Checklist - Questions submitted to Marty Ralph - FIRO Viability Chairman

Ralph Question - **R1a)** - Discuss how ID4 Interactive could be more adaptable than ID3 Prescriptive to changing variables and objectives such as; additional release capacity, infrastructure and climate change, by simply changing the rule stack and priority assigned to them? **R1b)** - How has it performed at Lake Mendocino?

Ralph Questions **R2a)** - In analysing the 1997 event, scaled to 120% (SPF equivalent) found on pages 117-119 in the FVA Appendix, what would you say were the limiting factors in meeting the downstream constraints? **R2b)** - Was it the "hard constraint" to minimize the use of the Auxiliary Spillway in its current condition?

R3a) - Why were Oroville's outflows held between only 50,000 cfs for ID4, and 90,000cfs for ID3 until just 24 hours before these peak inflows arrived. **R3b)** - Was it the limited release capacity of Oroville's current infrastructure and corresponding FIRO Space?

If the FIRO Space could be temporarily lowered to elevation 813', (FCO-Gate level) an additional 300,000af of water could have been pre released before peak inflows, thus minimizing the downstream damage.
R4a) - Was this option explored enough to run hydrographs on the outcome?
R4b) - If not, why wasn't it considered, infrastructure stability, end of event water recovery?

R5a) -Table 4-1 Relative performance of FIRO alternatives (FIRO FVA page 63), list the 1986, and 1997 historic events scaled by only 106% each, as the largest events to meet all the performance metrics, Does this approximately equate to a 90 yr and 200 yr level of flood protection?

Ralph Question **R6a)** - What's the current consensus from the scientific community for Oroville's projected climate altered stream flows for 2050 and 2075?

R6b) - According to the FVA, the 1986 historic storm, scaled by 106% each, is the largest event to meet all the performance metrics, and is equal to a 90 yr level of flood protection? When combined with the above climate altered stream flows for Oroville, what level of flood protection would the FVA proposed plans achieve in the year 2050? A 1/75 year?

Ralph Question **R7a)** - Before including the soil wetness index in the FVA report, was any attempt made to run hydrology models using a starting flood pool of 350,000 acre feet (top of the wetness index pool) instead of 600,000 acre feet models?

R7b) - With all the hydrology models in the FVA report using the top of the FIRO space instead of the top of the wetness index, doesn't that skew the evaluations and conclusions in the report now that Oroville's Soil Wetness Index was included to shrink the size of the FIRO Space?

<u>Checklist</u> - Questions submitted to California Nevada River Forecast Center (CNRFC)

Climate Change

<u>CNRFC Questions</u> C1a) - What's the current consensus from the scientific community for Oroville's projected climate altered stream flows for 2050 and 2075?

C1b) - According to the FVA, the 1986 historic storm, scaled by 106% each, is the largest event to meet all the performance metrics, and is equal to a 90 yr level of flood protection? When combined with the above climate altered stream flows for Oroville, what level of flood protection would the FVA proposed plans achieve in the year 2050? A 1/75 year?

C2a) - Since the above mentioned report, (CNFRC's estimation of return frequencies for historical events, page 121 PVA Appendize) is being used to quantify the level of flood protection the downstream communities can expect, can these estimations be improved upon?

C2b) -Please explain how Return Frequency Estimates are developed and what if any uncertainties could be addressed to improve the accuracy?

Soil Wetness Index exclusion of Snow Water Equivalent

A team led by Brian Henn, a former researcher at CW3E / Scripps looked at the March 2017 storm that led to the auxiliary spillway failure. It was estimated that the melt increased water available for runoff by 37% over rain alone". Freezing level forecasts can create reservoir inflow uncertainties up to 50 percent of the flood pool storages (Sumargo et al.2020) as snow water equivalent quickly converts to unexpected reservoir inflows.

<u>CNRFC Questions</u> C3a) - Even after the additional studies analyzed in the FVA, a lot of uncertainty remains when forecasting freezing levels, precipitation transition and snowmelt Looking at latest (FVA) hindcast estimates of snowmelt data to actual observed melt, what is the current range of uncertainty, such as 15% chance inflow are off by 30%?

C4a) - Aside from airplane surveys, what would you recommend to improve the accuracy of snowmelt data, since 50% of the Feather River watershed is below the lowest daily reporting snow pillow at elevation 5,202 ft.

C5a) - Assuming the precipitation estimates and snowmelt estimates are two different processes that are later combined for a total reservoir inflow estimate, couldn't the data used in the snowmelt estimate be used to develop snow water index to increase the flood pool similar to how soil wetness index could shrink the flood pool?

Checklist - Questions submitted to Department of Water Resources (DWR)

Oroville Spillway Capacity FERC and USACE are both working on 50 year update processes at Oroville Dam. Although their mandates are slightly different, both solutions are dependent on having adequate spillway release capacity to safely pass the PMF or the SPF. Although not required, shouldn't some format be created for routine exchange of information such as; SPF hydrographs, surcharge of Auxiliary Spillway, hillside stability, FCO-Gate vulnerability or planned infrastructure improvements that would increase the spillway release capacity?

DWR Question D1a) - As Dam owner, is it your responsibility to not be regulatory driven, and coordinate a holistic approach to these similar mandates of having adequate release capacity to safely pass both the SPF equivalent (USACE) and the PMF-Future (FERC)?

