

# Trinity River Winter Flow Variability

## Trinity River Restoration Program

### Presented by:

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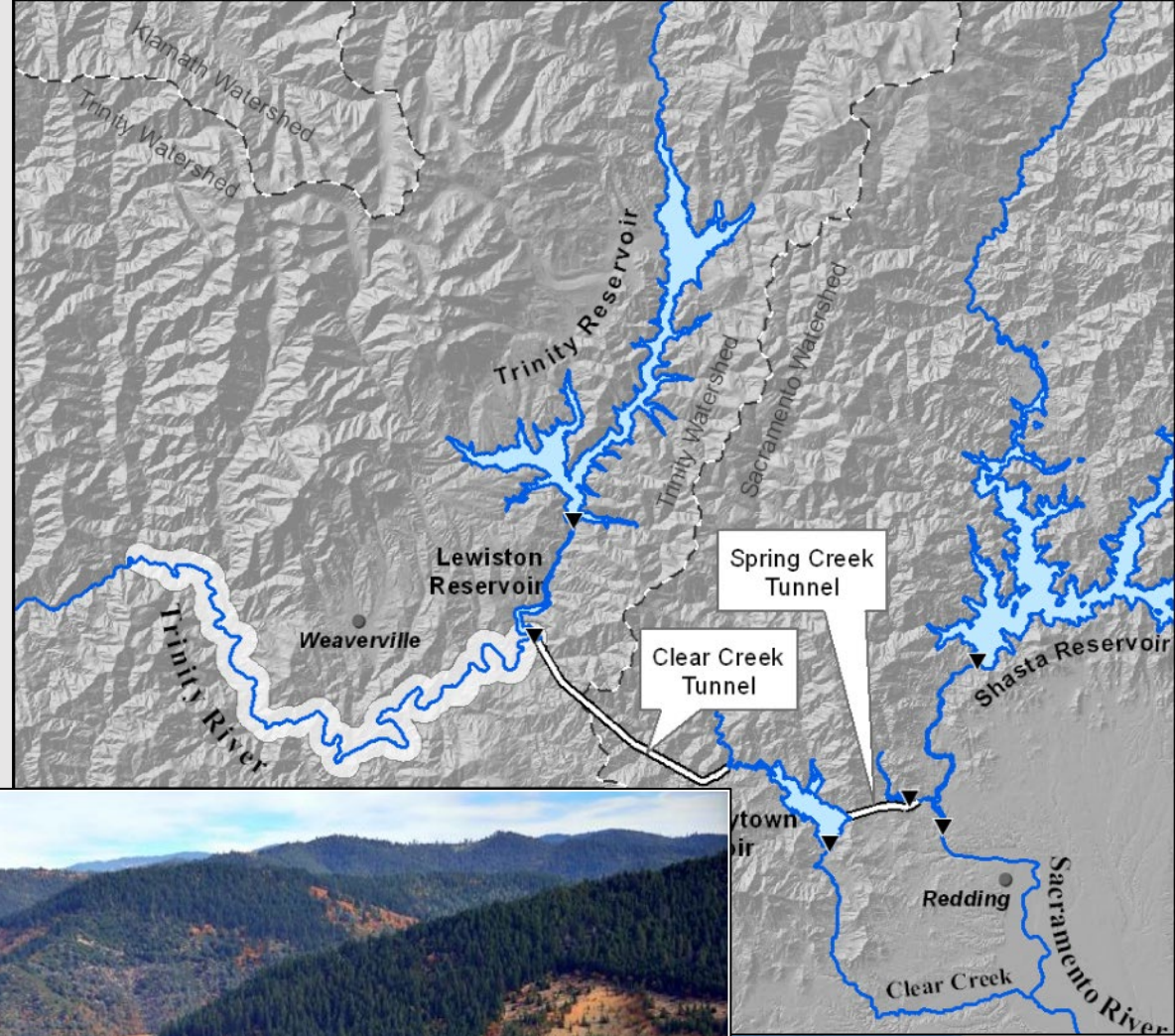
Patrick Flynn, Trinity County

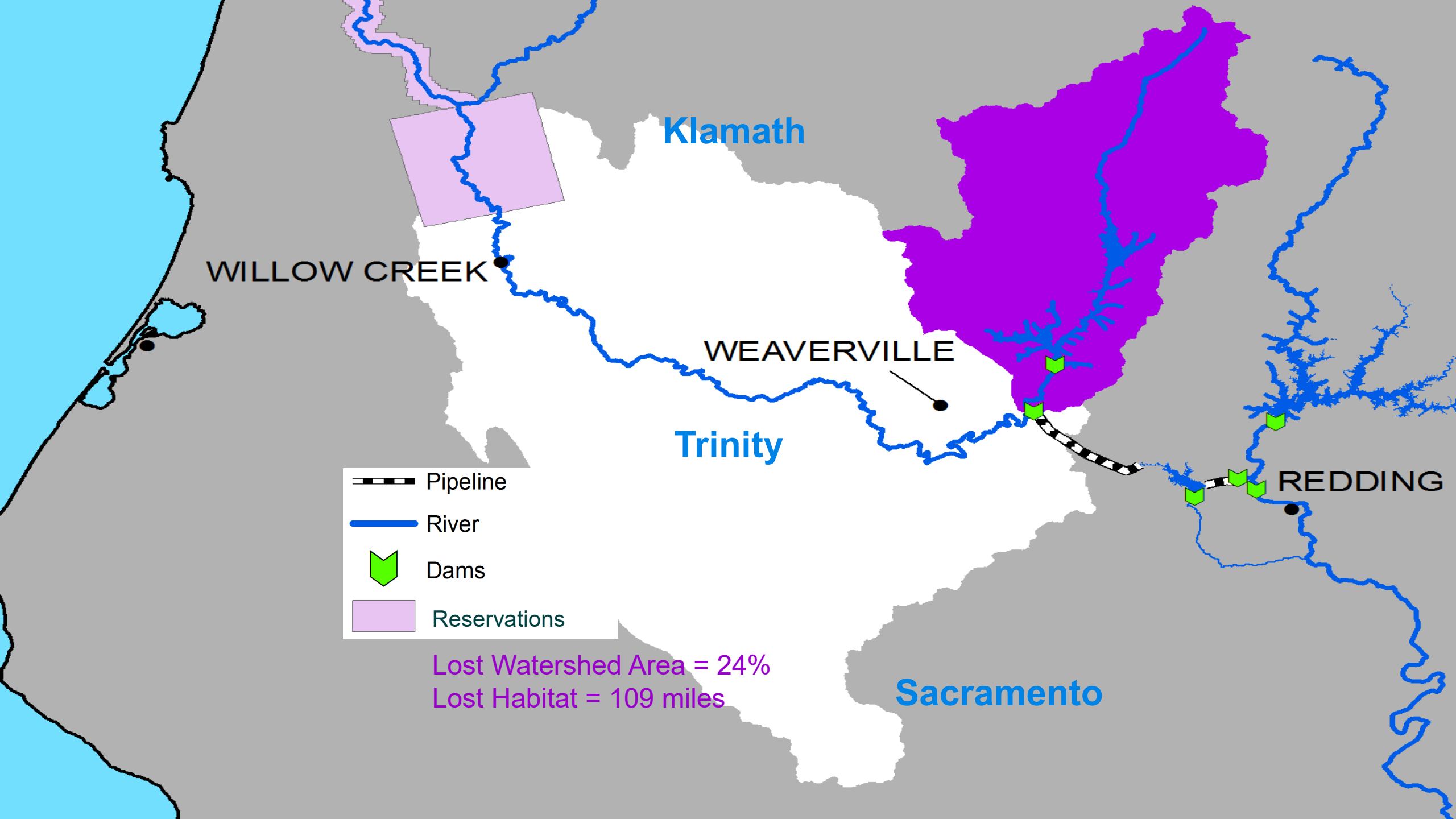


**Trinity River  
Restoration Program**

# Loss of Natural River Function: Diversions to Central Valley

Initially took 80-90%  
of the Trinity River.  
Still takes over 50%.





