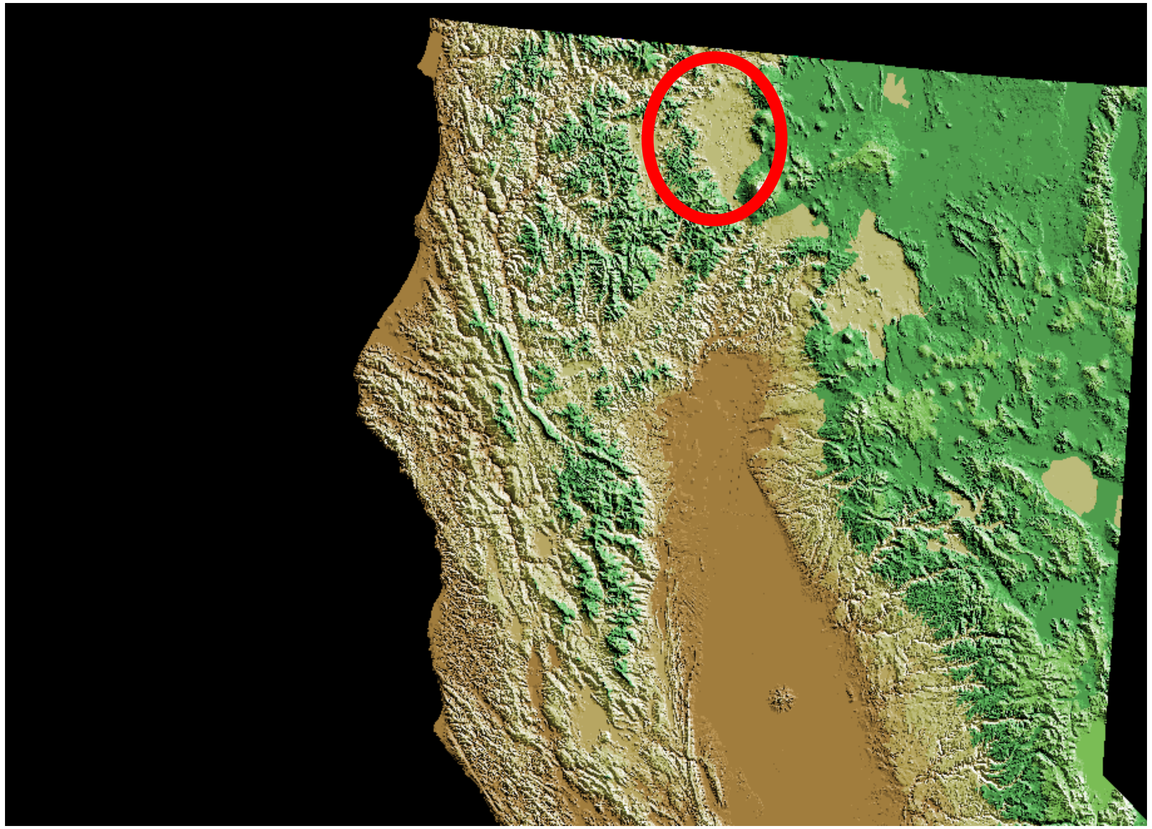
Real Wet Water for Fish: Improving Instream Flows through Water Accounting, Accountability, and Advocacy

Madi Richards

California Coastkeeper Alliance

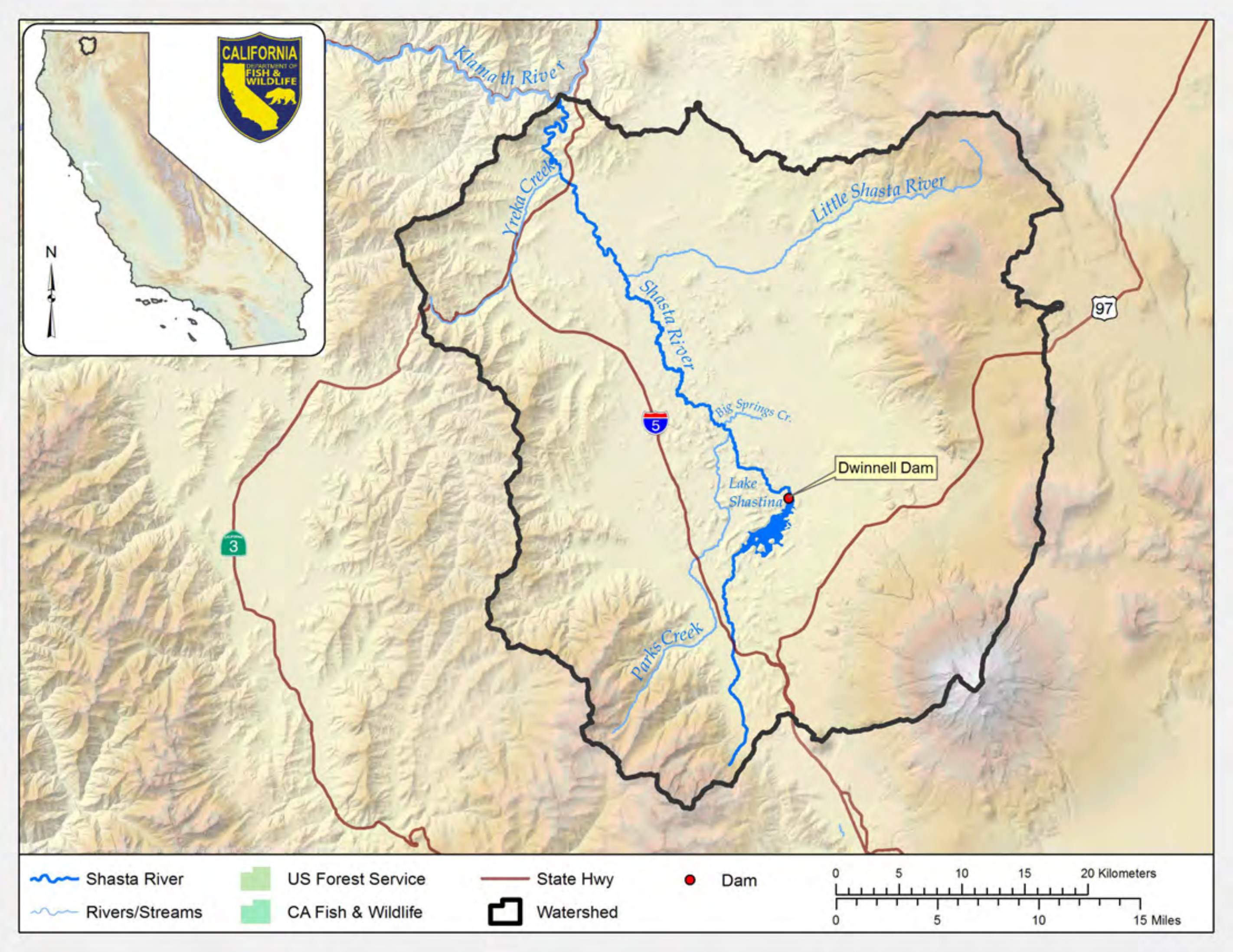
April 28, 2026

Shasta River

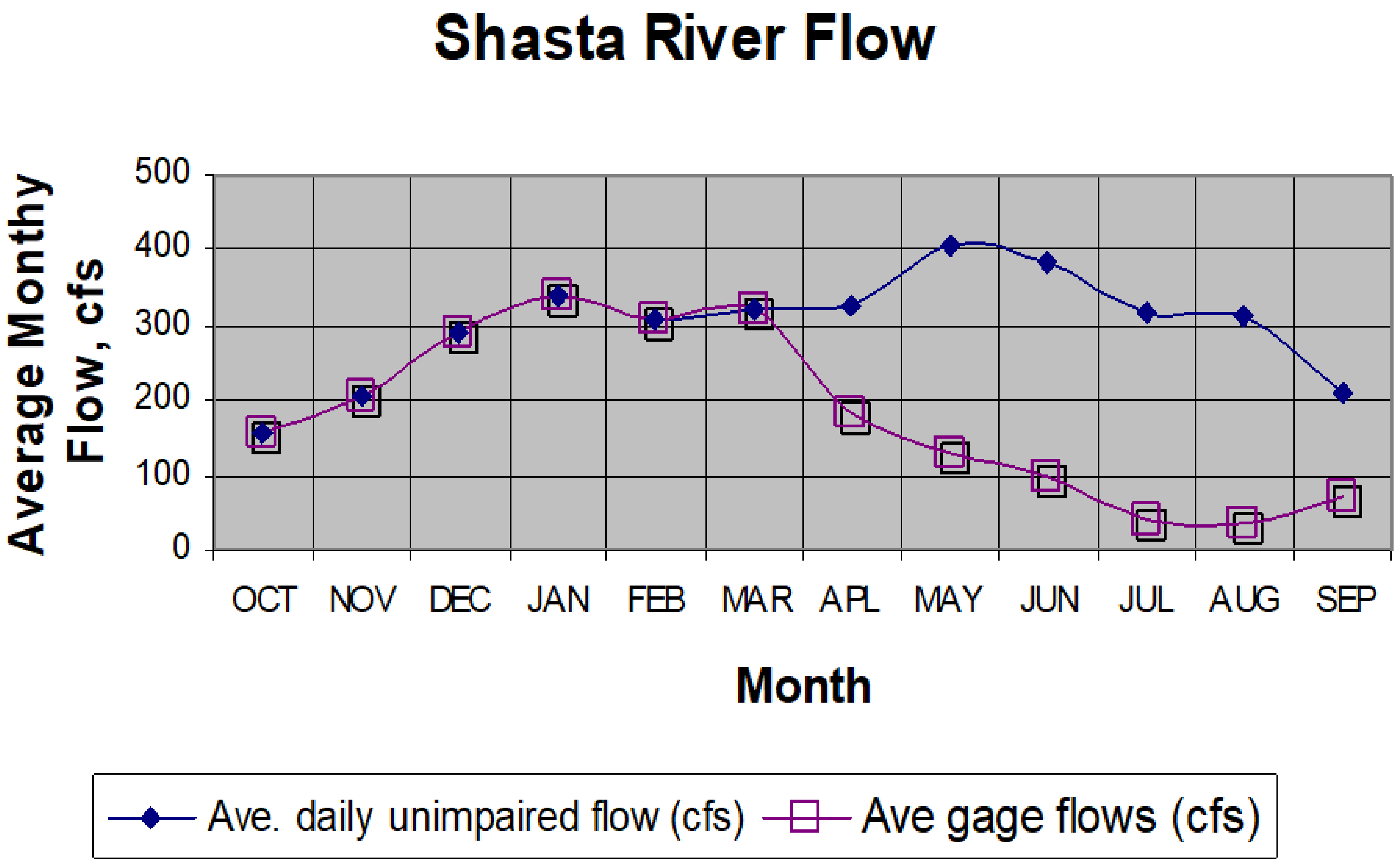


Source: USGS via Wikipedia

Shasta River



Source: CDFW


Shasta River Flow
Average Monthy Flow, cfs
500
400
300
200
100
0
OCT
NOV
DEC
JAN
FEB
MAR
APL
MAY
JUN
JUL
AUG
SEP
Month
Ave. daily unimpaired flow (cfs)
Ave gage flows (cfs)

Source: CDFW

Yreka gauge between 1934-2022, June through September

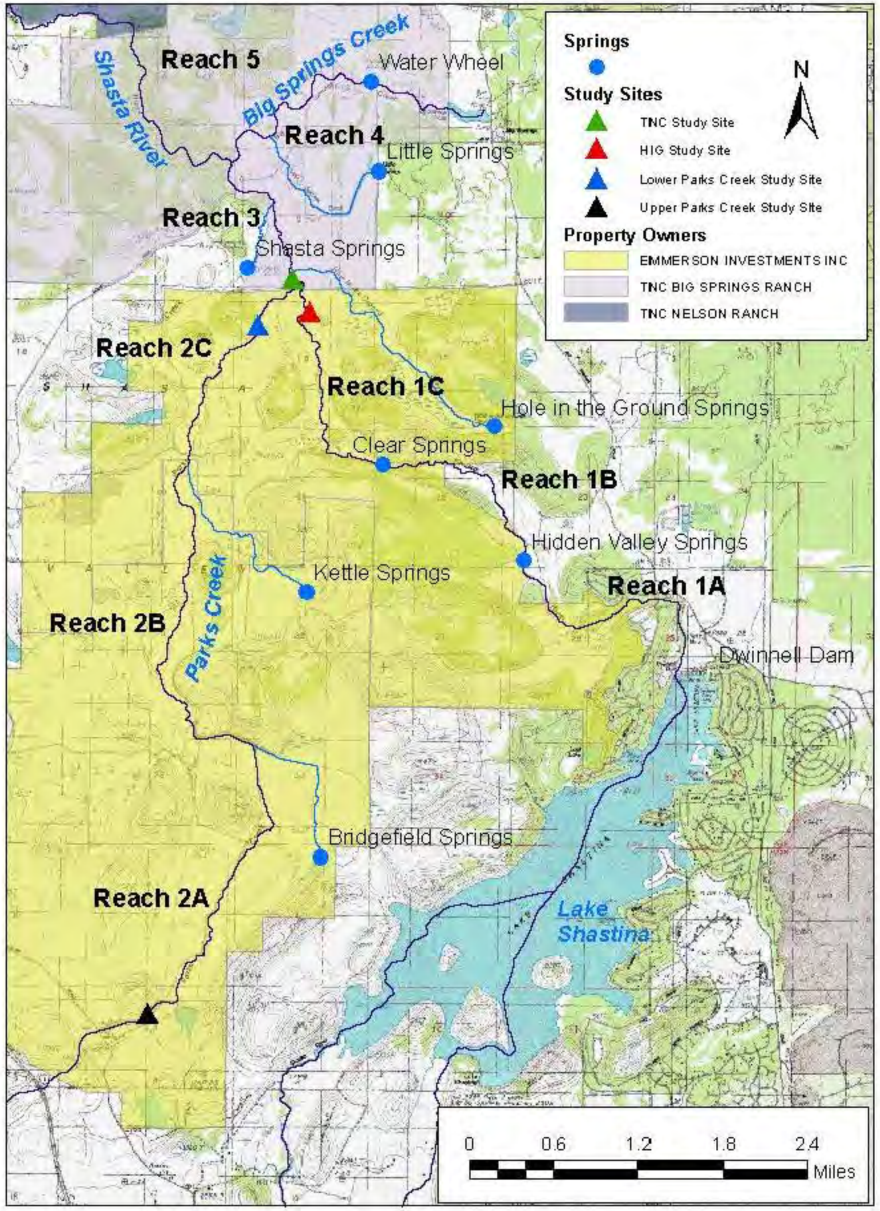
Monthly mean in ft3/s				
	Jun	Jul	Aug	Sep
E-reg	50	50	50	50-75
1934	35.9	18.3	13.8	41.5
1935	19.9	13	14.4	42.3
1936	48.8	15.3	14.1	39.5
1937	71.7	16.1	13.6	42.4
1938	143.8	115.6	96.2	104
1939	18.4	17.1	8.35	62.8
1940	73.6	58	59.8	111.4
1941	208.4	115.3	110.6	136.3
1945	102.8	30.9	31.6	66.7
1946	80.3	48.4	43.7	76.7
1947	77.1	22.5	29.2	55.7
1948	154.6	37.4	60.4	112.6
1949	66.4	20.1	26.7	88.6
1950	61.3	18.3	20.2	74.4
1951	32.6	16.2	22.2	61.3
1952	146.8	59.3	50.5	79.4
1953	283.6	46.3	48.6	82.6
1954	132.1	23.6	44.5	81.8
1955	17.9	12.7	11.3	49.8
1956	150.7	71.4	61.6	112.3
1957	59.1	20.8	35.6	102.5
1958	296.4	117.3	73.1	120.5
1959	55.7	20.4	32.5	84.9
1960	35.5	10.1	16.1	32.6
1961	96.4	17.2	34.6	105.2
1962	53.8	22.8	31.4	62.9
1963	131.8	78.4	49.8	103.7
1964	126.8	31.4	19.7	54.4
1965	98.7	66.4	81.7	91.5
1966	63.2	15	13.9	62.2
1967	162.2	38.4	28.6	72.3
1968	49.7	12.1	37.8	57.4
1969	126.7	72.5	34	80.7
1970	83.2	35.7	23.1	59.1
1971	201.8	66.6	34.5	84.8
1972	79	27.3	32.5	80.9
1973	28.1	19.9	16	55.4
1974	128	76.5	58.2	71.7
1975	159.8	82.5	54.2	75.2
1976	49.3	21.8	110.4	72.7
1977	44.3	19.1	17.3	30.9
1978	100.5	77.6	70.8	182.3
1979	31.5	21.7	30.8	70.6
1980	121.8	36.5	29.2	62.3
1981	35.7	13.7	9.51	26.7
1982	135.8	136.5	47.3	96.1
1983	294.4	105.3	91.4	116.7
1984	97	44.6	36.5	87.5
1985	69.6	18.3	24.9	115.2
1986	74.4	40.6	35.6	102.6
1987	44.7	35.4	23	57.1
1988	89.9	23.1	27.9	35.9
1989	66.9	27.2	36.7	103.7
1990	74.6	28	22.5	41.3
1991	44.8	34.7	22	31.2
1992	27.3	25.7	12.8	34.6
1993	166.1	40.2	45.9	55.1
1994	29.6	16.9	14.1	30
1995	162.1	146.6	54.8	62.9
1996	90.2	74.1	35	78
1997	85.1	66.9	46.4	86.4
1998	563.7	136.3	77.5	100.7
1999	139	57.8	57.4	79.2
2000	96.9	60.5	27.9	64.7
2001	25.7	23.6	19.4	47
2002	44.3	24.2	23.9	31.8
2003	88.9	62.2	68	82.1
2004	62.4	37.8	43.5	69
2005	94.1	34.1	35.6	63.3
2006	152.4	86.8	81.2	96.7
2007	60	40.5	27.2	48.8
2008	75.2	20.6	25.5	32.6
2009	70.7	18.6	18.5	23
2010	75.2	22.1	25.8	61.5
2011	193	87.4	56.9	79.4
2012	48.5	25.4	29.7	52.3
2013	25.2	17.1	27.2	34.7
2014	21.8	13.2	15.8	44.9
2015	42.1	28.8	27.8	39.6
2016	72.1	32.4	35	57.3
2017	131.1	45.4	63.3	88.4
2018	56.8	24.3	38.5	41.1
2019	102.8	41.7	41.4	73.6
2020	34.6	14.5	16.7	22.6
2021	17.7	15.9	18.9	47.4
2022	51	48.3	41.3	64.3

Comparison with Unimpaired Flows

Deas and Null, Estimates of Average Unimpaired Flows for a Representative Year in the Shasta Basin			
June	July	Aug	Sept
212 cfs	158 cfs	147 cfs	143 cfs

Big Springs Complex

Big Springs Complex Interim Instream Flow Needs February 28, 2013



Source: McBain & Trush

Figure 2. Reaches, sub-reaches, and study sites in the Big Springs Complex

Emergency Regulations

Aug 17, 2021 Emergency Minimum Flows at the Yreka Gauge in cfs											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec*
135	135	135	70	50	50	50	50	50	125	150	150/135

Emergency Minimum Flows at the Yreka Gauge in cfs – Aug. 2, 2022-Aug. 2, 2023													
Jan	Feb	Mar 1-24	Mar 25-31	Apr	May	Jun	Jul	Aug	Sept 1-15	Sept 16-30	Oct	Nov	Dec
125	125	125	105	70	50	50	50	50	50	75	105	125	125

Petition Process

- Petition submission
- State Board denial and petition for reconsideration
- State Board Order

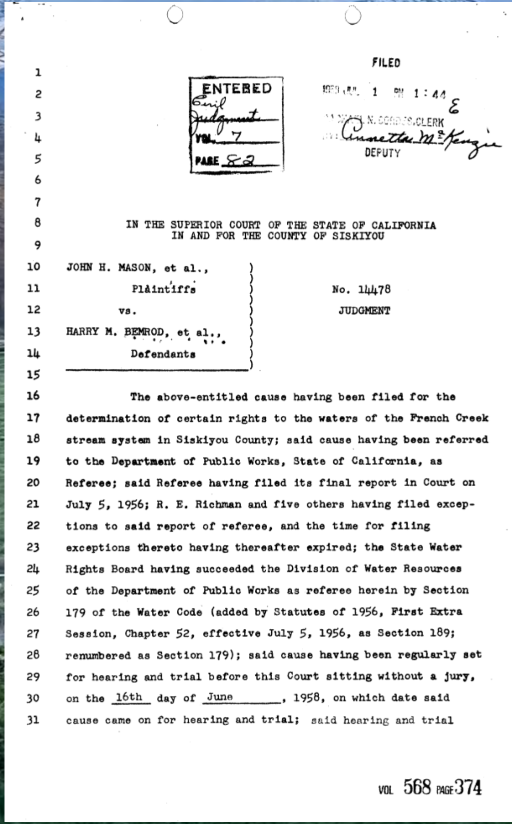
An Irrigator's Experience of Navigating Water Regulations and Suggestions on How to Improve Them for Better Ecological Outcomes

Betsy Stapleton, Scott Valley Landowner, Irrigator and Nature Lover

A personal tale of living in two worlds.

Why?
Fish
Food
Wildlife

French Creek Water Regulations: Adjudication and Watermaster


FILED

ENTERED
Civil
Judgment
VOL. 7
PAGE 82

1 1:44

CLERK

Annetta McKenzie
DEPUTY

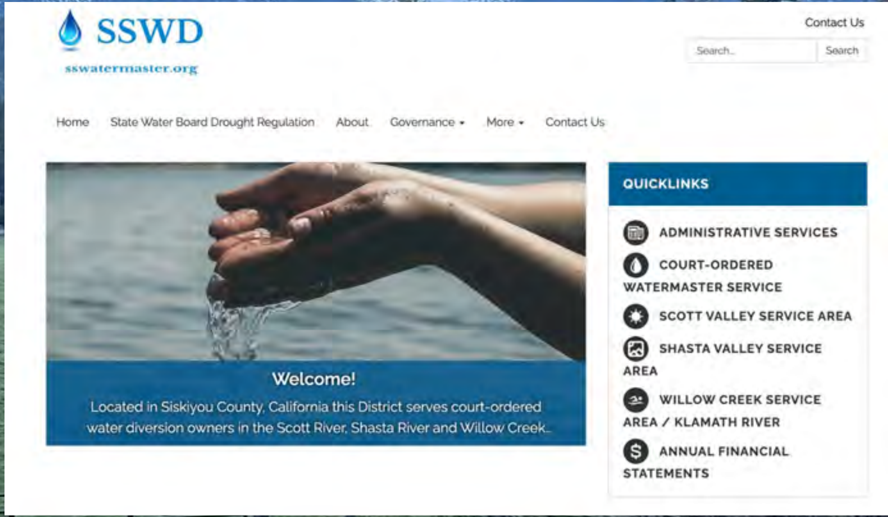
IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA
IN AND FOR THE COUNTY OF SISKIYOU

JOHN H. MASON, et al., Plaintiffs vs. HARRY M. BEMROD, et al., Defendants

No. 14478
JUDGMENT

The above-entitled cause having been filed for the determination of certain rights to the waters of the French Creek stream system in Siskiyou County; said cause having been referred to the Department of Public Works, State of California, as Referee; said Referee having filed its final report in Court on July 5, 1956; R. E. Richman and five others having filed exceptions to said report of referee, and the time for filing exceptions thereto having thereafter expired; the State Water Rights Board having succeeded the Division of Water Resources of the Department of Public Works as referee herein by Section 179 of the Water Code (added by Statutes of 1956, First Extra Session, Chapter 52, effective July 5, 1956, as Section 189; renumbered as Section 179); said cause having been regularly set for hearing and trial before this Court sitting without a jury, on the 16th day of June, 1958, on which date said cause came on for hearing and trial; said hearing and trial

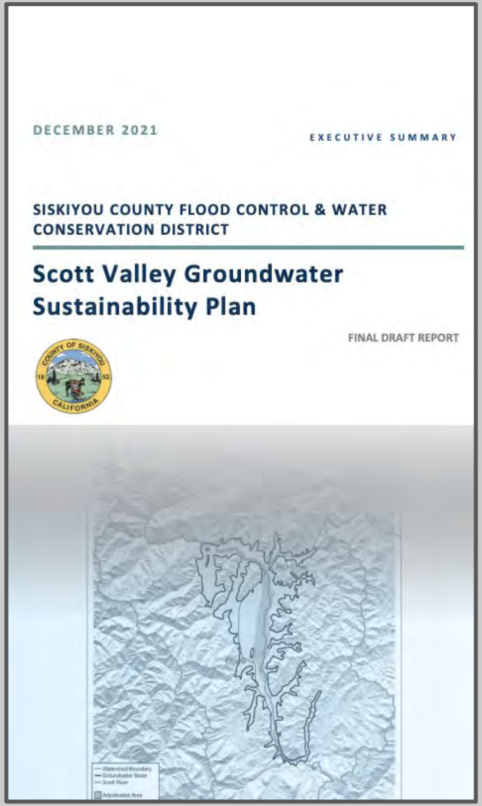
VOL 568 PAGE 374



The Deputy Watermaster will exercise professional judgment and refer to District policies, procedures and guidelines when adjusting water diversions and identifying potential conflicts or harm to others. The Deputy Watermaster may collect additional water right information or agreements when they effect flow at a point of diversion controlled by the District.

