Rainfall to Groundwater

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December 13, 2021

California Water Commission Members and Staff
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RE: Prop 1 WSIP Feasibility Determination for Pacheco Dam Project
December 15, 2021 Commission Meeting

Dear California Water Commission Members and Staff,

Regarding the upcoming feasibility determination for the Pacheco Dam project, proposed for funding under the Proposition 1 Water Storage Investment Program (WSIP), I ask that the commission please consider the following concerns in their determination.

Impacts of Increasing Evaporative Demand on Proposed Project Benefits

As the commission is doubtless aware, evaporative demand (a.k.a. vapor pressure deficit) is increasing with climate change, as we witnessed to the surprise of all paying attention this year.

California Department of Water Resources (DWR) was caught off guard in overestimating the quantity of snowmelt runoff this year, based on historical correlations. I understand that DWR is working with USGS California Water Science Center on Improving Forecasting for California's Snow Melt Water Supply, but at this point, all bets would appear to be off.

Here's an encapsulation of my understanding of what happened during the first half of 2021. Sierran snowmelt runoff was significantly overestimated this year, based on ***past experience that no longer applies under climate change***. The extra hot air just sucked up far more moisture this year than has ever been known. Sure, some of it likely soaked into the parched ground, but there are many indications that much evaporated right off the snow surface, including likely via sublimation, wherein the snow goes directly from a solid into a vaporous state, bypassing the liquid water state.

Following are a few examples of informed observations on this remarkable year that's coming to a close:

Water Year 2021: An Extreme Year – DWR
https://water.ca.gov/-/media/DWR-Website/Web-Pages/Water-Basics/Drought/Files/Publications-And-Reports/091521-Water-Year-2021-broch_v2.pdf

Pertinent excerpts:
p 3:

> It becomes increasingly difficult to rely on historical observations to predict water supply conditions, as was observed this spring when DWR's snowmelt runoff forecasts substantially over-estimated the runoff that occurred. DWR's median April 1st runoff forecasts for the Sacramento River Hydrologic Region, San Joaquin River Hydrologic Region, and Tulare Lake Hydrologic Region were overestimated by 68 percent, 45 percent, and 46 percent, respectively. …
>
> … Impacts of warmer and dryer conditions include not only the obvious water supply impacts of reduced streamflow and water storage but also increasingly observed watershed impacts such as increased wildfire damage and more prevalent harmful algal blooms.

p 10-11:

> … It was observed during California's 2012-2016 drought that harmful algal blooms, such as the one illustrated in the San Luis Reservoir photograph [p 1], are being more commonly observed (Figure 12) and that wildfire damage is increasing.

"California's Missing Forecast Flows in Spring 2021 – Challenges for seasonal flow forecasting". California Water Blog [UCD] (Posted on July 18, 2021 by jaylund)
by John Abatzoglou, Anna Rallings, Leigh Bernacchi, Joshua Viers, Josué Medellín-Azuara
https://californiawaterblog.com/2021/07/18/californias-missing-forecast-flows-in-spring-2021-challenges-for-seasonal-flow-forecasting/

Other reports of the overestimate include “685,000 acre-feet” according to DWR’s Sean de Guzman, chief of snow surveys and water supply forecasting, as reported by the Mercury News’ Paul Rogers in their June 24, 2021 e-edition piece, “A lot of our forecasts were off”.

Following is an excerpt from the Los Angeles Times enewspaper story, “Urgent water cuts for farmers”, dated Aug. 4, 2021:

> “The simplest terms are the snow was kind of there and then it wasn’t,” said David Rizzardo, chief of the hydrology branch at the state’s Department of Water Resources.
>
> According to Rizzardo, it’s not uncommon to lose 10% to 20% of the snowpack to normal hydrological processes, particularly after a dry year. But losing just under 80% — let alone in such a short period?
>
> “It’s beyond unprecedented,” Rizzardo said. The hydrologic conditions witnessed this year have been forecast in climate change models, but according to Rizzardo, such scenarios were expected to come to bear decades from now.

