Appendix D

Summary of Coordination with National Marine Fisheries Service (NMFS) regarding Lake Mendocino Forecast Informed Reservoir Operations (FIRO) Steering Committee Major Deviation Request from the Coyote Valley Dam – Lake Mendocino Water Control Manual

Members of the Lake Mendocino Forecast Informed Reservoir Operations (FIRO) Steering Committee requested a third consecutive planned major deviation to the Coyote Valley Dam – Lake Mendocino Water Control Manual (WCM) (USACE, 1986a), which follows the major deviations implemented for WY 2019 and WY 2020. The purpose of this request is to improve water supply reliability, flood risk management, and environmental conditions of Lake Mendocino and the upper Russian River. Staff from U.S. Army Corps of Engineers (USACE), National Marine Fisheries Service (NMFS), and the Sonoma County Water Agency (Sonoma Water) coordinated to ensure avoidance of potential effects to listed salmonid species downstream of Lake Mendocino in the Russian River.

<u>Background on Major Deviation Request and Lake Mendocino Operations</u>

The FIRO effort was led by a steering committee formed in 2014 consisting of representatives from the USACE, Sonoma Water, Scripps Institute of Oceanography (Scripps), National Oceanic and Atmospheric Administration (NOAA), U.S. Geologic Survey (USGS), U.S. Bureau of Reclamation and the California Department of Water Resources. NOAA staff that participate in the FIRO effort include technical staff from the NOAA Restoration Center and National Marine Fisheries Service, National Weather Service (NWS), California Nevada River Forecast Center (CNRFC), and NOAA Earth System Research Laboratory (ESRL).

The purpose of this request was to improve water supply reliability, flood risk management, and environmental conditions of Lake Mendocino and the upper Russian River. Lake Mendocino has experienced significantly reduced water supply reliability over the past several years due to a significant reduction of trans-basin transfers from the Eel River. The goal of FIRO was to help restore some of the diminished water supply reliability without reducing the existing flood protection capacity of Lake Mendocino. FIRO is a water management program that uses data from watershed monitoring networks and improved weather and hydrologic forecasting to help water managers selectively retain or release water from reservoirs in a flexible manner that more accurately reflects and leverages the natural variability and predictability of meteorology and hydrology. Potential ecosystems benefits include increased flexibility in reservoir storage that can improve the timing and volume of releases to improve water quality conditions and provide reliable flow for federal listed salmonids.

Operation of Lake Mendocino is governed by WCM rules that allocate storage to flood management and conservation (water supply) purposes in a seasonally varying manner and specify how water may be stored in the flood pool and conservation pool. The WCM rules allocate the 122,400 acre-feet (AF) of storage in Lake Mendocino to storage for flood management and storage for conservation purposes. The seasonally varying flood storage pool varies from a maximum of 54,000 AF in the winter rainy season to 11,400 AF in the drier summer season. Rules require the flood pool to be empty except briefly in periods of greatest inflow. Then flood runoff is stored and released at a rate that avoids or minimizes exceedance of downstream flow targets at Hopland (a key stream gage downstream from the reservoir), Healdsburg, Guerneville, and elsewhere (Jasperse, et al., 2017).

The conservation storage, used for water management objectives and meeting minimum instream flow requirements, is filled as water is available to do so. However, operation following the WCM rules strictly does not permit storage in the flood pool for conservation purposes. These rules apply even if inflow forecasts do not indicate an immediate need for empty space to manage flood water (Jasperse, et al., 2017).

Members of the FIRO Steering Committee requested USACE approval of a planned major deviation to store additional water above the existing guide curve for the Coyote Valley Dam Lake Mendocino WCM. With USACE's approval, this resulted in an additional storage of 11,650 acre-feet between November 1 and February 28 in each year, with an option to begin the increase in spring storage as early as February 15 (Modified Hybrid alternative), if conditions allow, or on March 1 (Hybrid alternative). This request for a planned major deviation to the WCM for WY 2021 through WY 2026 followed the successful implementation of major deviations granted by the USACE for WY 2019 (Figure D-1) and WY 2020 (Figure D-2); and was essentially the same as and followed the successful implementation of those previous major deviations, with the addition of an option to begin the increase in spring storage as early as February 15, which the USACE can exercise at their discretion. NMFS requested an advance opportunity to provide technical assistance to the USACE for increases in spring storage beginning February 15 to ensure upper Russian River conditions remain adequate for adult steelhead. Similar to the WY 2020 approved planned major deviation, the WY 2021 through WY 2026 request would allow USACE to pre-release in advance of a storm event into the water conservation pool if: (1) such a release is recommended by the FIRO decision support tools and (2) Sonoma Water is consulted about the pre-release and approves of the action in coordination with the National Marine Fisheries Service.

In the summer of 2017, the FIRO Steering Committee completed the *Preliminary Viability Assessment of Lake Mendocino Forecast Informed Reservoir Operations* (PVA; (Jasperse et al., 2017), which represented a major effort to develop the Lake Mendocino FIRO project, http://cw3e.ucsd.edu/firo-preliminary-viability-assessment-for-lake-mendocino/). This major body of work demonstrated that there was significant evidence that weather and water forecasts could be used to improve the operation of Lake Mendocino to recover lost water supply reliability without compromising flood management capacity. In addition, significant environmental benefits are achievable by improving fishery habitat for minimum flows and lower water temperatures. These conclusions were reached through three independent studies conducted by the USACE's Hydrologic Engineering Center (HEC, 2017), Scripps Center for Western Weather and Water Extremes (CW3E) (CW3E, 2017), Sonoma Water (Sonoma Water, 2017), and the National Marine Fisheries Service (NMFS, 2019)). As mentioned above, the FIRO Steering Committee worked on a Final Viability Assessment (FVA). In the extensive evaluation performed in support of the FVA, the Modified Hybrid model provided the highest level of benefits by virtue of both objective and expert-elicitation evaluation of 16 multi-purpose metrics. Draft documents on the FVA evaluation were reviewed by the FIRO Steering Committee, are available online and upon request, and will be published by the end of 2020.

The decision to repeat the WY 2020 major deviation for the upcoming five-year period was based on a collaborative process between members of the Steering Committee and USACE reservoir operators in which the results of the prior two years of operations were evaluated relative to options for different potential deviations. It is important to emphasize that if water levels are within the storage space allowed by this deviation, the USACE have the discretion to utilize the additional information provided to inform reservoir operations. USACE reservoir operators can retain full operational control and authority, with the Russian River Decision Support System (RR-DSS) providing an additional tool for dam operators to make flood operation decisions.

<u>Coyote Valley Dam/Lake Mendocino Flood Operations and Russian River Biological Opinion</u>

The NMFS issued its *Biological Opinion for Water Supply, Flood Control Operations, and Channel Maintenance conducted by the U.S. Army Corps of Engineers, the Sonoma County Water Agency, and the Mendocino County Russian River Flood Control and Water Conservation Improvement District in the Russian River Watershed* (Russian River Biological Opinion) on September 24, 2008 (NMFS, 2008). The Russian River Biological Opinion was a culmination of more than a decade of consultation among the USACE, the Sonoma Water, the Mendocino County Water Conservation and Flood Control Improvement District (MCDWFCID), and NMFS regarding the impacts of the USACE and Sonoma Water flood control and water supply activities on three fish species listed under the federal Endangered Species Act: Central California Coast steelhead (*Oncorhynchus mykiss*); Central California Coast coho salmon (*O. kisutch*); and California Coastal Chinook salmon (*O. tshawytscha*). Coho salmon are also listed under the California Endangered Species Act (CESA).

The Russian River Biological Opinion included an Incidental Take Statement with a term of 15 years that authorizes the USACE and the Sonoma Water to conduct specified lawful operations and make specified changes in operations as a result of the Russian River Biological Opinion so long as the terms and conditions of the Incidental Take Statement are met, even if incidental take may result from such operations. The Incidental Take Statement includes Reasonable and Prudent Measures (RPMs) that the USACE and Sonoma Water must implement to minimize and monitor the impacts of the incidental take of listed species due to implementation of the Sonoma Water and USACE's water supply and flood control activities and Reasonable and Prudent Alternatives (RPAs) (NMFS, 2008).

The Russian River Biological Opinion evaluated the USACE's flood control operations of Coyote Valley Dam/Lake Mendocino under the WCM, including the described releases from Flood Control Schedules 1, 2, and 3 used to empty the flood control pool following a storm (NMFS, 2008). The Biological Opinion identified Coyote Valley Dam flood operations as including both water storage and water releases. Water storage reduces the magnitude of flood peaks, while flood releases have the potential to scour the streambed, erode banks, increase turbidity, and may create dewatered channel conditions during ramp downs of flood releases. NMFS' analysis found potential adverse impacts to Chinook salmon spawning habitat from scour and bank erosion, and potential impacts to Chinook and steelhead spawning and rearing habitat from the release of turbid waters. Ramping of flows was found to create intermittent flow and/or dewatered conditions in rearing habitat used by both Chinook salmon and steelhead fry and juveniles during the winter and spring. Pre-flood and periodic inspections during the fall (September) are likely to cause dewatered channel conditions, adversely affecting rearing habitat for juvenile steelhead.

The 2008 Russian River Biological Opinion included an Incidental Take Statement. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2) of the Endangered Species Act, taking that is incidental to and not the purpose of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of an incidental take statement. Incidental take measures related to flood control activities at Coyote Valley Dam and Lake Mendocino were identified beginning on page 304 of the Russian River Biological Opinion (NMFS, 2008). The 2008 Russian River Biological Opinion expired on September 24, 2023, but consultation with NMFS has been reinitiated under Section 7 of ESA, and a new BO is currently in preparation.

Discussion of Viability Assessment Results

In an extensive evaluation performed in support of the FVA, the Modified Hybrid alternative provided the highest level of benefits by virtue of both objective and expert-elicitation evaluation of 16 multi-purpose metrics. Flood control operations would continue to be implemented in light of the Incidental Take Statement issued by NMFS under the Russian River Biological Opinion (see below).

