



Sonoma Water



RESEARCH & DEVELOPMENT FACT SHEET: Forecast-Informed Reservoir Operations Viability Assessment

Description of Research

Recent meteorological advances indicate the potential for improved predictability of certain weather patterns such as atmospheric rivers (ARs), naturally occurring weather phenomena which provide up to 50% of the precipitation in California and are the leading cause of floods in the region. Additionally, a recent update to the US Army Corps of Engineers Water Control Management Engineer Regulation (ER 1110-2-240) allows for forecast conditions to be used in planning water management operations. Therefore, a research effort is underway to determine if Forecast-Informed Reservoir Operations (FIRO) at reservoirs in the Western U.S. can improve water supply, enhance flood risk reduction, and achieve additional ecosystem benefits.

FIRO envisions modern observation and prediction technology that can provide water managers more lead time to selectively retain or release water from reservoirs based on longer-term forecasts. When storms cause moderate-to-high reservoir levels, normal operation is to release water to re-establish flood control space. A FIRO pilot study being conducted at Lake Mendocino in the Russian River watershed in northern California has demonstrated that some of that water can be retained for future supply as long as no major precipitation is expected and it can be shown that the retained water can be released past downstream flood prone areas prior to the arrival of the next storm. This strategy permits earlier supply capture in some years, improving summer season supply reliability for downstream water users and improving the timing and volume of releases to protect water quality and provide flows needed for recovery of fish populations. The pilot study has also shown that FIRO can decrease the potential for uncontrolled releases by signaling the need for preemptive releases ahead of an approaching storm. Optimizing reservoir operations in this fashion benefits water supply and environmental flows while also improving flood risk and dam safety.

Since 2015, a FIRO Steering Committee, composed of Federal, State, local agencies and academia, have been conducting this pilot study as part of a FIRO viability assessment using Lake Mendocino as a model.

Current Status

A Preliminary Viability Assessment (PVA) was completed, peer-reviewed and published in FY17. The PVA recommended a full viability assessment of applying FIRO tools in detail in real-time water management operations, considering and selecting components of the system and FIRO strategies that could be implemented in the near-term using current technology and scientific understanding. A series of major deviations to the existing Water Control Plan at Lake Mendocino was recommended to allow testing of FIRO scenarios under real-world conditions. Accordingly, the Lake Mendocino FIRO Steering Committee requested a major deviation to the existing Lake Mendocino Water Control Plan for the 2018-2019 water year to give operators the flexibility to use up to 10 percent of flood control capacity as storage if weather forecast and watershed conditions indicated that there was no risk of storing additional water. This major deviation was approved by the Corps' South Pacific Division in November 2018 and was used throughout the following winter to test

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FIRO operations in real time. Because FIRO was in use at Lake Mendocino during February 2019 when a series of AR storms impacted the region, flood risk management capacity was enhanced in the watershed and the reservoir was able to enter the dry summer season with a higher than normal water supply.

Based on the promising results realized by the pilot study at Lake Mendocino, approval for an expanded FIRO effort was given in Fiscal Year 2020 to allow the evaluation of additional test sites in areas with differing watershed, weather and management characteristics. Three additional reservoir sites will be evaluated using the pattern set at Lake Mendocino, including Prado Dam in southern California and dams on the Yuba and Feather river watersheds in the Sierra Nevada foothills. FIRO steering committees for both of these efforts have been formed and development of work plans for viability assessments have commenced. Through the application of FIRO at varied locations, a screening level assessment tool will be developed as part of the expanded FIRO effort to aid in identification of candidate FIRO sites.

Following the recommendation of the Lake Mendocino PVA, research and development of new science and technologies, particularly in the area of improved atmospheric forecasting capabilities, has continued with the goal of ensuring the safe and successful implementation of FIRO at reservoirs where it is applied. A campaign of airborne deployment of weather observation instruments by the US Air Force Reserve Hurricane Hunter aircraft has been conducted during recent winter seasons when AR systems have impacted the western US. The observation data collected from this campaign provides global weather forecast models with invaluable data for an area of great importance to detection and prediction of AR activity along the US west coast. The effort also contributed to the establishment of an AR category of intensity scale, similar to the Saffir-Simpson hurricane intensity scale, to be used in warning and informing the public and emergency management officials of potentially damaging flood conditions from particularly intense AR storms. This category scale was first introduced in February 2019 and is already in use by weather forecasters across the country.

Expected Outcomes

The FIRO full viability assessments will include analysis of various operating scenarios and, where warranted, a recommendation for updates to the Water Control Plans at tested reservoirs based on the FIRO process to improve operations to maximize flood control, water supply and ecosystem benefits. The effort will identify a suite of actions ranging from practical, short-term steps to longer-term research needs. FIRO will suggest incremental improvements as science evolves and implementation criteria are met. FIRO follows adaptive management principles for continual improvement of reservoir operations. In the case of the tested reservoirs, and much of the west coast, this hinges on opportunistically applying advances in monitoring and predicting atmospheric rivers, their associated precipitation and runoff. Lessons learned from the pilot study at Lake Mendocino and the additional reservoirs in the FIRO expanded effort will be captured and inform the process for evaluating and applying FIRO at applicable reservoirs across the country.

FIRO Steering Committee Represented Organizations

California State Climate Office, Department of Water Resources •
Center for Western Weather and Water Extremes at Scripps
Institution of Oceanography • NOAA Earth System Research
Laboratory • NOAA National Weather Service • NOAA National
Marine Fisheries Service • Sonoma Water • United States Geological
Survey • US Bureau of Reclamation • US Army Corps of Engineers

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