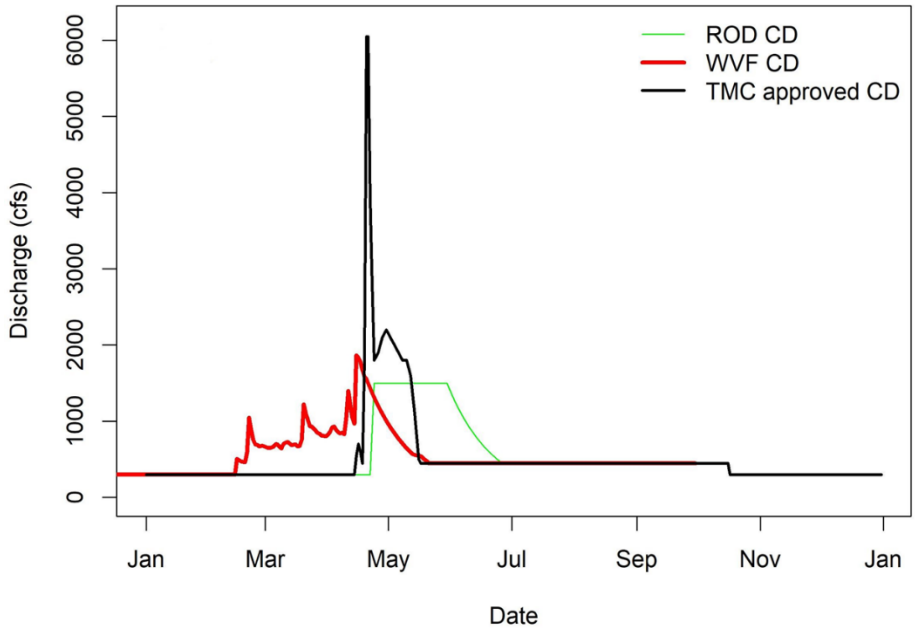
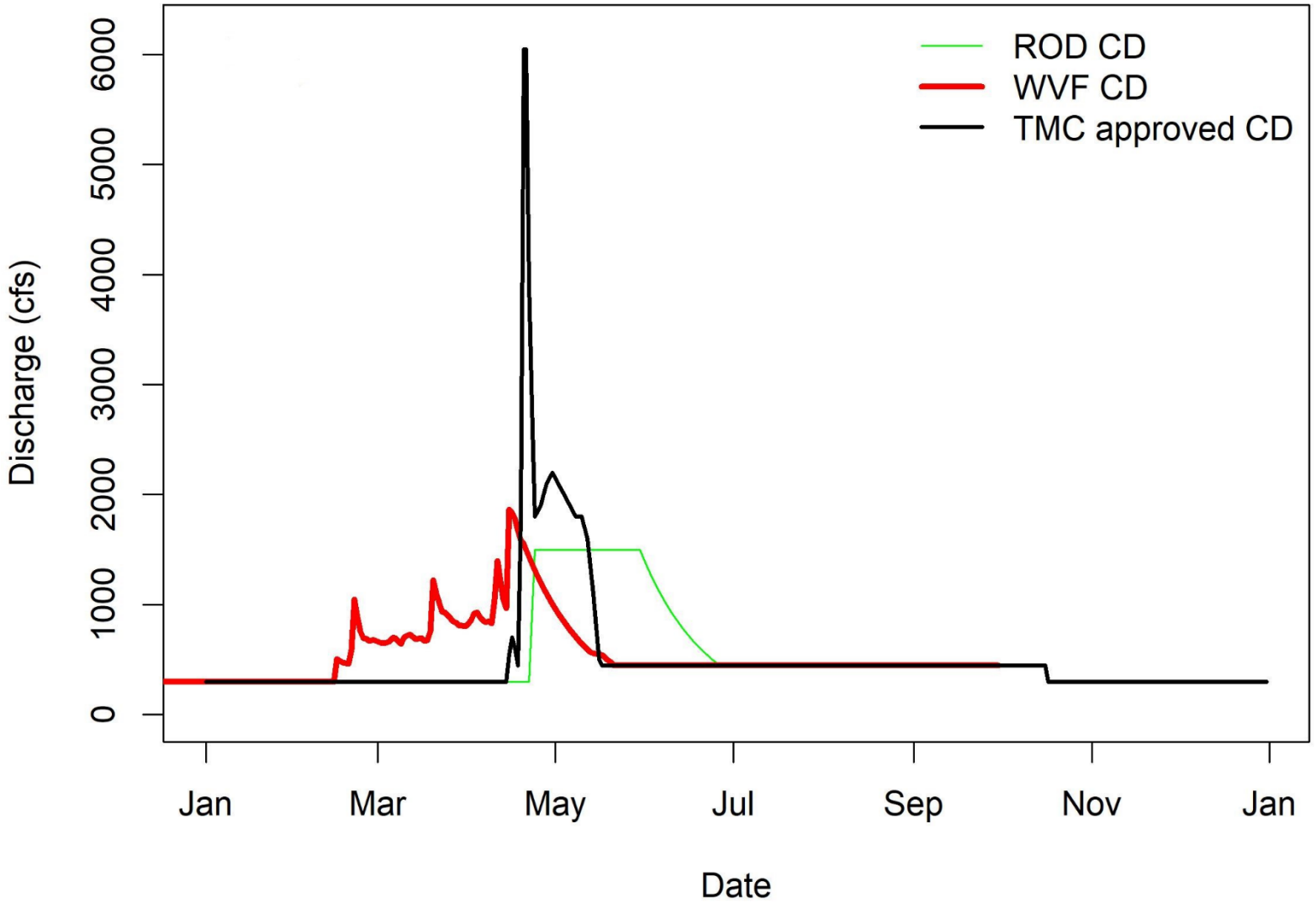
WY22 Retrospective and Winter Flow Scenario Analysis