The 5-year major deviation request would allow conditional encroachment of water into the flood control pool by 11,650 acre-feet; and potentially increasing stored water from November 1 to February 14 to 80,050 acre-feet (Figure D-3). From October 1 to 31, the 5-year major deviation would decrease the conservation pool by 1,030 acre-feet per day if storage is above 80,050 acre-feet. The 5-year major deviation would provide an option to begin the increase in spring storage as soon as February 15 (Modified Hybrid) or March 1 (Hybrid). Beginning the spring refill on February 15 would increase the conservation pool from February 15 to May 10 by 356 acre-feet per day. Beginning the spring refill on March 1 would increase the conservation pool from March 1 to May 10 by 436 acre-feet per day. The encroachment into the flood control pool is within the flood control pool schedules identified in the WCM and evaluated in the Russian River Biological Opinion. The RR-DSS was designed to inform operations when storage levels are within the proposed encroachment space. If reservoir storage is above the maximum encroachment limit (as previously defined), then water will be released as quickly as feasible, while considering all release constraints and downstream flow requirements, to return storage to a level that is at or below the maximum encroachment limit.

The 5-year major deviation as proposed would comply with existing operations, including Decision 1610 minimum instream flow requirements and the Russian River Biological Opinion, flood release requirements including that there would be no flood releases when Russian River flows at Hopland are greater than 8,000 cubic feet per second, and in compliance with new ramping schedule criteria identified by the NMFS and USACE (NMFS, 2016).[1] Modeling of historical hydrology (1985-2017) demonstrated that the 5-year major deviation helps support improvements in reliable reservoir storage at the beginning (Figure D-4) of the steelhead rearing

[1] Development of the new ramping schedule criteria was in response to the Russian River Biological Opinion Reasonable and Prudent Measure 3 to minimize and avoid adverse impacts to listed salmonids.

season and at the end of the water year (Figure D-5), helping to meet recommended Russian River Biological Opinion juvenile steelhead rearing minimum instream flows (Figure D-6), provide improved (cooler) water temperatures for releases out of Lake Mendocino, and reliable releases at the end of the water year to support adult Chinook salmon migration and spawning. Model results demonstrated that these improvements would not increase flood or spill risk (Figures C-7 and C-8).

These results were evaluated to ensure that the major deviation request and the RR-DSS, if used by the USACE for flood control operations, would not increase potential flood control operations impacts to salmonid migration and spawning. Figures C-9 (1986) and C-10 (1997) demonstrate implementation of the FIRO decision tool in years of atmospheric rivers with associated flood events, with a storm event preceded by a flood control release in advance of the storm and reduced flows after the storm event in comparison to existing operations. The 5-year major deviation includes an option to begin the spring refill as soon as February 15 (Modified Hybrid) or March 1 (Hybrid). Beginning the spring fill as early as February 15 as described in the Proposed Action, would result in reaching peak water surface elevations in the reservoir sooner in some years, but reservoir operations would be similar to the No Action alternative. Beginning the spring refill on February 15 versus March 1 would result in similar reservoir releases across the years evaluated, including in dry years (examples years provided: 1986, Figure D-11; 1997, Figure D-12; 2017, Figure D-13; dry years - 2009, Figure D-14; 2013, Figure D-15; 2014, Figure D-16; 2015, Figure D-17).

One observation previously raised by NMFS was related to model results, such as in 1996 (Figure D-18), when the Hybrid and Modified Hybrid alternatives show reduced fall flood control releases relative to existing operations. Due to the potential additional storage afforded by the flood pool encroachment under the proposed action, certain years could delay fall flood control releases due to additional time that the reservoir takes to reach capacity from early season storms. NMFS also observed that under existing operations, early season flood releases (prior to mid-November) made under dry season flow conditions, with no incoming precipitation events, may raise concerns regarding adult Chinook salmon migration in the fall. The proposed major deviation would reduce the frequency of early season flood releases (prior to mid-November) that would result in artificial pulse flows that could cue premature adult Chinook salmon migrations. If flood releases are needed in the fall, NMFS recommends that they should be coupled with the onset of precipitation events and/or made during the later fall period. NMFS requested an advanced opportunity to provide technical assistance to the USACE for the timing of such fall releases in order to determine the appropriate release strategy for spawning and migrating salmonids. Additionally, NMFS requested an advance opportunity to provide technical assistance to the USACE for increases in spring storage beginning February 15 to ensure upper Russian River conditions remain adequate for adult steelhead. Sonoma Water requested to be part of the coordination discussions as well. The USACE will provide notifications of proposed release changes electronically on the internet and by electronic mail to NMFS and Sonoma Water and will continue to make these notifications during implementation of the major deviation request.

Figure D-1. Water Year 2019 Major Deviation Summary of Lake Mendocino storage, releases, and flow at Hopland, including observed conditions and modified hybrid alternative model results.

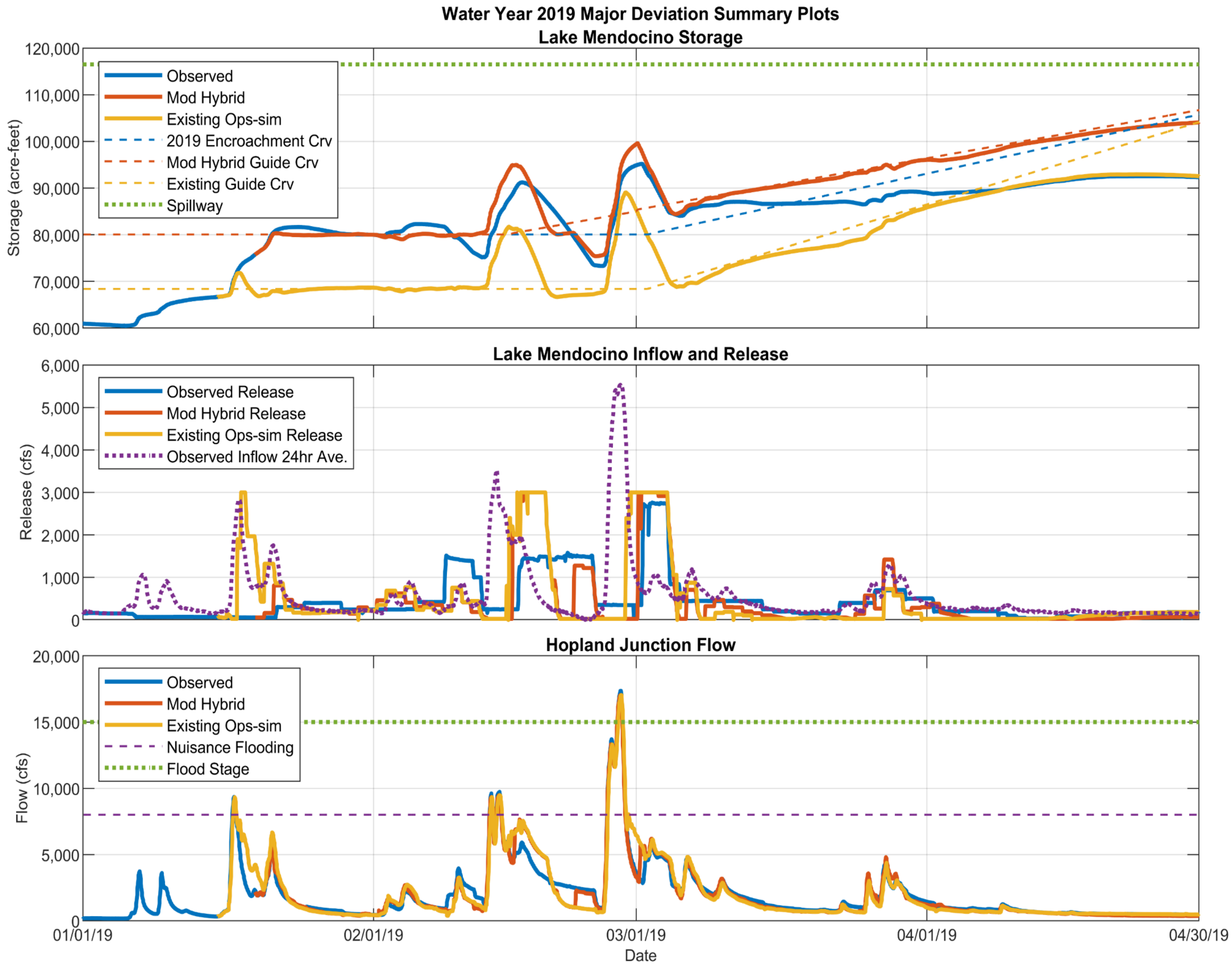


Figure D-2. Water Year 2020 Major Deviation Summary of Lake Mendocino storage, releases, and flow at Hopland, including observed conditions and virtual existing water control manual operations results.