Klamath

WILLOW CREEK

WEAVERVILLE

Trinity

REDDING

Sacramento

- Pipeline
- River
- Dams
- Reservations

Lost Watershed Area = 24%  
Lost Habitat = 109 miles

# Anadromous Fish



Spring and Fall Run Chinook



Coho



Steelhead



Pacific lamprey

# U.S. Department of Interior Record of Decision 2000 Establishes the Trinity River Restoration Program



## Trinity River Restoration Program

*The long-term goals of this Program are to restore the form and function of the Trinity River; restore and sustain natural production of anadromous fish populations in the Trinity River to pre-dam levels; and to facilitate full participation by dependent tribal, commercial, and sport fisheries through enhanced harvest opportunities.*

# Our toolbox



Gravel Augmentation



Channel Rehabilitation

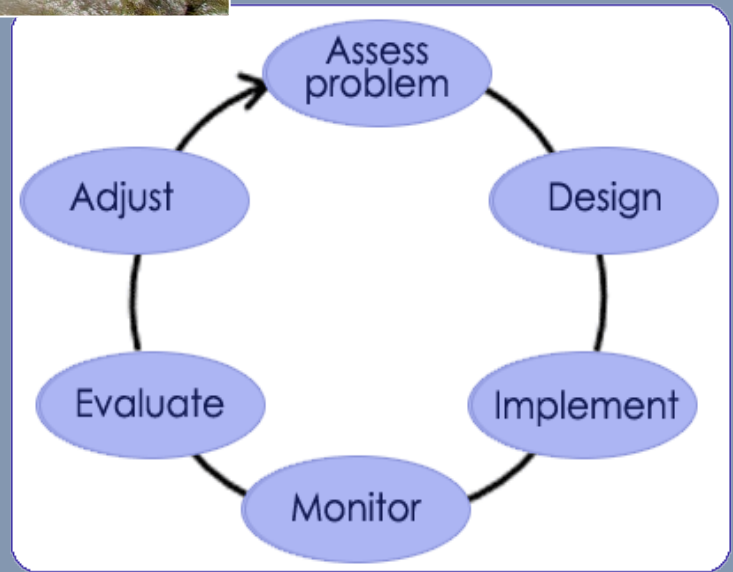


Watershed Restoration

Adaptive Management



Restoration Flows



# Water Year Types

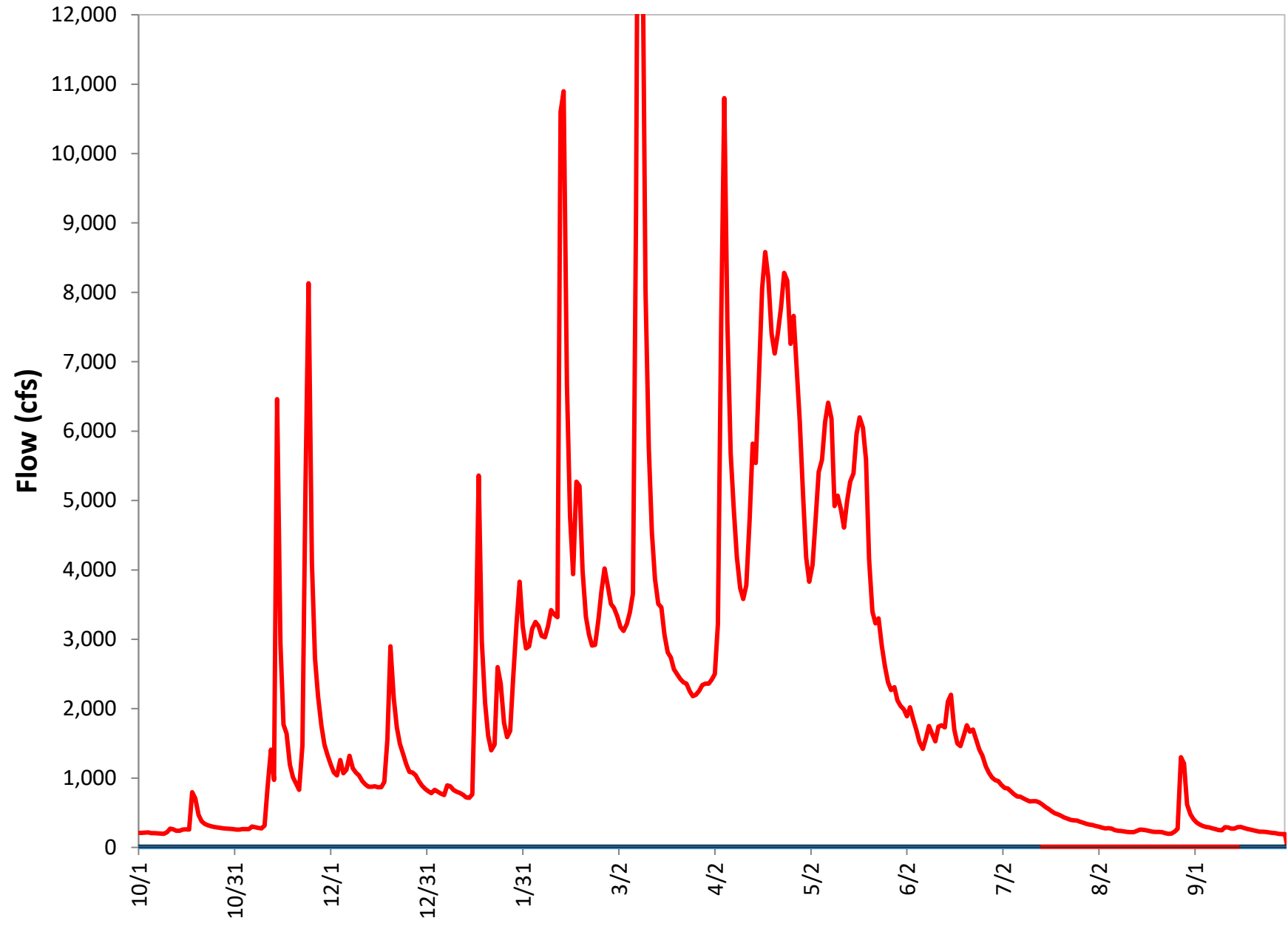
Based on Full Natural Flow: amount of water captured by the dams that would otherwise flow down Trinity River during the water year

Water Year is October 1 through September 30

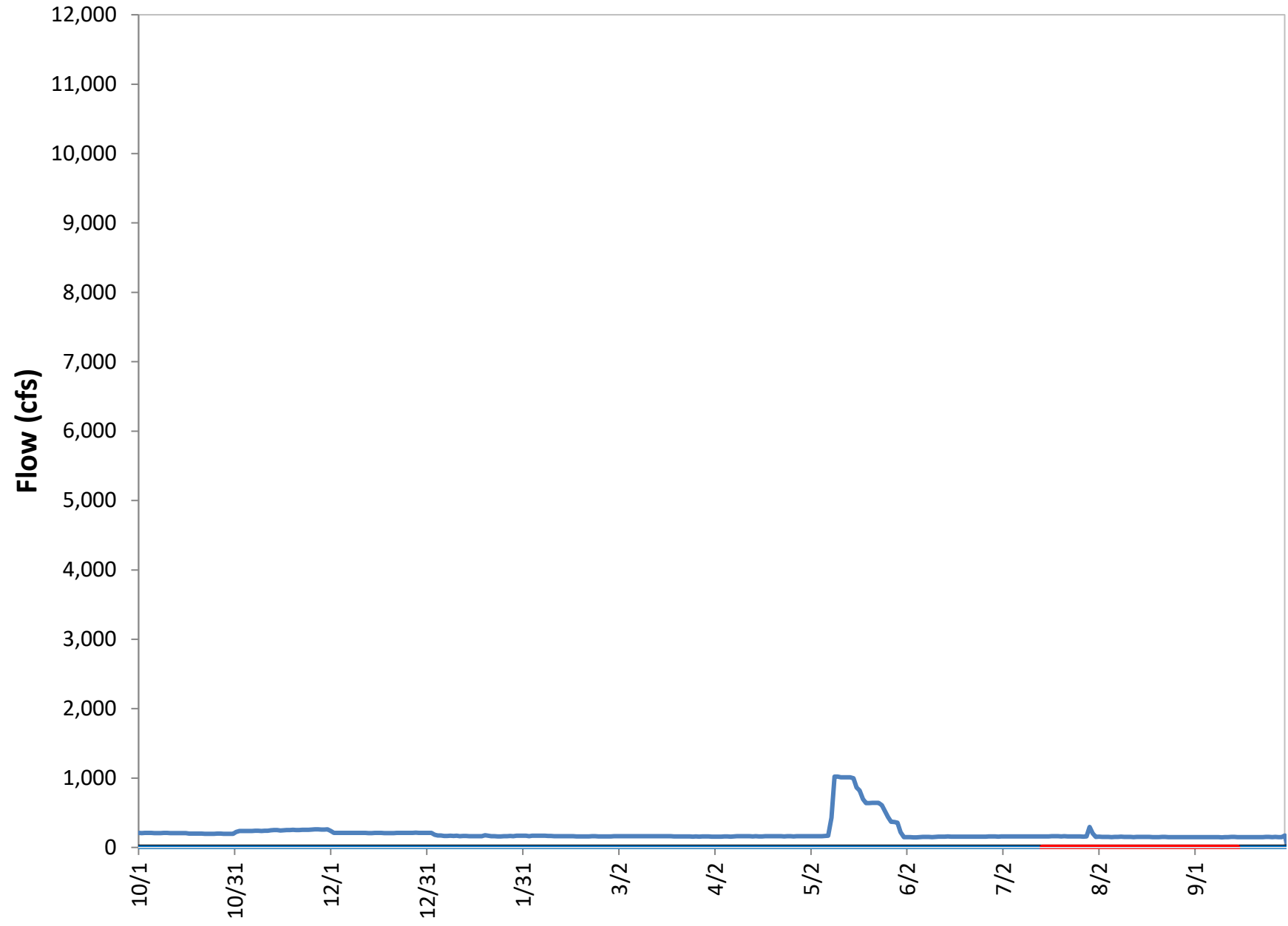
Water Year Type	Full Natural Flow (acre feet)	Water to Trinity River (acre feet)
Extremely Wet	> 2,000,000	815,000
Wet	1,350,000 – 1,999,999	701,000
Normal	1,025,000 – 1,349,999	647,000
Dry	650,000 – 1,024,000	453,000
Critically Dry	< 650,000	369,000