California Water Regulations:
Lake and Streambed Alteration Agreement
AKA “LSAA” or “1600”
Sometimes with Fish and Game Code 5937

State Water Regulations: Sustainable Groundwater Management Act
AKA SGMA



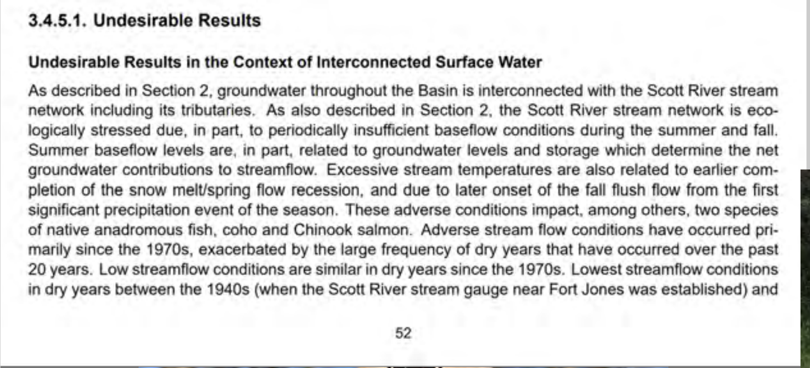
DECEMBER 2021

EXECUTIVE SUMMARY

SISKIYOU COUNTY FLOOD CONTROL & WATER CONSERVATION DISTRICT

Scott Valley Groundwater Sustainability Plan

FINAL DRAFT REPORT



3.4.5.1. Undesirable Results

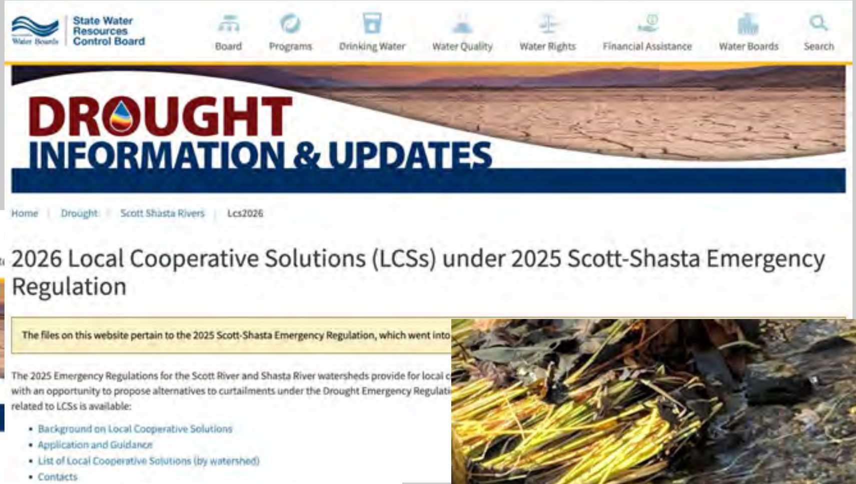
Undesirable Results in the Context of Interconnected Surface Water

As described in Section 2, groundwater throughout the Basin is interconnected with the Scott River stream network including its tributaries. As also described in Section 2, the Scott River stream network is ecologically stressed due, in part, to periodically insufficient baseflow conditions during the summer and fall. Summer baseflow levels are, in part, related to groundwater levels and storage which determine the net groundwater contributions to streamflow. Excessive stream temperatures are also related to earlier completion of the snow melt/spring flow recession, and due to later onset of the fall flush flow from the first significant precipitation event of the season. These adverse conditions impact, among others, two species of native anadromous fish, coho and Chinook salmon. Adverse stream flow conditions have occurred primarily since the 1970s, exacerbated by the large frequency of dry years that have occurred over the past 20 years. Low streamflow conditions are similar in dry years since the 1970s. Lowest streamflow conditions in dry years between the 1940s (when the Scott River stream gauge near Fort Jones was established) and

52

Scott Shasta Water Regulations: Emergency Drought Regulation

"Belly Scraping Flows"


State Water Resources Control Board

Board | Programs | Drinking Water | Water Quality | Water Rights | Financial Assistance | Water Boards | Search

DROUGHT INFORMATION & UPDATES

Home | Drought | Scott Shasta Rivers | Lcs2026

2026 Local Cooperative Solutions (LCSs) under 2025 Scott-Shasta Emergency Regulation

The files on this website pertain to the 2025 Scott-Shasta Emergency Regulation, which went into

The 2025 Emergency Regulations for the Scott River and Shasta River watersheds provide for local
with an opportunity to propose alternatives to curtailments under the Drought Emergency Regulati
related to LCSs is available:

- Background on Local Cooperative Solutions
- Application and Guidance
- List of Local Cooperative Solutions (by watershed)
- Contacts


State Water Resources Control Board

Board | Programs | Drinking Water | Water Quality | Wat

DROUGHT INFORMATION & UPDATES

Home | Drought | Scott Shasta Rivers

Scott River and Shasta River Watersheds Emergency Regulation

Curtailment Status:

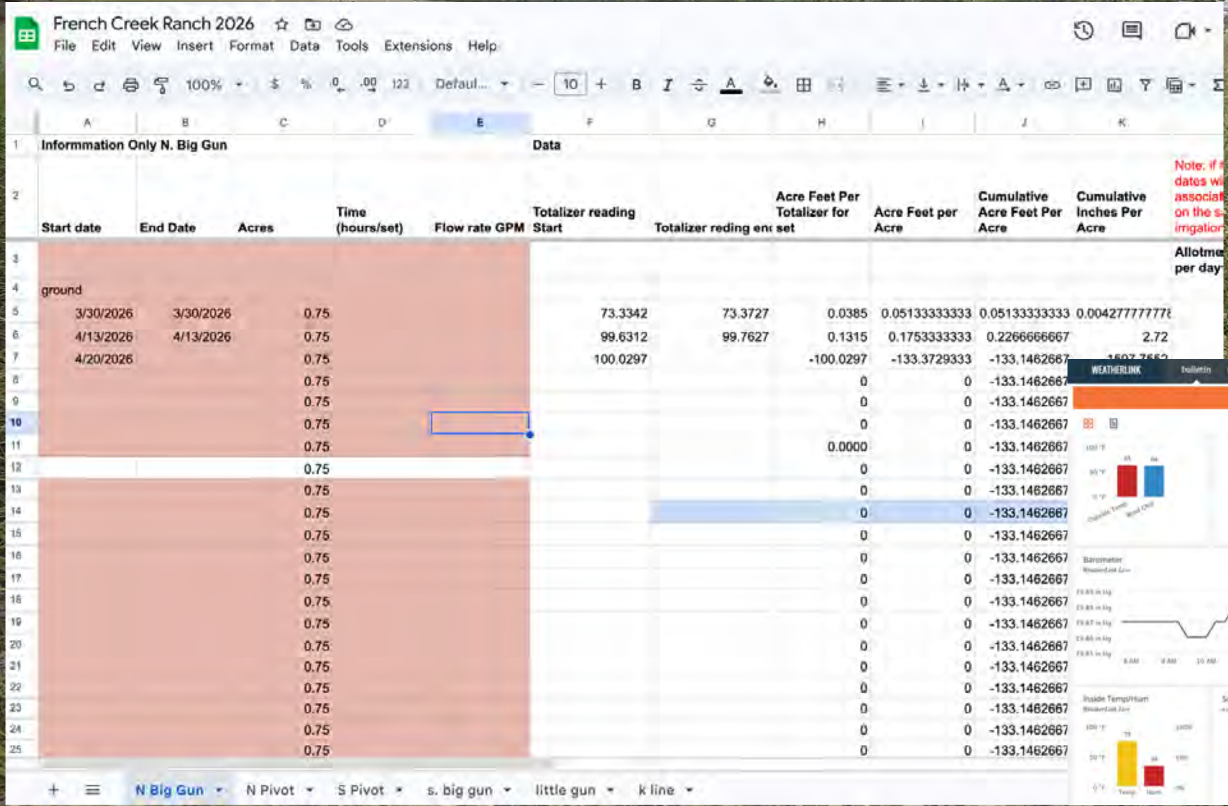
Scott and Shasta Watersheds - Opportunity to divert for Inefficient Livestock Watering: On November 14, 2025, California Department of Fish and Wildlife (CDFW) made the determination that flows have been sufficient to stimulate the coho salmon migration into the Scott and Shasta Rivers. This means that large livestock diversions may be possible in the Scott River and Shasta River watersheds as of November 14, 2025, so long as other conditions are met, including connectivity, bypass, and notification conditions. Parties that want to divert for livestock need to confirm all the criteria outlined in the Emergency Regulation is met before diverting surface water for livestock. This includes the diverter notifying the State Water Board by email to: ScottShastaFlows@waterboards.ca.gov with their: Name, Water Right Number and point of diversion, anticipated diversion amount, plans to track compliance, and maintain records.

Scott River Watershed: On July 22, 2025, the State Waterboard issued Addendum 8, suspending all curtailments in the Scott River. The State Waterboard recently issued Addendum 7 reinstating curtailments based on the flows at the Fort Jones USGS gage dropping below the July minimum flow requirement of 50 cfs. Several community members expressed concern regarding the accuracy of the measurement, and USGS has revised their flow measurements

Scott River Canyon

Irrigation Efficiency

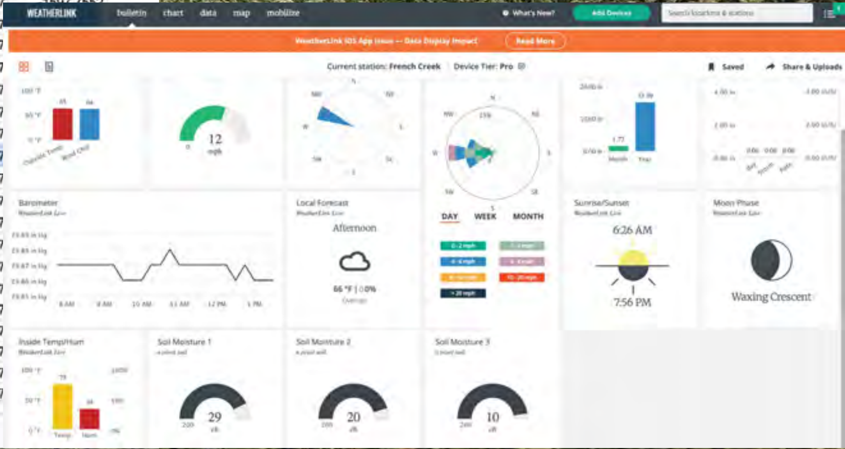
Data Driven Water Management and Reporting



French Creek Ranch 2026

	A	B	C	D	E	F	G	H	I	J	K	
1	Informmation Only N. Big Gun					Data						
2	Start date	End Date	Acres	Time (hours/set)	Flow rate GPM	Totalizer reading Start	Totalizer reding en	Acre Feet Per Totalizer for set	Acre Feet per Acre	Cumulative Acre Feet Per Acre	Cumulative Inches Per Acre	Note: if t dates wi associat on the s irrigation
3												Allotme per day
4	ground											
5	3/30/2026	3/30/2026	0.75			73.3342	73.3727	0.0385	0.05133333333	0.05133333333	[illegible]	
6	4/13/2026	4/13/2026	0.75			99.6312	99.7627	0.1315	0.1753333333	0.2266666667	2.72	
7	4/20/2026		0.75			100.0297		-100.0297	-133.3729333	-133.1462667	[illegible]	
8			0.75					0	0	-133.1462667		
9			0.75					0	0	-133.1462667		
10			0.75					0	0	-133.1462667		
11			0.75					0.0000	0	-133.1462667		
12			0.75					0	0	-133.1462667		
13			0.75					0	0	-133.1462667		
14			0.75					0	0	-133.1462667		
15			0.75					0	0	-133.1462667		
16			0.75					0	0	-133.1462667		
17			0.75					0	0	-133.1462667		
18			0.75					0	0	-133.1462667		
19			0.75					0	0	-133.1462667		
20			0.75					0	0	-133.1462667		
21			0.75					0	0	-133.1462667		
22			0.75					0	0	-133.1462667		
23			0.75					0	0	-133.1462667		
24			0.75					0	0	-133.1462667		
25			0.75					0	0	-133.1462667		

N Big Gun · N Pivot · S Pivot · s. big gun · little gun · k line



Active Restoration and Ecological Land Management

It’s a LOT!

Adjudication

LCS $$$

Watermaster $$$

LSAA $$$

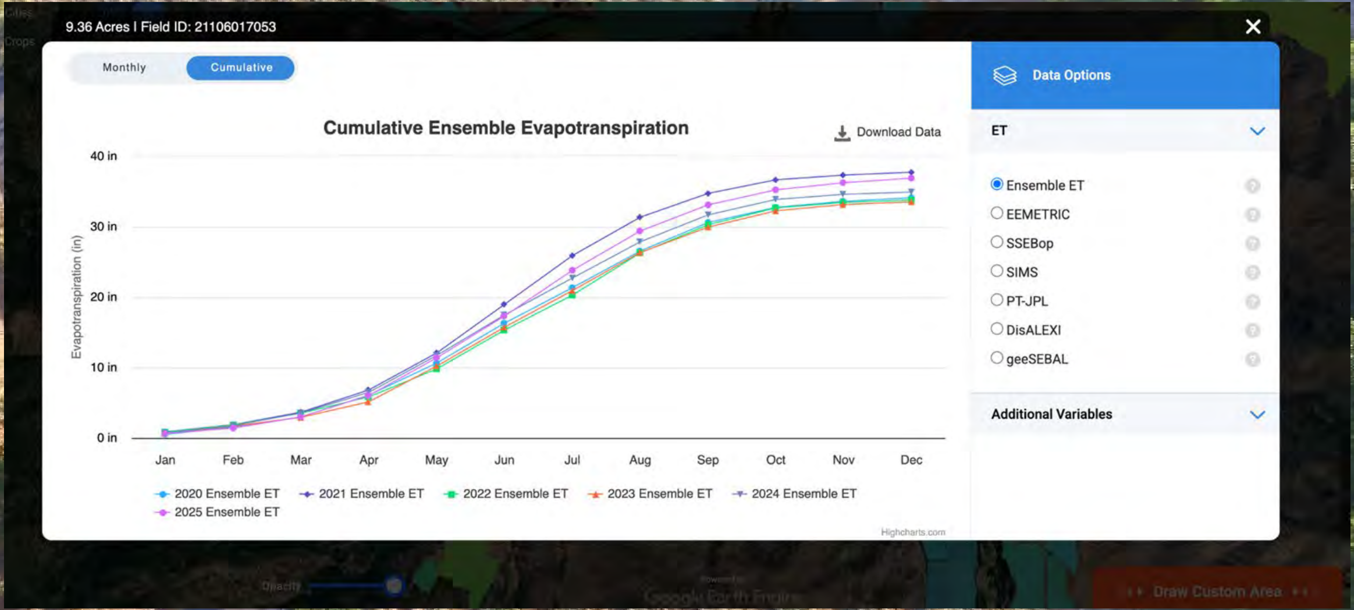
SGMA $$$

Irrigated Lands Permit $$$

More to Come:
Climate Change and AB 263


A cautionary story about local control

The Need for Individual Transparency and Accountability



Only Apply Effecyive Regulations
Make LSAAs a Requirement
Ensure Bypass Flows
Maintain State Oversight of Local Processes
Require Metering
Require Full Data and Reporting Transparency
Ensure Individual Accountability
Ensure Recovery, not just “Belly Scraping” Flows
Provide “Good Citizen” Reduced Regulatory Burden Pathways

Why?
For the next generation of fish lovers and food producers

Flow Setting Advocacy in Hydropower Licensing:
Making Rules Work for Resources

Chris Shutes
California Sportfishing Protection Alliance
For SRF Conference
April 28, 2026

FERC Licensing Offers Chance to Reset Flows Every 30-50 Years

- Federal Power Act (FPA) requires Federal Energy Regulatory Commission licensing and relicensing of hydroelectric projects
- Maximum license term: 50 years; default is 40
- A required check-in, almost always an opportunity to re-evaluate and reset flows

But Flow Setting in FERC Licensing Has Limitations and Rules

- Some limitations stem from FPA statutes
- More limitations stem from FERC staff's interpretation of the FPA
- Other limitations stem from FERC regulations
- Others limitations stem from the culture of FERC staff that has evolved around flows
- Licensees and their consultants systematically cultivate limitations on flow setting

FERC Licensing Is Not a Scientific Exercise

- FERC licensing is an adversarial regulatory process in which science is an element
  - Part of relicensing uses scientific language
  - Parties use scientific language to frame competing interests as science
- Other key elements are economics, power generation, water supply (often), law
  - Each of these elements also has its own language

A Constant Element of FERC Licensing Is Whether a Study is Admissible

- FERC regulations require a study proponent to show the study has a "nexus" to the project and that it could inform license conditions
- FERC staff interprets the regulations narrowly
- Licensees and consultants use this rule to narrow the scope and limit exposure
- It's not whether it's scientifically right or wrong; it's whether it gets in the door

How FERC Thinks About Flow

- FERC frames analysis as “project effects” of hydropower operations
- FERC considers existing conditions as the basis of comparison (not “pre-project” conditions)
- FERC generally does not require mitigation for “cumulative effects”
- FERC will generally not require flows that substantially reduce water supply
- FERC will not consider flows for reintroduction of species that are not yet present

How River Advocates Have to Think about Flow in FERC Licensing

- The State Water Board (in CA) generally has the Clean Water Act authority, but rarely has the courage, to require substantially higher flows than FERC is willing to order
- Creating a record in FERC's process also allows other authorities to defend better flows
- FERC doesn't order studies for other agencies
- Must fight over studies and their execution

Gaming the Rules to Limit Regulatory Exposure

- Licensees game the rules to keep costs down
  – Some do it more than others
  – Some do it all the time
  – A few accept regulation as a business expense
- Many consultants are experts in gaming rules
  – Some are more strategic
  – Some are more mercenary
  – Some pursue it on their own initiative
- National Hydropower Assn. strategy

Shaping the Rules

- The hydropower industry tries to limit definition of project effects to direct effects
- Licensees call most effects “cumulative”
  - If there are water supply diversions or inputs below a hydro project, it’s a cumulative effect
  - Limit length of river where FERC can set flow
- Similar to “close causal connection” of conservative attacks on ESA, CWA
- NHA legislation to limit 4(e) to direct effects

Physical Habitat Simulation Is FERC's Preferred Flow Setting Method

- Selects representative transects from different habitat types (pool, run, glide, riffle)
- Physically measures depth, velocity, and substrate at different flows.
- Establishes preferred depth and velocities of key life stages (spawning, fry, juveniles, adult) of target species ("habitat suitability curves")
- Measures "weighted usable area" (WUA)

Additional Possible Considerations under PHABSIM

- Water temperature
- Cover
- May evaluate “effective habitat” in which, for example, changing water temperature over the summer reduces usable area.
- Usually uses as a 1-dimensional model; may use 2-dimensional, esp. for amphibians

Output and Use of PHABSIM

- Create a series of weighted usable area (WUA) curves that show amount of usable habitat as absolute numbers and also as percent of maximum for each life stage.
- Provides a way of quantifying the values of different flows.
- Percent of maximum WUA is the primary metric for FERC flow evaluation

FOLLOWING SLIDES USE 2013 MERCED IRRIGATION DISTRICT PHABSIM STUDY FOR FERC LICENSING AS A CASE STUDY

Source for slides, stated as Merced Irrigation District (2013), unless shown otherwise on slide:

Merced Irrigation District Technical Memorandum 3-5, Instream Flow (PHABSIM) Downstream of Crocker-Huffman Dam (2013), , FERC eLibrary no. 20130131-5299: https://elibrary.ferc.gov/eLibrary/filedownload?fileid=01AB4D4D-66E2-5005-8110-C31FAFC91712