D2a) - Which of the Oroville CNA plans would most economically achieve both mandates, while still providing infrastructure resilience and redundancy into the year 2050 and 2075?
D3a) - Now that 50 year state water contracts have been renewed, could 35-40 year construction bonds help reduce the annual repayment cost?
D4a) - Would the annual 200,000 af increase in water storage benefit (Figure L-8 in the FIRO PVA Appendix) help soften the cost of the construction bonds?

Soil Wetness Index exclusion of Snow Water Equivalent

A team led by Brian Henn, a former researcher at CW3E / Scripps looked at the March 2017 storm that led to the auxiliary spillway failure. It was estimated that the melt increased water available for runoff by 37% over rain alone". Freezing level forecasts can create reservoir inflow uncertainties up to 50 percent of the flood pool storages (Sumargo et al.2020) as snow water equivalent quickly converts to unexpected reservoir inflows.

DWR Question D5a) - Although after-event reservoir refill was not an issue, was the inclusion of the Soil Wetness Index without an offsetting Snow Water index a firm request the department made for drought year reservoir recovery.

D5b) - Throughout the water control manual update process, the department has consistently stated, "they want to use the best science", does the old soil wetness index use the best science?

D6a) - Since NOAA Fisheries: Eric Danner was a member of the FIRO work team, what were his comments or concerns on the timing and rate of fall discharge and spring refill's effect on the spawning migration of endangered fisheries? Were downstream temperatures and hydrology models analyzed?

Transfer of Benefits

Transferring surplus storage to downstream flow reductions could reduce the frequency of mandatory evacuations and the associated indirect cost to communities, roughly estimated at $50-75 million during the 2017 evacuation.

DWR Question D7a)- Has there been any attempt to estimate the associated indirect cost of the 2017 evacuation? **D7b)** - When evaluating downstream benefits or assigning priorities to HEC-ResSim rule stack wouldn't this be useful information?

<u>Checklist</u> - Questions submitted to United States Army Corp of Engineers (USACE)

USACE Level of Flood Protection

<u>USACE Questions</u> A1a) - When the 1970 SPF was developed, was it considered a 1/500 year flood event?

A2a) - If Oroville dam was constructed today, could USACE exercise their full regulatory authority and require a return frequency of 1/500 yr event for its flood requirement?

A3a) - With the regulators acting as the lead agency in Orovilles WCM Update, could they exercise the full power of their current regulations and seek to achieve a similar level of flood protection?

A4a) - Has the regulator already entered into non-mandatory agreements with the dam owner that could compromise flood safety or inject additional uncertainty such as; soil wetness index, start of spring refill, bottom of the FIRO Space, water storage recovery, or only current infrastructure required? If so please explain.

Oroville Spillway Capacity

<u>USACE Question A4a)</u> - Should the results of the 2029 FERC Part 12 Inspection require DWR to adapt one of the CNA plans, thus improving Oroville's release capacity, could the new water control manual be easily adapted after construction, to further improve Oroville's flood operations?
A4b) - Could the bottom of the FIRO Space be adjusted to pre-release more stored water?
A4c) - Would a release diagram for the new Low-Level Outlet need to be created?
A4d) - Or would these changes require a NEPA process and congressional funding?

The downstream concern about formalizing the WCM update too quickly, is once it's finalized, any future improvements to Oroville's release capacity may not be fully utilized to improve flood protection without another lengthy WCM update process.

A5a) - What's the best solution to coordinate the goals of FERC and USACE, both working on 50 year update processes at Oroville, on somewhat similar mandates, spillway capacity to pass the PMF and SPF, but on different timelines?

Soil Wetness Index exclusion of Snow Water Equivalent

<u>USACE Question</u> A5a) - Aside from using 1986 and 1997 historic floods for evaluating operational performance, could previous storms with snowmelt driven inflows be modeled and scaled so these hydrographs with 350,000 af flood pools (top of the soil wetness index) could be used to evaluate the performance of the wetness index, during the water control manual update process?

A5b) - If the results of these hydrographs further reduces the flood protection, creates additional risk due to forecast uncertainty or increases the duration of downstream levee saturation, could a more comprehensive approach for Spring Refill be developed during the WCM update process?

A6c) - Assuming ID4 (Interative) is the selected plan could a “seasonal” lower priority rule in the HEC-ResSim rule stack help achieve end of season water benefit instead of the firm-ruled and risky approach the Soil Wetness Index would limit operators to?

Levee Stability

USACE Question A7a) - In a previous response to this, it was stated that “as part of the WCM update process, levee data will be collected and used as evaluation criteria for alternatives. What levee data will be collected that mirrors the requirements of ER 110-2-1913?

A8a) - Are there any viable options to help reduce the rapid drawdown rate caused by uncontrolled tributaries that could help reduce the downstream levee’s susceptible to slope slouching following long duration of saturation?

Water Storage Benefit

USACE Question A9a) - Could a period of record water storage benefit analysis be conducted for various situations such as; 813 ft elevation as bottom of the FIRO Space at Oroville, with / without use of Oroville’s proposed wetness index, with / without March 1st spring refill?

A9b) - Could the findings be available before the final selection of the alternative plan to help advise just how much flood risk should be taken for the benefit of water delivery?

Transfer of Benefits

Transferring surplus storage to downstream flow reductions could reduce the frequency of mandatory evacuations and the associated indirect cost to communities, roughly estimated at $50-75 million during the 2017 evacuation.

USACE Question A10a) - Assuming the ID4 (Interative) plan is adapted, could a suggested downstream flow that's short of triggering community evacuations be incorporated into the HEC-ResSim rule stack and assigned a lower priority?