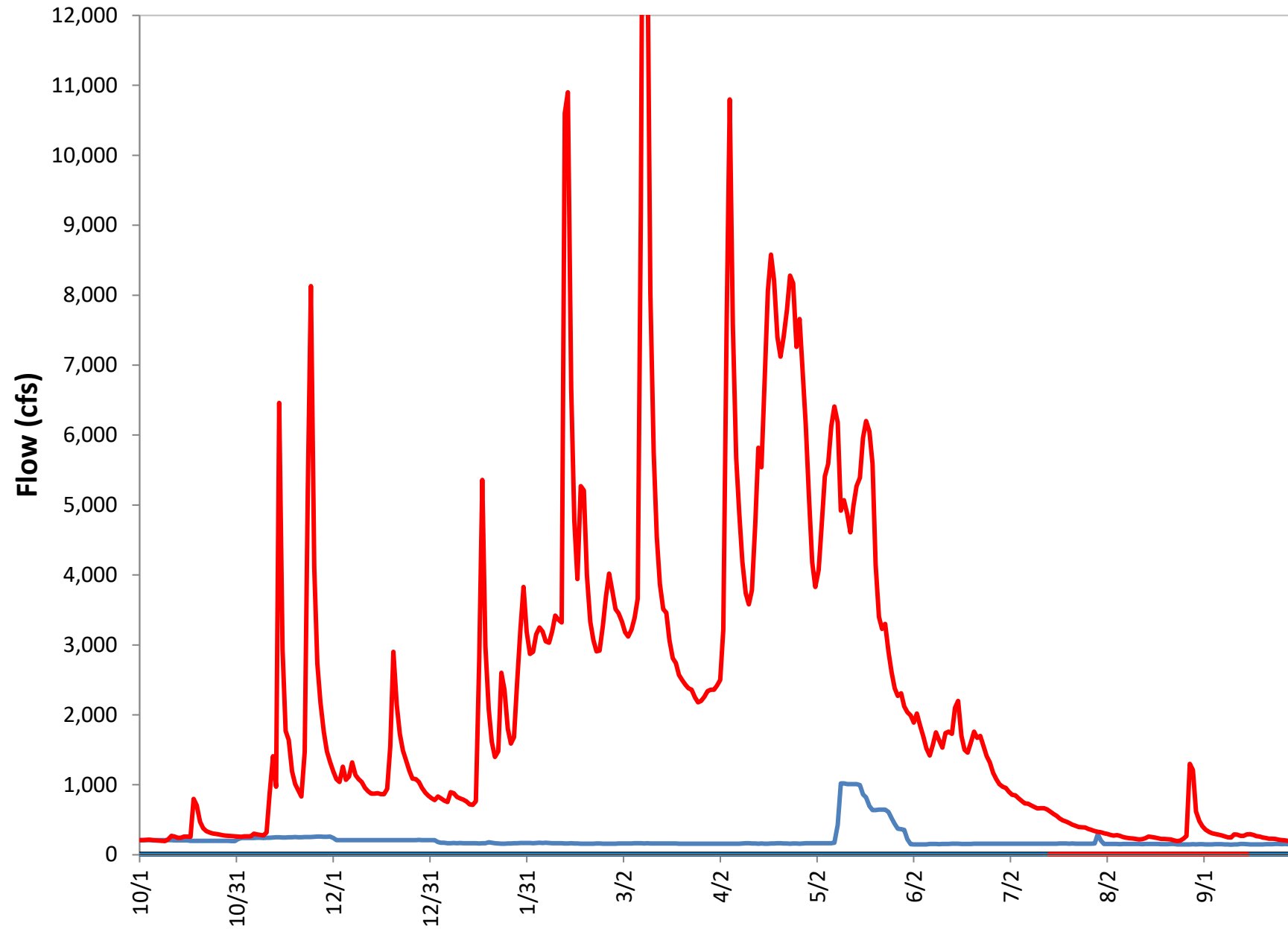
# 1954 – the last Wet water year prior to dam construction



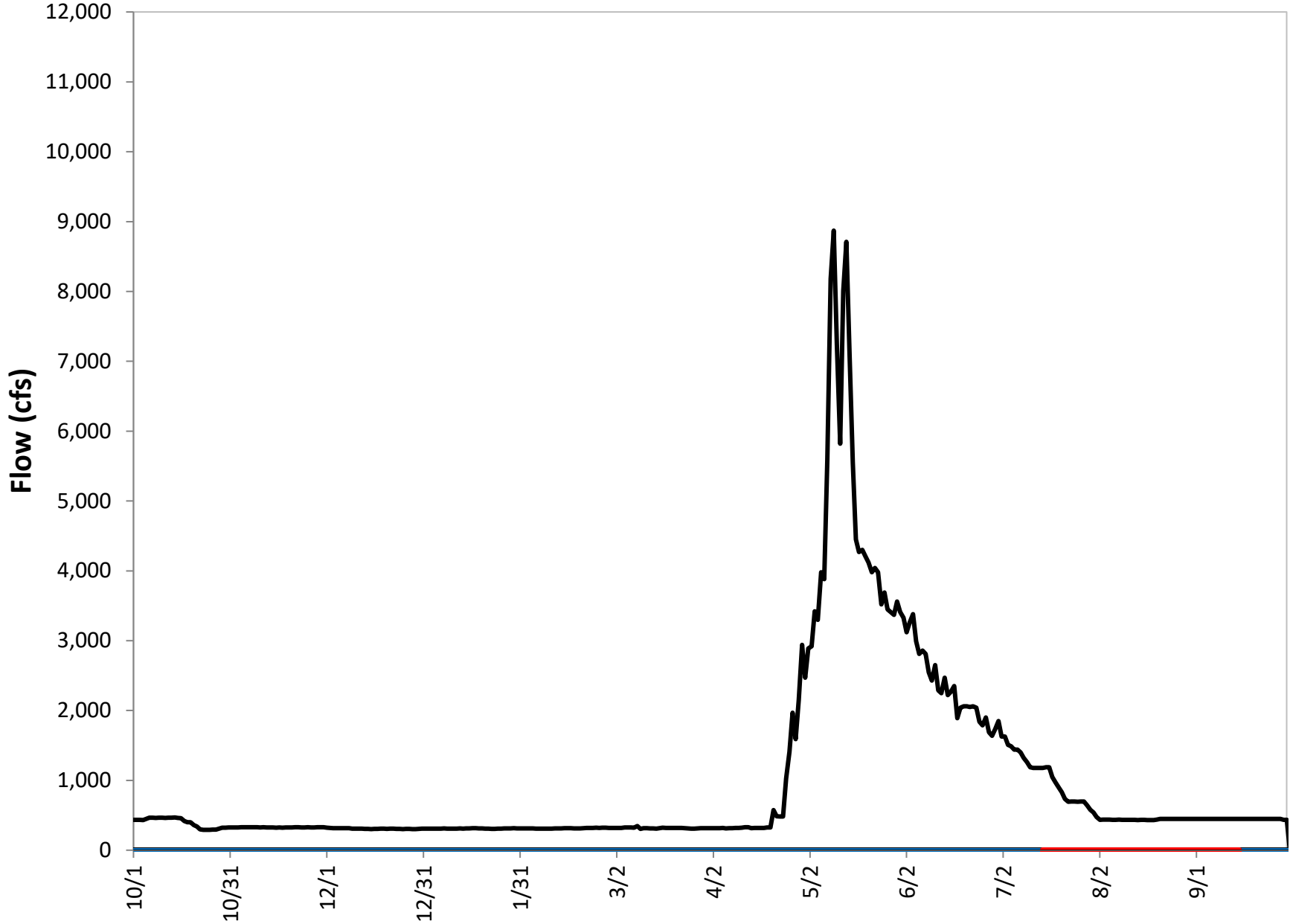
Flows from Lewiston gage – 1965 (after dam construction)



