Comments and Responses on the "Winter Flow Variability – Preliminary results and future recommendations" presentation to the Trinity Management Council, September 14, 2023.

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Below are specific comments and/or questions concerning the Winter Flow Variability (WFV) presentation given to the TMC on September 14, 2023. Some of these comments may have been addressed during the presentation and discussion at the meeting but since I was not in attendance any clarification that you can provide is greatly appreciated.

I think understanding and acknowledging the challenges in monitoring and assessing the effectiveness of flow management in a complex physical-biological system of the Trinity River requires some tempering of expectations of what can be achieved through monitoring, especially in one year. It is my understanding that some entities and individuals were under the impression that the TRRP would have the answer of how effective the WFV was after the first year, so being very clear with what expectations are and potential shortcomings of assessments is critical. Using the DSS Matrices in presenting summarized information could greatly help the facilitation of information transfer. The more comprehensive DSS table (Appendix A) in the July 2023 memo to the IDT and Technical Workgroups from the Flow Workgroup has most of the information that would really be useful in assessing the effectiveness of proposed hydrographs and could then be paired with actual monitoring data collected to measure the effectiveness of those flows. Of course the Table would have to be updated with newer metrics such as invertebrate production, changes in winter rearing temperatures, habitat availability, and others as appropriate.

I also want to thank all of you for taking the time to discuss this effort with me as I, like all of you, think evaluating the effects of increasing winter flows to enhance juvenile Chinook Salmon rearing is critical to meeting programmatic goals of increasing fish production in the Trinity River.

Specific Comments on Slides:

Slide 6 lists six intended benefits of the "winter Variable Flow" project. Understanding that some of the data are still being processed, at least that should be identified in the presentation. Also, timelines for when results will be available should be provided (at least ballpark estimates) to manage expectations of when answers will be available. And it is critical to manage expectations on the ability to detect large or definitive results in monitoring a complex system; and it will not happen in one year.

Response: While it isn't explicitly highlighted in the presentation, an attempt was made to explain that we were presenting all the information that we had to date and that additional analyses would be performed when additional data streams became available. While this was stated at both the public and TMC presentations, it is possible that information was not as clear as intended. Your points about providing timelines and abilities to detect changes are good and we will incorporate those moving forward. We are in the early stages of developing a formal peer reviewed report that will include numerous analyses of WY2023 WVF implementation.

Only information on the 1st and 6th bullet are presented to varying degrees.

- **1st Bullet.** Data on size from Willow Creek monitoring site, invertebrate biomass and water temperatures are presented. Information from the Pear Tree outmigrant monitoring site needs to be evaluated and included in this assessment because it is the most proximate location to the flow treatment.

  Response: We agree that Pear Tree data will be necessary to add, but the data was not available in time for these presentations. However, it is important to recognize the limitations of these data relative to biological responses to WVF implementation. We would expect to see some response to hypothesized increased food availability, but far less so for the benefits of temperature improvements expected in early summer because most of the fish are downstream of Pear Tree by then. It is more likely to see benefits of temperature improvements at Willow Creek. Regarding this year in particular, hypothesized benefits from food production may have been muted by the particularly cold temperatures observed this year during the residency time of juveniles in the upper river. We intend to use fish size and temperature data from Pear Tree to estimate ration using a bioenergetics model, and compare estimates to previous years in an attempt to account for these nuances.

- **2nd Bullet.** No information on outmigrant timing is provided. Since data for the population estimate at the Willow Creek site is available, the emigration timing analysis should be provided. Information on outmigrant timing from the Pear Tree outmigrant monitoring site needs to be evaluated and included in this assessment because it is the most proximate location to the flow treatment.

  Response: Outmigrant timing at the Willow Creek site is highly variable but is most correlated to accumulated thermal units at the Pear Tree site (Gast 2021). Additionally, desirable timing of outmigration is dependent upon Lower Klamath River conditions, and we have not developed specific criteria by which to assess timing other than noting that earlier is probably better in dry years and later is probably better in wet years. The distribution of timing of outmigration presents another problem, as RT80 has been used in the past, but is relatively unresponsive to environmental variability except for the formation of a thermal barrier. RT50 has been explored and is more responsive to environmental variability, but still is limited in its description of outmigration.

3rd Bullet. Since the prescribed flows did not occur during the Chinook and Coho spawning periods it is unclear how the winter variable flow project would expand spawning habitats and unclear why this was one of the intended benefits. This should be clarified. If this was associated with the winter "piggybacking" peak flow then that should be explained, especially how that would help expand spawning habitats since they were planned to be fairly short events.