Trinity Management Council
June 15-16, 2022
Weaverville (and virtual)

Chad Abel, Seth Naman, Ken Lindke, Kyle DeJuilio, Chris Laskodi, Eric Petersen, Nick Som, Mike Dixon

River Flows 2022



Water Temperatures 2022

- Difference between modeled temperatures for TMC approved flow and winter flow EA were generally small
- Expected result in dry and critically dry years
- Differences were larger when compared to the ROD hydrograph

		ROD Crit Dry	TMC approved	Winter Variable Flow
EIS Temperature objectives for adult salmon holding/spawning at Douglas City July1-Sept 14 (exceedance °C days)				
		0.04	0.04	0.04
EIS Temperature objectives for adult salmon holding/spawning at Douglas City Sept 15-Sept 30 (exceedance °C days)				
		9.7	9.7	9.7
EIS Temperature objectives for adult salmon holding/spawning at Douglas City Oct 1-Dec 31 (exceedance °C days)				
		5.0	5.0	5.0
Temperature Objectives for outmigrating juvenile salmon at Weitchpec (exceedance °C days)				
	Steelhead	36.2	54.2	69.7
	Coho Salmon	19.1	59.2	59.2
	Chinook Salmon	95.1	132.0	132.0
Temperature objective for juvenile salmonid rearing Trinity above NF Trinity River April 1-July 31 (degree days >13 °C <16.5 °				
		-30.8/92.9	-36.9/127.8	-27.1/127.8

Juvenile Chinook Salmon Biomass

- Used Stream Salmonid Simulator to model effects of winter flow action and TMC approved flow releases on juvenile Chinook Salmon biomass and abundance from 2006 to 2019.
- Calculated percent difference in biomass and abundance between winter flow action and TMC approved flow releases.

		Pear Tree						Weitchpec					
Water Year	WY Type	Fry Abundance	Parr Abundanc	Smolt Abundance	Total Abundance	Total Biomass	Biomass Per Fish	Fry Abundance	Parr Abundance	Smolt Abundance	Total Abundance	Total Biomass	Biomass Per Fish
2006	Ext Wet	-9.1%	7.5%	0.0%	-0.5%	8.8%	9.3%	-1.0%	6.2%	-89.8%	1.8%	9.5%	7.6%
2007	Dry	2.0%	2.3%	0.0%	2.2%	6.9%	4.6%	4.1%	-1.5%	226.3%	1.1%	6.1%	4.9%
2008	Dry	-1.8%	1.2%	0.0%	0.0%	5.0%	4.9%	-5.8%	6.5%	-66.9%	-0.3%	4.5%	4.9%
2009	Dry	0.7%	-0.9%	0.0%	-0.1%	-0.8%	-0.7%	5.4%	-2.0%	317.2%	1.2%	2.3%	1.0%
2010	Wet	-6.6%	8.5%	0.0%	-2.5%	2.8%	5.4%	-1.0%	2.0%	-52.8%	0.1%	2.2%	2.1%
2011	Wet	-9.0%	13.6%	0.0%	-1.9%	5.2%	7.2%	-10.9%	14.4%	-21.1%	-2.7%	1.1%	3.9%
2012	Normal	-6.1%	9.0%	0.0%	-0.6%	4.3%	5.0%	-4.2%	4.4%	-93.4%	-0.1%	4.0%	4.1%
2013	Dry	-2.7%	2.0%	0.0%	-0.7%	3.1%	3.8%	2.5%	0.4%	1105.1%	1.4%	3.8%	2.4%
2014	Crit Dry	-1.4%	0.9%	0.0%	-0.7%	-1.2%	-0.5%	-5.1%	-0.6%	-51.1%	-2.7%	-2.8%	-0.1%
2015	Dry	1.8%	-2.1%	0.0%	0.3%	-0.2%	-0.5%	-2.2%	0.5%	124.7%	-0.6%	-2.1%	-1.5%
2016	Wet	-0.4%	-1.3%	0.0%	-0.6%	-1.3%	-0.7%	19.2%	-10.4%	-95.0%	0.2%	-8.5%	-8.6%
2017	Ext Wet	0.8%	5.7%	0.0%	1.5%	-0.2%	-1.7%	0.1%	0.0%	-97.2%	0.1%	-1.0%	-1.1%
2018	Crit Dry	-4.2%	5.5%	0.0%	-1.4%	1.6%	3.1%	-6.5%	2.2%	45.5%	-2.2%	-0.5%	1.7%
2019	Wet	2.9%	-0.7%	0.0%	1.3%	3.5%	2.2%	-0.7%	2.8%	-90.7%	1.0%	1.9%	0.9%
	Average	-2.37%	3.66%	0.00%	-0.26%	2.67%	2.95%	-0.43%	1.77%	82.92%	-0.12%	1.46%	1.57%

Juvenile Chinook Salmon Biomass

- Increase in biomass in 9 of 14 years at Pear Tree and Weitchpec.
- Increases in parr and smolt abundance because fish grow larger in the model under winter flow scenario.
- The S3 model results indicate having higher flows in the winter and spring, which is how rivers normally function, has a positive effect on fish size and total biomass.
- Bottom line: The S3 model results suggest moving flows from the spring to the winter, in a more normal river flow pattern, moves the needle in the correct direction!