1954 pre-dam (in red) vs. 1965 after dam (in blue)

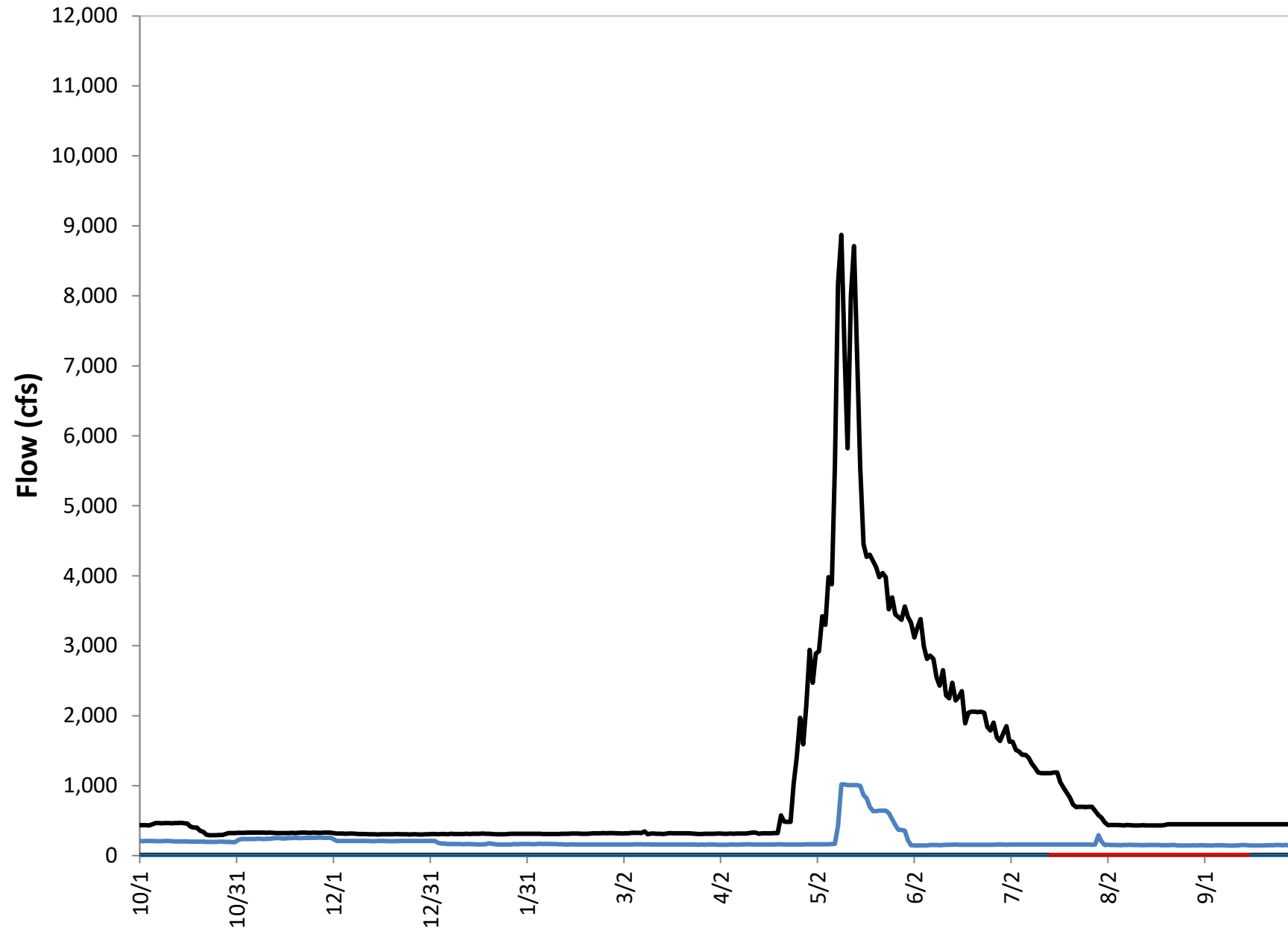


# 2016 wet year – TRRP hydrograph





# 2016 TRRP hydrograph (black) vs. 1965 post-dam management (blue)

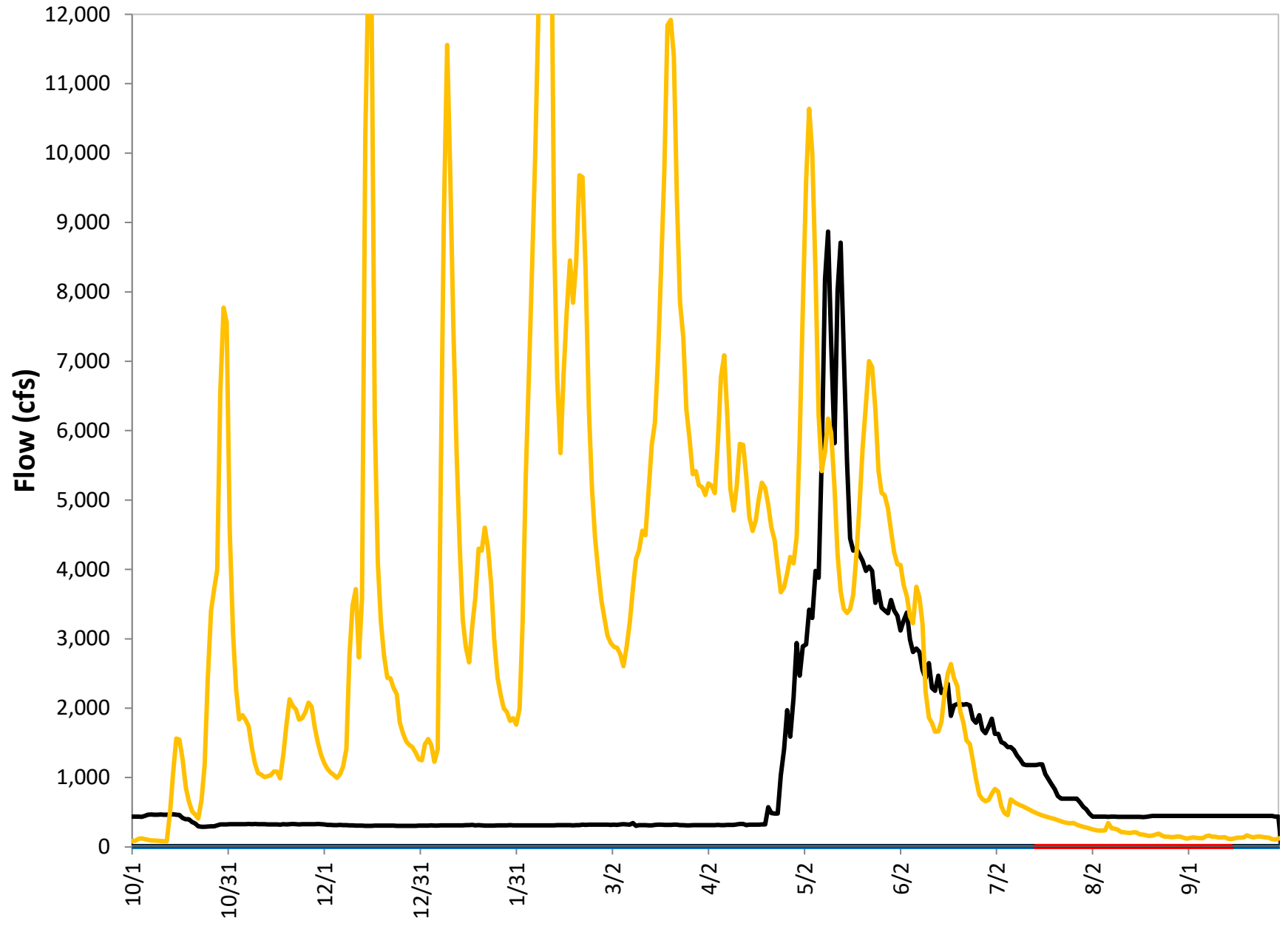


Great progress has been made since the first TRRP flows began in 2004 to provide spring high flow releases and adding variable flows to the Trinity River