Response: The synchronized flow release is not intended or expected to significantly improve spawning conditions for salmon and/or steelhead. The elevated baseflow does take place during the steelhead spawning season, albeit toward the tail end. Hatchery steelhead and Coho Salmon spawn primarily in the same section of river below Lewiston Dam, and the action could reduce superimposition of steelhead redds on top of Coho Salmon redds by providing newly

available habitat and changing the depth and velocity found at previous redd locations. The species intended to target under this bullet could have been specified.

- **4th Bullet.** What information is available to evaluate the benefits for frogs and turtles. Monitoring data or model outputs supporting this should be presented.

  Response: Water temperature and timing of scour are the primary factors that affect these populations. These can be assessed for foothill yellow-legged frogs using FYFAM. This was not done as management decisions are not particularly sensitive to these species, but we will consider adding this analysis.

- **5th and 6th Bullets.** It is unclear how the WFV was intended to meet geomorphic objectives since the only information presented was on bed disturbance. If this intended benefit was primarily expected if a flow was released during the Flow Synchronization Period, then disregard this comment but including that in the presentation would be helpful.
  Response: All geomorphic objectives are met by the synchronized portion of the action and re-scheduling of flows after April 15. This was analyzed and documented in the winter flow report. We have used bed disturbance in this work to refer specifically to a much lower level of bed mobility than geomorphic work, specifically just the tumbling of gravel and small boulders in the perennial channel to re-set the macroinvertebrate community.

Slide 11. What is the 9-week lag period of salmonid prey abundance and disturbance based on. The graph implied that the magnitude of prey abundance is directly proportional to the timing of the first 6000 cfs release; Is this the case or am I misinterpreting the graph?

Response: This slide is particularly difficult to interpret without seeing the presentation in-person. Most of the explanation was verbal. The red curve shows the distribution of the first date of the first 6,000 cfs flow of the year at Lewiston based on the historic record. The black curve is that same curve shifted 9 weeks later, which is intended to show how, on average, the peak macroinvertebrate (primarily chironomids) resulting from these disturbance events aligns with increasing abundance of emergent Chinook Salmon (shown on slide 13). The 9-week macroinvertebrate development is based on literature for colonization after inundation (Merz 2012).

Slide 12. The abundance timing graphs of juvenile spring and fall Chinook Salmon from Perry et al are based on model runs of flow releases without increased winter rearing flows. It would be appropriate to present model runs comparing a ROD hydrograph, or some modification of a ROD hydrograph that does not have increased winter rearing flows, and the flow schedule that was released for WY2023 so the differences in abundance and abundance timing can be evaluated. This is a perfect use of S3 and should be included in any flow management analysis.

Response: This was intended to simply show how emergence timing and the resulting increasing abundance of Chinook coincides with macroinvertebrate development under natural conditions. The

timing does not vary a lot relative to the phenology we're showing. It is a general ecological description, not specific to WVF. S3 could be used for something similar to what you suggest. However, numerous updates to S3 would be needed to make such analyses meaningful. This year was not like many other years, it was particularly cold. The RBM-10 model will also have to be updated with 2023 meteorological data before this can be done with any level of rigor. Unfortunately, S3 and other models are often not sensitive enough to discern the effects on biological metric from subtle differences in ROD versus ROD-modified hydrographs. The flow work group has modeled these differences numerous times over several years and there is little change in the model output from relatively small changes in hydrographs.

Slide 13. Like the comments on Slide 12, use updated S3 model runs.

Response: These slides were intended to demonstrate general phenological processes of river ecology, not specific to WVF implementation. Use of S3 for this analysis will require significant investment and will not be done until time and resources allow. To date all work on winter variable flows have been completed without allocating additional project-specific funding.

Slide 16. Like the comments on Slide 12, use updated S3 model runs to some the difference between ROD winter rearing flows and Winter Flow Variability project flows and how this compares to the historical pre-TRD hydrology.

Response: See comments above about S3

Slide 19. A summary statement comparing the Fraction of Bed Disturbed compares across the Actual, WFV, and 2019 Wet WY would be helpful. Not sure that these data are useful for percentage comparisons but that would be useful.

Response: Good comment and we will consider some more effective presentations for the WY2023 implementation retrospective report.

Slide 22 and 23. Graphs show changes in channel width changes related to flows for ROD flows, WFV and Actual flows. This is useful information showing the differences and, if possible, results for each of the objectives should be presented in this manner. An additional graph overlaying all the channel width results would be helpful for comparative purposes.

> One of the objectives of the WFV project is to increase rearing habitat when juvenile salmonids are most abundant in the restoration reach of the Trinity River. Estimates of habitat availability should also be presented in a similar manner as the stream width data are presented. Perry et al 2018, Figure 9 displays fry and parr carrying capacity time series related to different flow schedules. A similar presentation of carrying capacity for WY2023 WVF, Actual and the appropriate ROD hydrograph would be very informative.