Merced River Project Map

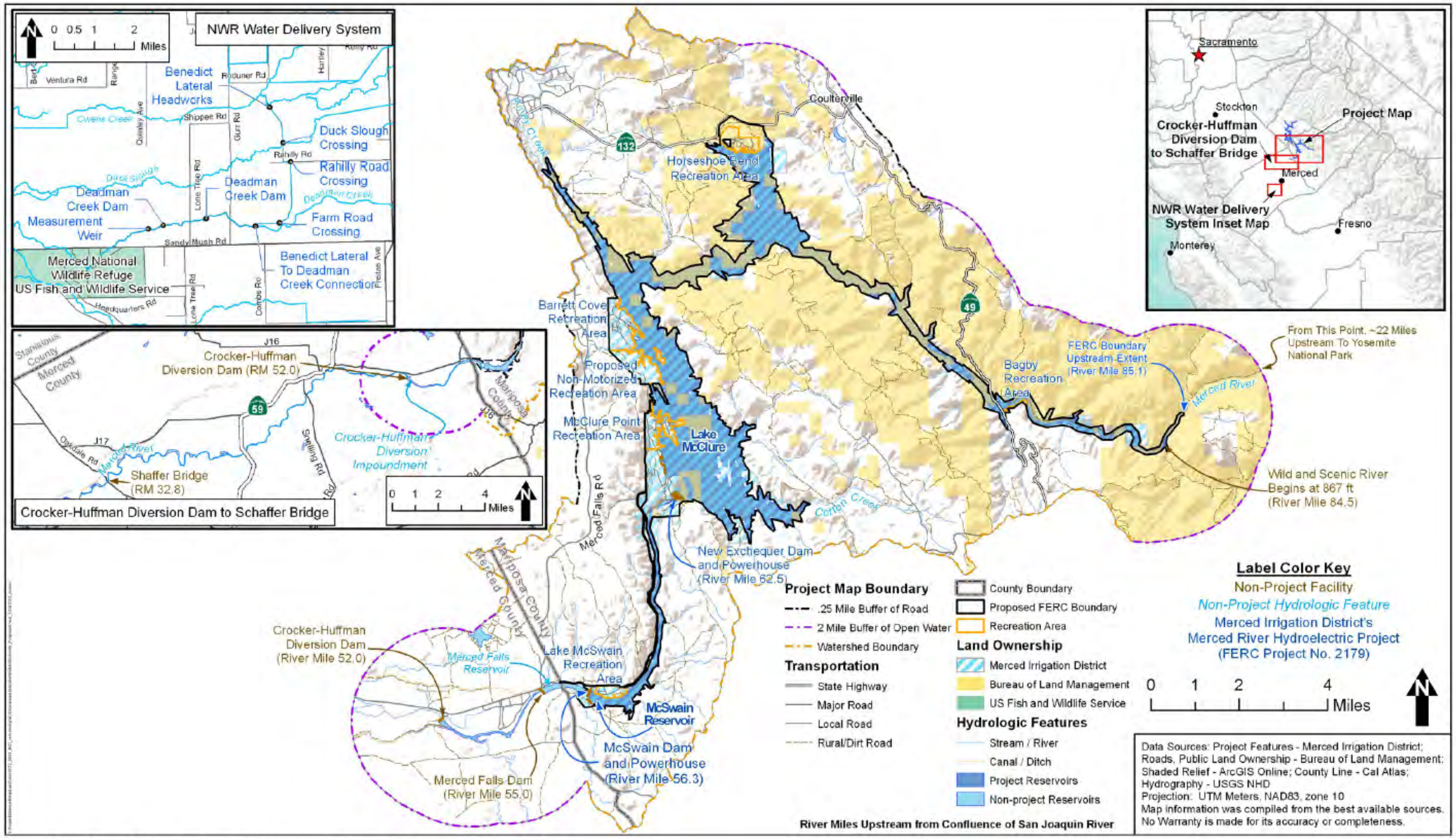
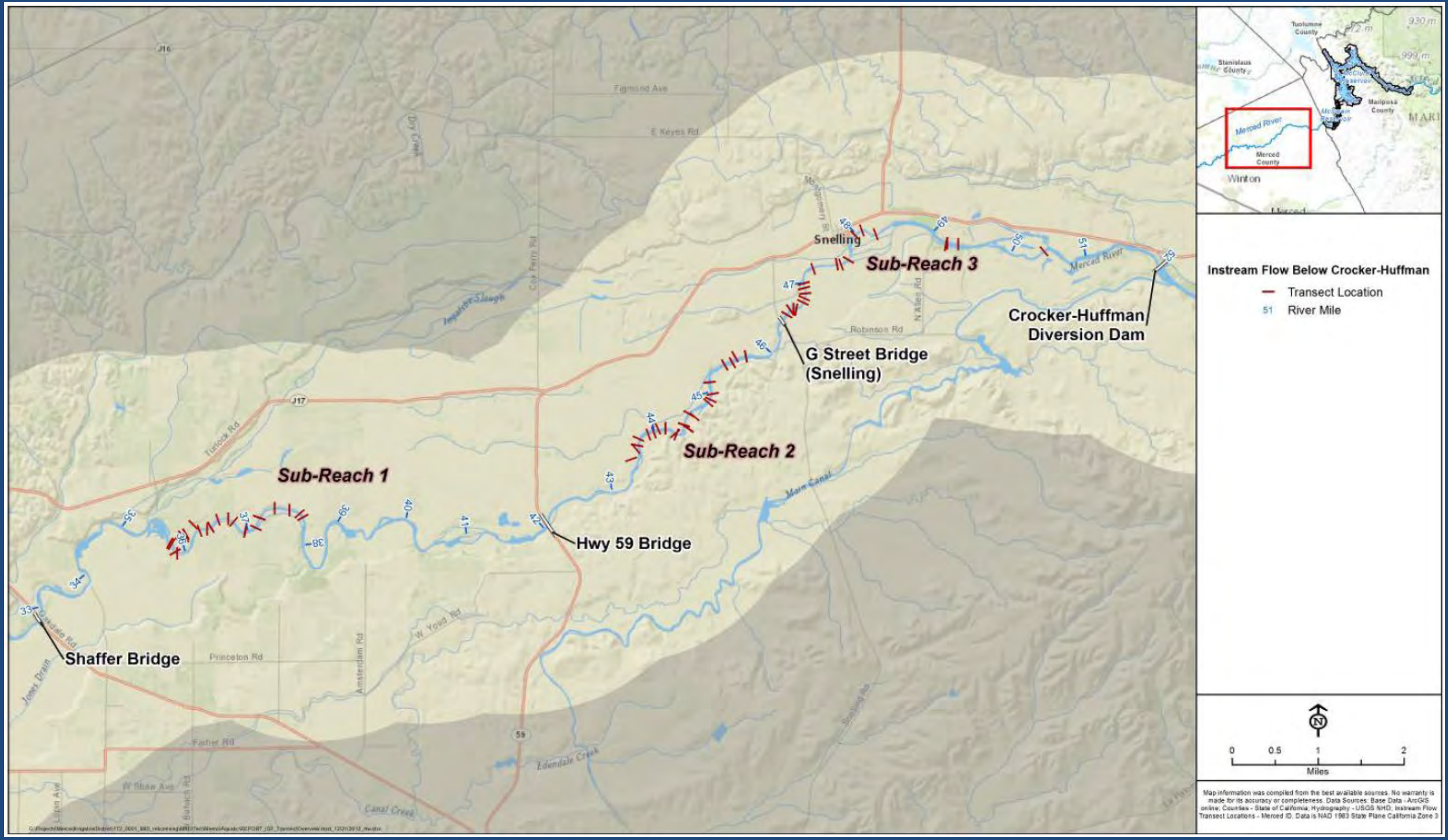


Figure 1.1-2. Merced River Hydroelectric Project facilities and features and Project Vicinity.

April 2014 Amended Application for New License ©2014, Merced Irrigation District Amended Exhibit E Page E1-5

Source: Merced River Project Amended Final License Application (042314): https://elibrary.ferc.gov/eLibrary/filedownload?fileid=01BF5AEE-66E2-5005-8110-C31FAFC91712

Merced River PHABSIM Study Sites



Source: Merced Irrigation District (2013)

Merced PHABSIM Study Ordered Only After 1 Year of Vigorous Advocacy

- Merced ID argued that water supply, not hydro operations control flow downstream of Merced ID ag diversion 4 miles below the hydro project

- "during the non-irrigation season (approximately November-February) when little or no diversions from Crocker-Huffman are occurring, the magnitude and duration of releases from New Exchequer dam have a ***direct effect*** upon flow-related habitat conditions in the lower Merced River …" (FERC, Revisions to Study Plan 040111)

  Source: https://elibrary.ferc.gov/eLibrary/filedownload?fileid=01CE6111-66E2-5005-8110-C31FAFC91712

PHABSIM Habitat Suitability Curves: Preferred Velocity, Depth for Salmon

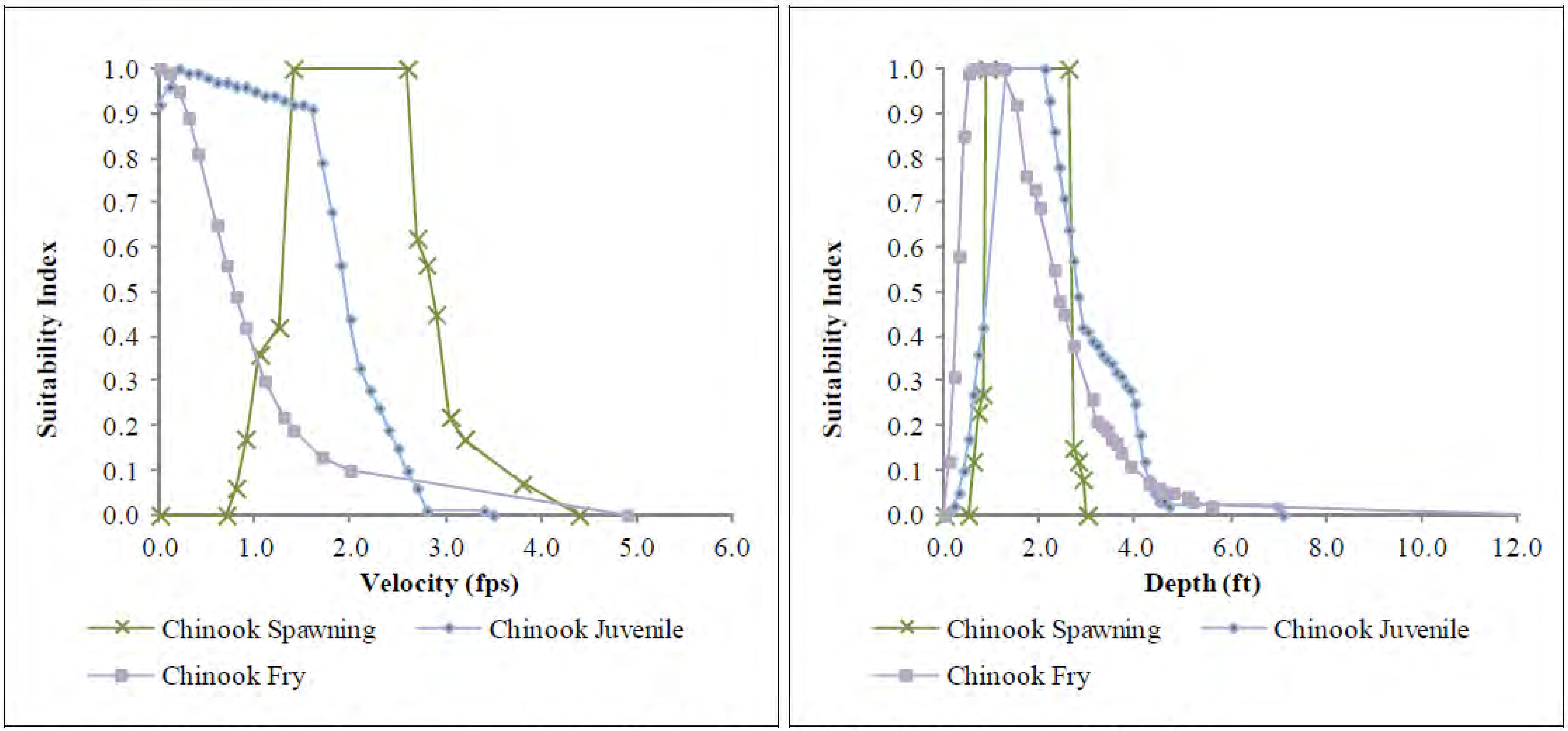


Figure 2.2-3. Chinook spawning, juvenile and fry HSCs (velocity and depth).

Source: Merced Irrigation District (2013)

PHABSIM Habitat Suitability: Salmon Spawning Substrate

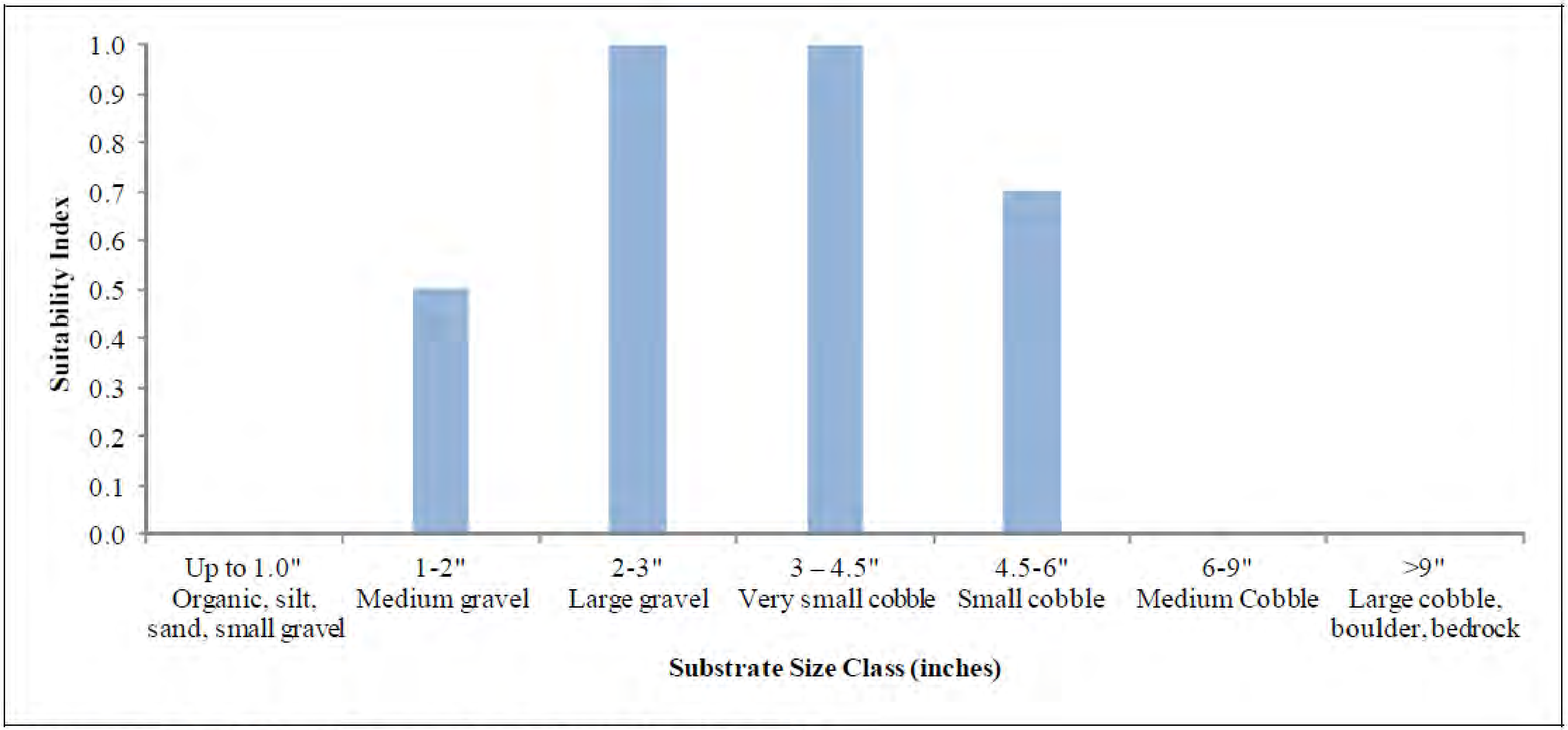


Figure 2.2-4. Chinook spawning substrate suitability.

Source: Merced Irrigation District (2013)

PHABSIM Habitat Suitability Curves: Preferred Velocity, Depth for Steelhead

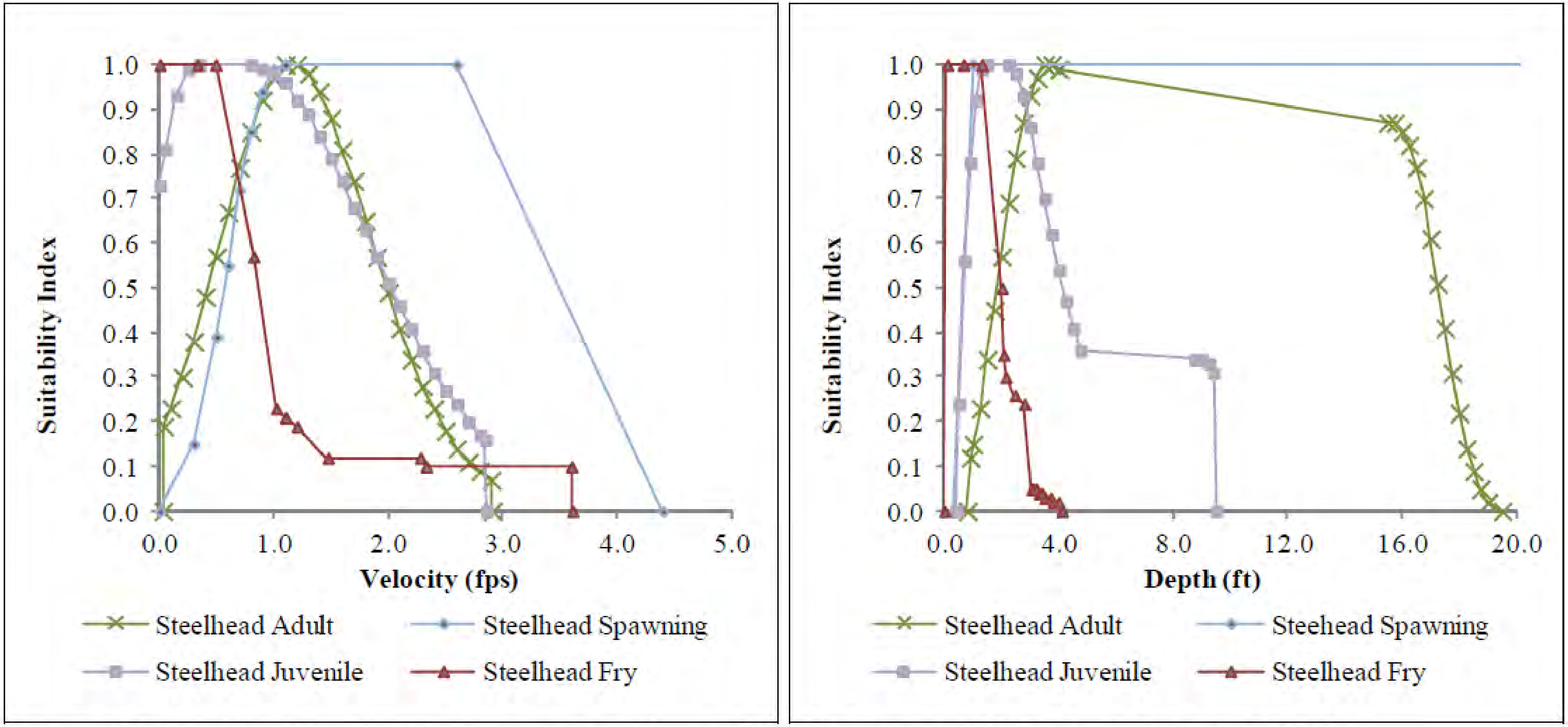


Figure 2.2-1. Steelhead spawning, juvenile and fry life stages HSC (velocity and depth).

Source: Merced Irrigation District (2013)

PHABSIM Habitat Suitability: Steelhead Spawning Substrate

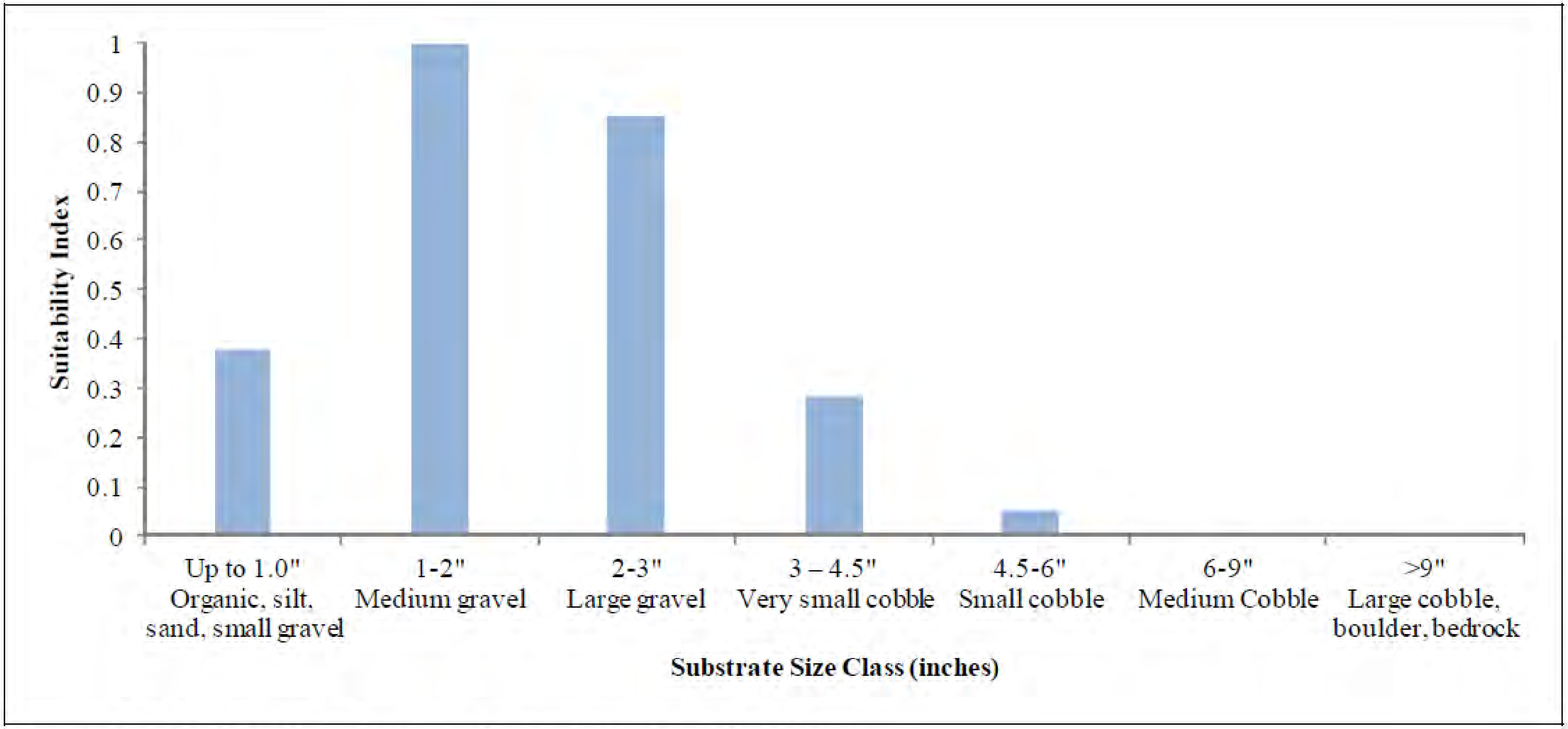


Figure 2.2-2. Steelhead spawning substrate suitability.

Source: Merced Irrigation District 2013

Weighted Usable Area: Salmon

Table 3.3-7. Values with conditional formatting from 80 to 100 percent of the maximum WUA. Bimodal curves have the lower peak highlighted in blue, and the upper peak highlighted in green for Sub-reach 1.