		Pear Tree						Weitchpec					
Water Year	WY Type	Fry Abundance	Parr Abundanc	Smolt Abundance	Total Abundance	Total Biomass	Biomass Per Fish	Fry Abundance	Parr Abundance	Smolt Abundance	Total Abundance	Total Biomass	Biomass Per Fish
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2007	Dry	2.0%	2.3%	0.0%	2.2%	6.9%	4.6%	4.1%	-1.5%	226.3%	1.1%	6.1%	4.9%
2008	Dry	-1.8%	1.2%	0.0%	0.0%	5.0%	4.9%	-5.8%	6.5%	-66.9%	-0.3%	4.5%	4.9%
2009	Dry	0.7%	-0.9%	0.0%	-0.1%	-0.8%	-0.7%	5.4%	-2.0%	317.2%	1.2%	2.3%	1.0%
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2015	Dry	1.8%	-2.1%	0.0%	0.3%	-0.2%	-0.5%	-2.2%	0.5%	124.7%	-0.6%	-2.1%	-1.5%
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2017	Ext Wet	0.8%	5.7%	0.0%	1.5%	-0.2%	-1.7%	0.1%	0.0%	-97.2%	0.1%	-1.0%	-1.1%
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2019	Wet	2.9%	-0.7%	0.0%	1.3%	3.5%	2.2%	-0.7%	2.8%	-90.7%	1.0%	1.9%	0.9%
	Average	-2.37%	3.66%	0.00%	-0.26%	2.67%	2.95%	-0.43%	1.77%	82.92%	-0.12%	1.46%	

Reservoir Storage

- For reservoir levels on the 4th of July, inflow was of greatest relevance, followed by carryover storage, then diversions and finally releases to the river.
- Diversions to the Sacramento River explained more than two times more variation than did releases to the Trinity River.
- Remember: you can see the water flowing down the Trinity River every day, but you cannot see the water flowing through the twin tunnels to the Sacramento River.

Retrospective Analysis of the Relevance of Trinity River Restoration Flows to Trinity Lake (Reservoir) Levels

Eric B. Peterson
Trinity River Restoration Program
Weaverville, CA

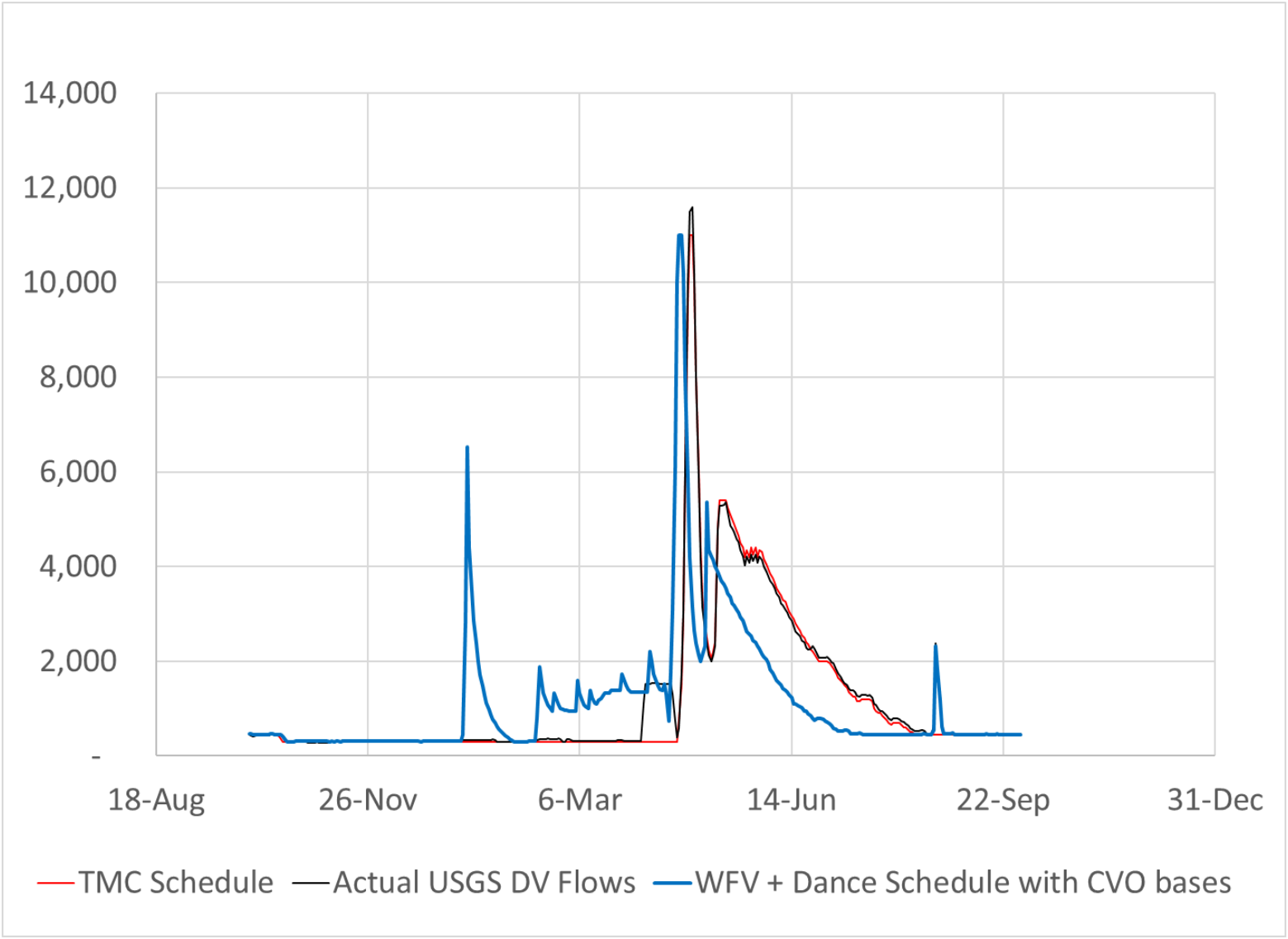
June 3, 2022

DRAFT

Filling of Trinity Lake (a reservoir), ca. 1961. Photo courtesy of the Van Metre family.