> Response: We intend to do this soon, but there are significant challenges in summarizing juvenile habitat over a hydrograph as the element of time and dynamic flow is very important. There is no consensus on how to do this, as habitat cannot be summed over time and there is not an agreed upon duration that habitat must be wet to be "provided." We have attempted to meet these challenges in a recent report (Cooper-Hertell et al. 2021) and will consider applying these

methods. Wetted width lends itself to this type of graphical analysis, but other biological metrics or factors to analyze can't really be estimated daily like flow and wetted width.

Slide 26. Why is the information presented as "Fish Food" vs. "Non-food"? I understand the need for juvenile salmonids to have sufficient food sources that are of the appropriate size and availability to grow and survive, but the presentation of this information seems to suggest that there is significant competition between "Food" and "Non-Food" invertebrates. I'm sure there are interactions (competition, predation, etc.) between the various invertebrate species but based on the data presented (slides 27 and 28) it seems like abundance of "Food" and "Non-Food" invertebrates are highly positively correlated. And maybe just the terminology "non-food" unnecessarily bugs me because the "non-food" inverts are a food resource for other critters.

Response: While we appreciate that all animals have value, this differentiates by species when considering certain needs. The needs of juvenile salmon forage are what is being considered here. Juvenile salmon forage is the same forage that predatory stoneflies are looking for and is in direct competition with other genera like caddisflies. A better job can be done distinguishing juvenile food vs. adult food. WVF and the work we're presenting is only focused on juvenile food, so things like some cased caddis flies and predatory stoneflies are not food in this context (with rare exception). Slide 9 and similar slides in the public presentation are misleading by showing fishing flies to illustrate that some species are food, but obviously nobody is fly fishing for little juvenile Chinook. This was an oversight on a short and stressful timeline and certainly not intentionally misleading. It could have been made clear that for juvenile salmonids, only certain types are edible, versus for trout and steelhead and larger fish big stoneflies and cased caddis are food. However, we stress it is important to target management actions that benefit the food juveniles can eat at the time they are in the river in order to increase the probability of successful juvenile salmonid emigration.

Slides 27 and 28. The trend lines are suggesting Biomass will endlessly increase with increasing inundation. Not really appropriate for the Sawmill site with two data points and, if anything, the data for the Junction City site may suggest an asymptotic relationship as inundation increases.

Response: We agree that the trendlines are inappropriate. The data suggests that production of invertebrates may peak at 9 weeks after sustained inundation. Merz et al. (2012) suggests that this peak in biomass can be roughly four times the production in adjacent perennial wetted areas and will return to similar levels of production as perennial areas after 12 weeks, without further disturbance. The Junction City site experienced a naturally occurring scouring flow at week 8 of inundation, which explains the lower biomass for that sample at that location (slide 28).

Slide 30. Data show that the water temperature within the juvenile temperature target (assuming this is above the North Fork as presented in Slide 29) in WY2023 shifted earlier as compared to Wet and Extremely wet water years but the water temperatures during the winter flow variability project are generally lower rearing period. Outmigrant monitoring at the Pear Tree sampling site show that, on average, 60% of the juvenile Chinook salmon leave the restoration reach by late April, with range of 47% to 87%. It seems like increasing flows during the winter rearing period decreased water temperatures while most fish would be expected to be in the rearing reach while most fish would have left when water temperatures were within the rearing water temperature targets. Using S3 to

compare the effects of changes in water temperatures on growth and outmigrant timing would be useful. It could also be used to go some gaming to evaluate different thermal regimes during the WFV period. It is likely that the observed temperatures are a product of releasing more cold water from Trinity Dam, and it may take some infrastructure modifications and/or managing releases and diversions to provide more suitable thermal regimes during the winter rearing period.

Response: Releases from Lewiston Dam are warmer than ambient or unimpaired water temperatures in winter until roughly May, then become increasingly colder than ambient through summer (Asarian et al. 2023). During winter, water temperatures decrease as you move downstream from Lewiston (because of e.g., low nighttime temperatures), and elevated releases extend the warmer water further downstream, a similar but opposite effect as we see in summer. The abnormally cold-water temperatures seen at Pear Tree through May in 2023 are most likely due to the abnormally cold winter, not WVF releases. It was one of the coldest winters in recent memory. The abnormally "warm" (actually optimal for fish growth) temperatures roughly May-July as compared to previous Wet years is likely due to lower flows, which is the expressed purpose of moving water out of that time period. We have presented numerous lines of evidence, modeling, and analyses in this work and others in recent years showing that the ROD flow release schedules disrupt the normal seasonal warming pattern that occurs in spring. The ROD flows do not inundate floodplains at the right time, and they make the water too cold in the spring.

See earlier response about the use of S3.

