Lake Mendocino
Forecast-Informed Reservoir Operations (FIRO)

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FIRO is a collaborative viability assessment between the U.S. Army Corps of Engineers, Sonoma County Water Agency, Center for Western Weather & Water Extremes/ Scripps Institute of Oceanography at the University of California at San Diego, National Oceanic and Atmospheric Administration (National Marine Fisheries Service, Office of Oceanic & Atmospheric Research, National Weather Service), U.S. Bureau of Reclamation, U.S. Geological Survey, California Department of Water Resources, and the Mendocino County Russian River Flood Control & Water Conservation Improvement District.

Collaborative Research

Determining Resiliency for Water Supply & Flood Risk

BACKGROUND: Although the U.S. Army Corps of Engineers (USACE) involvement in studies in response to flooding dates back to the 1850s, Congress first authorized USACE to construct projects for flood control in the Flood Control Act of 1917, which is often considered the foundation of what we now call flood risk management. Lake Mendocino was created in 1958 by the construction of Coyote Valley Dam on the East Fork of the Russian River in Mendocino, Calif. The dam was built for flood control, water supply and recreation. As a water resource management agency, USACE is primarily concerned with flood risk management but also recognizes the challenges posed by hydrologic drought. USACE uses the reservoir's Water Control Manual to operate the dam and water releases in accordance with the authorities Congress has given, along with applicable laws, regulations and Executive Orders. Sonoma County Water Agency (SCWA) and the Mendocino County Russian River Flood Control & Water Conservation Improvement District are the local water agencies that partnered with USACE in construction of the dam. SCWA is the primary decision-maker on the amount of normal water released as governed by state laws (Decision 1610).

To reduce flood risk, USACE uses the Water Control Manual to manage reservoir water levels using what's known as a "rule curve" to provide flood storage capacity to minimize downstream flooding. The rule curve is based on typical historical weather patterns and specifies the top of the conservation pool. In general, reservoir operation is designed to store water during a flood event and to release water soon after to create storage space for another flood event. The Water Control Manual and rule curve incorporate monitored meteorological data in operational decision-making. For five decades, the Coyote Valley Dam water management operations have successfully prevented several flood events from becoming major flood events.

THE CHALLENGE: The Water Control Manual estimates water supply storage and release requirements for flood storage capacity. While it effectively reduces flood risk and accounts for changing conditions in its normal operations, it does not account for increased demand for water in the watershed for instances such as reductions in PG&E Potter Valley Eel River diversions into the Russian River which have flowed into Lake Mendocino since 1986. Given changing hydraulic conditions, technical advances in weather forecasting and increasing demand for water supply, a collaborative team of federal, state and local agencies is assessing the viability of possibly increasing the water supply pool at the reservoir while preserving flood-risk reduction.

Collaborative Research

Determining Resiliency for Water Supply & Flood Risk (*Cont.*)

POTENTIAL SOLUTION: The assembled collaborative team has made possible a multi-disciplinary research and development effort called Forecast-Informed Reservoir Operations (FIRO). At its core, FIRO represents the possibility of using innovative emerging science and technology to optimize limited resources and address potential impacts of climate change without building costly new reservoir infrastructure. Multi-agency partners' research and development efforts are being conducted to determine if meteorological forecasting capability and predictability can be improved at reservoirs in the Western U.S. to better inform decision-making on water supply while maintaining or improving flood risk reduction and realizing additional ecosystem benefits. Recent advances in the detection and forecasting of atmospheric river (often called "pineapple express") precipitation events, together with the impact and import of such events in the water-sensitive areas of the West, have highlighted the need for research at this time.

Currently in the second year of effort, a collaborative steering committee partnership of federal, state and local agencies and academia is following a five-year work plan which lays out an approach for improved meteorological forecasting and a proof-of-concept FIRO viability assessment using Lake Mendocino in the Russian River Watershed as a pilot test bed. The work plan describes efforts to quantify current technical and scientific capabilities and determine needed scientific advances to demonstrate the potential of improved forecasts with regard to FIRO for reservoir management.

TANGIBLE BENEFITS: It is anticipated that FIRO may improve water supply and environmental outcomes without diminishing flood protection or dam safety. Examples of possible tangible benefits include:

Improved Supply Reliability for Downstream Users - When storms cause water levels behind the dam to encroach into the flood control space, normal operation is to release water to re-establish flood control space for future storms. With FIRO, some of the water could be retained for future supply as long as no major precipitation event is predicted for several days and it can be demonstrated that the retained water can be released past downstream flood-prone areas before the arrival of the next storm. This strategy may permit earlier water supply capture in some years, hence improving summer season water supply reliability for downstream water users. In addition, a byproduct of FIRO could allow flexibility in reservoir releases, making possible the management of downstream flows needed for recovery of fish populations.

Enhanced Flood Risk Reduction - When a storm is predicted to cause flooding, normal operations call for release of reservoir water and drawdown of water levels. With FIRO, release decisions would consider weather observations and predictions as well as current watershed soil conditions, which, in some cases, may indicate a need for greater drawdown of the lake level to allow for greater flood-risk reduction downstream. This requires forecasting confidence on the amount, timing and location of precipitation and runoff to restore the lake level after the storm.

Ecosystem Benefits – Reservoir storage increases enhance the ability to control releases for improved water quality conditions and reliability, benefiting the listed threatened and endangered salmonids' habitat.

CURRENT STATUS: The USACE Engineer Research and Development Center (ERDC) has engaged the Corps' Hydrologic Engineering Center to conduct a preliminary viability assessment using current reservoir operation tools paired with past rainfall record as a "perfect" forecast in order to determine the maximum benefit that could be realized from improved forecast capability. Additionally, an interdisciplinary research team is exploring opportunities to capitalize on atmospheric forecasting capabilities being developed through FIRO to assess the viability of those forecasts for real-time water management operations.

EXPECTED OUTCOMES: If deemed viable, FIRO-developed capabilities will be furthered studied by USACE for possible incorporation into the water management practices without increasing the risk to flood protection or dam safety. It is hoped that FIRO may improve water supply and environmental outcomes. The decision to incorporate these FIRO-developed capabilities into Lake Mendocino's water control management strategy ultimately remains with USACE to ensure the dam is operated safely without placing lives and property downstream at risk.

Possible Transferability Potential - While the FIRO effort and work plan are designed to benefit water management at Lake Mendocino, the project has transferability potential. If proven viable, the FIRO work plan documents a process whereby FIRO-developed capabilities may be applicable in other areas impacted by atmospheric rivers and other similar meteorological phenomena.