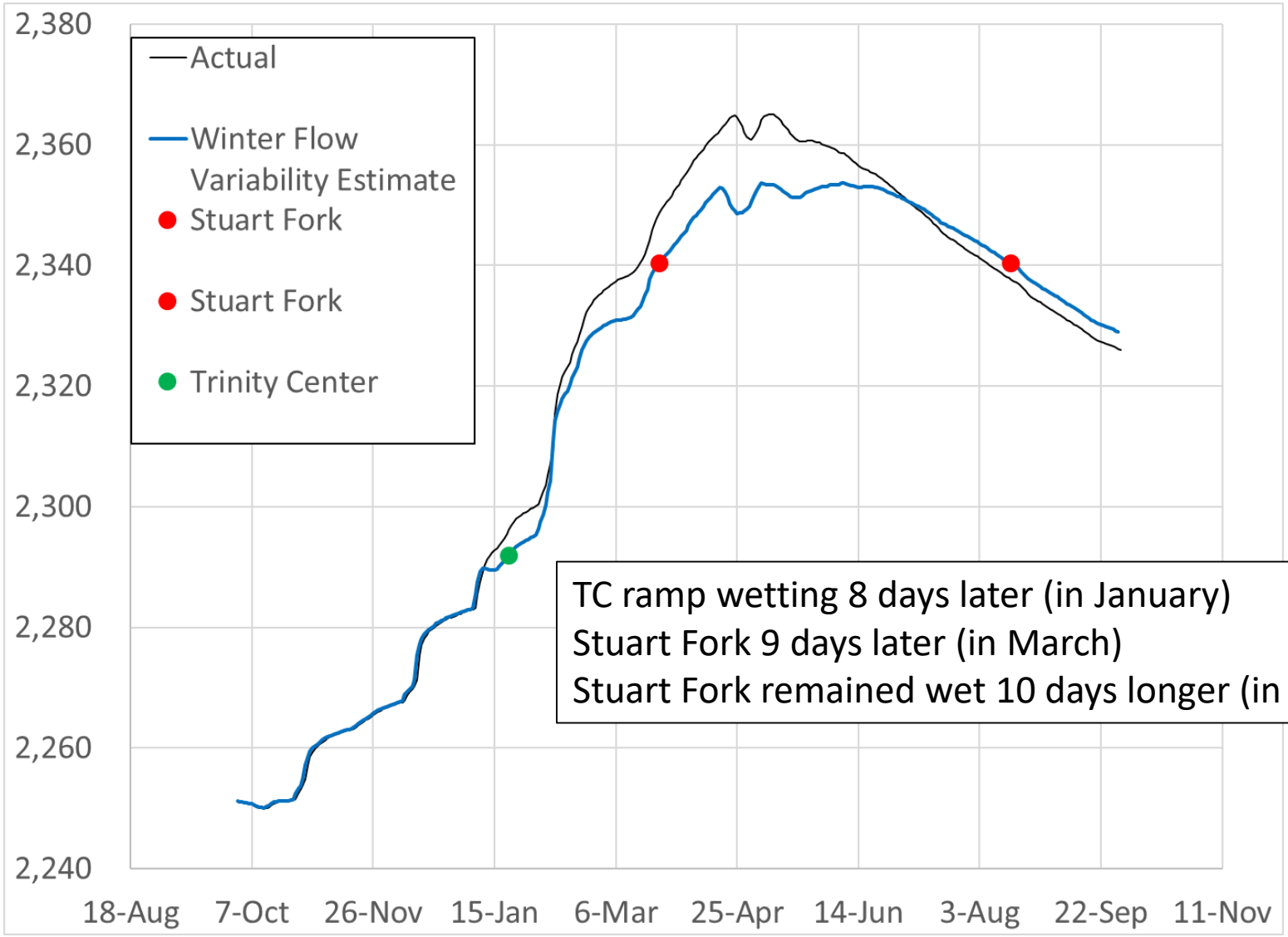
WY 2017

River Flows



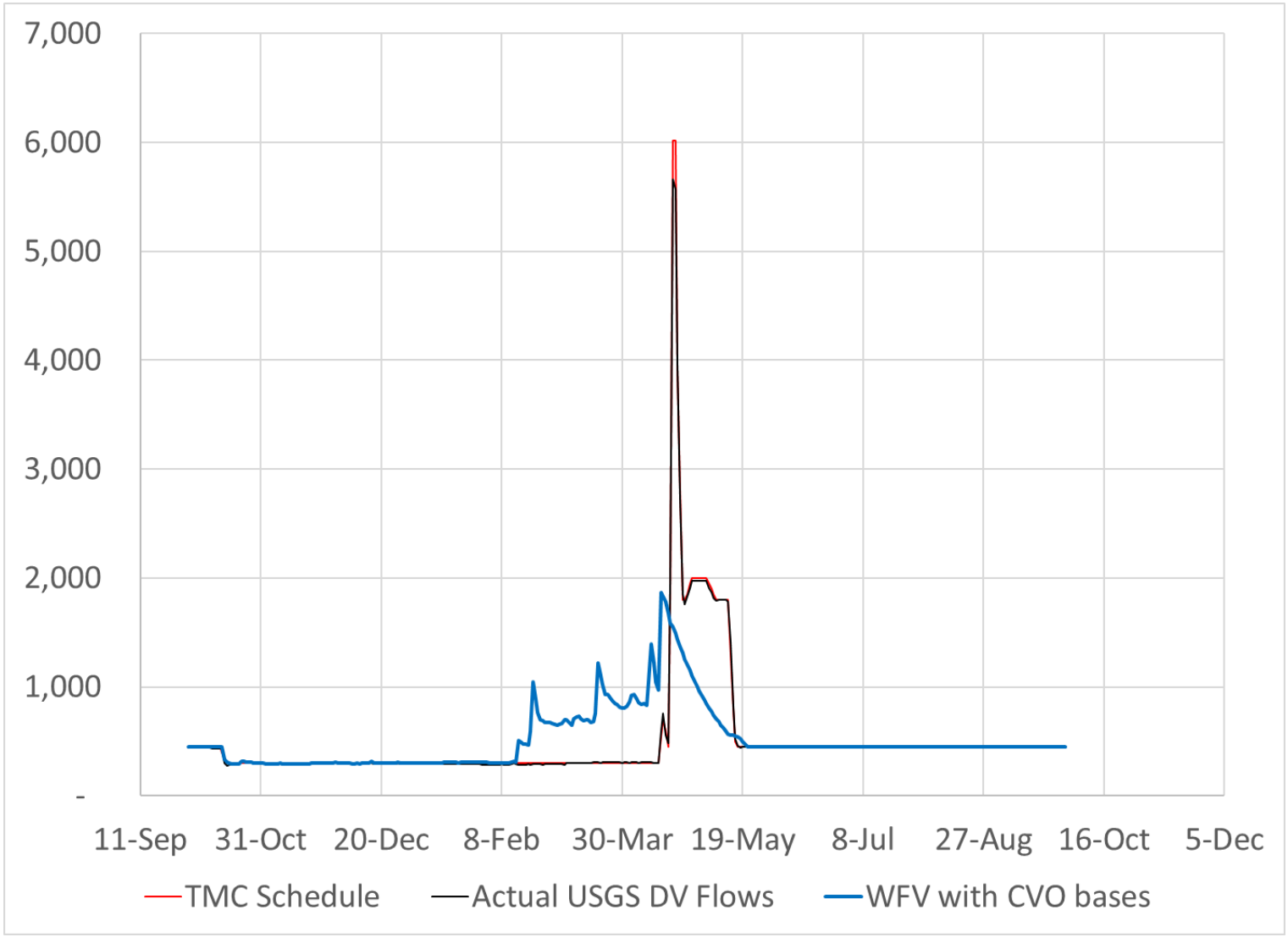
WY 2017

Reservoir Elevation



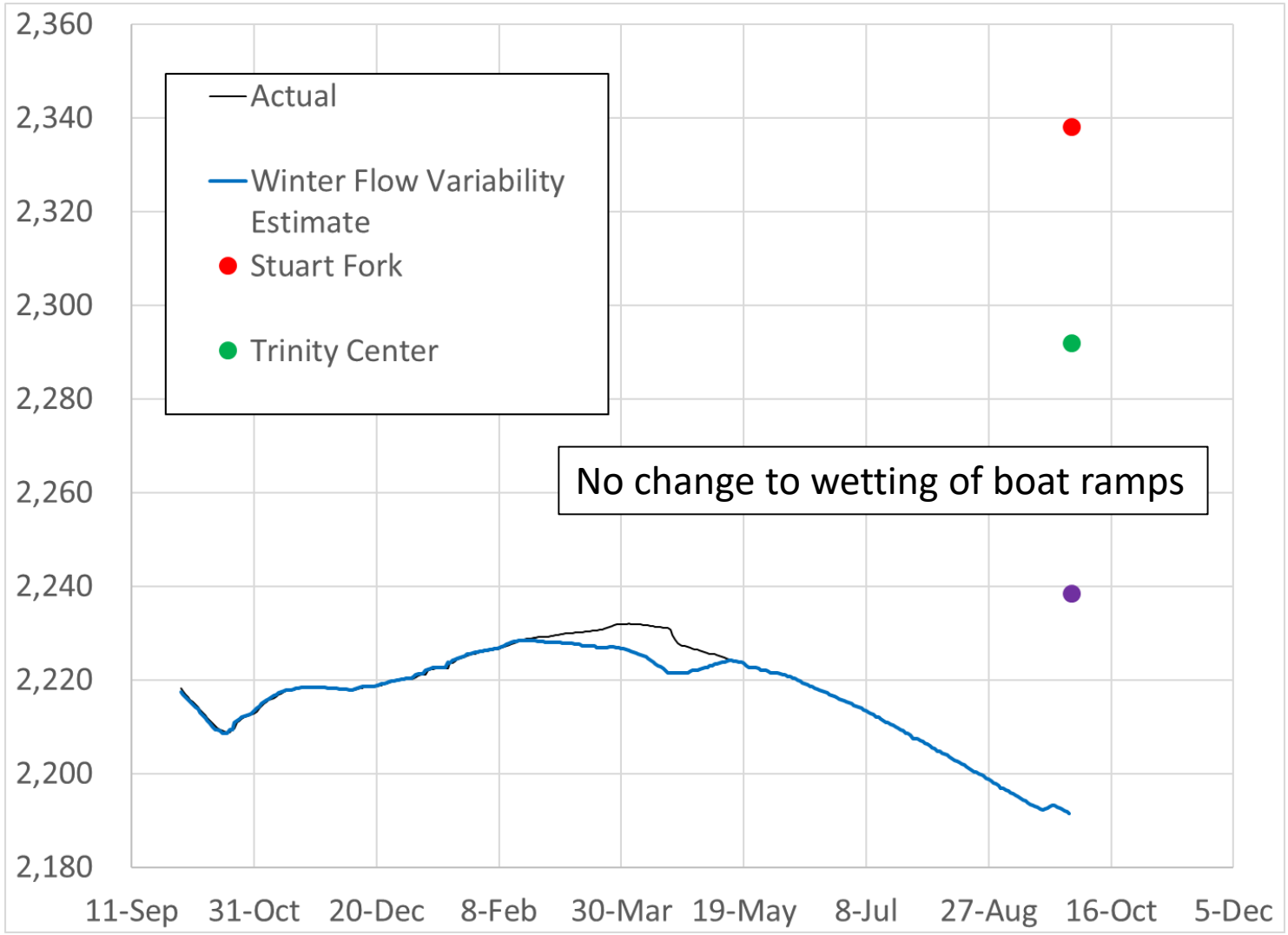
WY 2022

River Flows



WY 2022

Reservoir Elevation



Reservoir Storage

- As described in the Winter Flow EA, the action uses the same volumes of water as the ROD volumes.
- Therefore, the effects of the action on reservoir levels is not different than the typical ROD spring only flow release.
- The release of water as a diversion to the CVP is more than twice as strong of a predictor of Trinity Reservoir levels than river releases (Peterson 2022).