But...

for 8 months in 2016, the river was held at baseflow (flatlined), and we haven't met our goals to restore salmon populations to the fishery

# 2016 TRRP hydrograph (wet water year) vs. 2016 full natural flow



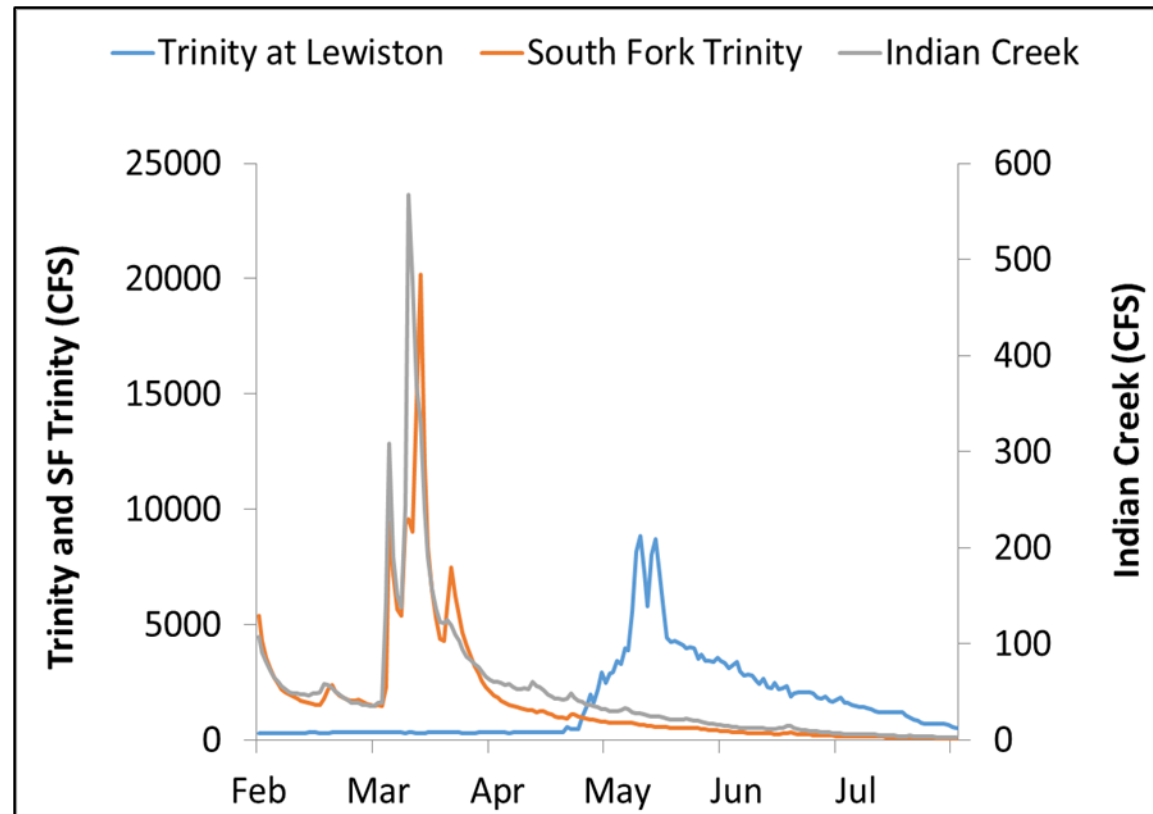
- What we can't change:
- Water volume provided to river
  - Release Temperature

- What we can change:
- Timing of release
  - Magnitude of release

Why are winter flows important, and how does current flow management affect the Trinity River?

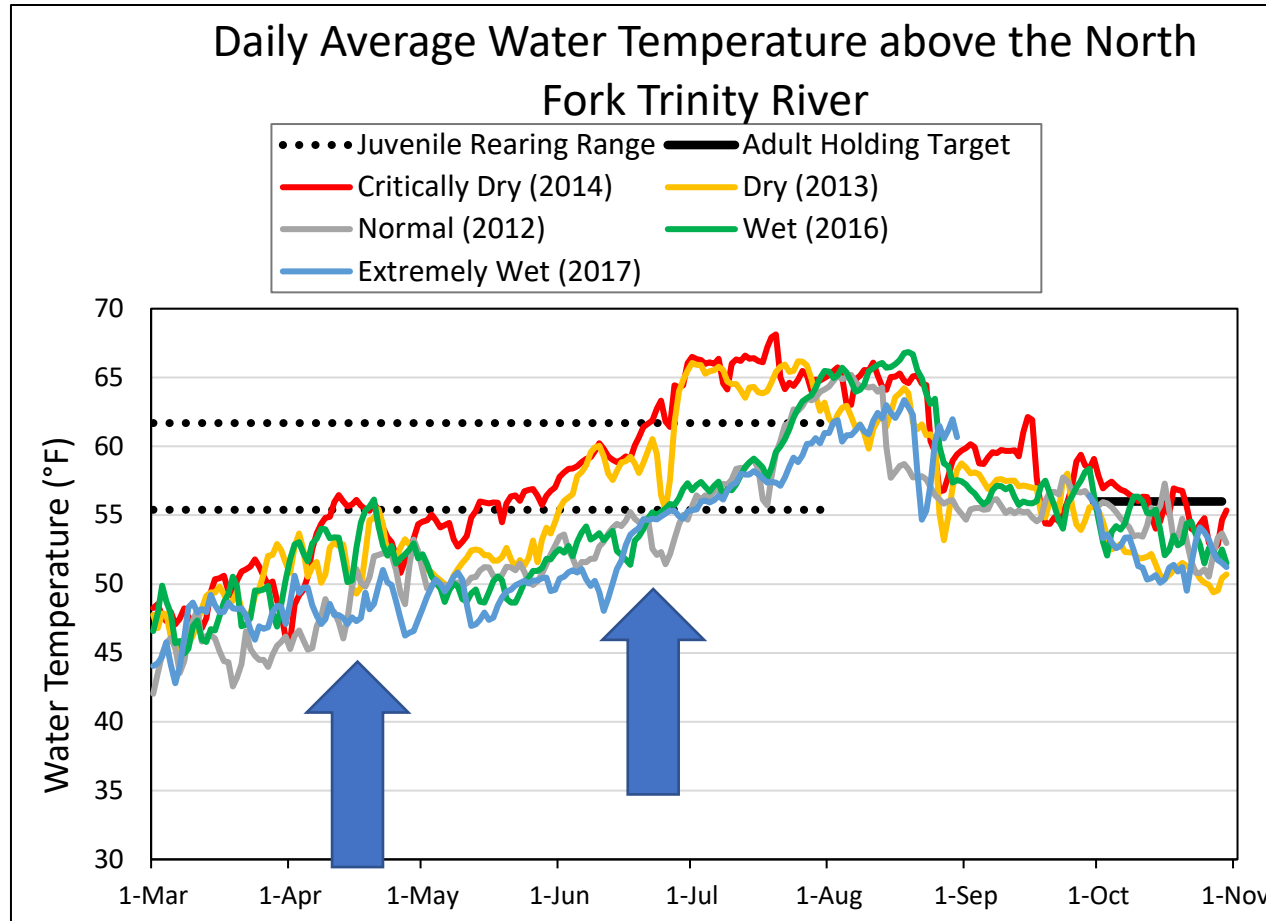
# Current flow management

Tributaries to the Trinity River are receding in flow by the time flow releases occur from Lewiston Dam in mid-April