	Chinook		
Discharge (cfs)	Spawning (% of Max)	Fry (% of Max)	Juvenile (% of Max)
75	30%	77%	81%
90	47%	75%	83%
105	61%	72%	85%
120	71%	70%	86%
135	76%	68%	87%
150	80%	65%	87%
165	85%	63%	86%
188	90%	60%	85%
225	93%	56%	81%
275	100%	51%	76%
325	100%	48%	72%
400	85%	44%	67%
475	70%	42%	63%
550	62%	41%	58%
650	54%	40%	54%
742	47%	41%	50%
900	36%	42%	46%
1,100	26%	45%	43%
1,300	9%	47%	45%
1,500	6%	54%	47%
1,750	3%	60%	51%
2,000	3%	65%	57%
2,284	4%	70%	64%
2,600	5%	79%	71%
2,950	6%	90%	77%
3,300	6%	97%	84%
3,800	6%	100%	93%
4,400	7%	97%	100%
5,000	7%	92%	100%
5,710	7%	87%	96%

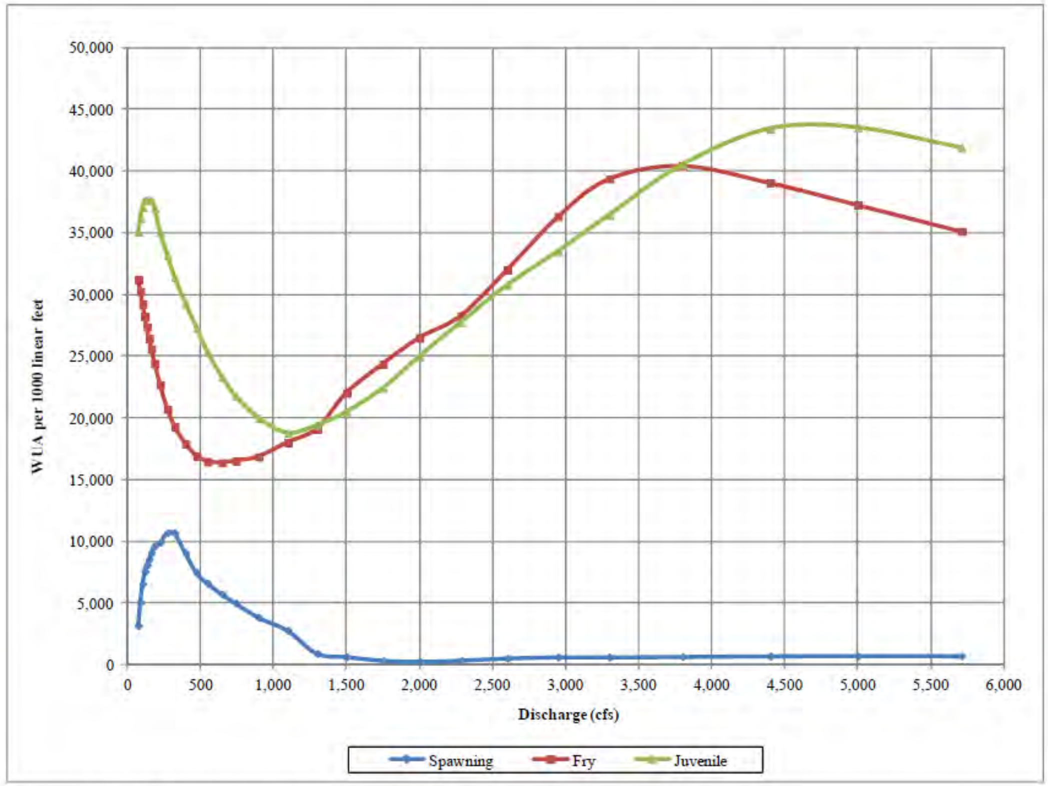


Figure 3.3-2. WUA for Chinook salmon in Sub-reach 1.

Source: Merced Irrigation District (2013)

Weighted Usable Area: Steelhead

Table 3.3-5. Values with conditional formatting from 80 to 100 percent of the maximum WUA. Bimodal curves have the lower peak highlighted in blue, and the upper peak highlighted in green for Sub-reach 1.

	Steelhead			
Discharge (cfs)	Spawning (% of Max)	Fry (% of Max)	Juvenile (% of Max)	Adult (% of Max)
75	31%	74%	79%	39%
90	37%	71%	82%	46%
105	44%	68%	84%	53%
120	49%	66%	85%	59%
135	51%	64%	85%	64%
150	56%	62%	86%	68%
165	60%	60%	86%	73%
188	66%	57%	86%	79%
225	72%	53%	85%	87%
275	83%	48%	82%	95%
325	89%	45%	79%	99%
400	94%	42%	74%	100%
475	97%	41%	70%	98%
550	99%	42%	66%	94%
650	100%	42%	61%	88%
742	100%	42%	58%	81%
900	98%	45%	54%	71%
1,100	92%	47%	51%	60%
1,300	78%	55%	50%	54%
1,500	69%	61%	50%	51%
1,750	60%	68%	54%	49%
2,000	54%	72%	57%	48%
2,284	50%	82%	62%	50%
2,600	47%	90%	68%	53%
2,950	47%	96%	75%	57%
3,300	47%	100%	84%	63%
3,800	48%	97%	92%	70%
4,400	49%	91%	98%	78%
5,000	50%	84%	99%	84%
5,710	51%	79%	100%	91%

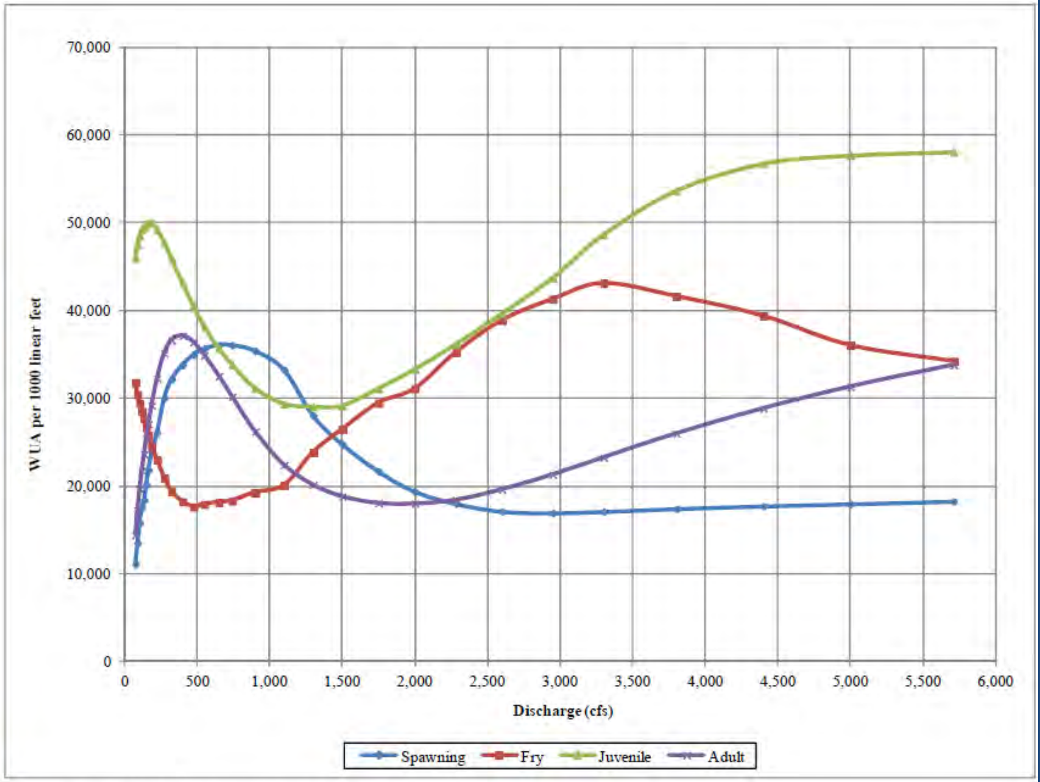


Figure 3.3-1. WUA for steelhead in Sub-reach 1.

Source: Merced Irrigation District (2013)

Weighted Usable Area: Hardhead and Splittail

Table 3.3-9. Values with conditional formatting from 80 to 100 percent of the maximum WUA. Bimodal curves have the lower peak highlighted in blue, and the upper peak highlighted in green for Sub-reach 1.

Hardhead and Splittail				
Discharge (cfs)	Hardhead Juvenile (% of Max)	Hardhead Adult (% of Max)	Splittail Juvenile (% of Max)	Splittail Adult Spawning (% of Max)
75	79%	60%	91%	10%
90	79%	62%	91%	12%
105	80%	65%	91%	13%
120	79%	67%	90%	15%
135	79%	68%	89%	16%
150	78%	69%	88%	17%
165	78%	71%	86%	18%
188	76%	72%	84%	20%
225	74%	73%	80%	22%
275	69%	74%	76%	25%
325	63%	73%	72%	27%
400	59%	70%	68%	29%
475	55%	67%	64%	32%
550	52%	64%	60%	33%
650	48%	60%	57%	35%
742	47%	56%	54%	37%
900	45%	53%	52%	39%
1,100	44%	47%	52%	42%
1,300	43%	43%	52%	45%
1,500	47%	42%	56%	49%
1,750	52%	43%	60%	54%
2,000	55%	45%	64%	59%
2,284	59%	48%	68%	63%
2,600	66%	54%	77%	69%
2,950	76%	62%	87%	75%
3,300	86%	70%	95%	81%
3,800	93%	78%	100%	89%
4,400	97%	86%	100%	94%
5,000	98%	93%	99%	97%
5,710	100%	100%	98%	100%

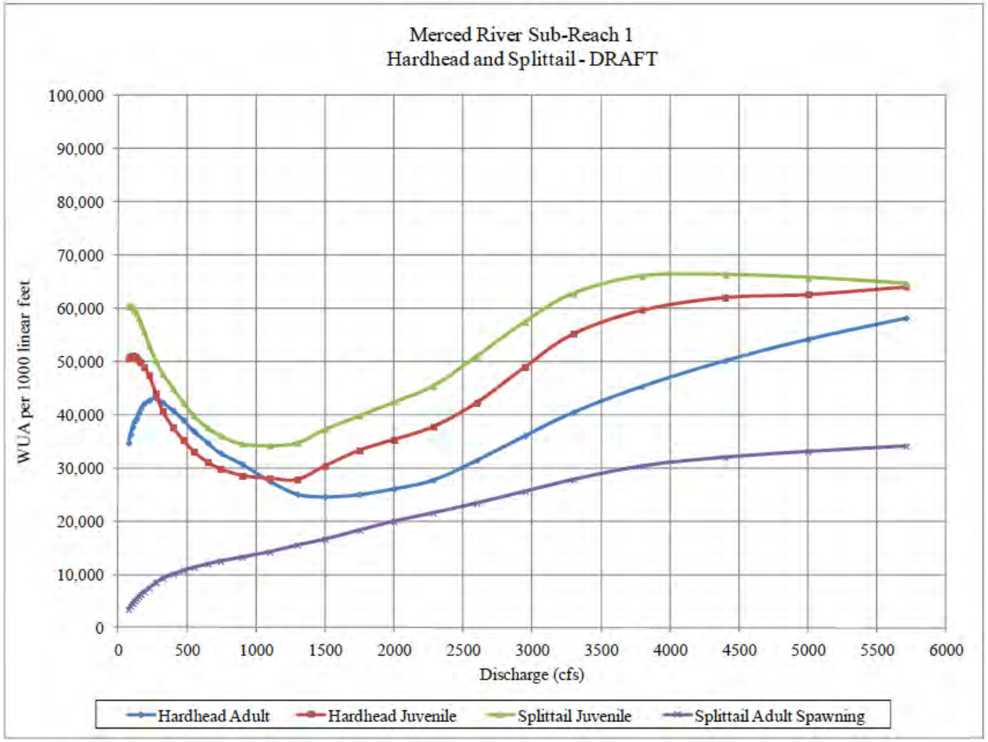


Figure 3.3-3. WUA for hardhead and Sacramento splittail in Sub-reach 1.

Source: Merced Irrigation District (2013)

Notes on WUA Curves Previous 3 Slides

- Bimodal: one peak in-channel, one floodplain
- Steelhead adult life stage does not have salmon equivalent (salmon adults in ocean)
- High juvenile habitat values at very low flows driven by velocity
- Very few splittail in Merced River; 2011 high flows last instance of high SJ Valley abundance
- Hardhead is not a target management species in the Merced River for any entity

Positive Notes on Merced Study

- On its own terms, the study was generally well-executed
  - Large number of transects in three reaches
  - Included very high flows; captured floodplain as well as in-channel values
  - Floodplain and high flow depth measured in the dry; velocity values calculated, not measured
  - Included “effective” habitat; excluded otherwise usable habitat if water temperature unsuitable

Ways Licensees "Game the WUA" (Examples; Not all Done in this Study)

- Include and then manage for species that prefer lower flows (in this case, hardhead; often, foothill yellow-legged frogs (FYLF))
- Manage for species that prefer warm water
- Manage for life stages that prefer low flows
  - Example: on the Tuolumne, propose low flows for juvenile steelhead in June despite water temps
- Use results of PHABSIM to oppose flow setting methods that would require higher flows

Ways Entities Support Gaming the WUA

- Selectively cite to, or conduct, studies that highlight the benefits of lower flows
  - Example: PG&E and Placer County Water Agency study that correlated high summer water temps in dry years with strong populations of FYLF
- Defer to agencies that emphasize species that arguably prefer lower flows
- Hire experts to write comments or supporting papers that defend the low-flow choice
- Produce “technical memos” that use WUA and other information to argue for low flows

Wrap-Up

- FERC licensing offers a date-certain opportunity to re-evaluate flows in rivers and streams affected by hydropower operations
- There are limitations on what FERC considers, and written and unwritten rules of evaluation
- Advocates for flow improvements must:
  - Understand the rules and FERC's culture
  - Unpack and expose licensee biases
  - Develop evidence and argument to propose and defend superior alternatives

In the End, It's a Negotiation (at a Table, in EIR/EIS, in a Courtroom)

- There are almost always site-specific factors
- So, know your watershed! Ops model helps!!
- Different entities use flow setting methods to support outcomes that meet their interests
- Methodologies provide quantification
- There are no silver bullets
- The negotiation is as much art, law, politics, and economics as it is science

Thank you!

Merced River at 5000 cfs April 2017. Photo: C. Shutes

CShutes@
calsport.org

The Nature Conservancy

Lessons learned on Instream Flow Dedications (CWC § 1707)

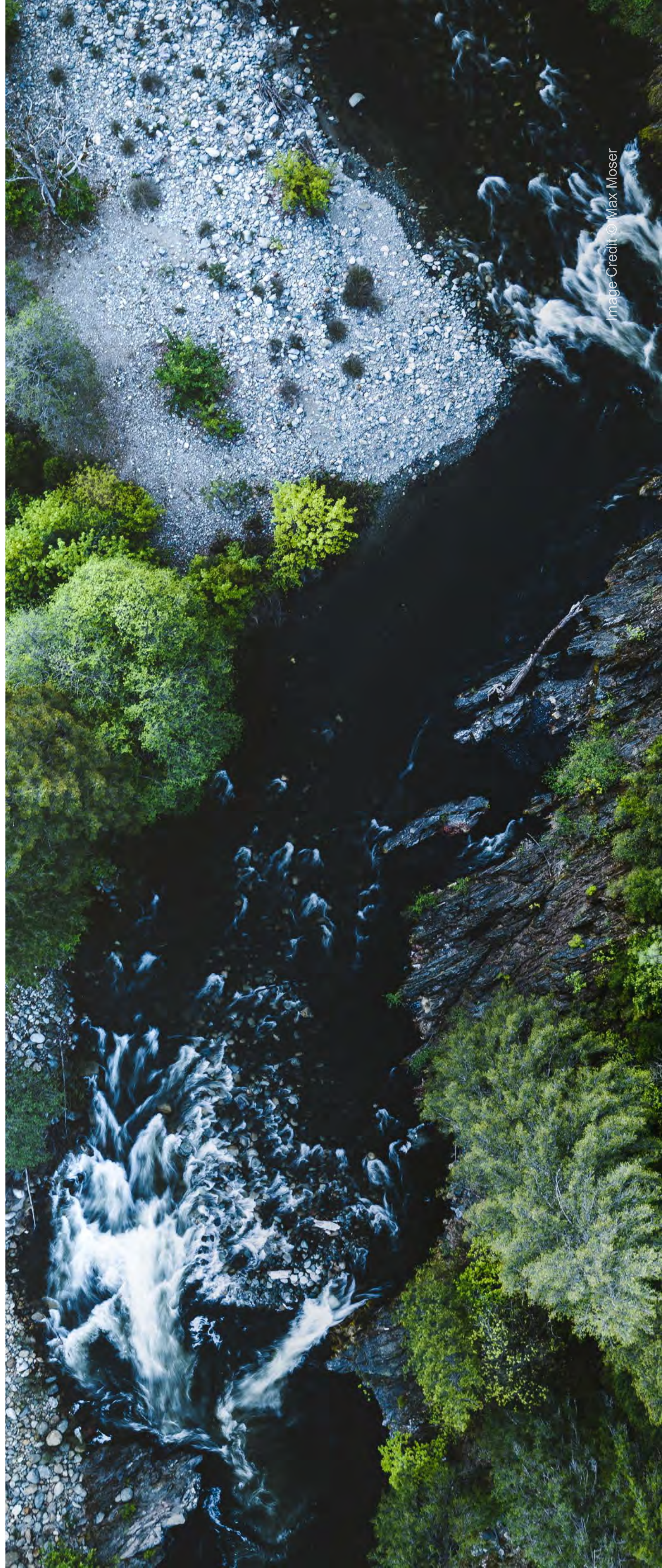
Salmonid Restoration Federation Conference 2026

APRIL 28, 2026 AMY CAMPBELL

Lessons learned on streamflow dedications (1707's)

What we'll cover today…

- Brief recap on 1707s
- Types of 1707's
- Key questions to ask before you start
- Lessons learned



HOW WELL WERE YOU CAFFEINATED THIS MORNING?

What are 1707s?

- Adds fish and wildlife as a beneficial use to a water right.
- Protects against forfeiture.
- No injury
- Water right is owned by water right holder (California is unique)

Exclusive vs Permissive § 1707

Exclusive:

Adds fish and wildlife as a beneficial use and takes all other beneficial uses away from the water right

Permissive:

Adds fish and wildlife as a beneficial use *in addition* to other beneficial uses (agriculture, hydro, stockwater, domestic)

Key questions before you start…

What type of water right are you working with: riparian, pre-1914, etc.?

What are the conservation values you are trying to achieve?

How far downstream do you want this water right to be protected and where are their other water right holders?

Permissive or exclusive dedication?

What "harm" that could occur to other water users by leaving this water right instream?

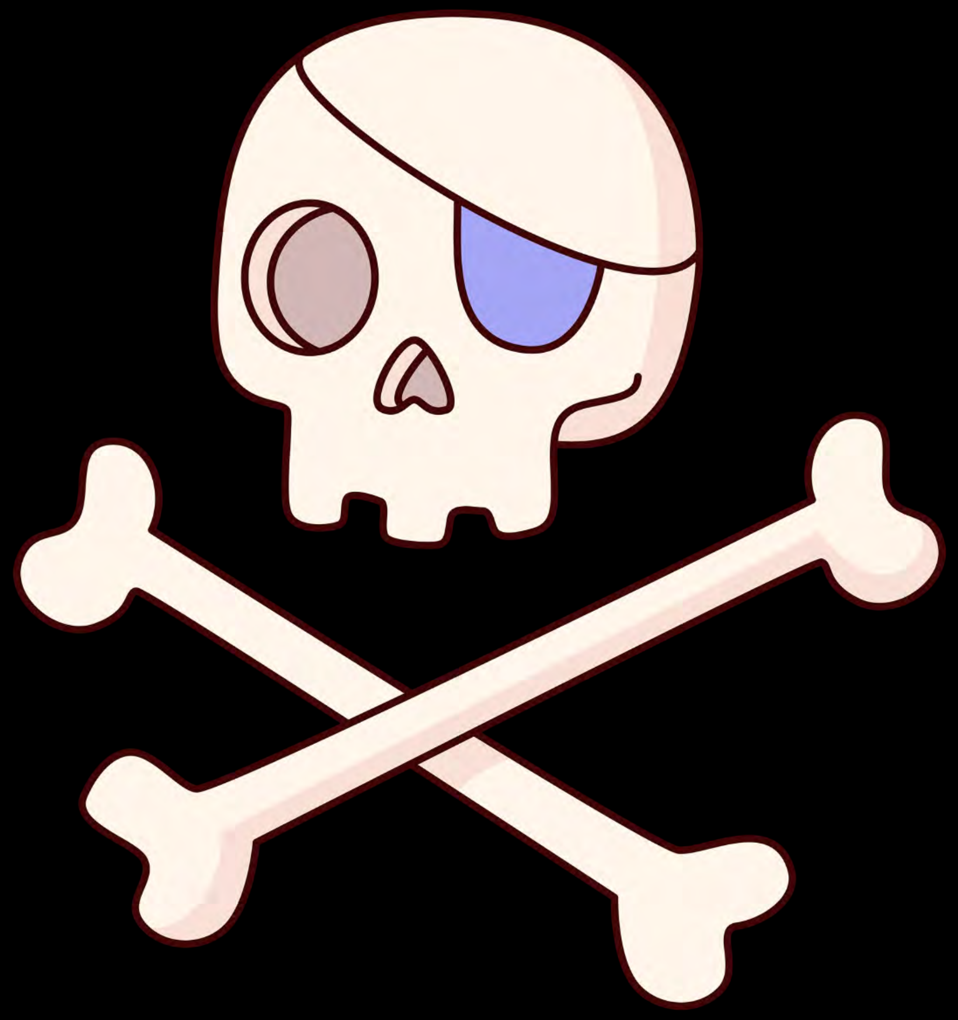
Lessons Learned

1. Be aware of the underlying water rights.
2. I.D. the best tool for what you are trying to accomplish.
3. Start with early conversations.
4. Ensure longevity.

Special thanks to:

Matt Clifford and Lauren Bernadett (Trout Unlimited)
Chris Alford (Alford Environmental)
Ada Fowler (California Trout)
Leah Easley (Scott and Shasta Valley Watermaster)
Jennifer Carah (TNC)
Water right holders

Lesson 1:
Be aware of the complex nature of underlying rights!



- Do no harm. Have honest and transparent conversations about potential risks.
- Do your due diligence before making commitments.
- Assume errors in water right reporting.
- Be careful about unintentional exposure to other regulatory processes (ie 1602)
- Ensure a project will result in real-water instream (aka “wet water).

Leson 1: Be aware of the complex nature of underlying rights!

Case Study

Lesson 2: What's the best tool for achieving your goal?

It might not be a 1707.

What are you trying accomplish and what is the best tool be to achieve your goal?

- Physical tool: Start with improving efficiency and reducing water demand and then explore legal mechanisms.

OR, maybe it's a

- Legal tools: What is the appropriate legal mechanism needed to achieve your objective?

Lesson 2: What's the best tool to use for achieving your goal?

Case Study

Lesson 3: Begin early conversations.

State Water Board and Local Watermaster

- Before petition submittal, ideally during the water rights due diligence stage.
- Helps with identifying issues/problems early on- potential injury cases,
- Helps with I.D. inaccuracies with the water right.
- Helps think through your approach- downstream place of use.