While the first half of this year stood out palpably to anyone paying attention, it is merely the most recent culmination of a pattern in progress for the past nearly two decades, as documented in the following paper, whose abstract is appropriate here.

Pascolini-Campbell, M., J. T. Reager, H. A. Chandanpurkar, and M. Rodell. 2021. A 10 per cent increase in global land evapotranspiration from 2003 to 2019. *Nature* 593:543–547. https://doi.org/10.1038/s41586-021-03503-5

> Abstract
> Accurate quantification of global land evapotranspiration is necessary for understanding variability in the global water cycle, which is expected to intensify under climate change. Current global evapotranspiration products are derived from a variety of sources, including models, remote sensing and in situ observations. However, existing approaches contain extensive uncertainties; for example, relating to model structure or the upscaling of observations to a global level. As a result, variability and trends in global evapotranspiration remain unclear. Here we show that global land evapotranspiration increased by 10 ± 2 per cent between 2003 and

> 2019, and that land precipitation is increasingly partitioned into evapotranspiration rather than runoff. Our results are based on an independent water-balance ensemble time series of global land evapotranspiration and the corresponding uncertainty distribution, using data from the Gravity Recovery and Climate Experiment (GRACE) and GRACE-Follow On (GRACE-FO) satellites. Variability in global land evapotranspiration is positively correlated with El Niño−Southern Oscillation. The main driver of the trend, however, is increasing land temperature. Our findings provide an observational constraint on global land evapotranspiration, and are consistent with the hypothesis that global evapotranspiration should increase in a warming climate.

The context of this new awareness, combined with an already deepening understanding that climate change seems to pose increasing "weather whiplash" extremes for California, would seem to call into question the net effectiveness of *any* proposed new surface water storage.

Indeed, in CNRA Secretary Crowfoot's July 13th Speaker's Series discussion, Drought: The Signals of Climate Change, he emphasized the importance of increasing groundwater storage, as did two of his three co-presenters during closing "low hanging fruit" responses. The other panelist, a DWR hydrologist, emphasized the importance of improved runoff forecasting. She surely had a front row seat to the surprises 2021 had in store.

Public Policy Institute of California's recent blog post echos the theme:
"What's Really Important? Putting Recent Water News into Perspective". PPIC Blog, posted December 8, 2021 Sarah Bardeen queried PPIC Senior Fellow Jeff Mount and PPIC Water Policy Director Ellen Hanak on recent news for this post.
https://www.ppic.org/blog/whats-really-important-putting-recent-water-news-into-perspective/

Excerpt from Jeff Mount: "… To adapt to less snow we have got to change the way we store water. This means moving more water underground whenever possible." Ellen Hanak was among Secretary Crowfoot's two July 13th co-presenters who emphasized the importance of storing water in the ground.

These ongoing climate change impacts will surely impact the water quantities proposed by Pacheco Reservoir proponents to be delivered for both water users and the environment. And that surely impacts all previously calculated cost/ benefit ratios.

Valley Water's Supplemental Feasibility Documentation Water Storage Investment Program report, section 5.2.2.1 Water Balance for Pacheco Reservoir, page 5-9 (pdf p 99) indicates in Table 5-5 , under Average Annual Pacheco Reservoir Outputs, Reservoir Evaporation (AF), as 600 acre-feet under current conditions and 4,900 acre-feet "With-Project".

Since they do not share the formula used to arrive at this 4,900 acre-feet figure, nor the assumptions used for that calculation, it is impossible to verify its accuracy. Estimation of evaporation is not a simple task. Following is an online response to a query regarding evaporation loss formulas, which can be daunting even to hydrological engineers: https://earthscience.stackexchange.com/questions/5071/evaporation-loss-formulas

Note this encapsulation: "the three main variables: temperature, rate of advective removal of moisture (proportional to surface wind velocity), and difference in vapour pressure (which can be related to humidity)." Clearly, evaporative losses are not set in stone, but are absolutely dependent on ambient weather conditions.