# Current Flow Management

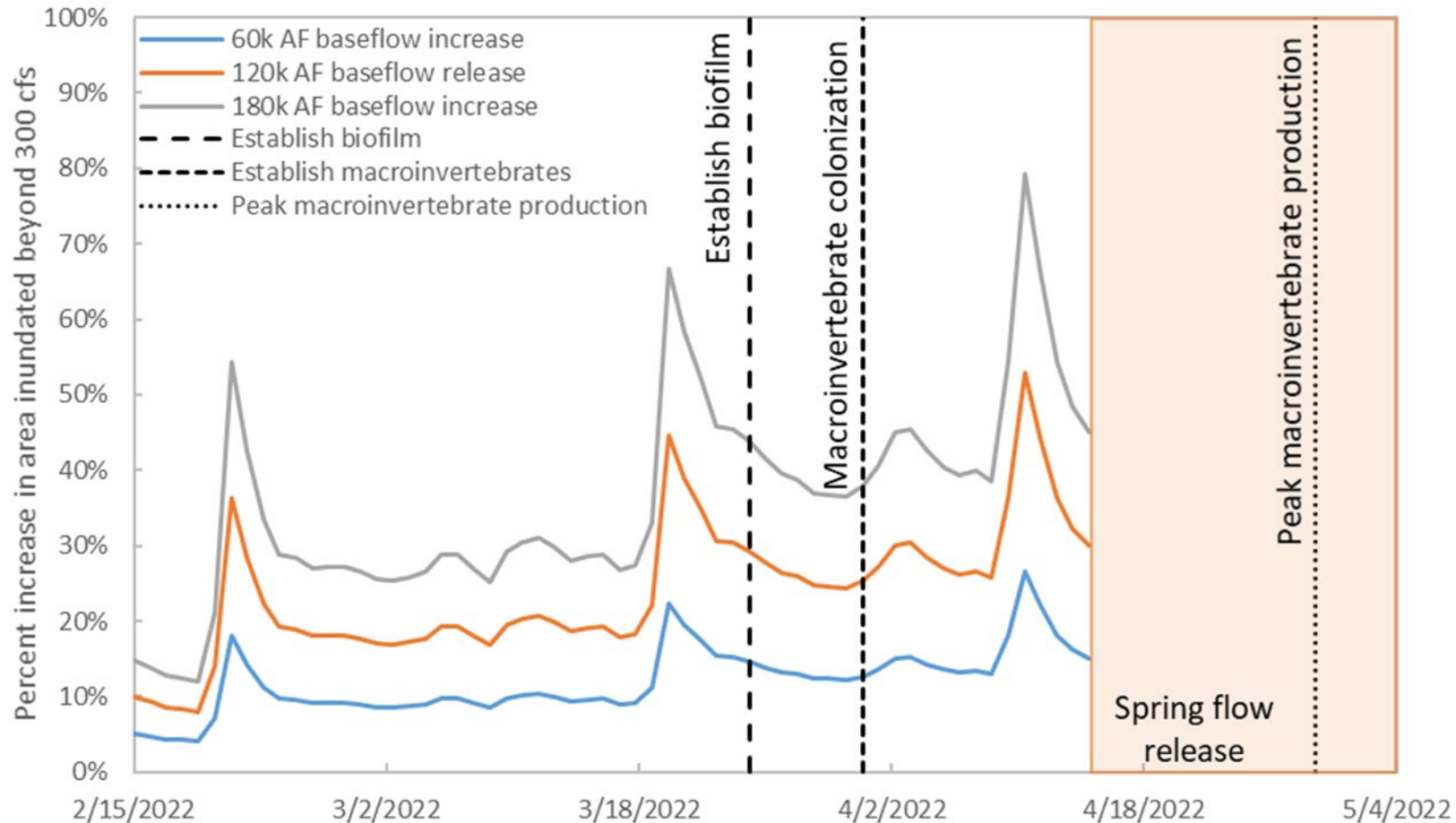
Cold water from Trinity Dam suppresses juvenile salmon growth and delays timing of outmigration.



Consistently low water temperatures are assumed by most fishery managers to be either positive or at least not harmful; however, cold water during juvenile rearing periods can limit fish growth ([Lusardi et al. 2019](#)).

# Improving Flow Management

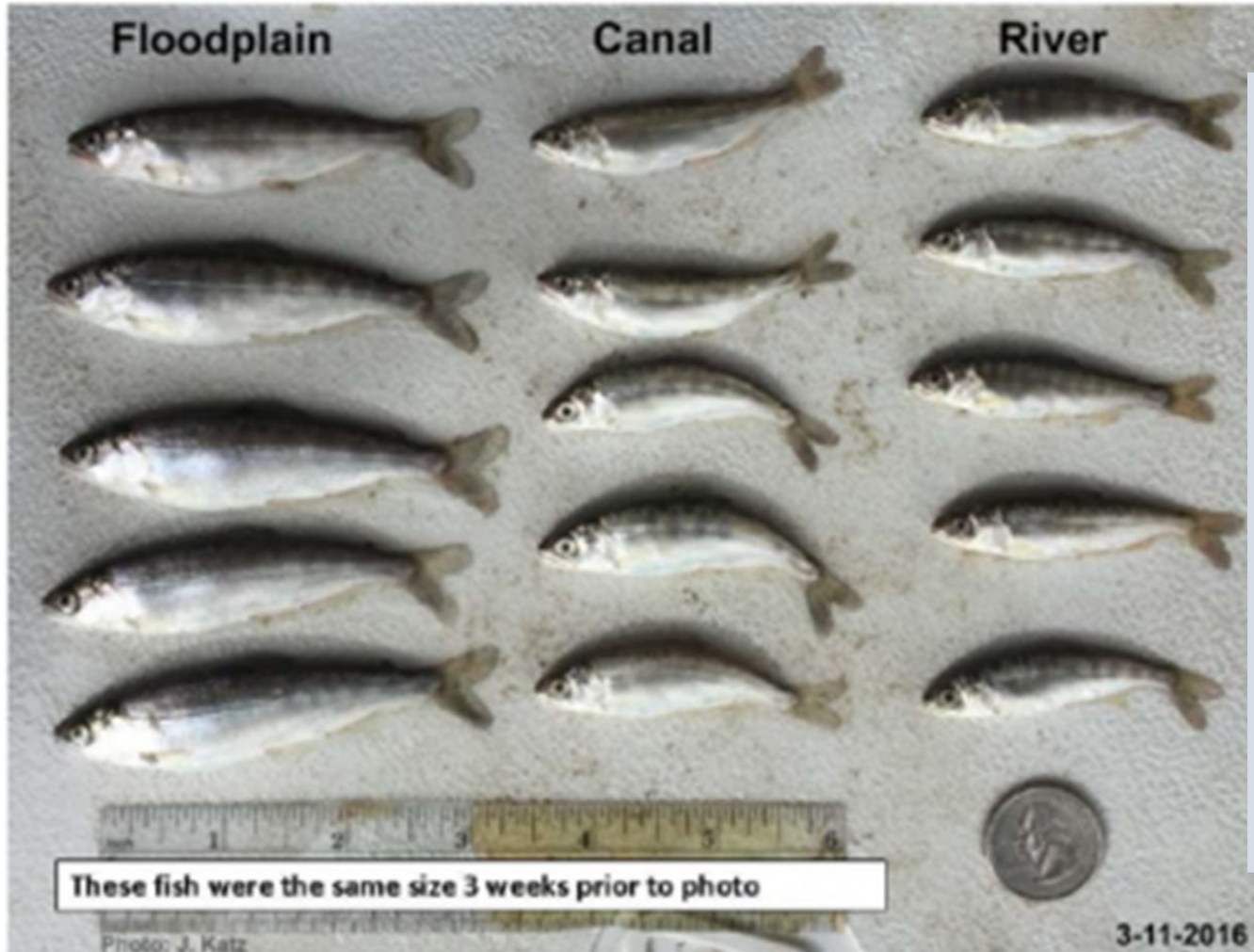
Production of prey (aquatic insects) would benefit from earlier flows.



Primary production, macroinvertebrates: Prior to June 15, inundate surfaces for 28d for establishment of biofilm, 35d for macroinvertebrate establishment, and 63d for peak macroinvertebrate production.

# Improving flow management

Juvenile salmon need earlier access to floodplains for nursery habitat



Year	% Outmigration (February 1)	Spring Flow Release Date	% Outmigration (release date)
2003	11%	April 30	74%
2005	14%	April 22	72%
2006	0%	April 12	50%
2007	0%	April 27	53%
2008	1%	April 23	46%
2009	2%	April 27	50%
2010	8%	April 23	62%
2011	14%	April 22	58%
2012	1%	April 21	49%
2013	5%	April 21	53%
2014	0%	April 23	47%
2015	16%	April 22	83%
2016	46%	April 21	87%
Averages	9%	April 22	60%

Screw trap data on the Trinity River at Pear Tree.