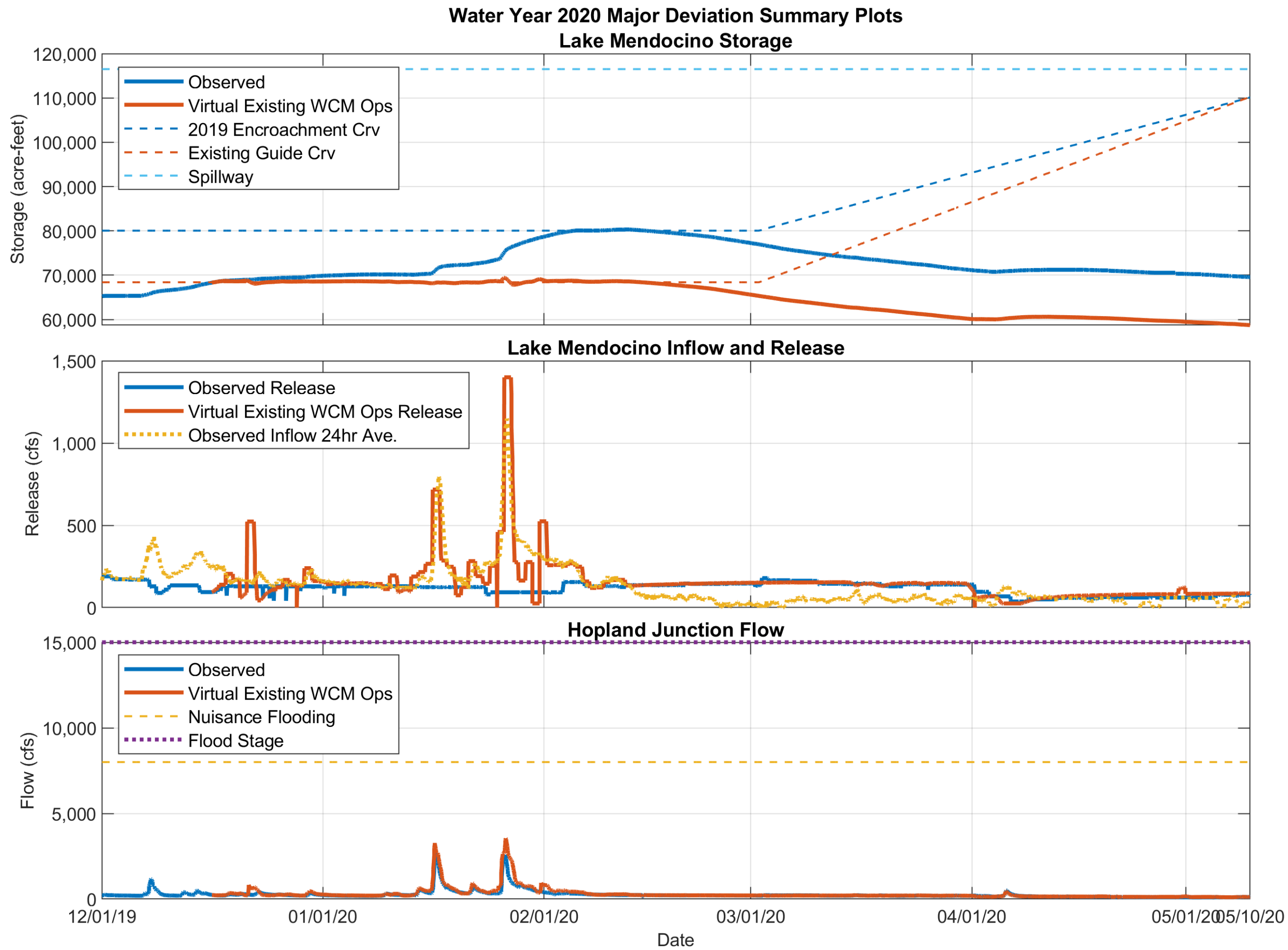


Figure D-3. Existing Guide Curve from Coyote Valley Dam – Lake Mendocino Water Control Manual (USACE 1986a) and Proposed Maximum Deviation Limit Major Deviation Request beginning on February 15 and March 1.

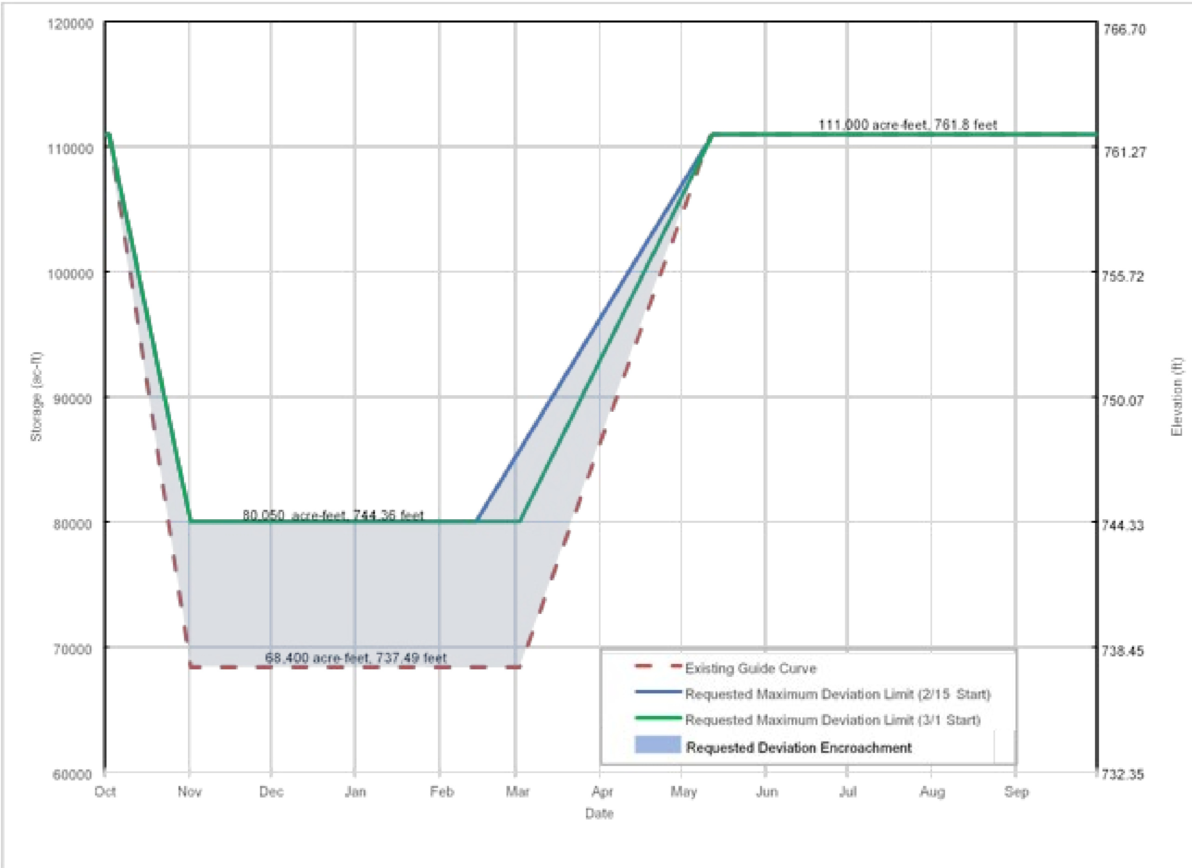


Figure D-4. Lake Mendocino reservoir storage at early steelhead rearing season (May 10) for existing operations and with Modified Hybrid (February 15 spring refill start) and Hybrid (March 1 spring refill start) alternatives.

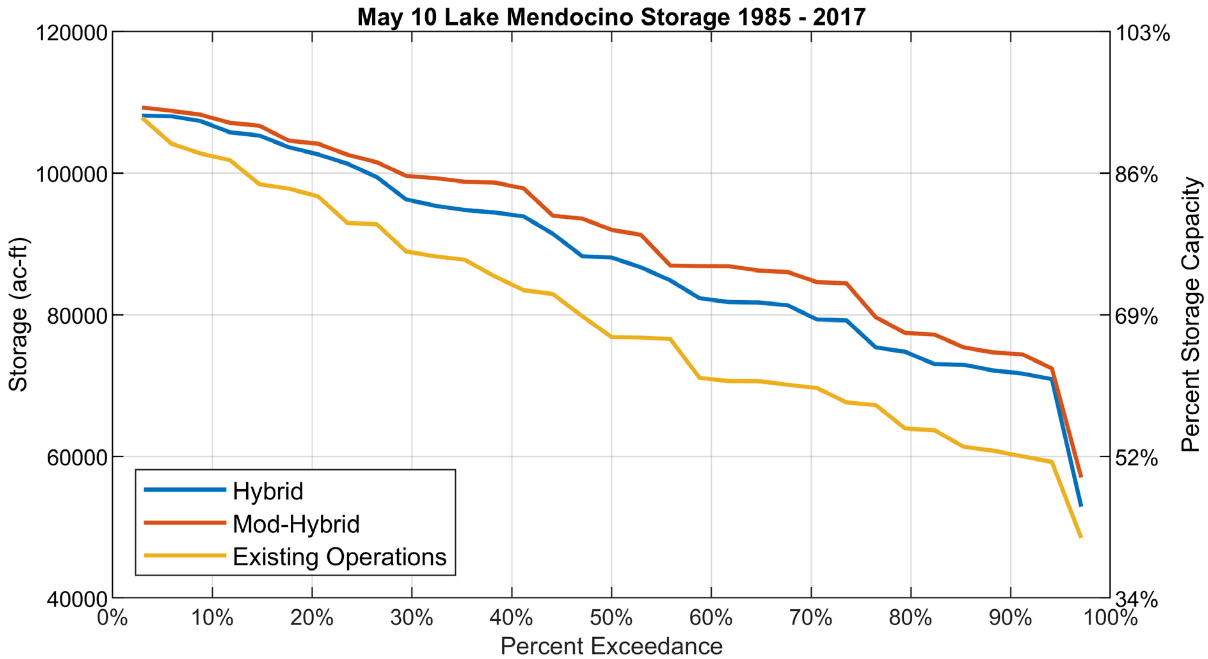


Figure D-5. Lake Mendocino reservoir storage at end of water year for existing operations and with modified hybrid (February 15 spring refill start) and hybrid (March 1 spring refill start) alternatives.