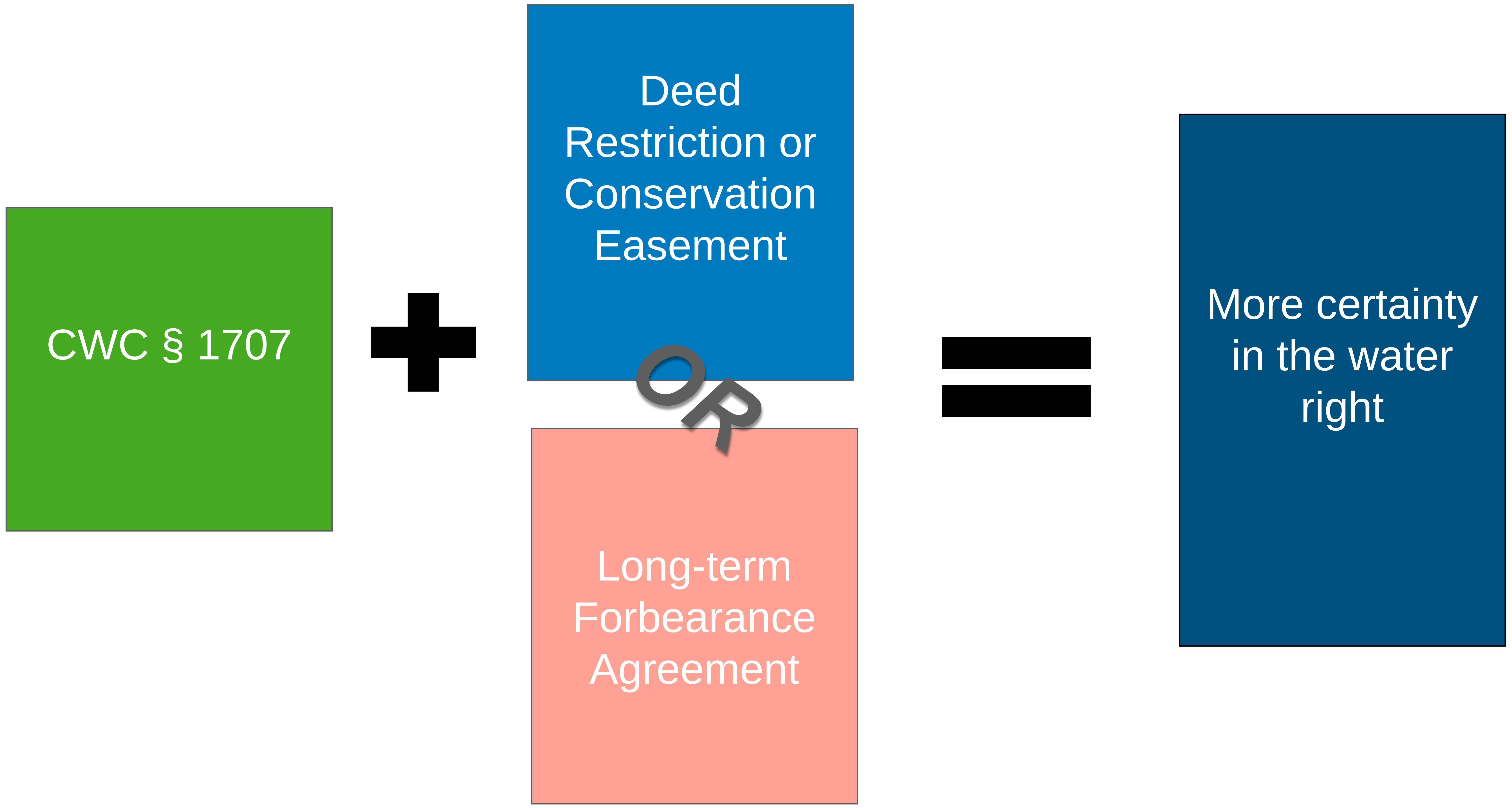
California Department of Fish and Wildlife

- Region water rights and local staff contacts.
- Issue spotting- before too much investment has occurred.
- Connect your DFW partner with someone else with DFW with experience with 1707's.

Community outreach- neighbors, local government, etc.

- Great way to identify potential concerns that may result in a protest.
- One-on-one meetings- most effective.
- Encourage your landowner to engage directly with the community.

Lesson 4: Ensure longevity

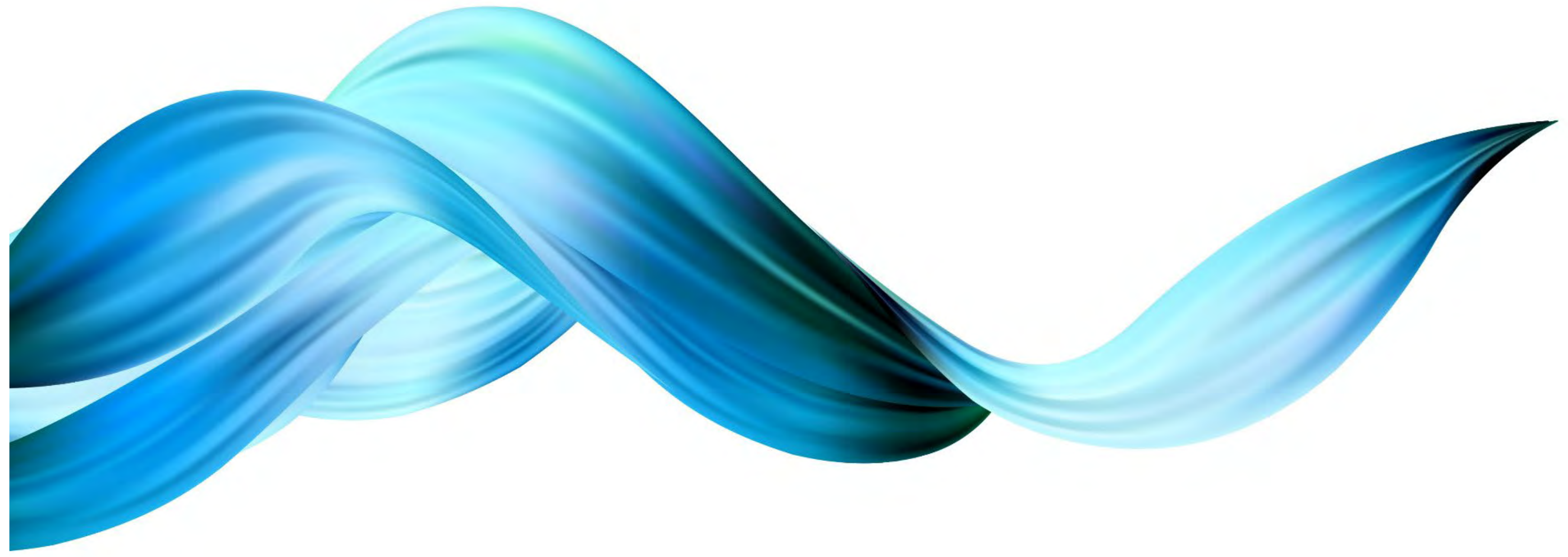


Lesson 4: Ensure longevity

Gaging and Monitoring

In cases where the 1707 dedication flows past downstream other water right users, think through **how you are going to track and monitor this water**.

Ensure a long-term commitment **to funding and maintaining gages** and capacity to track water.



Lesson 4: Ensure longevity

Case Study

Lessons Learned

1. Be aware of the underlying water rights.
2. I.D. the best tool for what you are trying to accomplish.
3. Start with early conversations.
4. Ensure longevity.

Resources

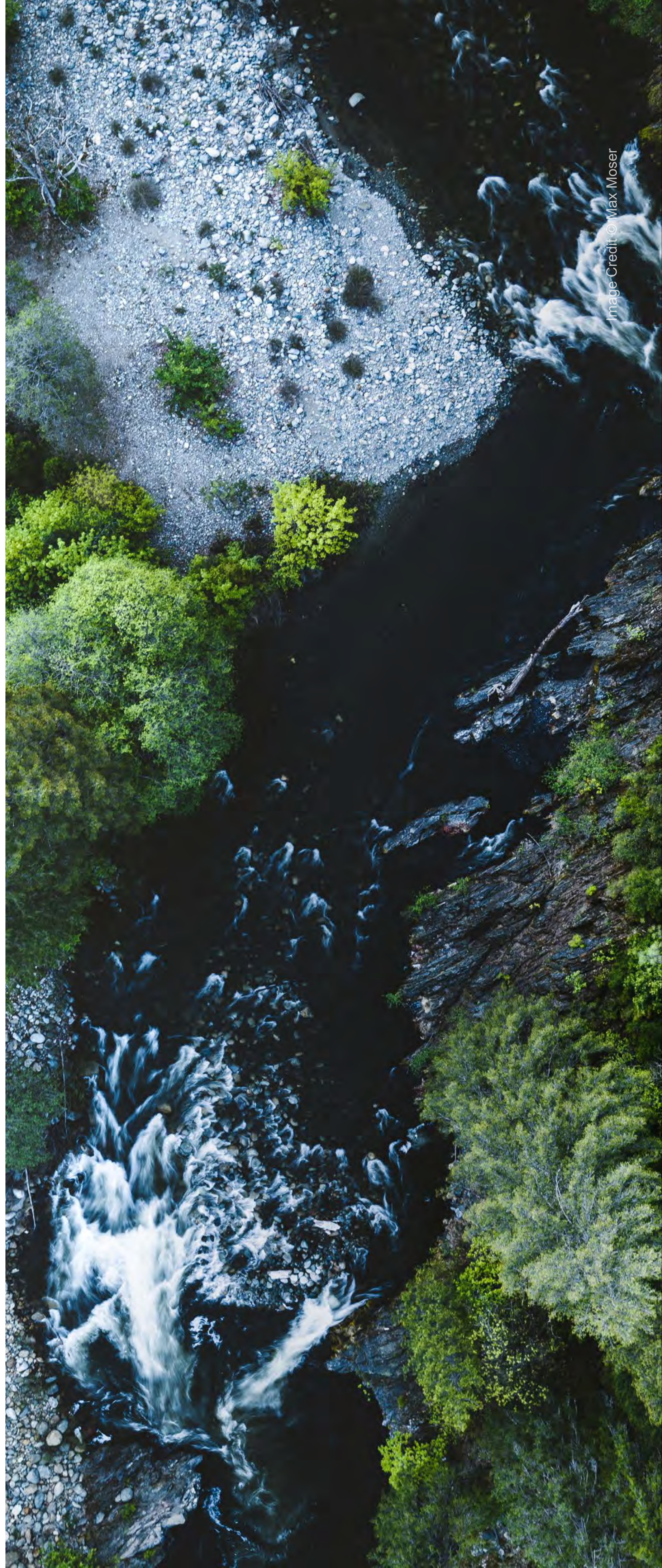
Salmon and Steelhead Coalition:

calsalmonandsteelhead.org/resources

- A Practitioners Guide to Instream Flow Transfers in California
- A guide to California Water Rights for Small Water Users
- VIDEO: Farms, Fish and Flow – animated short

California Environmental Water Network-

cah20network.org

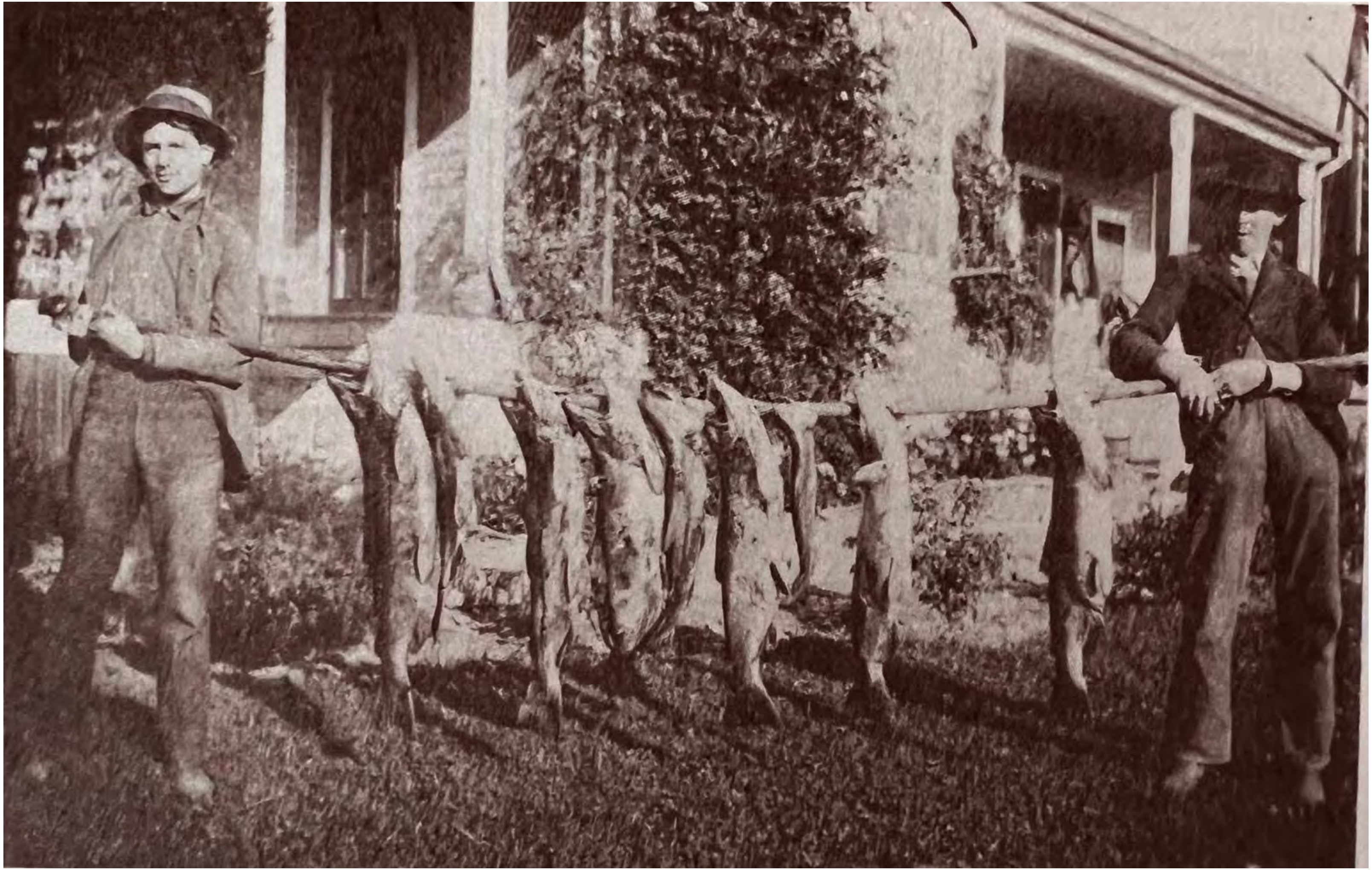


The Nature Conservancy

Amy Campbell
acampbell@tnc.org

The Devil is in the Details- Avoiding Unintended Consequences While Developing Flow Restoration Projects

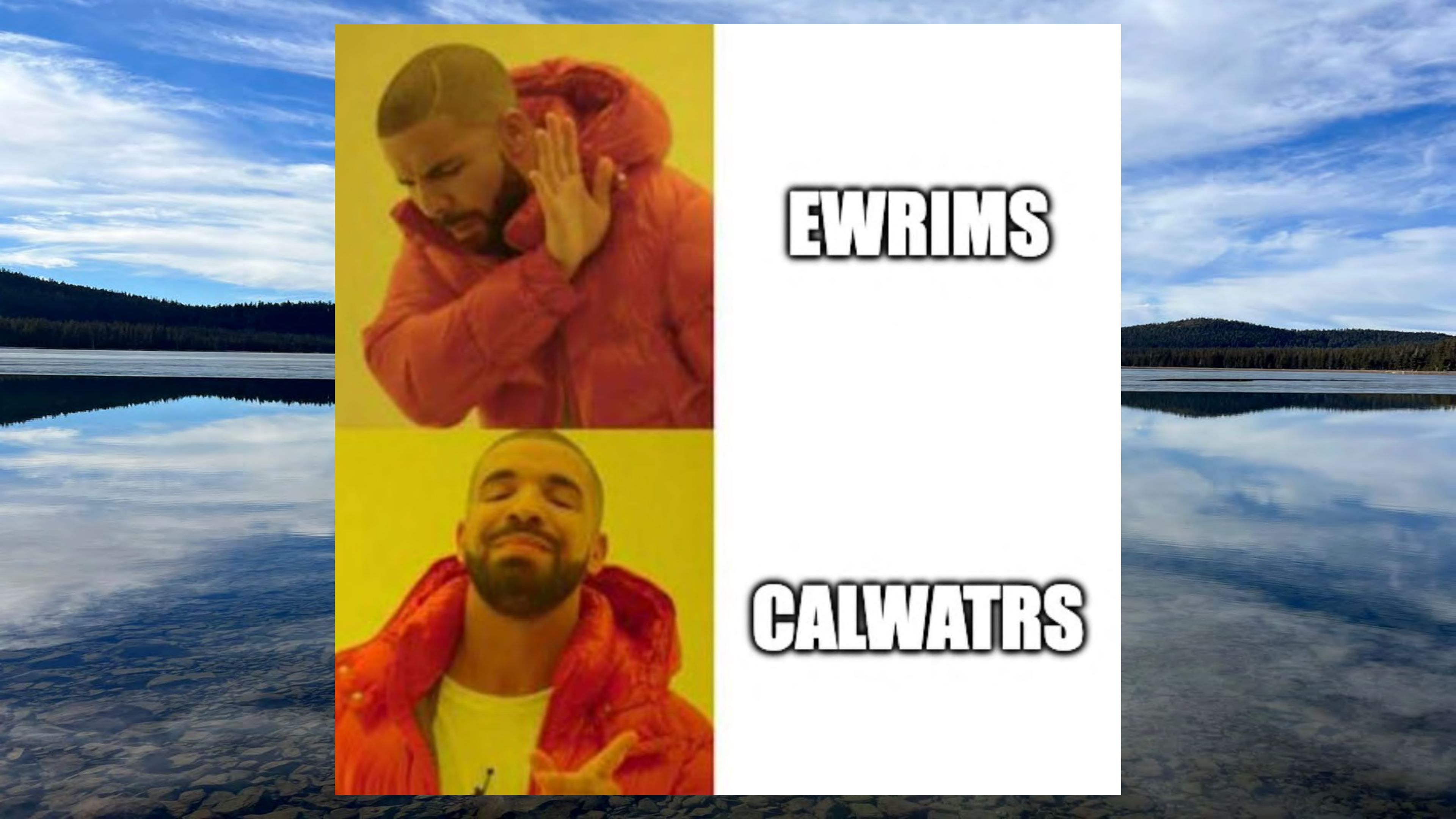
Nick Joslin
Mount Shasta Bioregional Ecology Center



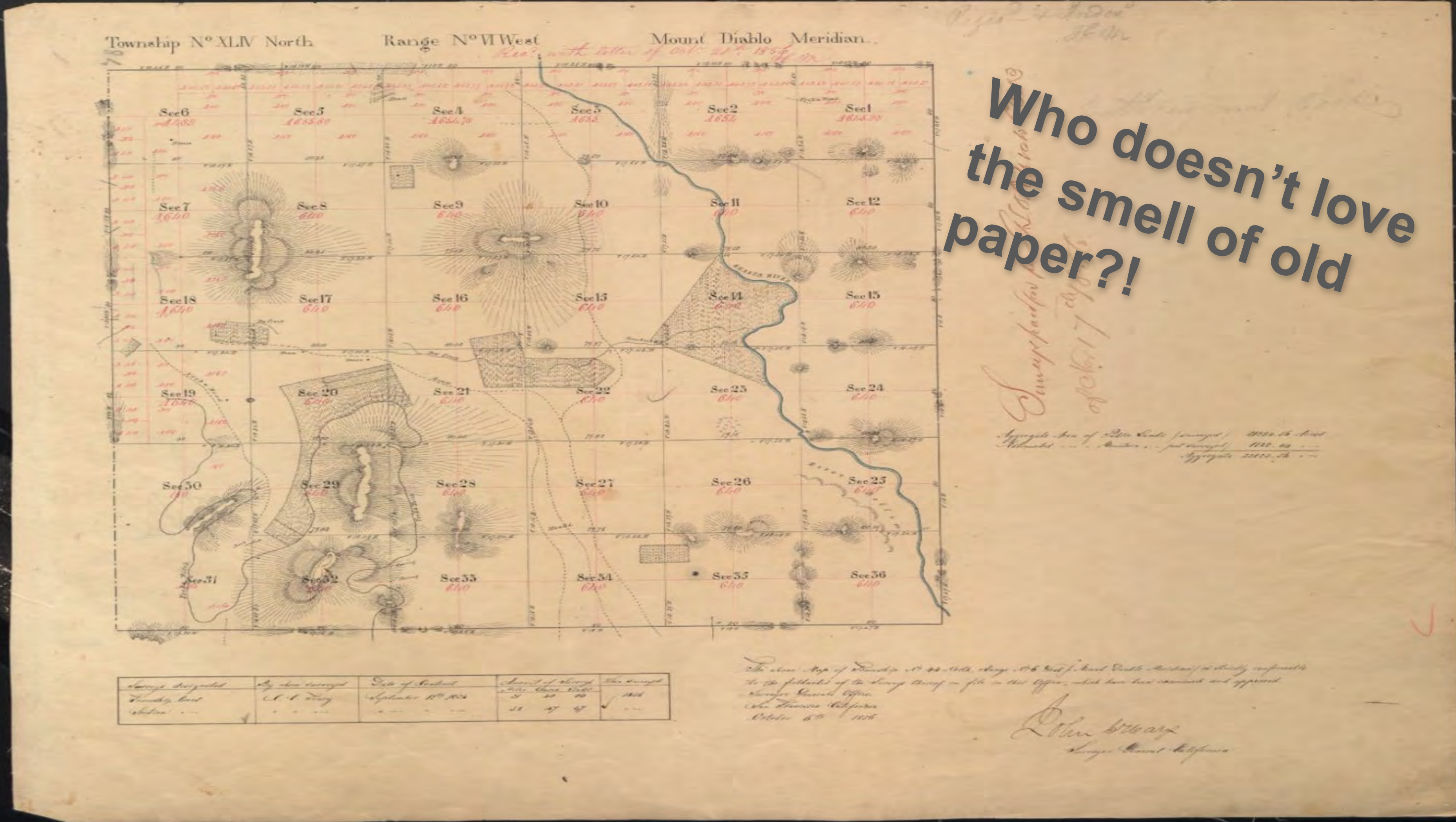
Riparian vs Appropriative

- Riparain rights won’t be in a decree and will difficult to research.
- Can’t be curtailed
- Only limited by what is reasonable use
- Reports can be found on CalWATRS

- Appropriative rights will be include in decrees of adjudicated watersheds.
- Can be curtailed
- Assigned a volumetric value
- Reports can be found on CalWATRS


EWRIMS
CALWATRS

Who doesn't love the smell of old paper?!



Inflated Baseline Syndrome

- One of the most common follies in evaluating the need and the value of water in project development is relying on water use statements from diversters.
- The concept of "use it or lose it" in water rights system leads diverters to report they have *always* used their entire paper right so they don't "lose" it.
- Overstating water use makes it very easy to look like a reduction in water use has been made by changing nothing except the entries in the water use reporting system.

Acreage + crop type + evapotranspiration + number of crop rotations
\+ other factors
Can give you a much better understanding of crop demands and thus true irrigation needs

Direct Diversion Infrastructure Upgrades

Goals: don't oversize infrastructure and don't alter diversion seasonality

Ditch Lining

Pipelines

Tractor farmed hemp, irrigated with drip lines under plastic mulch

Wasabi grown directly in nutrient-rich spring water

What to do with leftover water?

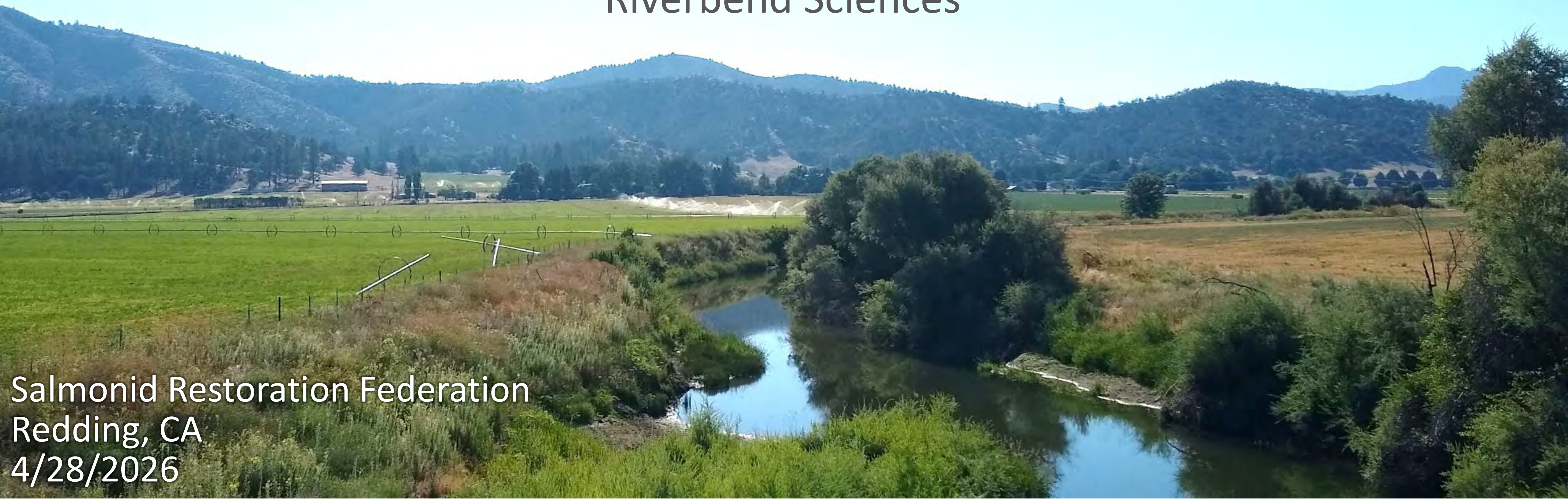
Try to avoid playing Santa Clause!