Slide 31. Suggest putting the mean for length and other pertinent statistics on the figure. There is some confusion as to the meaning of the F- and p-value to some of the audience and including the statistic on mean length might help to clear this up. Where are the data from the Pear Tree monitoring site? It seems like the Pear Tree data would be more appropriate to evaluate the effects of WFV on growth of juvenile Chinook Salmon since the fish sampled at the Willow Creek site are more removed from the "treatment" of increasing winter rearing flows and other factors can be influencing size of fish at the downstream sampling site.

Response: These data could be presented better and mean values are better to present than F-statistics and p-values. During the TMC presentation it was clarified what these statistics are and are not (i.e., they are not measures of the magnitude of change). Several questions were fielded from TMC members to further clarify this issue following the public presentation. See earlier comments on strengths and weaknesses of using Pear Tree to measure fish response. One could argue that the fish sampled at Willow Creek have experienced more of the action. The elevated flows in winter are only one part of the action. The decreased flows during the late spring are just as important and have temperature impacts throughout the river's length. Actual mean values in table form would help this figure.

Slide 32. Where are the data from the Pear Tree monitoring site? It seems like the Pear Tree data would be more appropriate to evaluate the effects of WFV on growth of juvenile Chinook Salmon since the fish sampled at the Willow Creek site are more removed from the "treatment" of increasing winter rearing flows and other factors can be influencing size of fish at the downstream sampling site.

Response: See comments about Pear Tree site throughout

Slide 34. WY2023 Summary

- **2nd bullet.** While monitoring indicated that invertebrate biomass increased with increasing inundation was there an increase in invertebrate production? Would the same results have been realized at ROD winter rearing baseflow with similar inundation? Possibly providing information on the amount of invertebrate habitat provided in open gravel bars (or whatever the appropriate metric might be) similar to presenting the amount of available fish habitat could help show the benefits of winter flows to invert production.

  Response: The ROD winter baseflow does not have similar inundation, it actually has desiccation of the 450 cfs wetted area when flows are dropped to 300 cfs and remain static until mid-April. Elevated baseflows inherently increase inundation. The wetted width analysis (slide 22) is presented as a surrogate for inundation and the streambed scour analysis (slide 23) is presented as a surrogate for bed disturbance. Both of these are physical mechanisms that increase invertebrate production. Increased wetted area and area of scour should increase invertebrate production. The use of surrogates like inundation at the correct time of year is appropriate when direct measurements are unavailable.

  3rd bullet. It is unclear by the information presented that there were improved temperature conditions for growth. The change in the hydrograph shifted the period where water temperatures were within the rearing temperature target range approximately a month earlier (Slide 30) which would definitely benefit the juvenile Chinook remaining in the restoration reach of the Trinity Rivers. But the water temperatures from approximately late January through May were lower than Wet and Extremely Wet water years presented which would decrease juvenile for Chinook growth during the majority of the rearing period in the restoration reach of the Trinity River. Using S3 to evaluate the effect of the different temperature regimes shown in Slide 30 may show what the overall difference growth/size and abundance/biomass resulted from the shifting thermal regime.

  Response: See comments above regarding temperatures. Elevated baseflows Feb-Apr did not contribute to low temperatures during that period, whereas reduced spring releases resulted in temperatures moving into the optimal range and staying there longer than any previous Wet water year by a substantial margin. Also see previous comments on the limitation of S3. One additional and critical thing to note about S3 is that it completely ignores one of the fundamental intended benefits of the WVF action, increased food availability. In its current configuration ration is held constant, so S3 is incapable of showing that benefit.

- **4th bullet.** It would be important to evaluate and include fish response data from the Pear Tree site because it is closer to the treatment of increased winter rearing flows and avoids some of the confounding factors that affect the data collected at the Willow Creek site.

  Response: See comments throughout about Pear Tree.

Literature Cited

Asarian, J. E., K. De Juilio, D. Gaeuman, S. Naman, and T. Buxton. 2023. Synthesizing 87 years of scientific inquiry into Trinity River water temperatures. 190 p. + appendices. Prepared for the Trinity River Restoration Program, Weaverville, California.

Gast, T. 2021. Analysis and model evaluation of long-term data collected at the Willow Creek outmigrant trap. 29 March. Prepared for the Yurok Tribe, Klamath, CA. https://www.trrp.net/library/document/?id=2492.

Merz, J., B. Rook, C. Watry, and S. Zeug. 2012. Evaluation of the 2008-2010 Sailor Bar Gravel Placements on the Lower American River, California. 2010-2011 Data Report. Cramer Fish Sciences. Prepared for City of Sacramento Water Forum and U. S. Bureau of Reclamation and U. S. Fish and Wildlife Service CVPIA Gravel Program. Contract 2010-1049. May 2012. https://www.researchgate.net/publication/267365136_Evaluation_ of_the_2008-2010_Sailor_Bar_Gravel_Placements_on_the_Lower_American_River_ California.