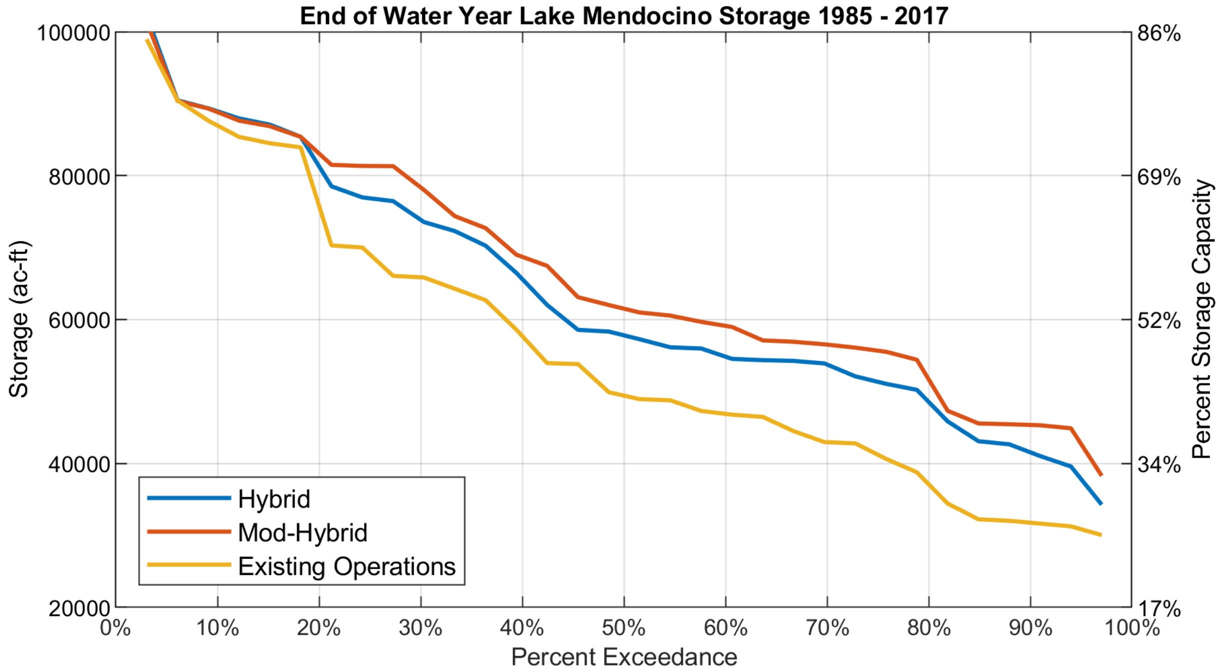


Figure D-6. Percent of days per season, June through September, in which flows satisfy 125 cubic feet per second (cfs) at Cloverdale for alternatives considered in FIRO Final Viablity Assessment (in prep.).

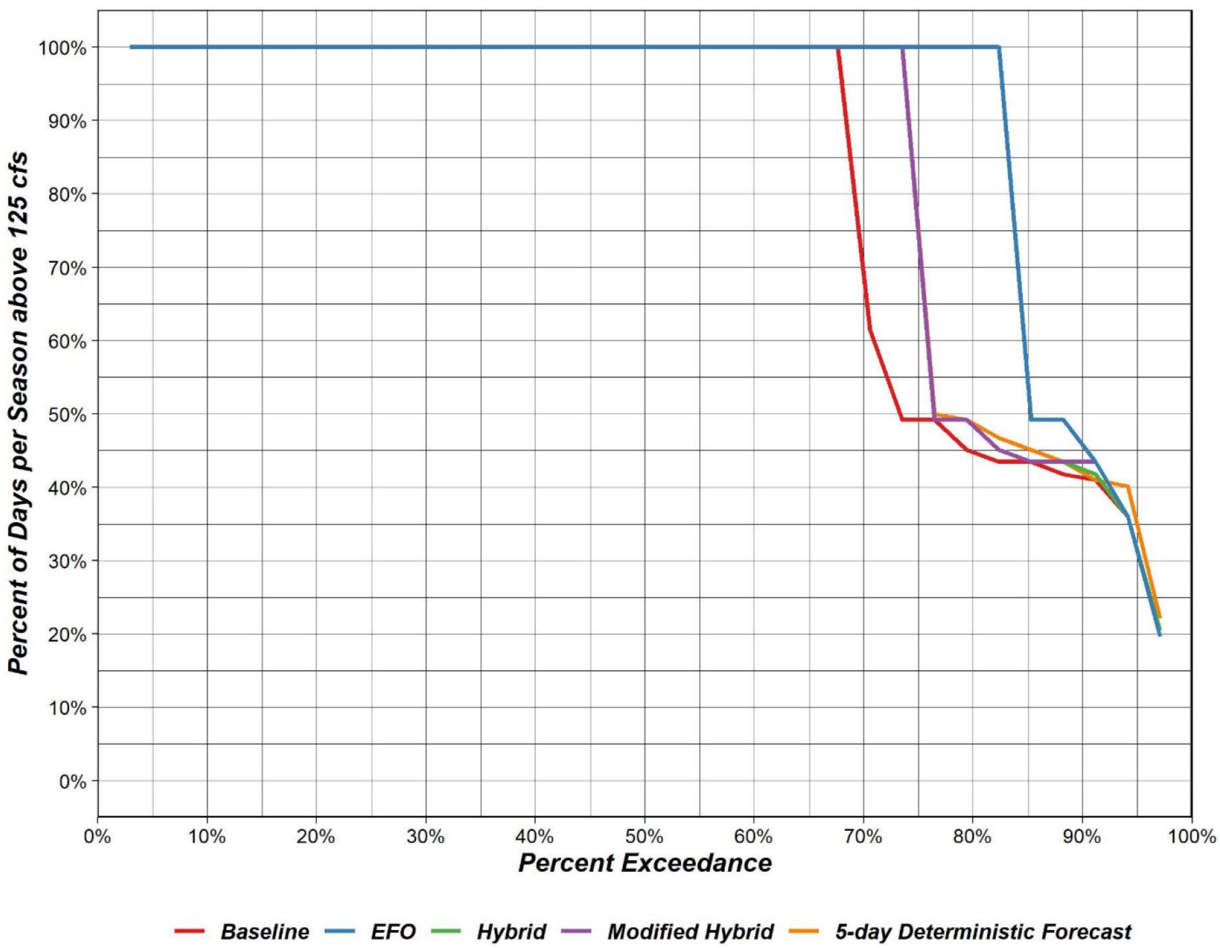


Figure D-7. Annual maximum flow exceedance probability at Hopland for alternatives considered in FIRO Final Viablity Assessment (in prep.).

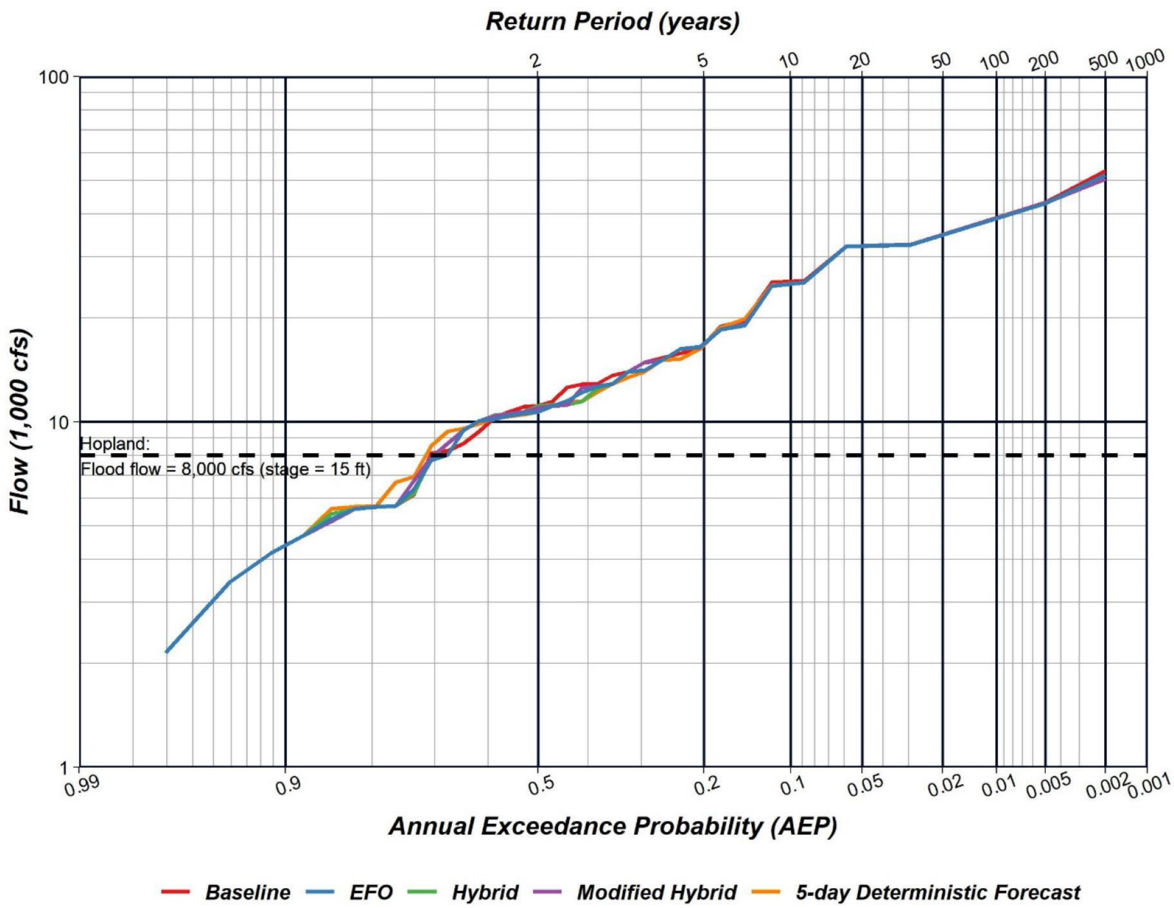


Figure D-8. Annual maximum uncontrolled spill-frequency in Lake Mendocino for alternatives considered in FIRO Final Viablity Assessment (in prep.).