Questions?

Mount Shasta Bioregional Ecology Center

Don't rob Peter to pay Paul–
To improve river flows, irrigation improvement projects should reduce consumptive water use and avoid reducing groundwater recharge

Eli Asarian
Riverbend Sciences



Salmonid Restoration Federation
Redding, CA
4/28/2026

Fairy tales aren't real

But ET is!

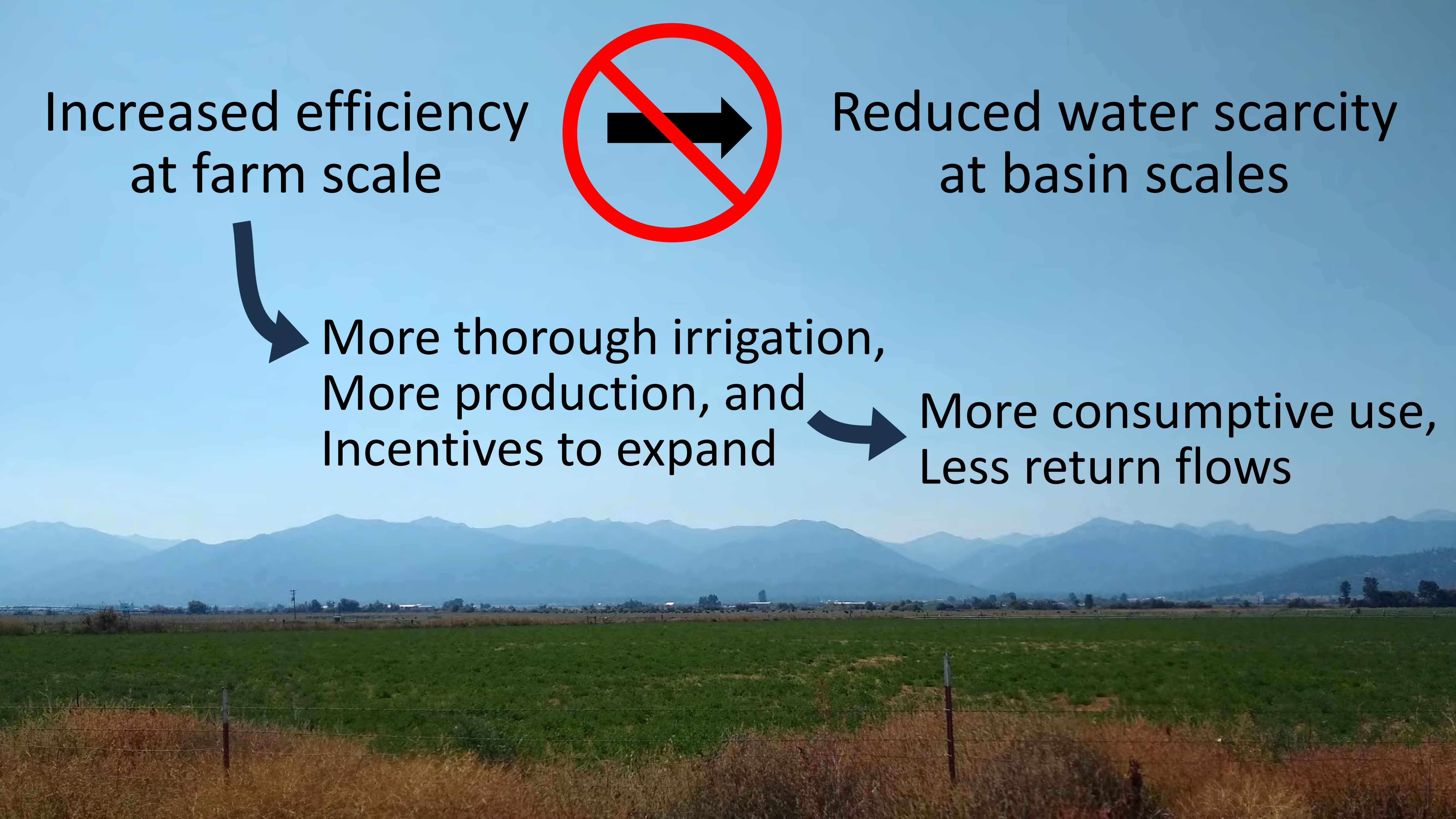
Does irrigation efficiency improve river flows?

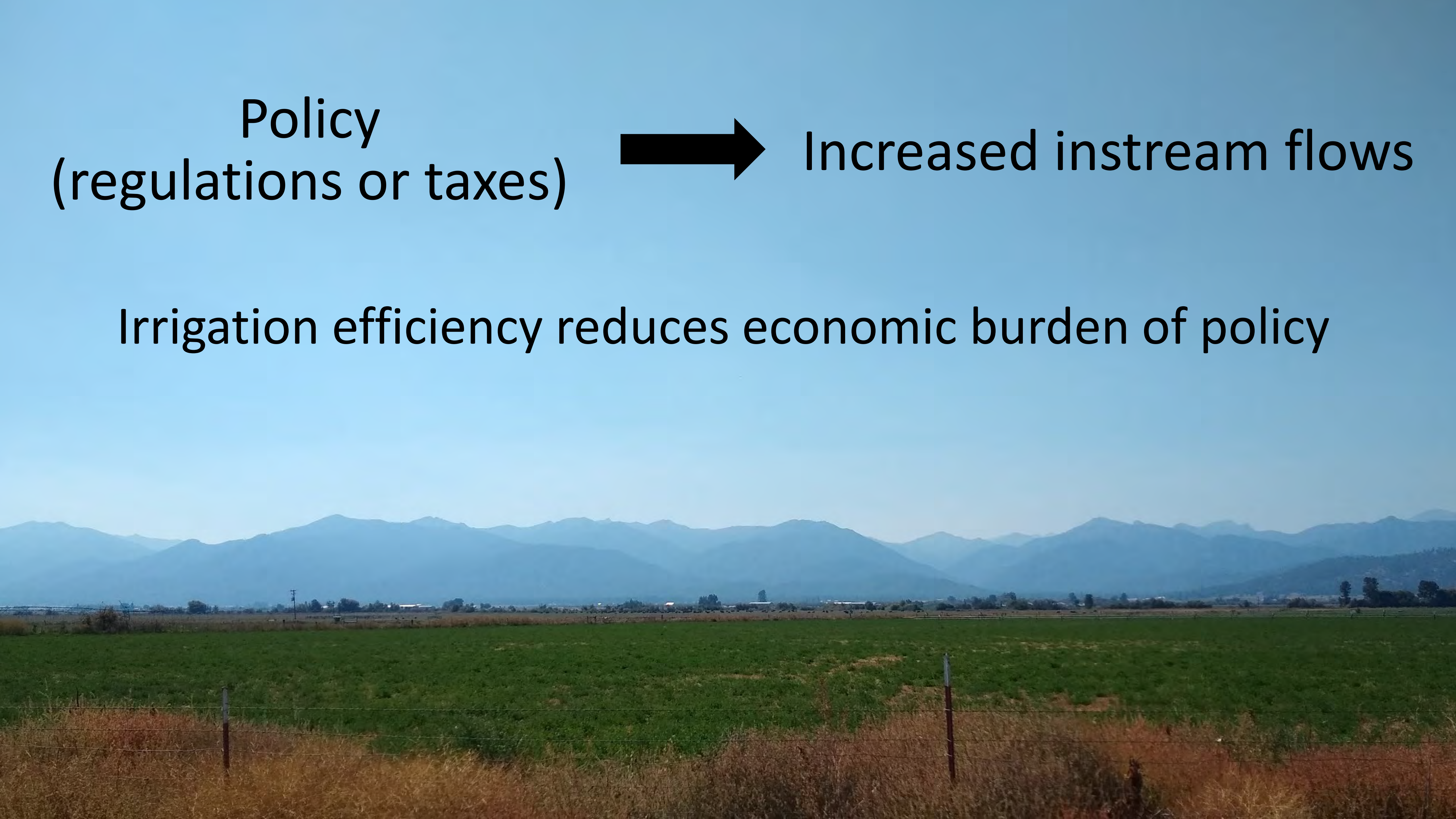
WATER

The paradox of irrigation efficiency

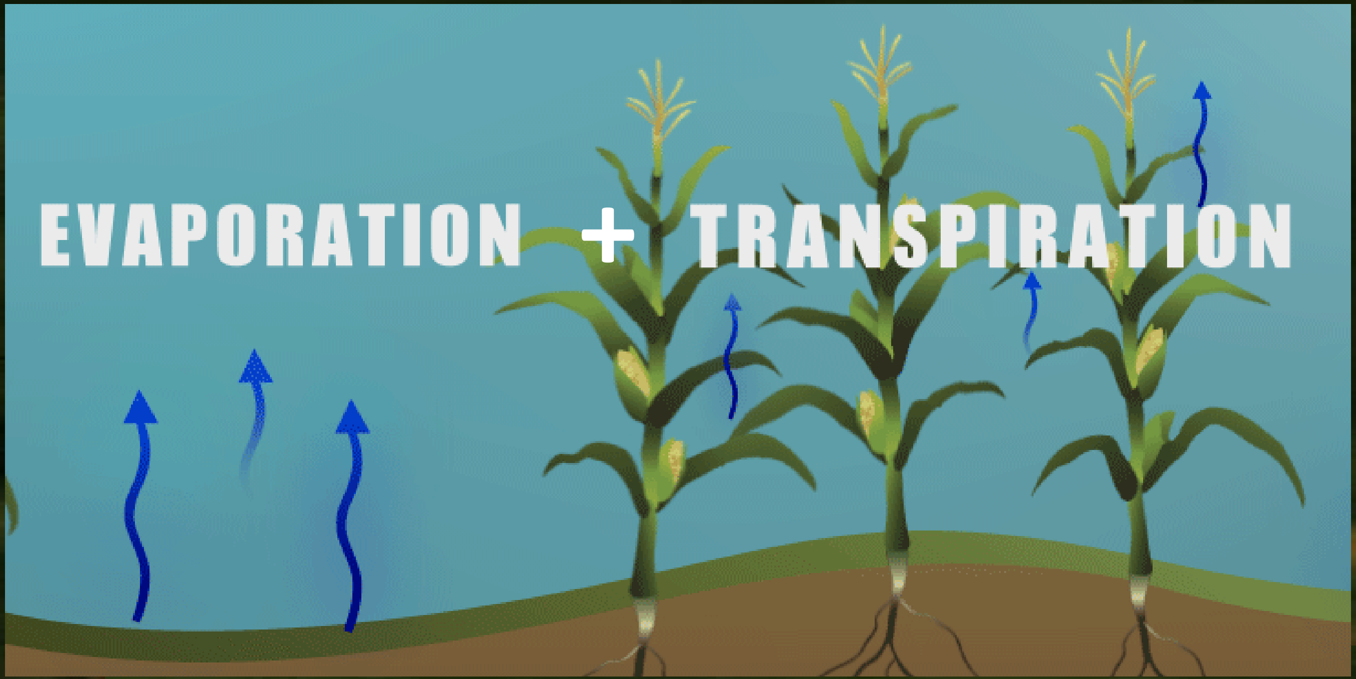
Higher efficiency rarely reduces water consumption

By **R. Q. Grafton[1,2], J. Williams[1], C. J. Perry[3], F. Molle[4], C. Ringler[5], P. Steduto[6], B. Udall[7], S. A. Wheeler[8], Y. Wang[9], D. Garrick[10], R. G. Allen[11]**


Increased efficiency at farm scale
Reduced water scarcity at basin scales
More thorough irrigation, More production, and Incentives to expand
More consumptive use, Less return flows


Policy
(regulations or taxes)
Increased instream flows
Irrigation efficiency reduces economic burden of policy

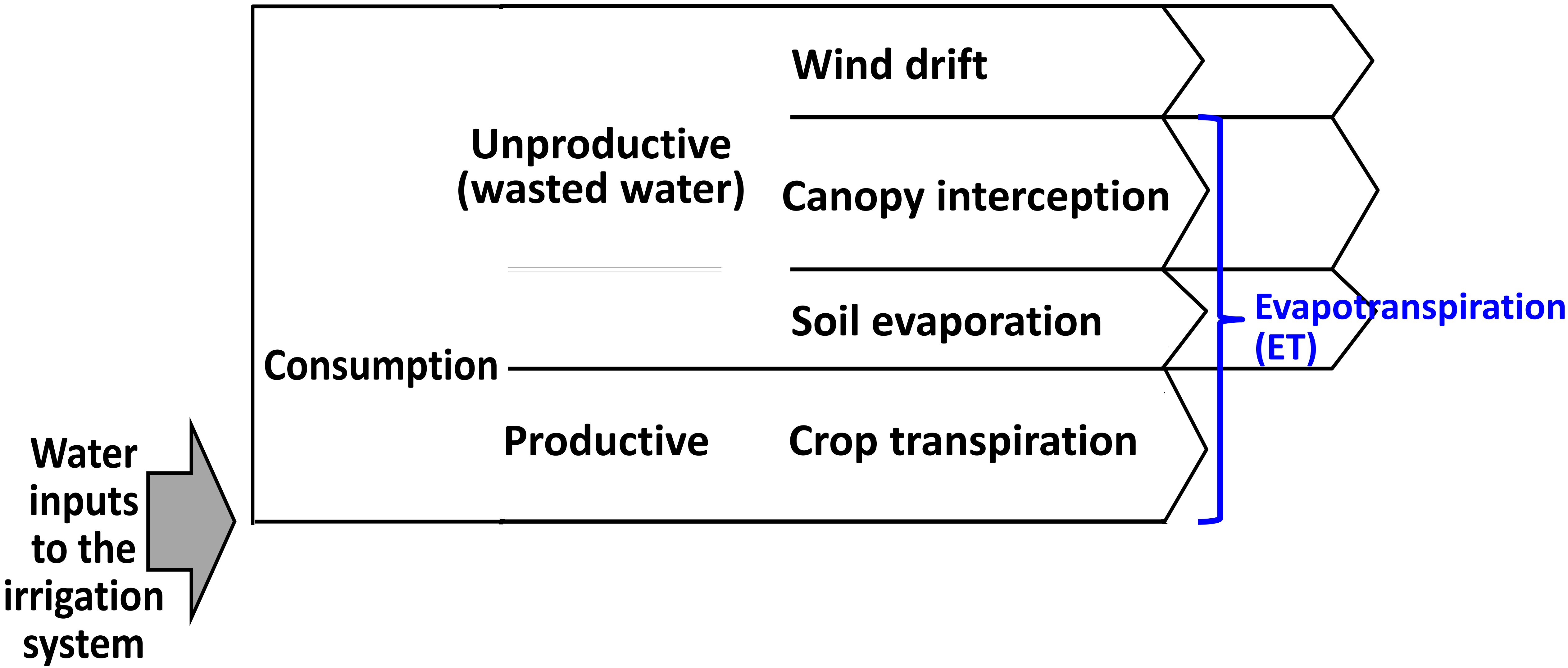
What is ET?
Evapotranspiration

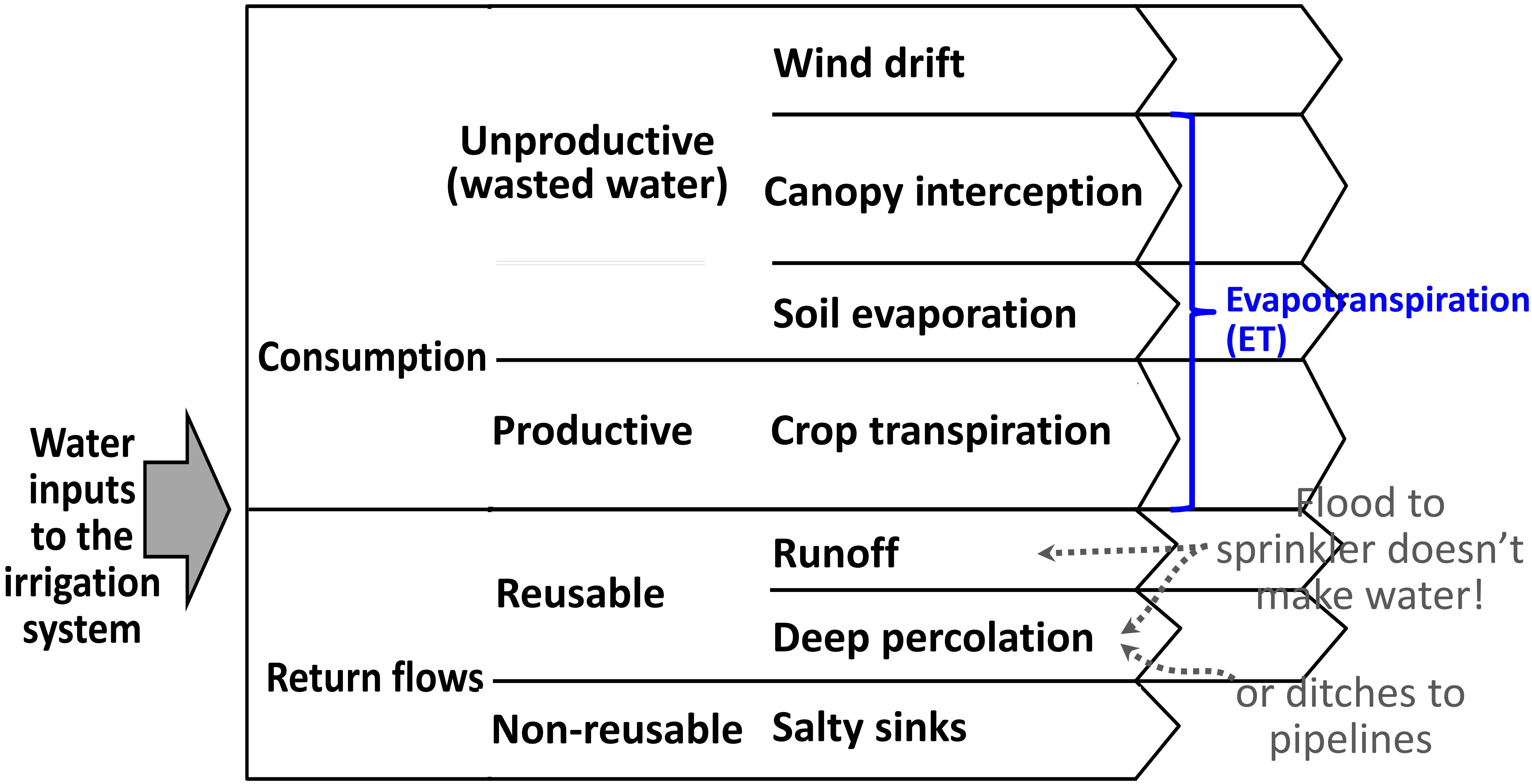


At long time scales (multi-year):

Streamflow = Precipitation - Evapotranspiration

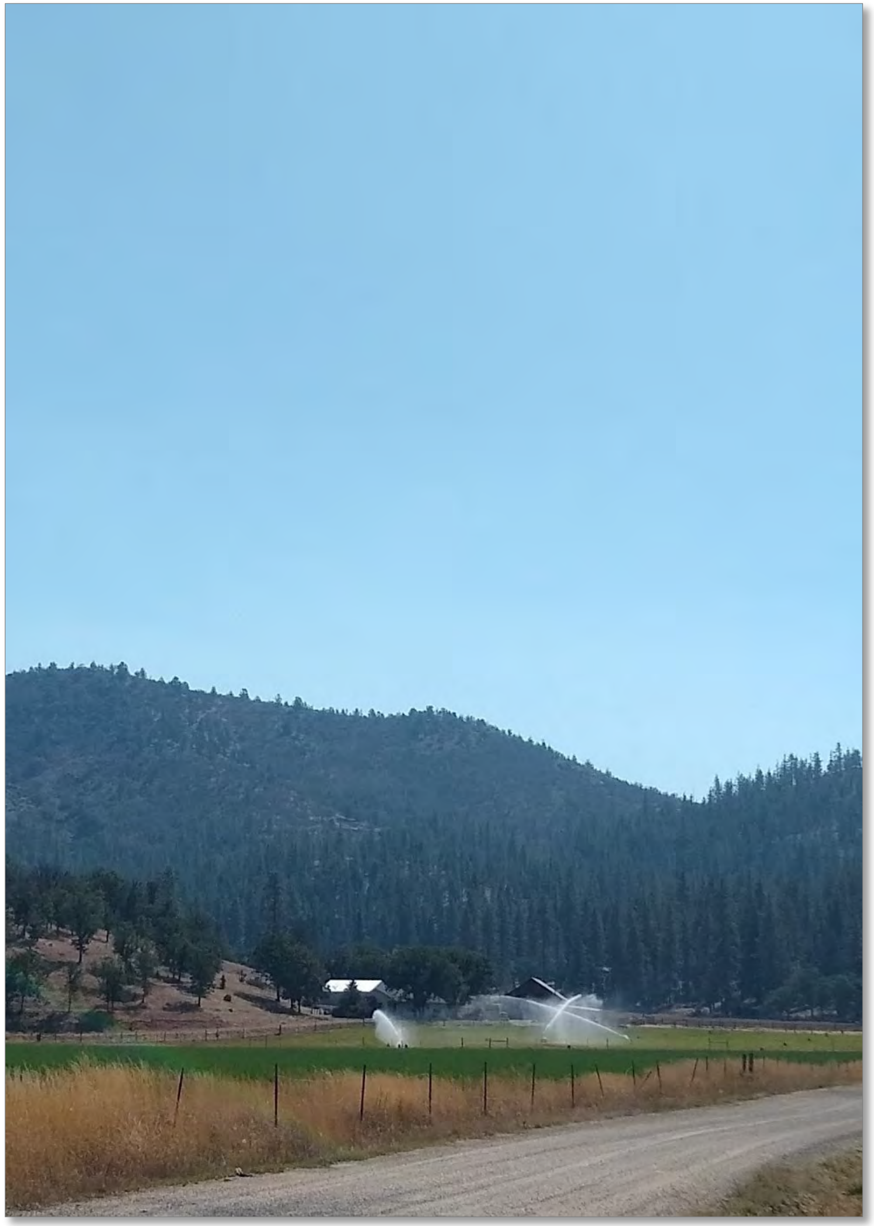
At shorter time scales:
- Water storage in soil, aquifer, lakes/reservoirs
- Time lags


Wind drift
Unproductive
(wasted water)
Canopy interception
Soil evaporation
Evapotranspiration
(ET)
Consumption
Productive
Crop transpiration
Water
inputs
to the
irrigation
system


Water inputs to the irrigation system
Consumption
Unproductive (wasted water)
Productive
Wind drift
Canopy interception
Soil evaporation
Crop transpiration
Evapotranspiration (ET)
Return flows
Reusable
Non-reusable
Runoff
Deep percolation
Salty sinks
Flood to sprinkler doesn't make water!
or ditches to pipelines

Reducing unproductive consumptive use

- Primary method
  - Upgrading irrigation infrastructure
- Other methods
  - Crop management, soil management, mulching, and micro-climate regulation
- Jovanovich et al. (2023):
  - Water savings usually<20%, but large volumes of water at basin scales