To strike me as a reasonable and earnest figure, the estimated Reservoir Evaporation would have to be a ***range, depending on weather variables***. So the simple statement of 4,900 acre-feet in evaporative losses from the proposed expanded surface reservoir seems suspect in itself, especially as a stand-alone figure without further documentation.

Then, add the complexity of increasing evaporative demand that we are coming to understand as among the impacts of ongoing climate change – not that we have a good enough grasp of that yet to even make sound predictions. Nevertheless, some uncertainty should be built into contemporary evaporative loss equations to account for this "new normal".

But that's not the only problem with this estimation. As the title of section 5.2.2.1 Water Balance for Pacheco Reservoir Project, as well as that for Table 5-5, indicate, the project considers (inasmuch as they apparently have) evaporative losses solely for the existing and proposed expanded Pacheco Reservoir, whereas the nature of this proposed project involves **two other sources of evaporative losses from Central Valley Project water en route**

to Pacheco Reservoir: 1.) the California Aqueduct and 2.) San Luis Reservoir. Each of those open surface water bodies is subject to evaporative losses and each has its own inherent range of temperature, vapor pressure and wind velocity variables, which have apparently not been considered in the proposed project's water budget.

On top of the evaporative losses in the proposed project's regional pathway, there is also the impact of these changing conditions on the source of Central Valley Project water, as noted in foregoing observations.

The Sierra Club Loma Prieta Chapter prepared the "Pacheco Reservoir Replacement Project Fact Sheet", including the graph, "San Luis Reservoir Storage for the Past Twenty Years", indicating, as stated there,

> The reservoir has been at capacity at most six times in the past twenty years. This raises questions on whether the San Luis Reservoir will provide enough excess water supplies to make Pacheco a viable option.

Compound the experience of the past two decades with the new realizations of 2021 and project viability becomes even further reduced in terms of cost/benefit for all proposed beneficial uses. And then there is the issue of the increasing tendency for harmful algal blooms that is not restricted to San Luis Reservoir. I understand that Valley Water purports to resolve this problem by moving water to the expanded Pacheco Reservoir, but that reservoir is unlikely to be shielded from such harmful algal blooms. The location is near enough to San Luis Reservoir that ambient temperature is not that different. "Figure 12. Harmful Algal Blooms Reported to Date in 2021" in DWR's previously cited brochure, *Water Year 2021: An Extreme Year*, illustrates numerous mapped examples of surface water bodies subject to this problem in just this past year alone.

Furthermore, there is one alternative that has yet to be considered by Valley Water, DWR and all pertinent water agencies – namely **catchment, a.k.a. watershed restoration** as proposed by me to DWR, beginning over a decade ago and via unopened communications in recent years with Valley Water's GSA contact person, among those of other pertinent water agencies. I find it appalling that even CNRA's Water Resilience Portfolio failed to consider catchment restoration. *What? How can catchment/ watershed restoration not be considered a water resilience strategy???*

The central problem is that all our water resource agencies are dominated by mechanistic engineering thinking that views and treats our water systems as **plumbing problems**, rather than recognizing the **inherent *systemic* (naturally cybernetic) potential of catchments for subsurface detention storage** and moreover, the history of anthropogenic impacts to those catchment functions.

I understand that the issue of alternative approaches is not before the commission at present. I mention it solely, FYI, to assure you that **these water agencies have not yet turned over every stone in seeking water supply solutions – including and especially those that benefit *all residents of the environment, namely those who can't speak up for themselves in these human processes.*** More info on my catchment restoration strategy, so far ignored by all pertinent water agencies, can be found on my Rainfall to Groundwater site.

Environmental Feasibility

A Disneyland-Style Steelhead Stream?