"Using the B120 90 percent exceedance water supply forecast to predict water volumes available for elevated base flows after February 15 is a conservative approach that would avoid "overspending" ROD volumes during the Flow Synchronization or Elevated Baseflow periods because the forecast is a conservative water year prediction tool." Page 17

Under the Proposed Action and as described in Section 2.2.2, winter baseflow increases based on predicted water year type would occur during the Elevated Baseflow period, between February 15 and April 15. Since the implementation of ROD flows in 2004, the February and March 90 percent exceedance water supply forecast has never overpredicted the observed water year determination. Page 17

"This flow management action has been designed to safeguard against the possibility that the actual water year determination (made in April each year) ends up being less wet than predicted, as the overall volume of water to be shifted to the winter flow period (Table 1, fourth column) is considerably less than the ROD volume for the water year type" Page D8

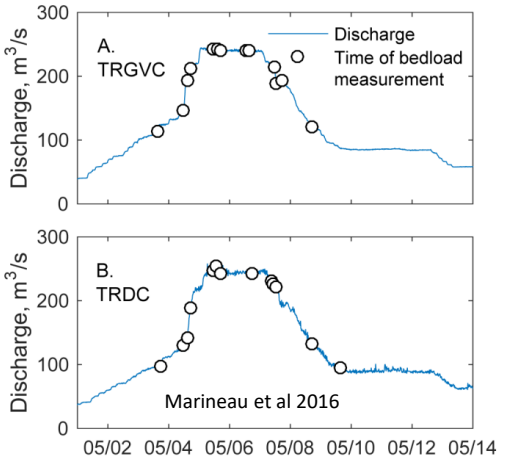
Other concerns with EA- Lack of SAB Review

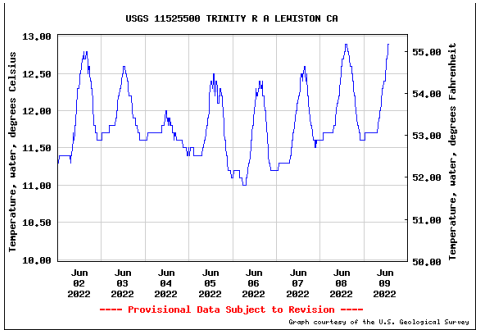
- SAB Members John Buffington and Andrew Paul reviewed Winter Flow white paper
- Provided 21 comments, not including editorial and other changes
- All comments tracked and addressed
- White paper included as appendix
- All SAB reviewer comments adopted into EA