Move sprinklers as close to the ground as possible

Decrease pressure

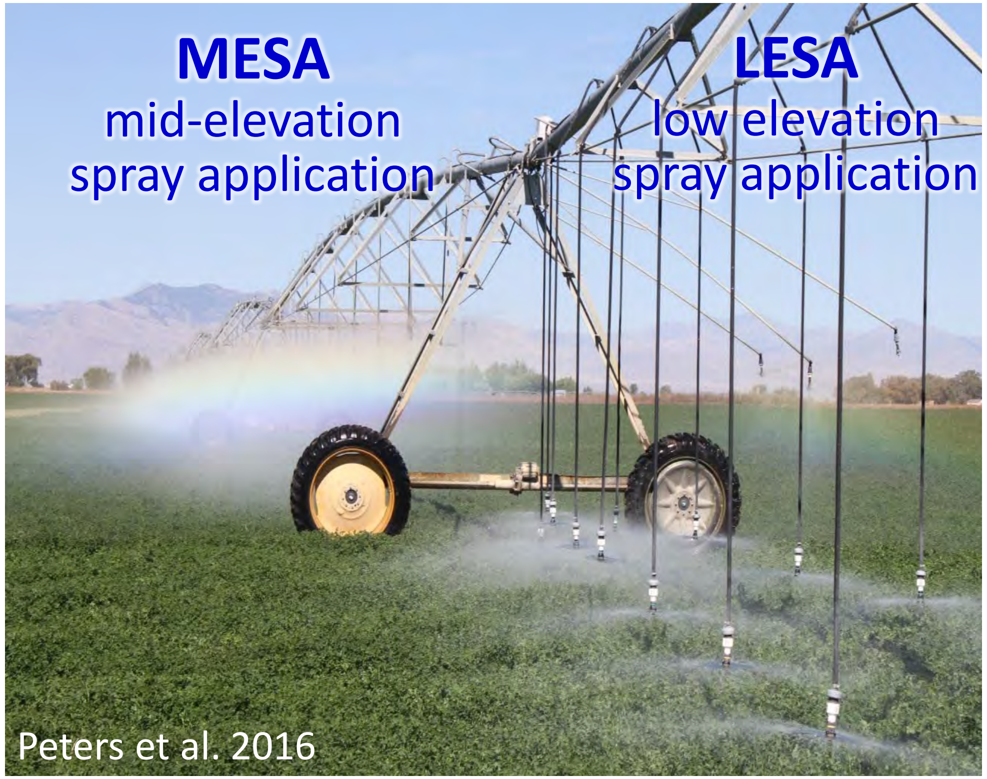
Increase nozzle sizes

Large droplets, but don't compromise water distribution uniformity and runoff

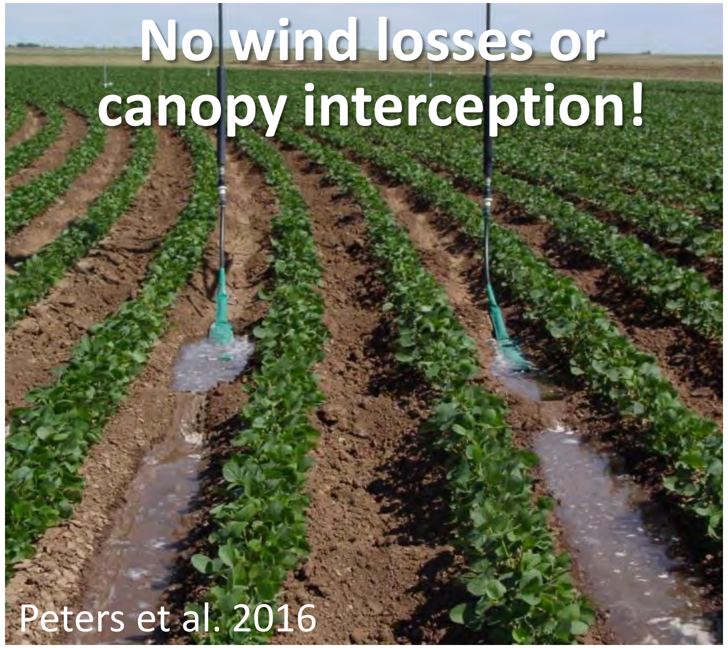
~5-20%?

More consumptive use → **Less consumptive use**

High-pressure impact sprinkler
(wheel line or big gun)



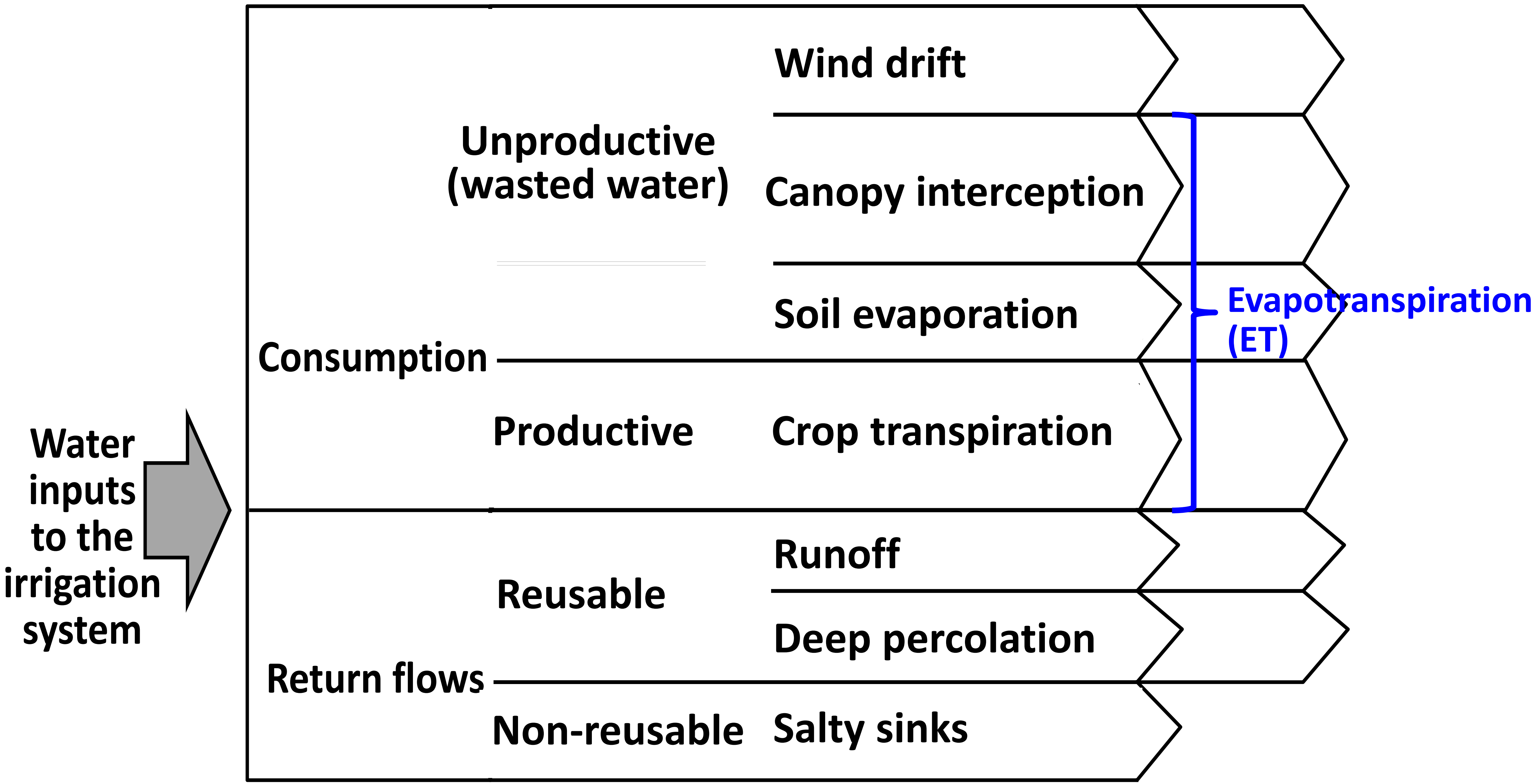
LEPA
Low energy precision application



Surface flood furrow

Surface drip

Sub-surface drip

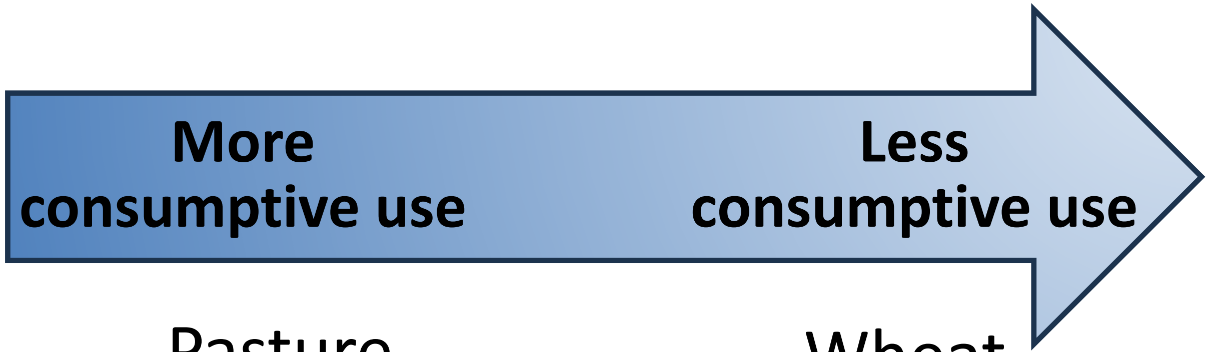

Water inputs to the irrigation system
Consumption
Unproductive (wasted water)
Wind drift
Canopy interception
Soil evaporation
Productive
Crop transpiration
Evapotranspiration (ET)
Return flows
Reusable
Runoff
Deep percolation
Non-reusable
Salty sinks

Reducing crop transpiration

1) Deficit irrigation

Reduces yields on most crops
(except some trees and vines)

2) Crop switching



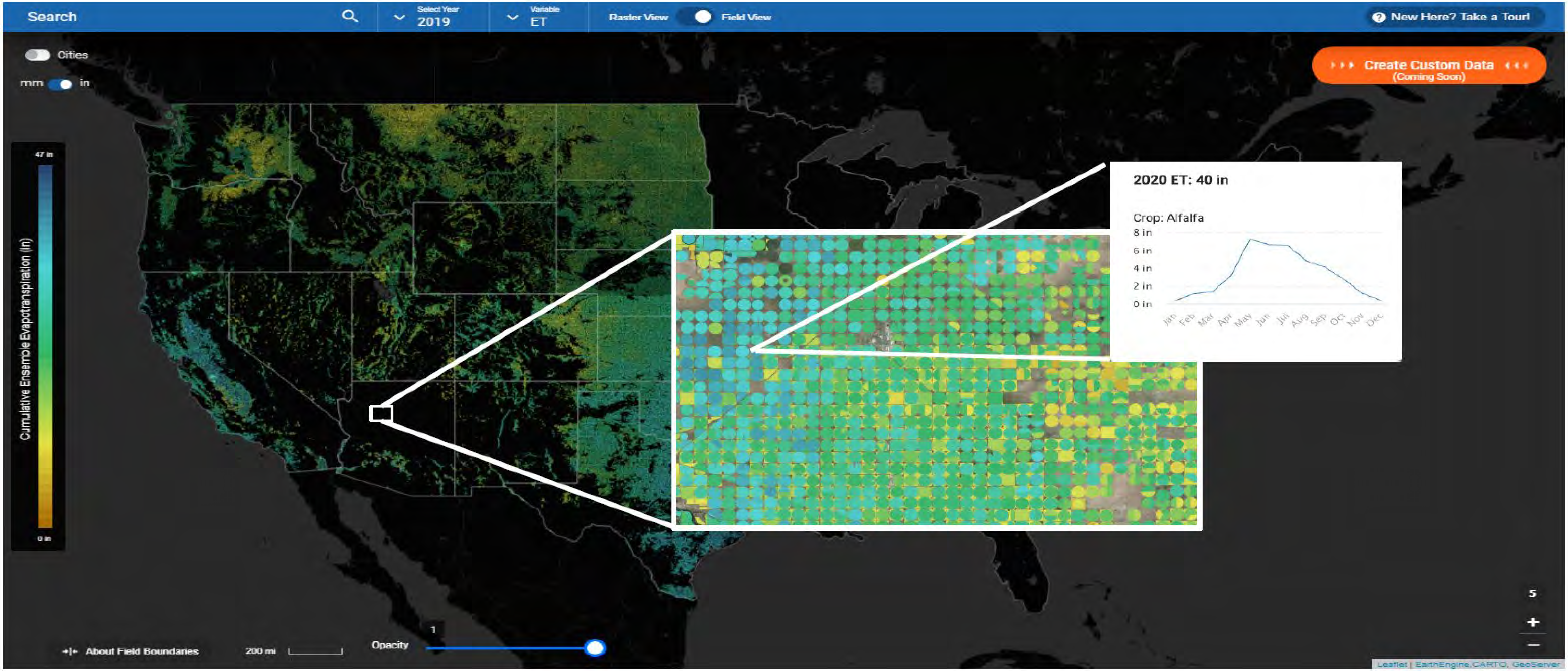
Pasture, alfalfa, rice, tree nuts

Wheat, barley

3) Fallowing

Measuring ET with: OPENET

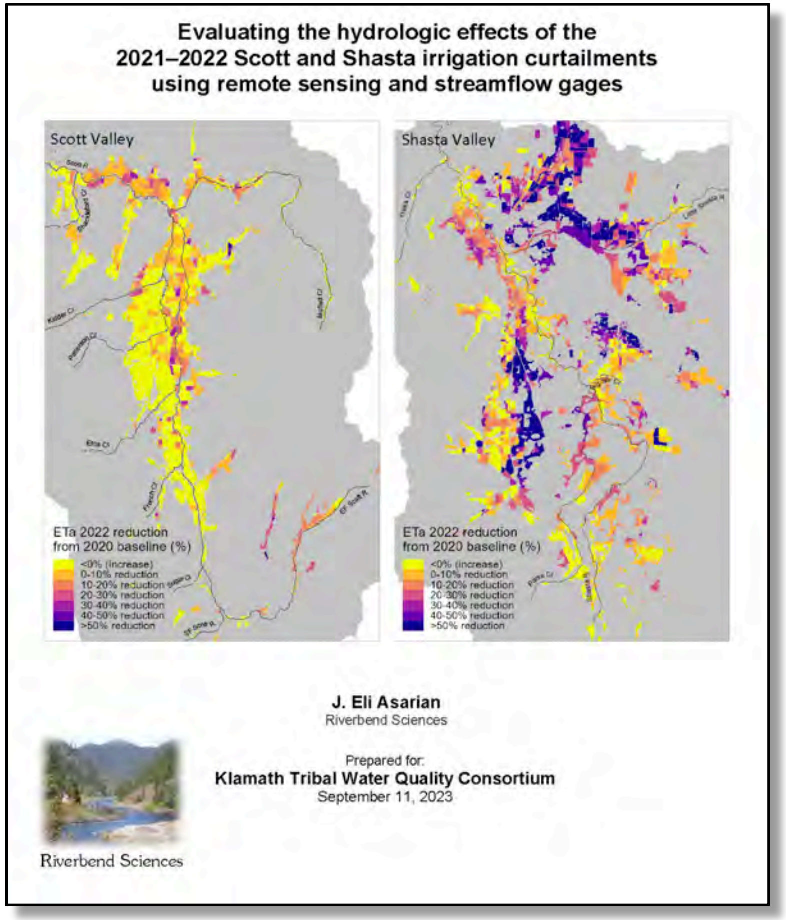
https://etdata.org/



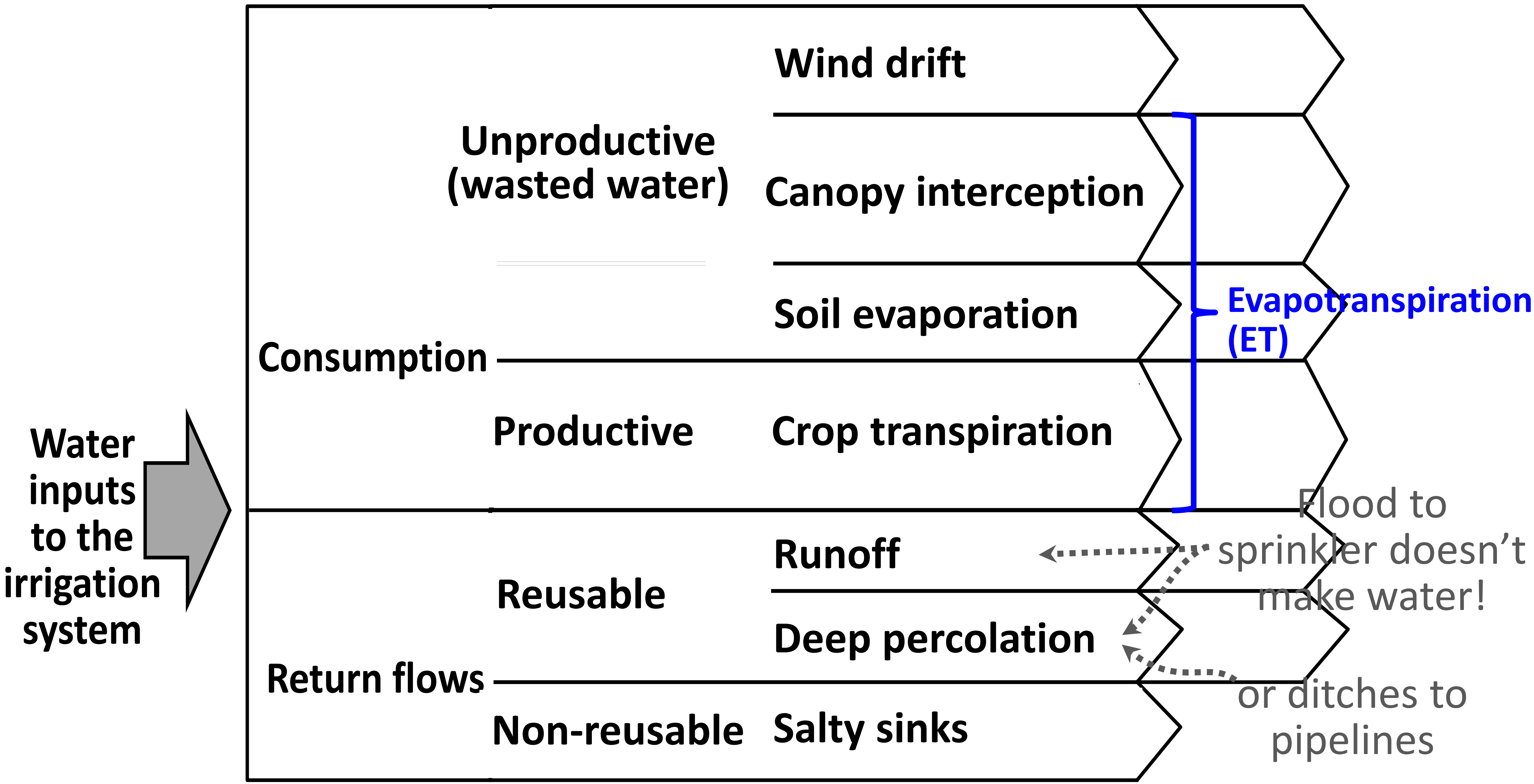
Research papers

Pairing OpenET remotely sensed evapotranspiration with streamflow data to assess the effectiveness of irrigation curtailment for aquatic conservation

J. Eli Asarian [a,*], Bronwen Stanford [b], Nicholas P. Murphy [b], Michael M. Pollock [c]



https://www.riverbendsci.com/reports-and-publications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Salty sinks
Flood to sprinkler doesn't make water!
or ditches to pipelines


Beware of unintended consequences if you reduce groundwater recharge!
…reduced flow at springs and seeps

Does it ever make sense to reduce return flows?

- Yes:
  - Water quality
  - <u>localized</u> water quantity in biological hotspots

- Remember… no effect on flows at basin outlet

Photo credit:
Aqua Terra (2021)

Other water infrastructure changes not affecting return flows or consumptive use

- Relocate withdrawals downstream to lower-quality waters
  – Cold spring to warm river
  – Groundwater pumping to river diversions
- Localized benefits to water quality (and maybe local quantity)
- Remember… no effect on flows at basin outlet

Photo credit: https://caltrout.org/projects/parks-creek-flow-enhancement-and-fish-passage-project/

When to recharge groundwater?

- If/when water is abundant (winter/spring)
  - Move water from rivers/streams into aquifers
  - Use recharge to offset effects of summer/fall withdrawals, not enable withdrawals that wouldn't otherwise occur
- Surface storage


Ma et al. (2022)


When to recharge groundwater?
• Not during summer/fall low flows
– Minimize surface diversions
– Reducing diversions can increase flow even if no effect on consumptive use? (e.g. fall/winter livestock water)


To increase basin-scale streamflow, reduce consumptive use
(and store water when appropriate)

Measuring Cost Effectiveness of Environmental Water Transactions

43rd Annual Salmonid Restoration Conference

Tuesday, April 28th, 2026

Redding, CA

fluent

FRESHWATER INSIGHTS

Presentation Overview

- Introduction
- Environmental Water Transactions
- Perspectives on Cost-Effectiveness
- Cost and Benefit Metrics
- Cost-Effectiveness Metrics

fluent
FRESHWATER INSIGHTS

PURPOSE

Balancing water uses for the benefit of ecosystems and communities to realize a sustainable future.

MISSION

To use proven methodologies + creativity + collaboration to address today's most pressing water and watershed challenges.

VISION

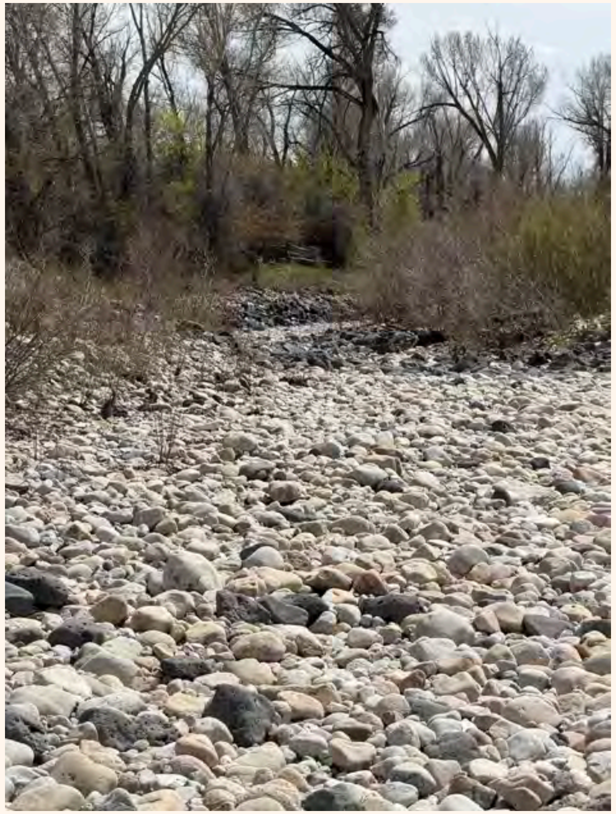
A world where water use and watershed health are sustainable, ecologically sound and equitable.