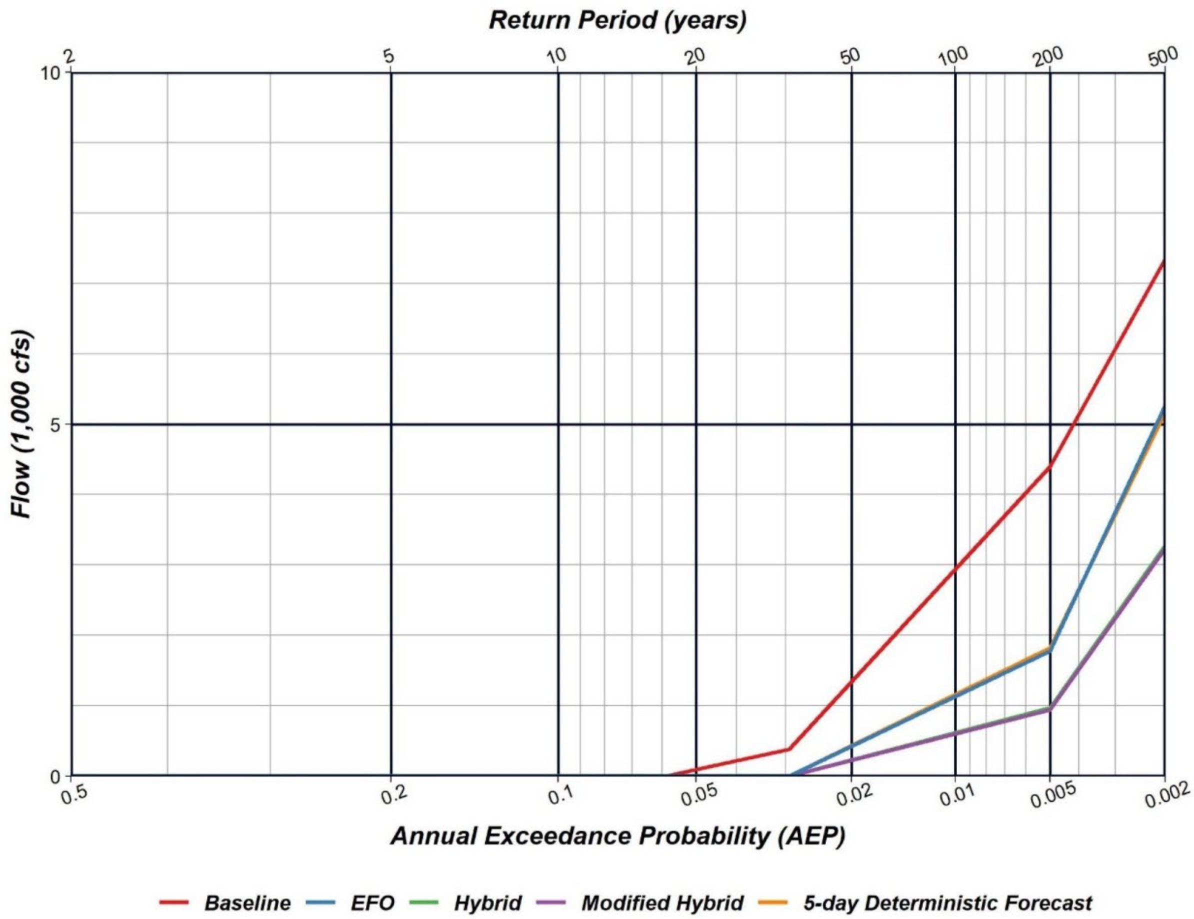


Figure D-9. Water Year 1986 FIRO operations (hybrid and modified hybrid alternatives) simulation results. Water Year 1986 included a mid-winter atmospheric river event.

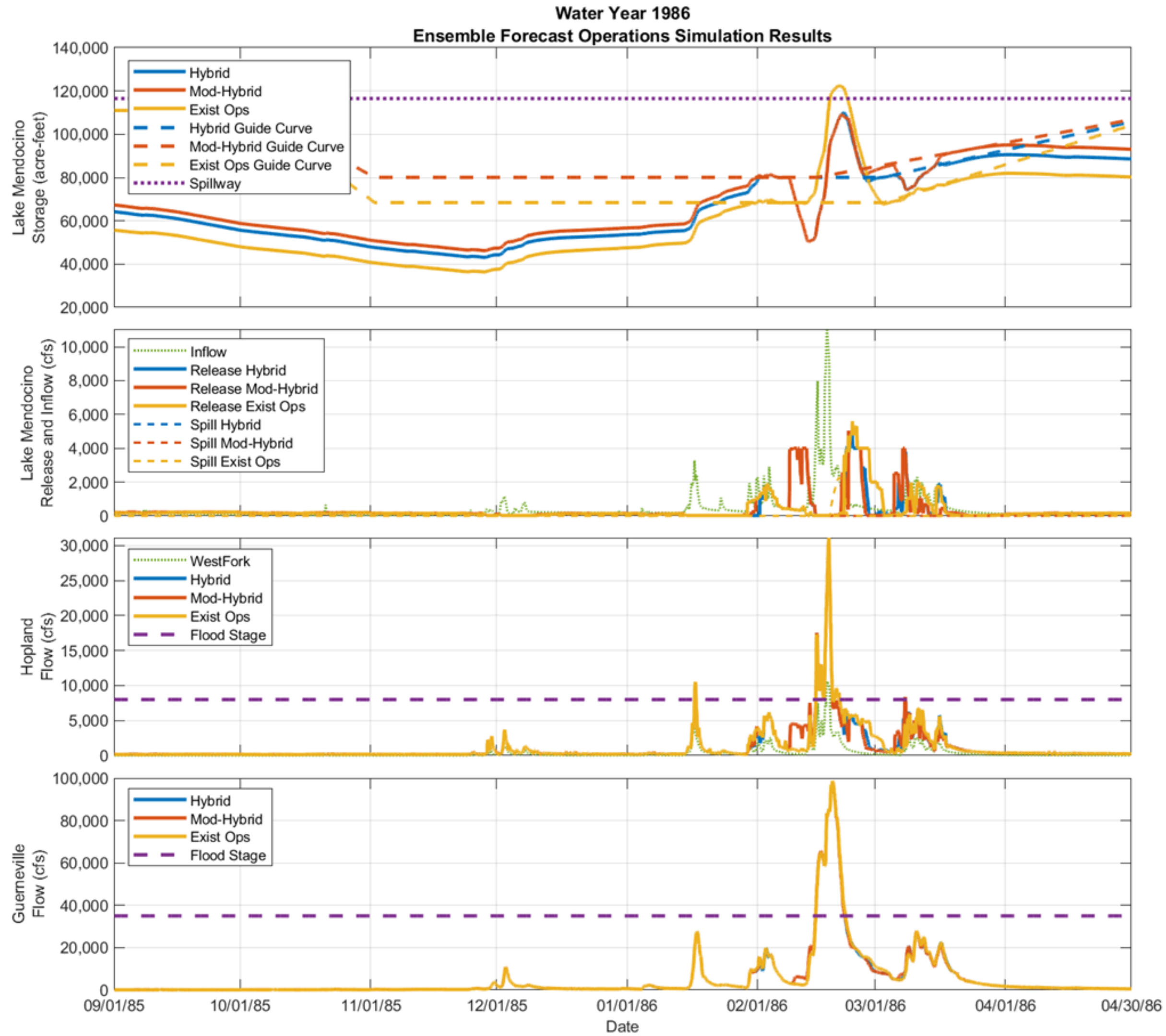


Figure D-10. Water Year 1997 FIRO operations (hybrid and modified hybrid alternatives) simulation results. Water Year 1997 included an early-winter atmospheric river event.

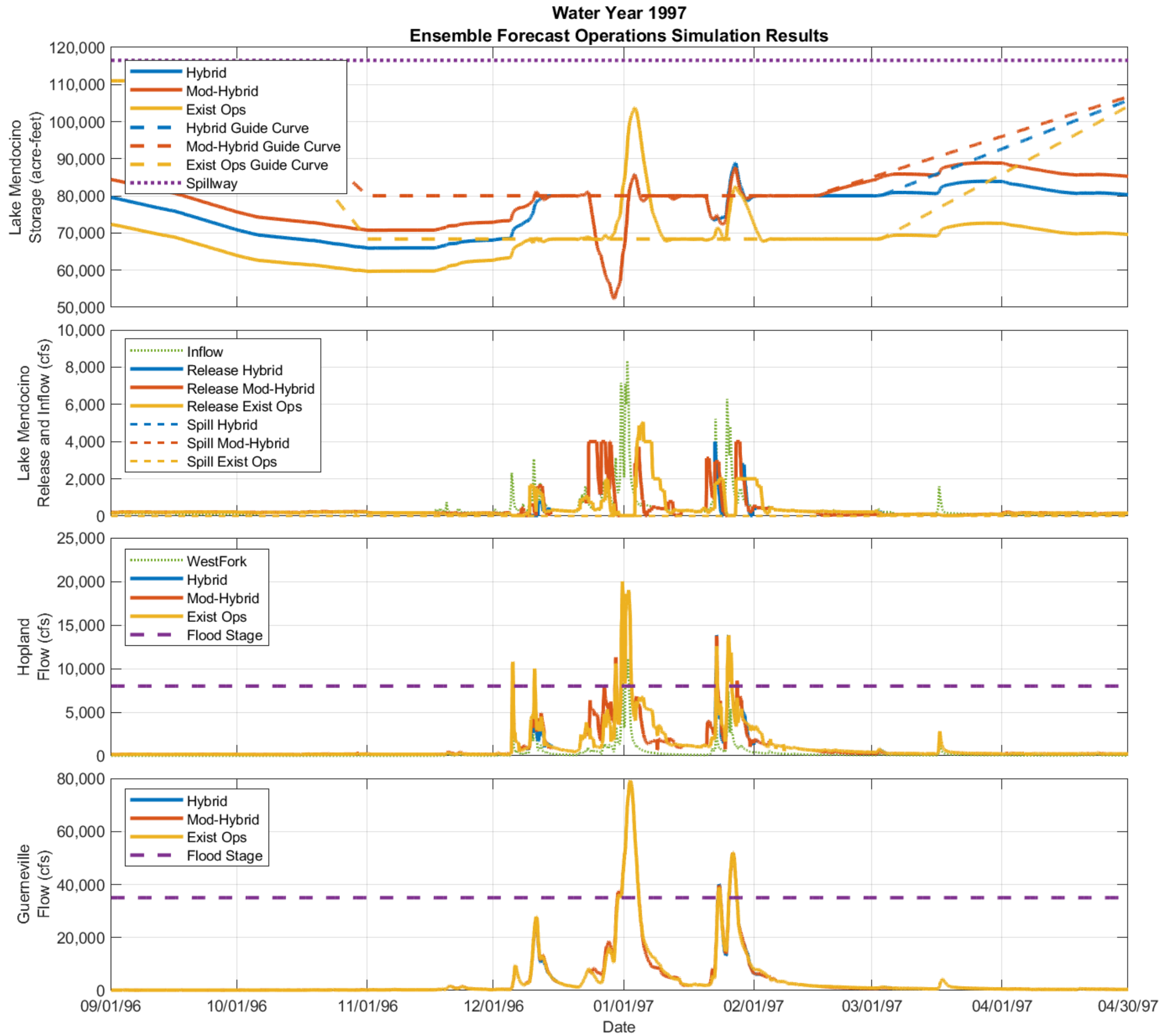


Figure D-11. Simulated comparison of spring refill on beginning February 15 (modified hybrid alternative) versus March 1 (hybrid alternative) Lake Mendocino storage, releases, and flow at Hopland and Guerneville, including observed conditions and virtual existing water control manual operations results from February to April 1986.