“Simplistic, static, environmental flow rules are misguided and will ultimately contribute to further degradation of river ecosystems” –Arthington et al 2006

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## Basic Principles and Ecological Consequences of Altered Flow Regimes for Aquatic Biodiversity<sup>1</sup>

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regimes; Thirdly, maintenance of natural patterns of longitudinal and lateral connectivity is essential to the viability of populations of many riverine species; Finally, the invasion and success of exotic and introduced species in rivers is facilitated by the alteration of flow regimes. The impacts of flow change are manifest across broad taxonomic groups including riverine plants, invertebrates, and fish. Despite growing recognition of these relationships, ecologists still

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### Flow variability and the ecology of large rivers

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**Abstract.** Ecological processes in large rivers are controlled by their flow variability. However, it is difficult to find measures of hydrological variability that characterize groups of rivers and can also be used to generate hypotheses about their ecology. Multivariate analyses of the hydrographs of 52 rivers worldwide revealed distinctive patterns of flow variability that were often correlated with climate. For example, there were groups of rivers that corresponded broadly with 'tropical' and 'dryland' climates. However, some rivers from continental climates occupy both extremes of this range, illustrating the limitations of simple classification. Individual rivers and groups of rivers may also have different

## COMMUNICATIONS

*Ecological Applications*, 16(4), 2006, pp. 1311–1318  
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### THE CHALLENGE OF PROVIDING ENVIRONMENTAL FLOW RULES

# The Natural Flow Regime

*A paradigm for river conservation and restoration*

N. LeRoy Poff, J. David Allan, Mark B. Bain, James R. Karr, Karen L. Prestegard, Brian D. Richter, Richard E. Sparks, and Julie C. Stromberg

Humans have long been fascinated by the dynamism of free-flowing waters. Yet we have expended great effort to tame rivers for transportation, water supply, flood control, agriculture, and power generation. It is now recognized that harnessing of streams and rivers comes at great cost: Many rivers no longer support socially valued native species or sustain healthy ecosystems that provide important

**The ecological integrity of river ecosystems depends on their natural dynamic character**

The extensive ecological degradation and loss of biological diversity

ing. However, current management approaches often fail to recognize the fundamental scientific principle that the integrity of flowing water systems depends largely on their natural dynamic character; as a result, these methods frequently prevent successful river conservation or restoration. Streamflow quantity and timing are critical components of water supply, water quality, and the ecological integrity of river systems. In-

# Objectives

- Increase growth of salmon fry and parr
- Synchronize flows of the regulated mainstem with its free-flowing tributaries
- Provide thermal cues for smoltification and downstream migration earlier in the year
- Increase nursery habitat availability for juvenile salmon
- Provide seasonally appropriate disturbance of the macroinvertebrate prey species for rearing salmonids
- Reduce effects of temperature suppression on growth of rearing salmonids

# Shifting a portion of Trinity River releases to the winter period

## Flow Synchronization Period (Dec 15 – Feb 15)

Synchronize a 60,000 af, high magnitude dam release with a winter flow event

- 6,500 cfs maximum flow from Lewiston Dam
- Forecasting tools from CNRFC at USGS mainstem gage above North Fork predicts 4,500-12,000 cfs event
- 72-hour notice to USBR
- 6 of 17 years analyzed from 2004-2019

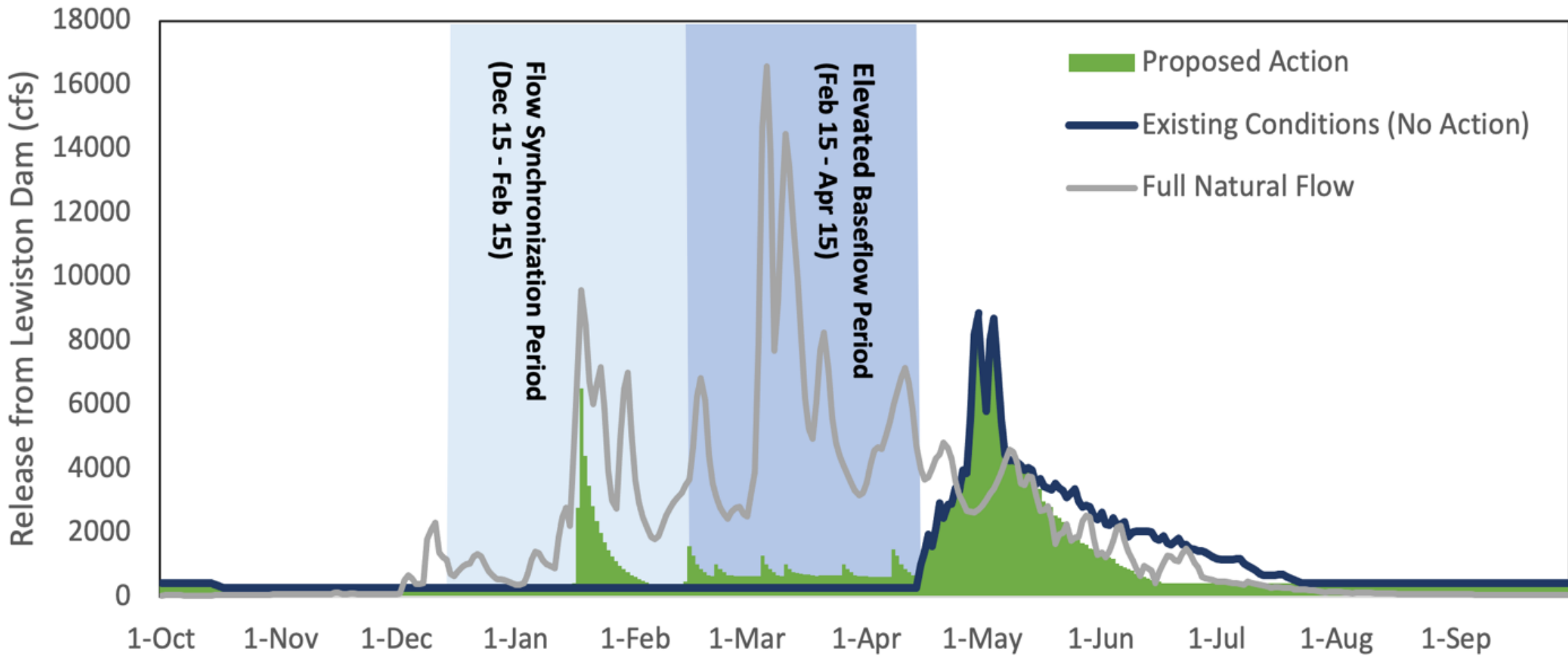
## Elevated Baseflow Period (Feb 15 – April 15)

- Two possible releases in Feb and March based on B120 90% exceedance forecast to predict water year type
- Volume released based on Decision Tree and winter period allocation of water year type

Water Year Type	ROD Water Volume (af)	ROD Volume Shifted to Winter Period under Proposed Action (af)	Percent ROD Volume Shifted from Summer to Winter under Proposed Action
Critically Dry	369,000	60,000	16%
Dry	453,000	80,000	18%
Normal	647,000	120,000	19%
Wet	701,000	180,000	26%
Extremely Wet	815,000	220,000	27%