I trust that others are scrutinizing the proposed purported "restoration" of steelhead habitat on Pacheco Creek; I've not had the time to look closely at it. But I understand that the idea is to operate the dam so as to provide cold flows for steelhead at key times during their life history, while reducing overall flows on Pacheco Creek. According to their Feasibility Documentation, "under the Project, the expanded reservoir allows for greater controlled releases and optimized reoperation to provide flows to meet SCCC steelhead needs". In other words, this is a Disneyland-style approach to habitat restoration – 'looks good on the surface but is based on a wholly mechanistic, artificial infrastructure that is not to be trusted..

Please just name a reservoir that is truly helping to restore any salmonids in California. They offer big promises but if they had actually delivered on those promises, salmonids would not be in the poor shape they are in today. For a current example, please refer to this paper, published in August:

Willis, A. D., R. A. Peek, and A. L. Rypel. 2021. Classifying California's stream thermal regimes for cold-water conservation. *PLOS One* 16:e0256286. https://doi.org/10.1371/journal.pone.0256286 Please consider the following excerpt from the abstract:

> … Several salient findings emerge from this study. Groundwater-dominated streams are a ubiquitous, but as yet, poorly explored class of thermal regimes. Further, flow regulation below dams imposes serial discontinuities, including artificial thermal regimes on downstream ecosystems. Finally, and contrary to what is often assumed, California reservoirs do not contain sufficient cold-water storage to replicate desirable, reach-scale thermal regimes. …

Those findings are summarized in this blog post:

"Dammed hot: California's regulated streams fail cold-water ecosystems"
Posted on August 29, 2021 by UC Davis Center for Watershed Sciences
by Ann Willis, Ryan Peek, and Andrew L. Rypel
https://californiawaterblog.com/2021/08/29/dammed-hot-californias-regulated-streams-fail-cold-water-ecosystems/

And BTW, my Rainfall to Groundwater approach was originally designed as a conservation measure to support inland Central Coast steelhead streams, especially the Pajaro and Salinas Rivers – I'm attaching my dissertation abstract for your convenience. It is the only one I've seen to date that addresses the ubiquitous groundwater-dominated streams that the above abstract refers to as a "poorly explored class of thermal regime". Not by me.

But then, consider the history of aquatic species biodiversity in Santa Clara County under the historical management of Valley Water. This agency has no qualifications to recommend them as "stewards of salmonids". That is why the historical steelhead population on Coyote Creek has apparently met its demise. Witness:

Smith, J. 2018. Fish population sampling In 2017 on Coyote Creek. Pages 48-86 in Comment Letters Received subsequent to the Workshop for the 2018 Triennial Review of the San Francisco Bay Basin Water Quality Control Plan (Basin Plan). Water Boards, CA. https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/planningtmdls/basinplan/web/docs/Triennial_Review/2018%20Triennial%20Review%20Workshop%20Comments%20Package%205-21-18.pdf

Here's an example of how locals feel about it:
Coyote Creek Steelhead Trout Disappearance Prompts Battle
By Karla Lant on June 4, 2018 *Environmental Monitor*
https://www.fondriest.com/news/coyote-creek-steelhead-trout-disappearance-prompts-battle.htm

Loss of Rare Sycamore Alluvial Woodland & Questionable Mitigation

Finally, while it appears in this project's DEIR documentation as "Impact Bio-19: Conflict with the Santa Clara Valley Habitat Plan", the rarity of Sycamore Alluvial Woodland is far more than a local issue; it is essentially statewide; that is, it's occurrence and certainly long-term viability has been severely impacted wherever it historically occurred.

That is precisely because the habitat for this rare association is fluvially created and maintained and the proliferation of dams regulating flows throughout the state has halted the natural processes that are vital to maintaining this association. While the DEIR does actually explain some of these issues, it curiously does so only in the discussion related to Alternative A.

Acknowledging that "California sycamore alluvial woodland is a rare natural community type within the SCVHP boundaries and consequently, opportunities to preserve and restore or enhance California sycamore alluvial woodland may be limited within the SCVHP boundaries", Valley Water proposes to, "prioritize utilizing potential mitigation areas outside of the SCVHP boundary, with agency approval (e.g., CDFW), to the extent feasible when there are viable options to mitigate for California sycamore alluvial woodlands to prevent conflicts with the SCVHP."