Comment Type	Page Number	Line Number	Comment	
			The argument for the proposed shift in flow release makes ample sense to myself and is well supported. However, at the time the current flow release was developed under the record of decision in 2000, the natural flow paradigm was well established in the scientific literature and was becoming increasingly recognized in applied river management. A question that should be addressed in this white paper is why wasn't a larger portion of the available flow shifted to match the natural season pattern? Where there other interests that superceded environmental concerns or was this an oversight? If the former, the white paper will need to address these interests.	The Authors of the Trinity River Flow Evaluation (TRFE; USFWS and HVT 1999) expected the document to be litigated and were given council that "natural for the sake of natural" was not an argument that was likely to hold up in court. The prescribed flows were justified using models for various ecosystem services, including bedload transport, temperature, and physical juvenile salmonid habitat. The "habitat dip" predicted similar amounts of habitat to be available at both relatively low and moderate flows. Despite physical habitat models being insufficient to describe the needs of fish, beyond areas of depth and velocity similar to those where fish are observed, lower flows were selected. We think you may be oversating the established nature of the natural flow paradigm at the time of the TRFE. While Junk 1989 had been around for a decade, it was focused on tropical systems. It can be argued that the natural flow paridigm was only just being established in literature for montaine temperate systems . Poff et al. 1997 and Tockner et al. 2000 were published at the end of or just after the TRFE was complete. Without a willingness to rely on the natural flow regime as justification for water volume or timing, water interests called for the water year to be determined prior to large releases occuring, which resulted in the April 1 determination and resulting release schedule. The interests that required information about the water year are addressed by describing in detail the predictive tools that will be used to make decisions about release to prevent over allocation.
	e 1	para. 1	The term "instantaneous" is ambiguous An "instantaneous" decline (if interpreted as within the same year) of returning adult salmonids might suggest something other than the flow diversion lead to the decline. Given juvenile salmonids spend several years (2-5?) at sea, we may have expected a "delayed" or "lagged" decline in returning adults. Be specific (i.e., years), as to when the decline was observed relative to the start of diversions.	The term instantaneous was borrowed from the authors of the Flow Eval Study
	e 1	para. 1	Delete the reference to Figure 1. There's no information in Figure 1 that 90% of inflows are being exported.	change made
	e 1	para. 4	Change to "...TRD removed nearly all high flows that **are important** for forming and maintaining the alluvial river..." High flows aren't the only factor responsible for alluvial rivers but rather the combination of several factors including geology, valley morphology, etc.	change made
	e 2/3	Objectives	State the end objectives, e.g."provide synchronized connectivity between tributaries and mainstem river", "restore alluvial river features", "increase juvenile salmonid growth during the summer growing season"... The objectives currently listed are hypothesised means to obtain the desired objectives. Although this might seem a subtle difference, it's a very important distinction for both stakeholder understanding and future monitoring. That is, there's an important differnce between "wanting higher winter flows because they're closer to natural" versus "wanting higher winter flows because they're closer to natural and are expected to	rewrote these objectives and elaborated on hypothesized mechanisms under "proposed action" subheading
	e 3	Figure 1	Remove the green Carr Diversion bars from the figure...they provide no relevant information and distract from the shift in seasonal flows on the Trinity.	True, but the figure as-is also demonstrates the volume shift in the full diversion and transitional era that's of additional value to reader, even if not the primary purpose of the figure
	e 3	para. 3	Define the acronym OCAP...or better yet delete the acronym and just use the actual words.	change made
	e 3	para. 3	Acronym TRD has already been defined. A very cool adaptive management experiment would be to remove all acronyms from some Trinity River documents and test whether readers are more or less confused by either using or omitting acronyms ;-)	change made
	e 3	para. 4	You can now link the prior objectives (see comment above) to the means (hypothesized mechanisms) by which shifting flows to the winter period would achieve the end objectives.	This relates to rewriting the objectives above. Change made
	e 4	para. 1	Why is this called the "Flow Synchronization Period"? Specifically state the purpose of this flow release would be to synchronize a winter high flow event in the tributaries with a corresponding high flow event that would have naturally occurred in the mainstem from the watershed above the Lewiston Dam. Link this recommendation to the hypothesized means discussed previously...that is, what means objectives are these objectives expected to acheive? Movement of alluvial material?	change made
	e 4	para. 2	What's the B120? What hypothesized means objectives are these releases intended to achieve?	
	e 4	Figure 2	Is a synthesized natural flow record available for the 2016 water year? If so, add this to the figure.	Added
	e 4/5	Forecasting	State that the proposed flow management regime requires releases to be made earlier (December to April) than in previous management regimes (mid April). This is necessary to mimic the natural hydrograph and produce the hypothesized benefits to the aquatic environment. Then discuss how this proposed change is not expected to produce downstream flooding or alter the annual water year volume release to the Central Valley given NOAA's river forecast centre and past performance of the B-120 water year predictions on February 15th.	incorporated this comment and moved "flow forecasting" subheading immediately below Flow Synch Period for clarity as to when the forecasting tool will be used.
	e 5	para. 3	Discharge under the proposed action after April 15th would not follow the same pattern as the current action (see Figure 2). Explain how the reductions in the proposed action are implemented to ensure total volume delivered to the Central Valley remains the same as the current action.	It would follow the same protocols for implementation through the TRRP, TMC, and USBR process using a lesser water volume, there would be no impacts because the total volume remains the same.
	e 7	para. 3	"No population increases without limit"...from Charlie Krebs (1988) book *The Message of Ecology* . Density-dependent effects are to be expected so are you hypothesising the mean length regression would: a) become a flat line; or, b) be shifted upwards ? The latter is still density-dependence but with bigger fish. Unless you have a specific hypothesis regarding the observations, I would suggest simply deleting the entire paragraph.	The third paragraph under "Food Availability" has been removed
	e 10	Figure 5	In the caption note which graphs are the extremely wet and the critically dry years.	added
	e 11	para. 1	Figure 6 gives us no information on Cmax beyond 15C so we don't know what's happening at 18C. All species will show proportion of Cmax decline at some point as temperatures continue to increase.	I can provide graph with higher range of temps
Specific	page 11	para. 3	Can you just call "non-adipose fin-clipped" "wild"? Change the figure as well, if so.	no, only 25% of hatchery fish are adipose cliped and the term used for fish produced outside of the hatchery in an integrated population is "natural origin" which is inclusive of hatchery progeny, "wild" is a term that has conotation of lack of domestic influence, a more appropriate term would likely be farel.
Specific	page 13	Redd Scour	Isn't the strongest argument against this perceived concern being redds naturally would have handled even higher peak flow events? Or, is their an argument the redds would have historically been constructed in areas that would have avoided higher flow events (e.g., above Lewiston Dam)?	no, experiencing higher flows under a historic channel form with different dimensions, grain size composition gives no representation of the risk of scour under current conditions or the proposed action.