# Trinity River Flow Management

example from water year 2016

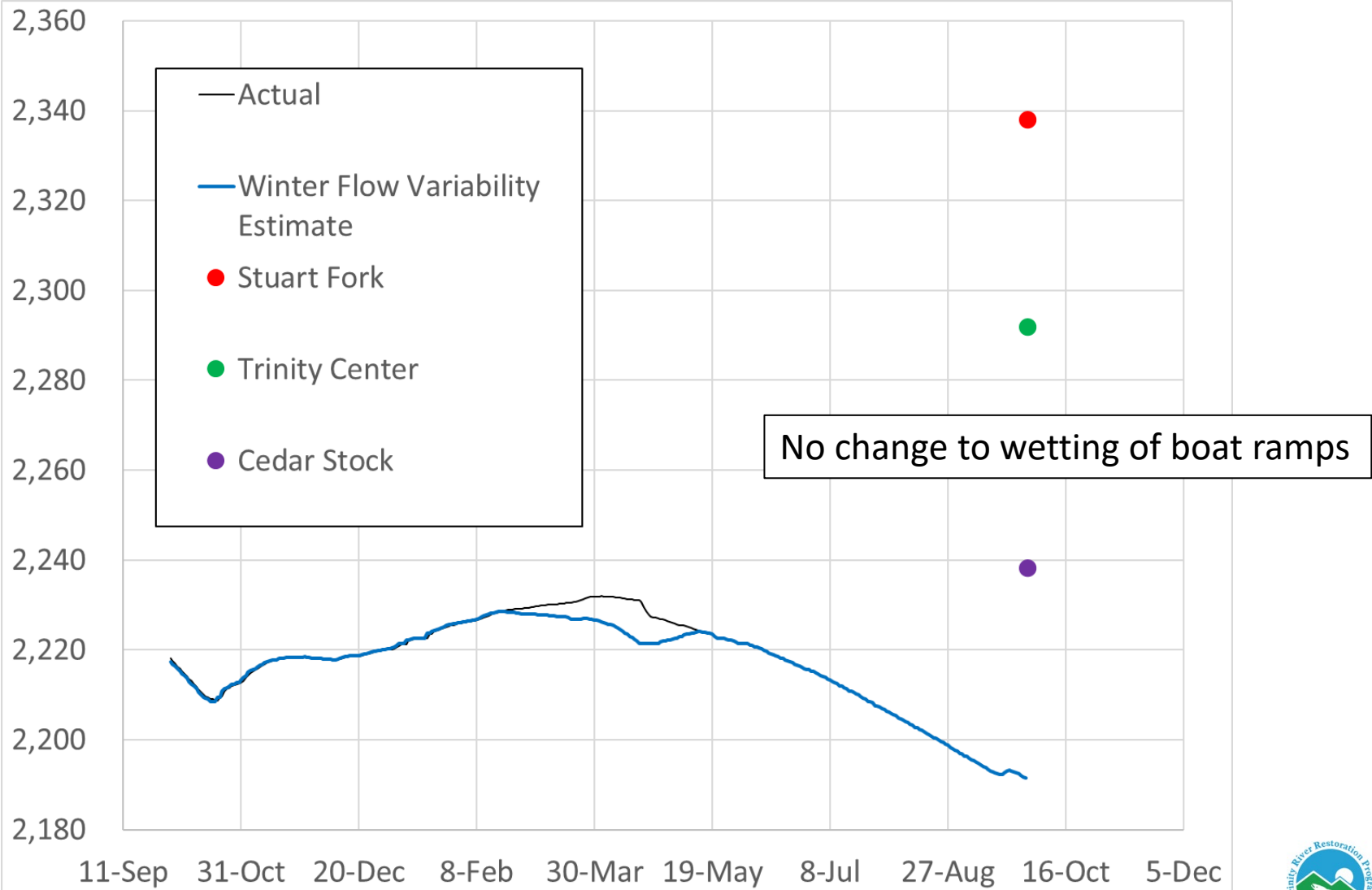


Year	Water Year Type	Trinity Power Plant Generation Market Value (\$ million)			
		No action (Existing Conditions)	Proposed Action	Market Value Difference	Percent Difference
2010	Normal	10.64	10.94	0.30	2.8
2011	Wet	12.46	12.98	0.52	4.0
2012	Normal	11.52	11.33	(0.19)	-1.7
2013	Dry	16.86	17.37	0.51	3.0
2014	Critically Dry	16.86	16.78	(0.08)	-0.1
2015	Dry	10.72	10.60	(0.12)	-1.3
2016	Wet	8.79	8.52	(0.27)	-3.1
2017	Extremely Wet	13.31	13.48	0.17	1.3
2018	Critically Dry	10.11	10.15	0.04	0.4
2019	Wet	10.05	11.72	1.67	15.3
<b>Total</b>	<b>All Water Year Types</b>	<b>121.28</b>	<b>123.86</b>	<b>2.58</b>	<b>2.1</b>



# WY 2022

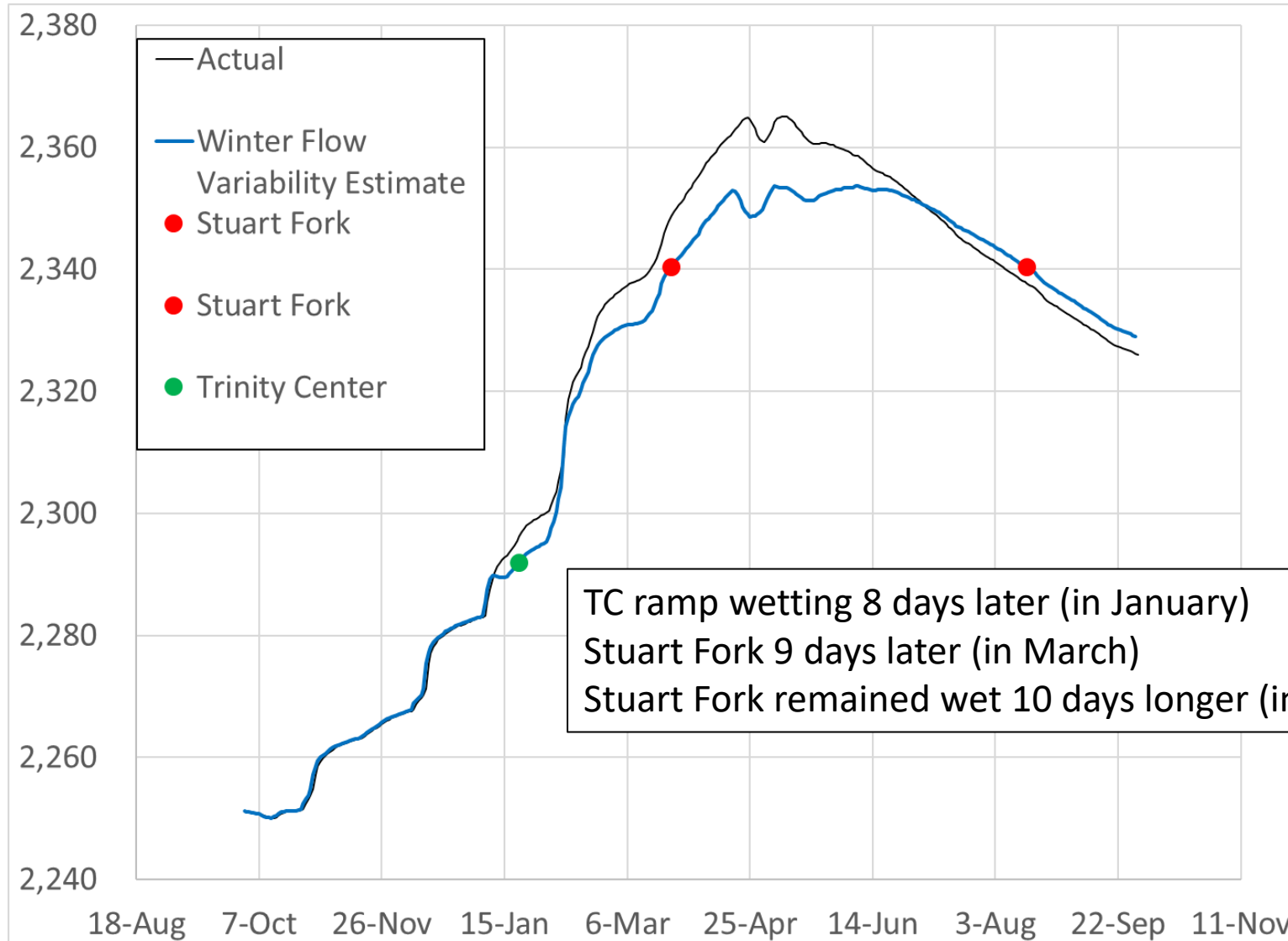
## Reservoir Elevation






# WY 2017

## Reservoir Elevation





If the benefit of providing naturalized flows to the Trinity is obvious, and the evidence is overwhelming, why hasn't TRRP changed their flow management?

- Change comes slowly
  - Adaptive Management moves slower than science. Its subject to politics and policy constraints
  - What seems obvious in retrospect takes time to mature to the point of implementation, especially for scientists!
  - Still, we recommend a conservative approach as a starting point to learn and adapt moving forward.
- The Trinity Management Council (TMC) approves flow changes
  - We would like to return to BOS in September to request the County's perspective on this important issue prior to the TMC meeting
  - We plan to take the winter flow proposal back to TMC for WY2023 at their September meeting with additional analyses to address key questions

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# Questions?

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