Again, just as true for Coyote Creek steelhead, Valley Water's historical actions are the reason sycamore alluvial woodland is a rare natural community type within the SCVHP boundaries. Proposing to "protect" sycamore alluvial woodlands outside of the SCVHP boundary promises a **net loss** of this rare association within California. I don't think they are proposing to eliminate any dams that block the fluvial flows the association is endemic to. They apparently merely propose to purchase some habitat outside the district. This is not real conservation.

For confirmation of the sycamore alluvial woodland lost to historical human land uses and especially Valley Water's (mis-)management of the Coyote Creek floodplain, whose riparian habitat has been wholly converted to different habitat types through alterations of natural seasonal flow timing, please refer to the following documentation:

Grossinger, R. M., C. J. Striplen, R. A. Askevold, E. Brewster, and E. E. Beller. 2007. Historical landscape ecology of an urbanized California valley: wetlands and woodlands in the Santa Clara Valley. Landscape Ecology 22:103–120. https://doi.org/10.1007/s10980-007-9122-6 https://www.researchgate.net/profile/Robin_Grossinger/publication/225792833_Historical_landscape_ecology_of_an_urbanized_California_valley_Wetlands_and_woodlands_in_the_Santa_Clara_Valley/links/55f0a08c08aedecb68ffbac6/Historical-landscape-ecology-of-an-urbanized-California-valley-Wetlands-and-woodlands-in-the-Santa-Clara-Valley.pdf

Thank you for your consideration of comments,

Verna Jigour, PhD

V•Jigour LLC: Rainfall to Groundwater

Watershed Restoration for Baseflow Augmentation

Verna Marie Jigour PhD Dissertation[1] Abstract

California's water problems lie not just in the amount of precipitation but in its timing. The temporal disposition of precipitation is strongly influenced by the vegetation of the watersheds it falls on, but for at least the last five decades that relationship has been largely misunderstood in water resources management. Ponce (1989) succinctly defined the goal as "baseflow augmentation", focusing there on streambank storage, while pointing to the potential for management of uplands and rangelands to contribute.

This dissertation expands on the efficacy of potential upland/rangeland management strategies to augment baseflow, focusing on the existing nonnative grasslands, including hardwood rangelands, that cover expansive areas of California's semi-arid watersheds. Extensive review of little-known scientific and policy literature dating back to the early 20th century demonstrates that a body of knowledge supports the essential watershed functions conferred by native vegetation types, their deep rooting systems, and the soil ecosystems they engender—the soil profile as a natural detention reservoir. Framed within the context of the evolving biosphere per Budyko (1986), biospheric feedbacks on regional and local climate are included in this systems evaluation.

The synthesis considers the impacts of aboriginal burning, along with subsequent land management, on the watershed functions of vast areas of the state, proposing vegetative restoration of lands currently clothed in shallow-rooted, nonnative annual grasses to restore those vital functions and augment baseflow; replacing the existing high albedo landscapes that likely feed back into the regional climate system by reducing precipitation, with mosaics of native cover types.

Analyses performed on a GIS database I developed of historical California steelhead streams and watersheds south of San Francisco Bay provide correlations among steelhead status, land-cover types, stewardship status and counties. Most significant are estimates of the potential new detention storage with watershed restoration. Estimated additional storage possible on Salinas River subwatersheds not obstructed by dams surpasses the total storage capacity of the two largest reservoirs on that drainage. Potential detention storage in uplands of the upper Pájaro River watershed could significantly reduce downstream flooding.

This concept holds even greater potential for the watersheds feeding the troubled San Francisco Bay-Delta ecosystem.

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[1] Union Institute & University Graduate College – submitted in partial fulfillment of the requirements for the degree Doctor of Philosophy in Interdisciplinary Studies: Arts & Sciences: Conservation Ecology; approved by doctoral committee 2008, finalized 2011