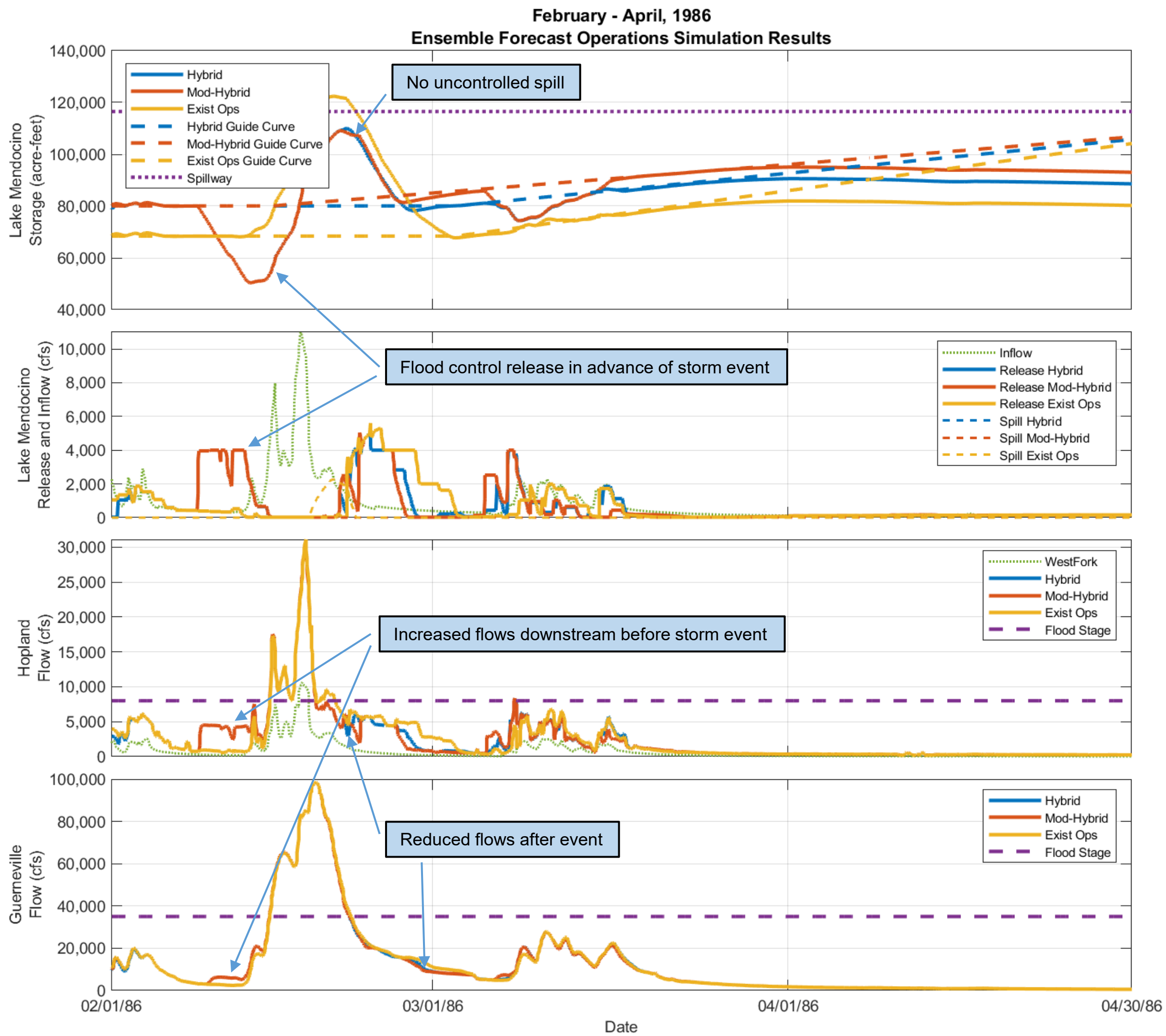


Figure D-12. Simulated comparison of spring refill on beginning February 15 (modified hybrid alternative) versus March 1 (hybrid alternative) Lake Mendocino storage, releases, and flow at Hopland and Guerneville, including observed conditions and virtual existing water control manual operations results from February to April 1997.

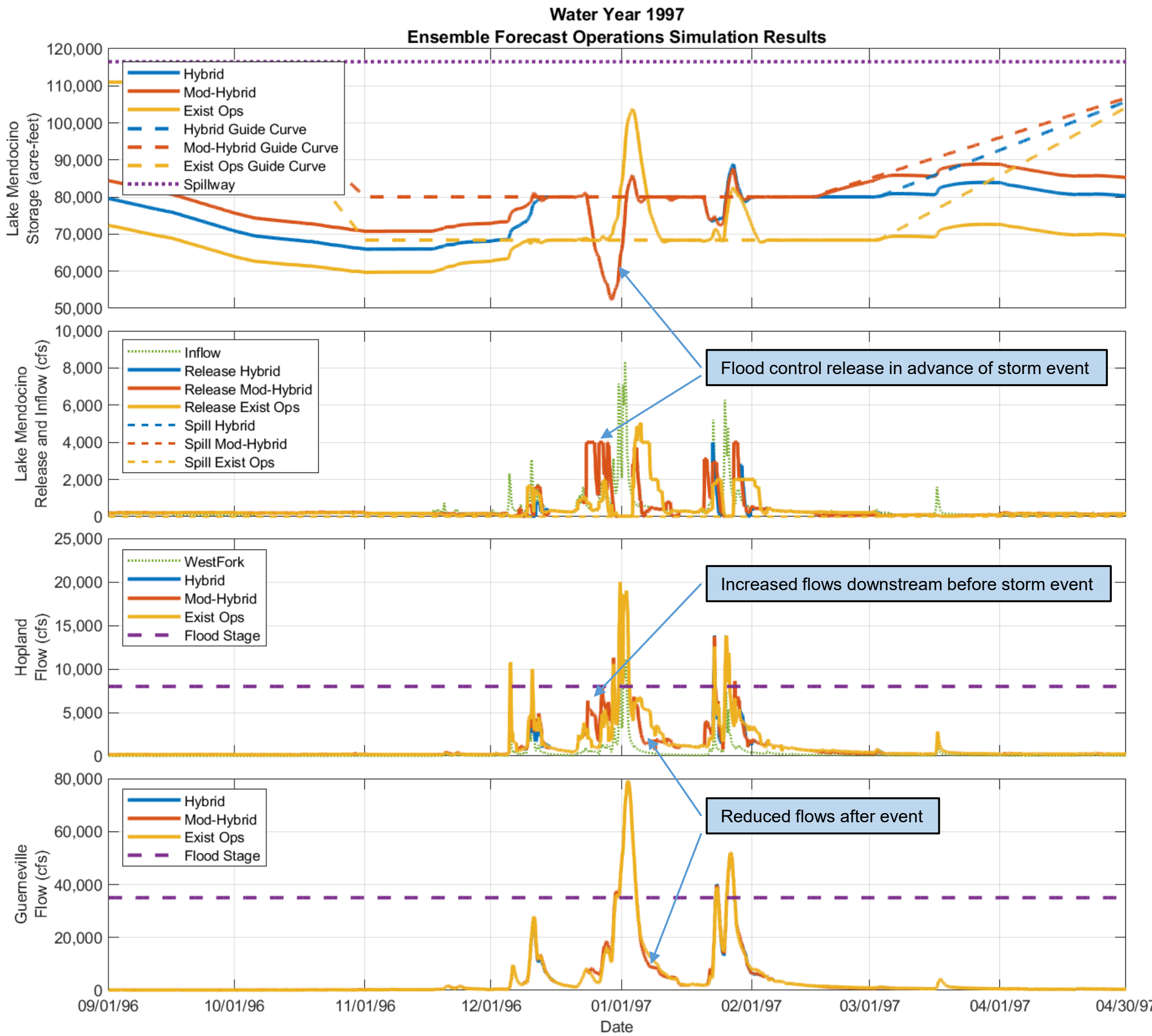


Figure D-13. Simulated comparison of spring refill on beginning February 15 (modified hybrid alternative) versus March 1 (hybrid alternative) Lake Mendocino storage, releases, and flow at Hopland and Guerneville, including observed conditions and virtual existing water control manual operations results from February to April 2017.