Other concerns with EA- Lack of Effectiveness Monitoring

- **Channel mobilization**
  - Bedload monitoring equipment can be deployed with as little as one day of notice at selected locations, and used to show whether channel bed mobilization occurred.
- **Water temperature**
  - Currently monitored extensively.
  - Ongoing juvenile salmonid trapping combined with water temperature monitoring can provide insight on growth (long term time series may be needed).
- **Trinity Reservoir**
  - Reservoir elevation and boat ramp inundation is easily monitored





Other concerns with EA- Lack of Effectiveness Monitoring

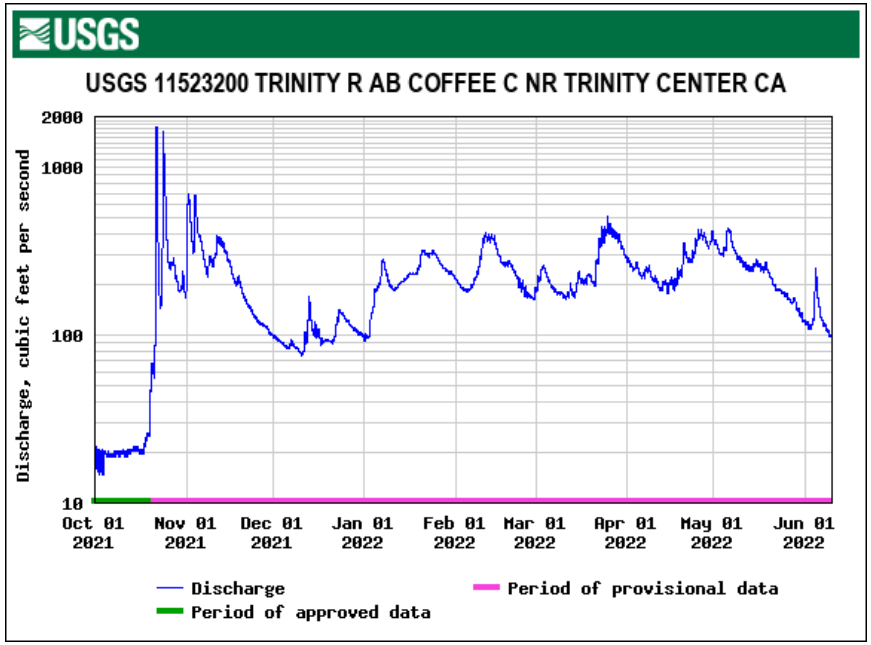
- **Food availability**
  - Can be monitored through floodplain inundation frequency and duration using SRH-2D.
  - Direct sampling of invertebrates on floodplains can be performed pre, during, and post winter flows.
  - Research to be implemented in FY2023 will conduct macroinvertebrate and periphyton sampling in inundated floodplains, comparing colonization and productivity to adjacent perennially wetted areas.
- **Floodplain inundation**
  - Can be monitored through floodplain inundation frequency and duration using SRH-2D and real-time field monitoring.

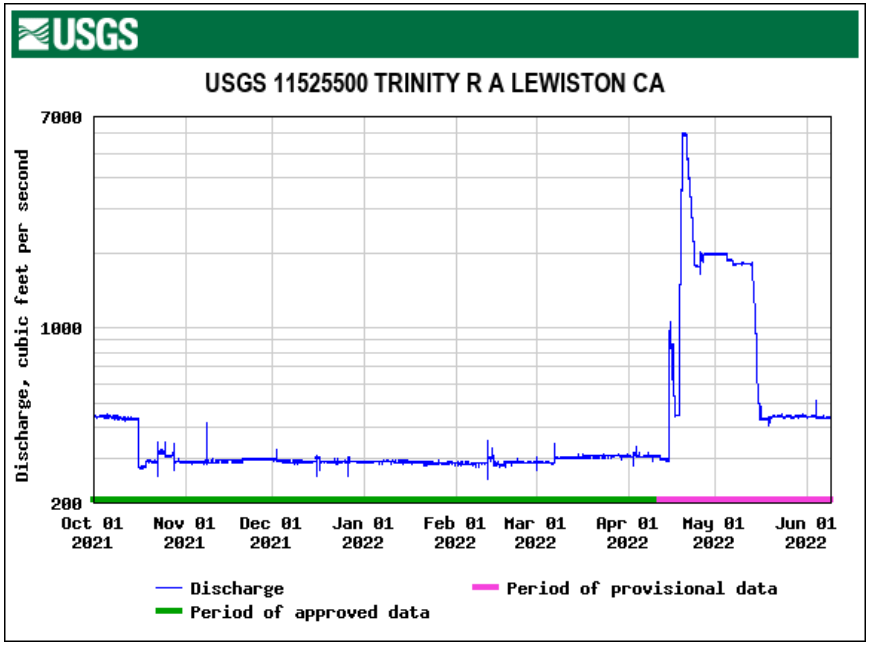
Conclusion

- Implementing the winter flow EA for water year 2022:
  - Would have inundated floodplains during the juvenile salmonid rearing period
  - Would have provided more foraging opportunities for rearing salmonids
  - Would have provided a more dynamic ecosystem for fish and wildlife
  - Would not have had deleterious temperature effects
  - Would not have changed carryover reservoir elevation except to increase in years when dam safety releases would have been needed.
  - Several TRRP objectives could have been monitored
  - Likely would have increased parr and smolt abundance as well as total biomass

blm.gov

Questions?


USGS
USGS 11523200 TRINITY R AB COFFEE C NR TRINITY CENTER CA
Discharge, cubic feet per second
2000
1000
100
10
Oct 01 2021
Nov 01 2021
Dec 01 2021
Jan 01 2022
Feb 01 2022
Mar 01 2022
Apr 01 2022
May 01 2022
Jun 01 2022
Discharge
Period of provisional data
Period of approved data


USGS
USGS 11525500 TRINITY R A LEWISTON CA
Discharge, cubic feet per second
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1000
200
Oct 01 2021
Nov 01 2021
Dec 01 2021
Jan 01 2022
Feb 01 2022
Mar 01 2022
Apr 01 2022
May 01 2022
Jun 01 2022
Discharge
Period of provisional data
Period of approved data