Environmental Water Transactions

Environmental Water Transactions (EWTs) Definition

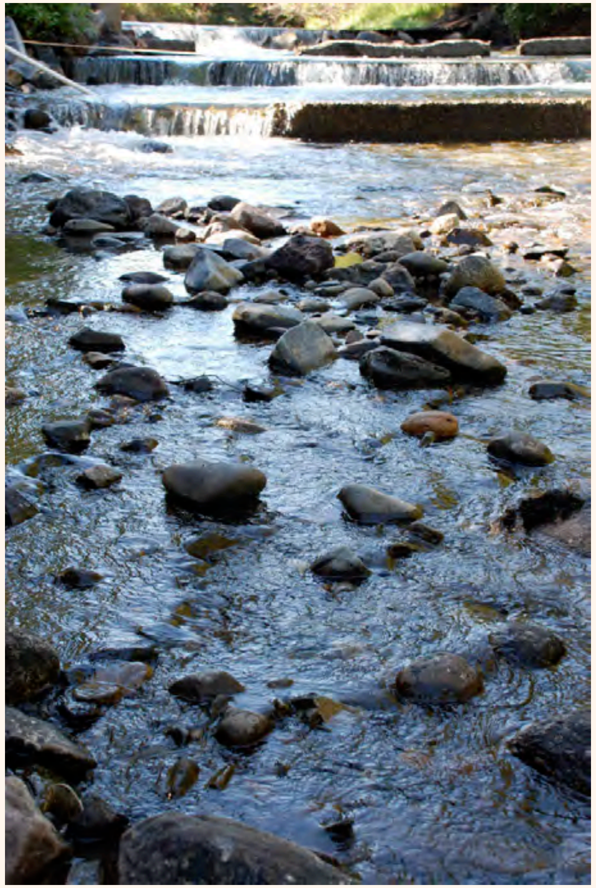
An environmental water transaction is any agreement (or set of related agreements) by which a water right user commits to a change in their water use and/or water right leading to legal or de facto protection of additional water in a waterway or water body for environmental purposes.

Aylward 2013



Classifying EWTs

- Many ways to classify transactions:
  - How water is saved or freed up
  - What ownership interest is acquired
  - How water saved is committed to instream use
  - Duration of commitment
  - Source of water



Water Management Transactions

- Upstream Management
  - Timing of Storage Release
  - Source Switch
  - POD Change
- Conveyance Efficiency
  - Diversion Efficiency
  - Delivery Efficiency
  - Transmission Efficiency
- On-Farm Efficiency

↑

"Conserved Water"

Water Management Transactions

- Upstream Management
  - Timing of Storage Release
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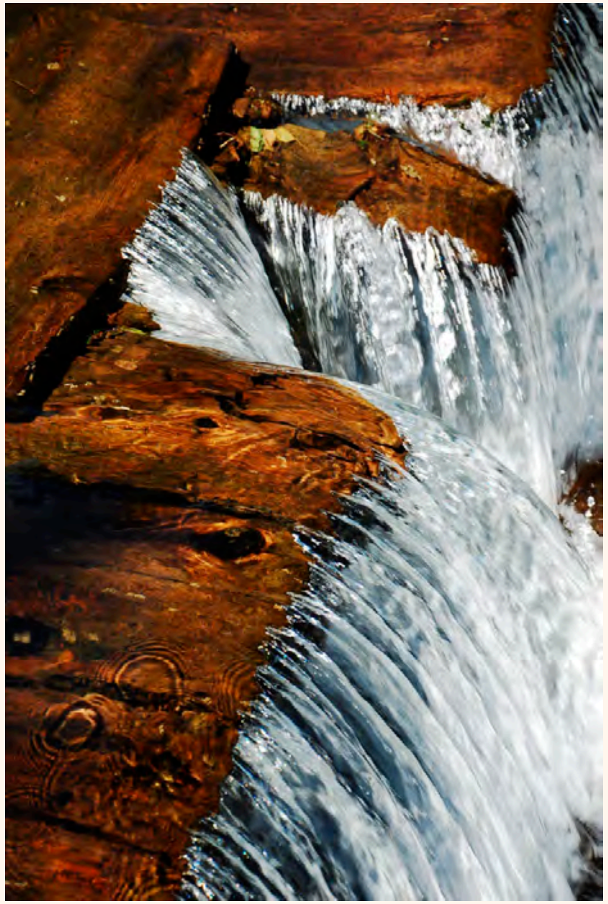
  - Transmission Efficiency
- On-Farm Efficiency

"Conserved Water"

- Oregon's Conserved Water Allocation Program
  - Allows conserved water to be reallocated ***when possible***
    - Instream flow
    - Additional acreage
  - Minimum 25% dedicated instream
  - More required instream depending on % of public funding

Consumptive Use Transactions

- Reducing Crop Consumptive Use
  - Deficit Irrigation
  - Crop Switch
- Taking Land Out of Agricultural Production
  - Fallowing (temporary or permanent)
    - Full or partial season
    - Rotational/static implementation



Transaction Strategies

- How do practitioners decide what transactions to pursue?
- How do funders consider what to fund?
  - Based on multiple criteria not just costs
  - Comparative analysis of costs should be part of the decision though

  - ***But how? What are the methods and standards?***

Developing a Cost-Effectiveness Metric

Framing: Cost-Benefit vs. Cost-Effectiveness

E[illegible]omic Cost-B[illegible]efit

- Un[illegible] and c[illegible] and benefits to the [illegible]
- Measur[illegible]omic well-being
- Non-[illegible]ket [illegible]ation of en[illegible]mental [illegible]s

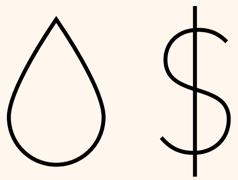
Financial Cost-Effectiveness

- Understand and track performance
- Improve performance over time
- Ensure accountability
- Promote dialogue and understanding

What Costs to Include?

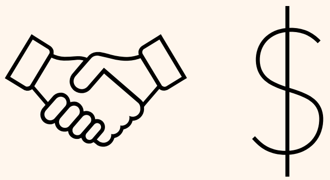
Water Costs

- Money directly related to freeing up water



Transaction Costs

- Cost to develop EWTs



Water Costs

Cost Item	Short Term	Split Season	Long Term	Water Purchase	Conserved Water	Land & Water Purchase
Capital costs						
Water rights purchase				•		•
Long-term water rights payment			•			
Land and water rights purchase						•
Conserved water investment					•	
Recurring costs						
Payments for water	•	•	•			
Property tax						•
Irrigation assessments						•
Energy cost		•			•	
Operations and maintenance		•			•	

Water Costs

Water Costs	Never	Sometimes	Always
Enter costs into file or database	17.4%	21.7%	60.9%
Send annual report to funders, etc.	26.1%	26.1%	47.8%
Generate summary table of all transactions	8.7%	47.8%	43.5%
Present internal annual report	30.4%	43.5%	26.1%

Transaction Costs

Staff costs	
	Hours by staff
	Salary by staff
	Fringe/Benefits by staff
Professional Services and Consulting Fees	
	Engineering, Hydrology, Biology, etc.
	GIS, Mapping, Water Rights Examiner, etc.
	Legal Fees
	CPA, tax advice
	Appraisal - Water or Land

Travel	
	Staff travel
	Contractor travel
Supplies and Fees	
	Maps
	Printing
	Water Right Fees
	Recording Fees
	Escrow Fees
	Other Supplies and Fees
General & Administrative	
	Indirect Expenses (as % of other costs)

Transaction Costs

	% of responses
We do not estimate or calculate transaction costs	26.1%
Separate water transaction costs from other organizational costs regularly	21.7%
Calculate transactions costs only when a funder requires it	21.7%
Record/track costs for each transaction as it happens	17.4%
Record/track costs for each transaction as it happens & Separate water transaction costs from other organizational costs regularly	13.0%

Flow and Water Benefit (Examples)

- Volume of water (AF)
- Rate of water (cfs)
- Season (days)
- Duration (years)
- Period of ecological significance
- Reliability of the water right
- Reach (miles)
- % of flow or target

Flow and Water Benefit (Examples)

Metric	% of responses
Flow rate	90.0%
Volume of water	86.4%
Miles of stream receiving additional water	77.3%
Time period transaction is in effect	77.3%
Reliability of water right	68.2%
% of streamflow target reached	50.0%
% change in flow rate	40.9%
Other	22.7%

Other Relevant EWT Parameters

- Water right reliability
- Ecological benefits (habitat, passage, etc.)
- Water quality benefits
- Species-level results

Cost-Effectiveness Metric

Potential Cost-Effectiveness Metrics

- $/acre-foot
- $/cfs
- $/river mile
- $/river flow increase metric
- $/increment of habitat benefit
- $/increment of ecological benefit

Constraints on Metrics for Cost-Effectiveness Analysis

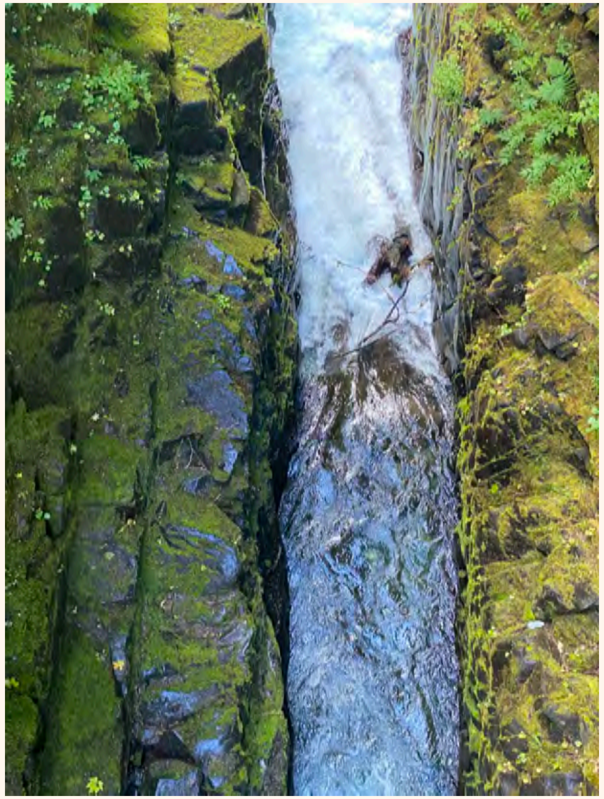
- Scale: Transaction-by-transaction, by reach or by program
- Timing: CEA pre- and/or post-project
- Practicality and replicability: reliable quantification across types

Potential Cost-Effectiveness Metrics

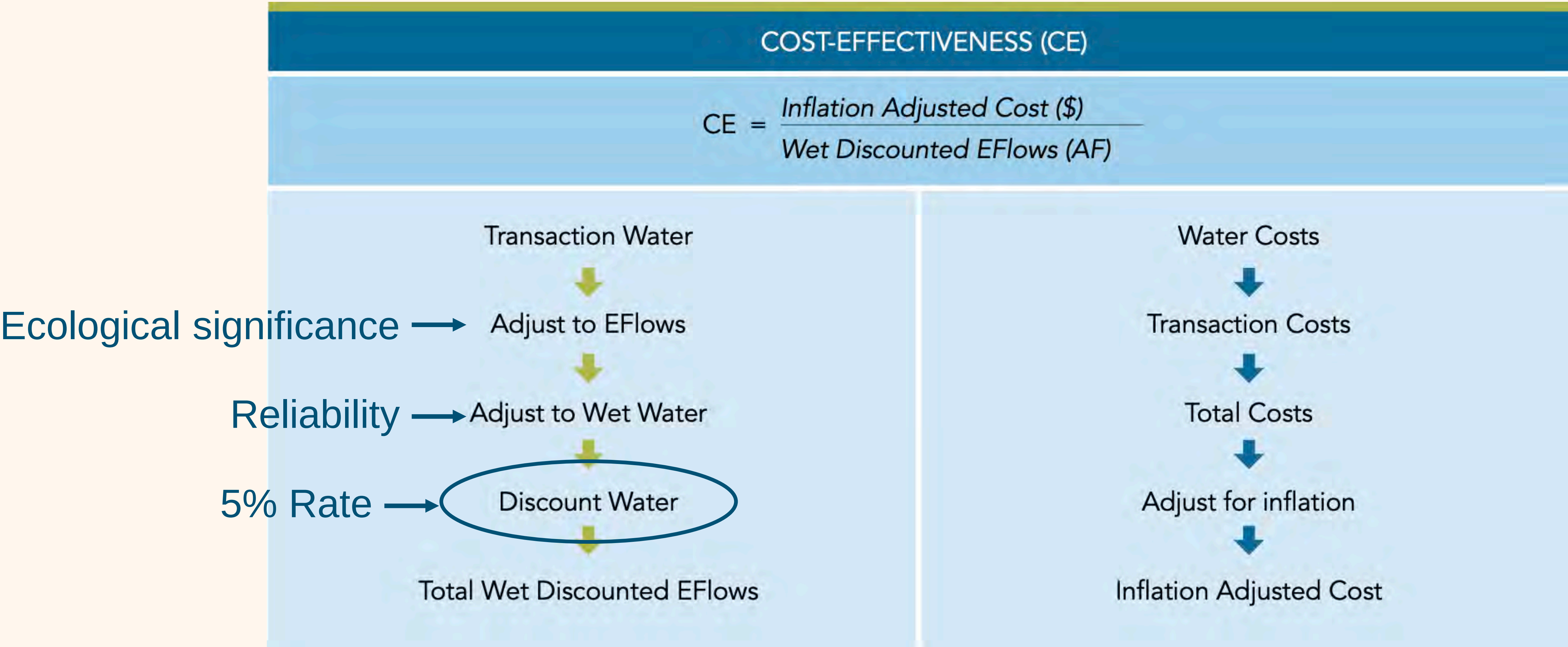
- Metrics should be **practical** and **replicable** and applicable to individual transactions at the pre-project stage
- Need metrics that can be derived:
  - for individual transactions and for groups of transactions (in a reach)
  - before and after the project
  - by the practitioner, i.e. they cannot be costly or time-consuming to generate
- *Ideally, they depend on a limited number of generally available data across suite of transactions*

Determining Flow/Water Benefit

- Expected additional flow during period of ecological significance
- Calculate volume
- Discount volume



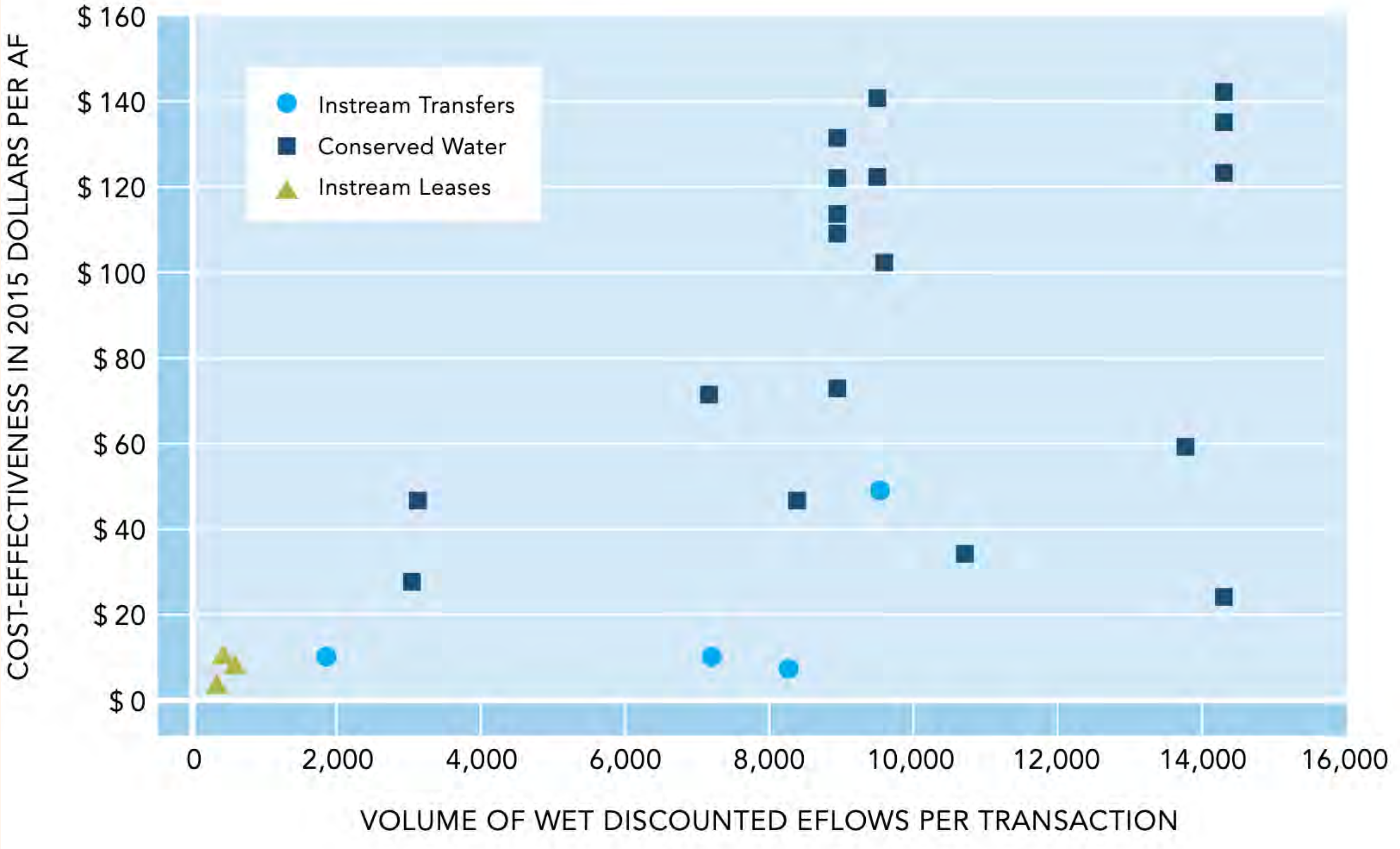
Cost Effectiveness Metric



Cost-Effectiveness

- Why discount water?
  - Water today > water tomorrow
    - Salmon could be extinct tomorrow
    - Uncertainty about future benefits
  - Consistency w/cost side of the equation
- If water scarcity is increasing, isn’t water in the future worth more than water today?
  - Good argument that it is
  - Choose a lower (or even zero) discount rate

Figure 5: Cost-Effectiveness of Whychus Transactions



Summary

Why Cost-Effectiveness? **Practitioners**

- Provide a relatively easy tool for understanding and tracking performance
- Facilitate consistent data collection
- Improve performance over time
- Ensure accountability
- Promote dialogue and understanding

Why Cost-Effectiveness? **Funders**

- Provide an additional metric for funding decisions and tracking investments
- Allow for cost comparisons between projects with different profiles
- Ensure accountability
- Target cost-effective investments when all other factors are equal

Conclusion: Why ***This*** Cost-Effectiveness Metric

- Focus on wet water (reliability)
- Focus on ecologically significant flows
- Promote data collection required for the above
- “Walk first, run later”


Water Funding Principles
To Enhance or Minimize Harm to Environmental Flows
$ = Water **for** rivers
$ = Water **from** rivers

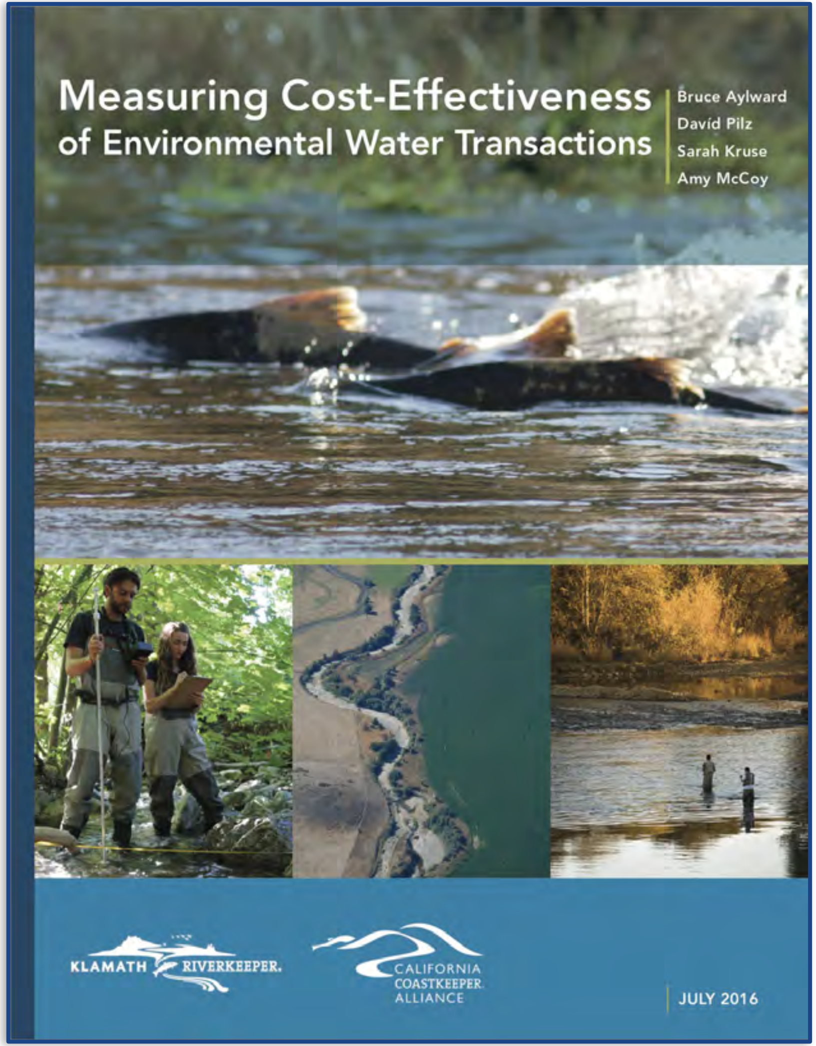
First Do No Harm

Stop funding projects that reduce flows for endangered fish, river-dependent Native American Tribes, and other instream beneficial water uses.

Measure the Impact on Instream Flows

- Funding agencies should collect information needed to measure the impact of proposed projects on environmental flows.

- One methodology is described in the 2016 report: "*Measuring Cost-Effectiveness of Environmental Water Transactions*"



Maximize Benefits (Prioritize Cost-Effective Environmental Water Transactions)

Agencies that fund environmental water transactions should adopt:

(a) grant scoring criteria to rank proposed transactions based on relative cost-effectiveness,

(b) funding requirements to reject proposed transactions that reduce environmental flows or provide negligible or unverifiable benefits.

If a project goal is to increase instream flows, grant seekers should prove that flows will increase as a result of the project.

Dedicate Conserved Water to Environmental Flows

- Water that is conserved with public funding should legally dedicated for instream use.
- Land trust acquisitions should be paired with instre water dedications when possible.
- Instream water dedications should be perman legally enforceable, and dedicated instream for many stream-miles as possible.

Instream Flow Studies Should Support Instream Flow Requirements

- Publicly funded instream flow studies should provide recommendations that are consistent with existng laws: ESA, CESA, PTD, Reasonable Use Doctrine, FGC § 5937, Tribal reserved rights.

- Politics should not determine which questions scientists are allowed to answer.

Provide Benefits Greater Than Required by Law

- Public funds earmarked for fisheries and ecosystems should provide benefits greater than required by law.
- To this end, funding agencies could require that water dedicated for instream use augments, rather than satisfies, instream flow requirements.
- Where instream flow requirements have not yet been established, EWTs could provide flows in excess of future instream flow requirements.

Water Transactions ≠ Substitute for Instream Flow Requirements

- Agencies should adopt instream flow requirements that are consistent fish flow laws: ESA, PTD, Reasonable Use Doctrine, FGC § 5937, Tribal reserved rights.
- EWTs & water conservation projects divert time, money, and political will away from the work needed to instream flow requirements.
- Nonetheless, EWTs & water conservation are well funded and favored by politicians.
- Therefore, funding agencies should implement funding principles to:
  - **Measure impact - Avoid harm - Maximize benefits - Dedicate conserved water to ecosystems - Fund studies that support instream flow requirements - Provide benefits greater than required by law**

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