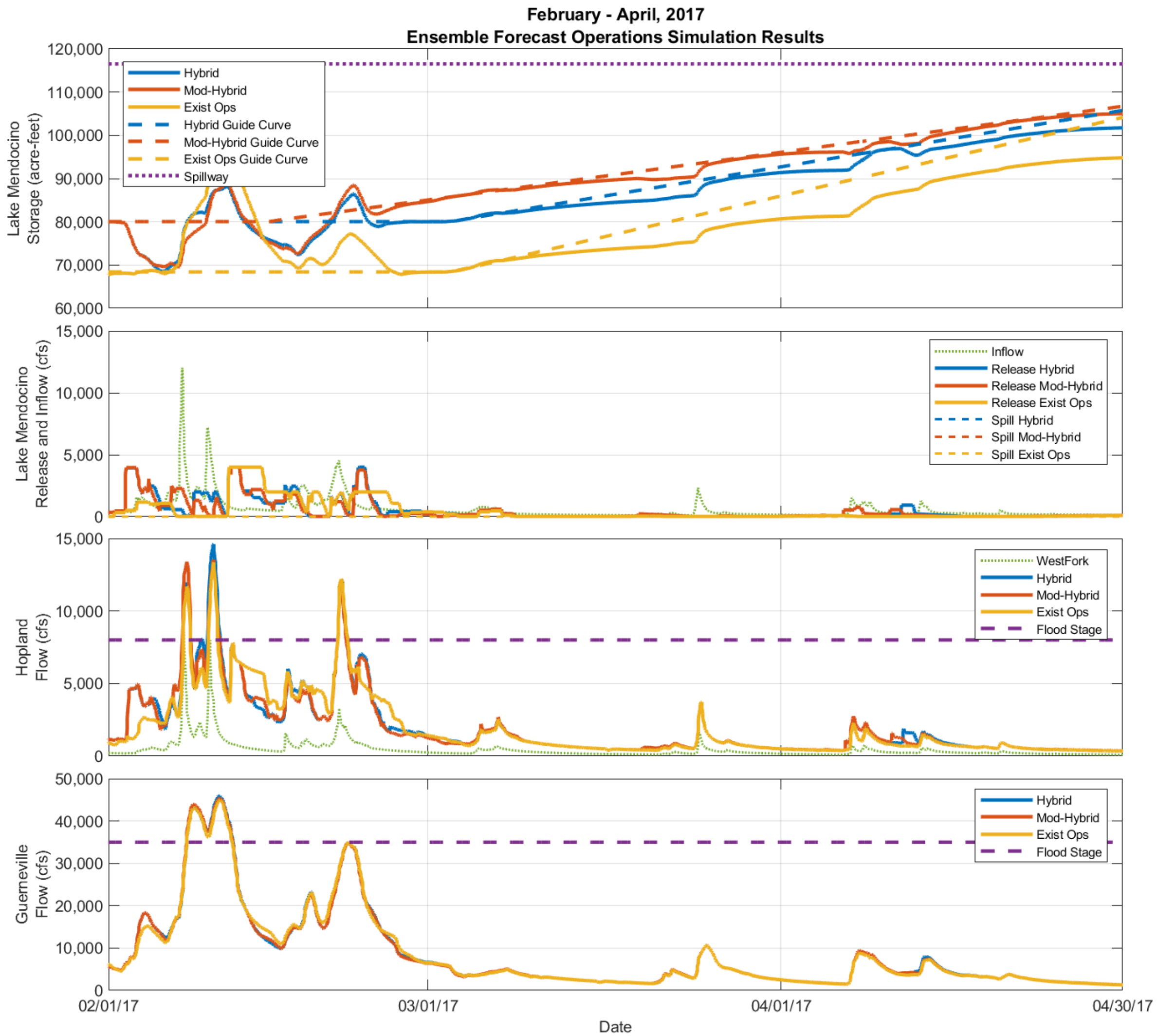


Figure D-14. Simulated comparison of spring refill on beginning February 15 (modified hybrid alternative) versus March 1 (hybrid alternative) Lake Mendocino storage, releases, and flow at Hopland and Guerneville, including observed conditions and virtual existing water control manual operations results from February to April 2009.

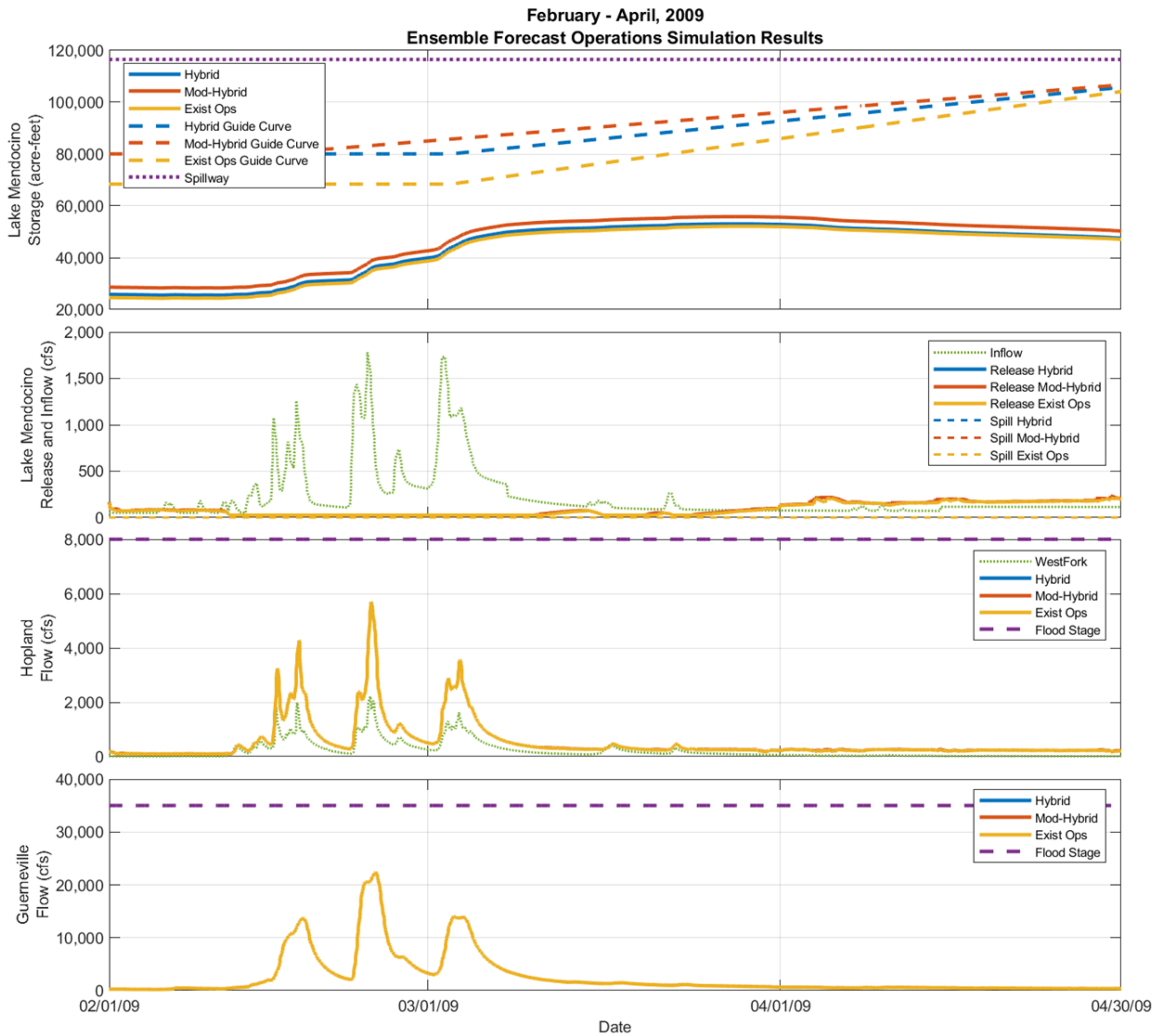


Figure D-15. Simulated comparison of spring refill on beginning February 15 (modified hybrid alternative) versus March 1 (hybrid alternative) Lake Mendocino storage, releases, and flow at Hopland and Guerneville, including observed conditions and virtual existing water control manual operations results from February to April 2013.

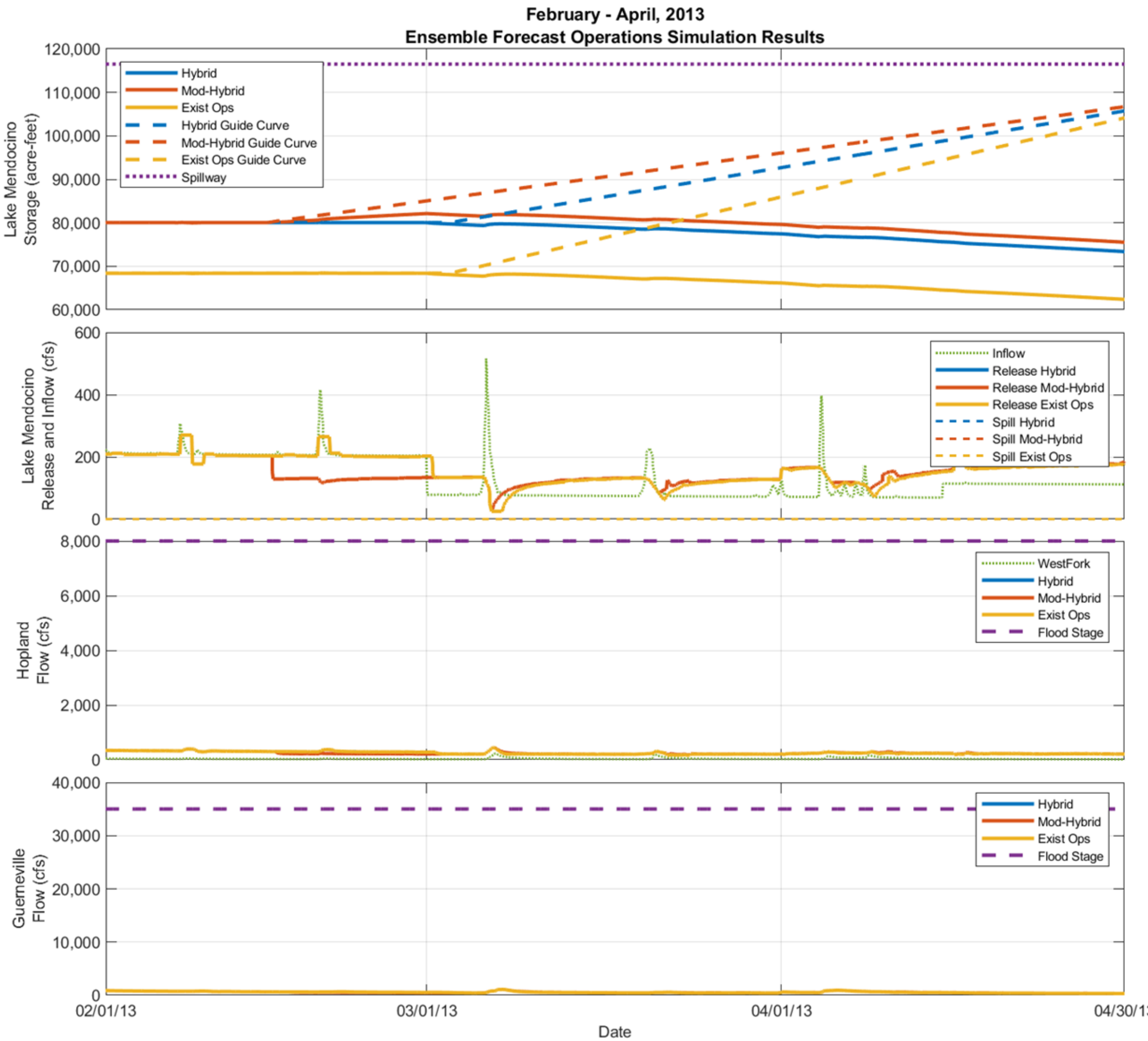


Figure D-16. Simulated comparison of spring refill on beginning February 15 (modified hybrid alternative) versus March 1 (hybrid alternative) Lake Mendocino storage, releases, and flow at Hopland and Guerneville, including observed conditions and virtual existing water control manual operations results from February to April 2014.

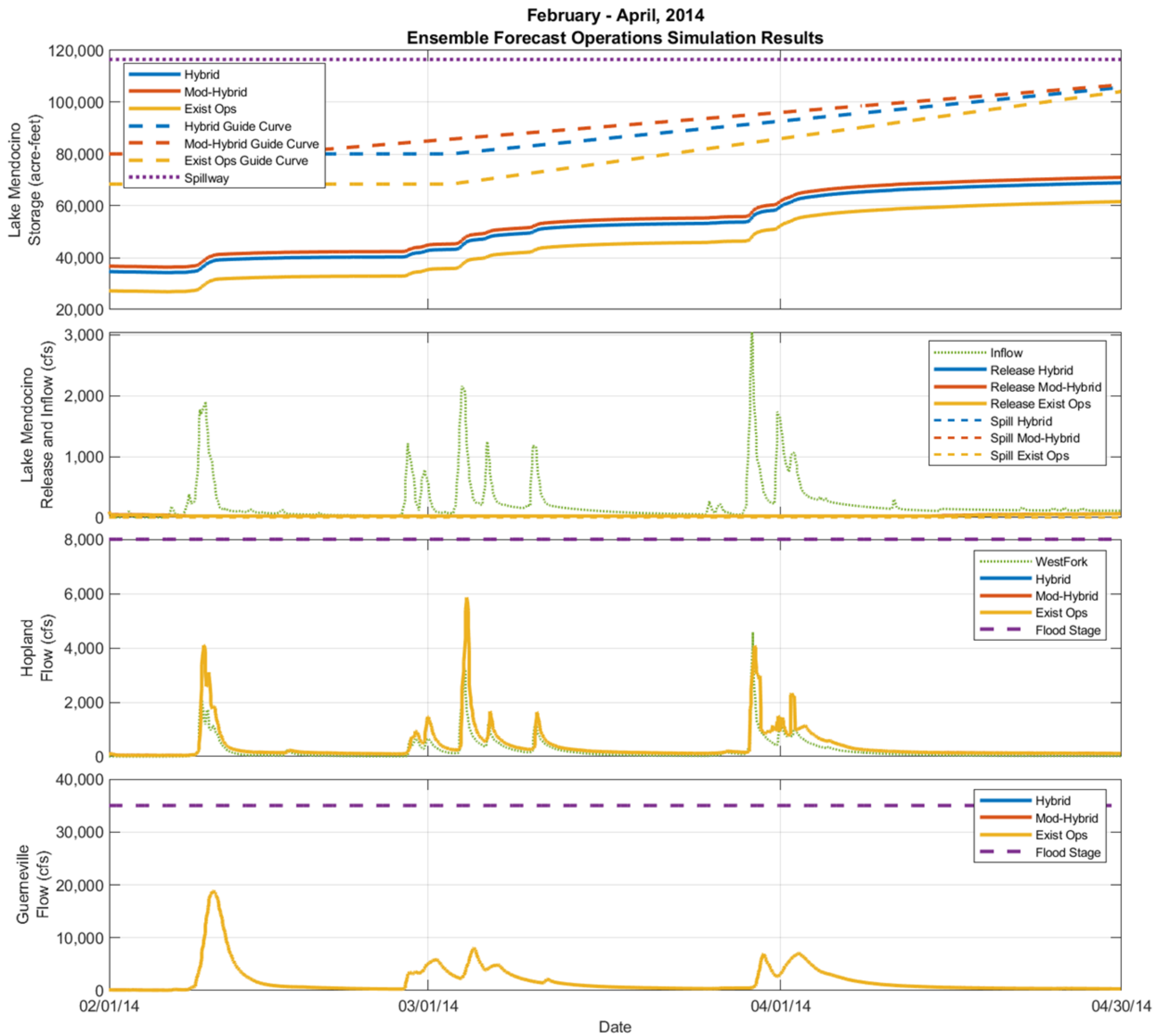


Figure D-17. Simulated comparison of spring refill on beginning February 15 (modified hybrid alternative) versus March 1 (hybrid alternative) Lake Mendocino storage, releases, and flow at Hopland and Guerneville, including observed conditions and virtual existing water control manual operations results from February to April 2015.

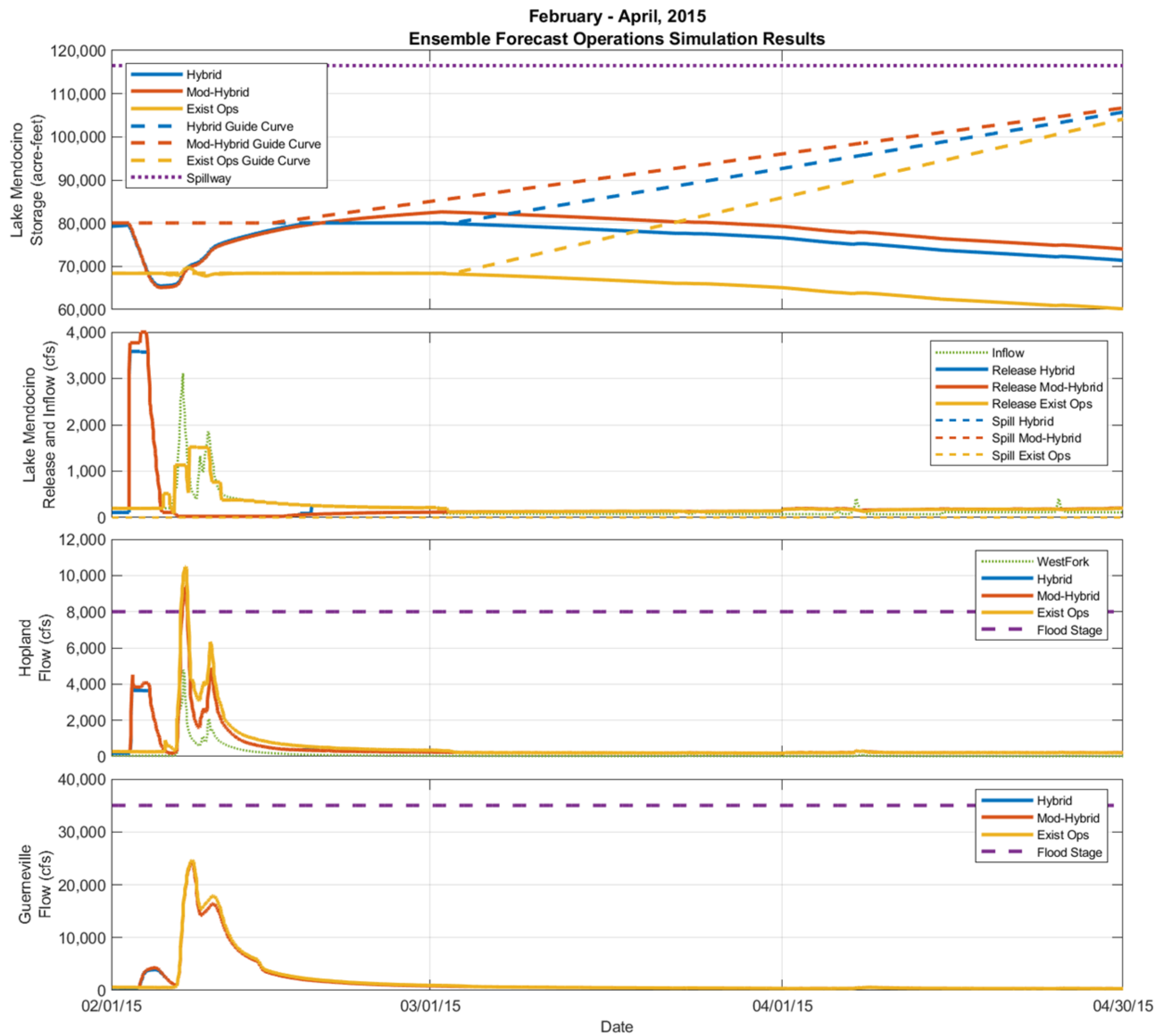
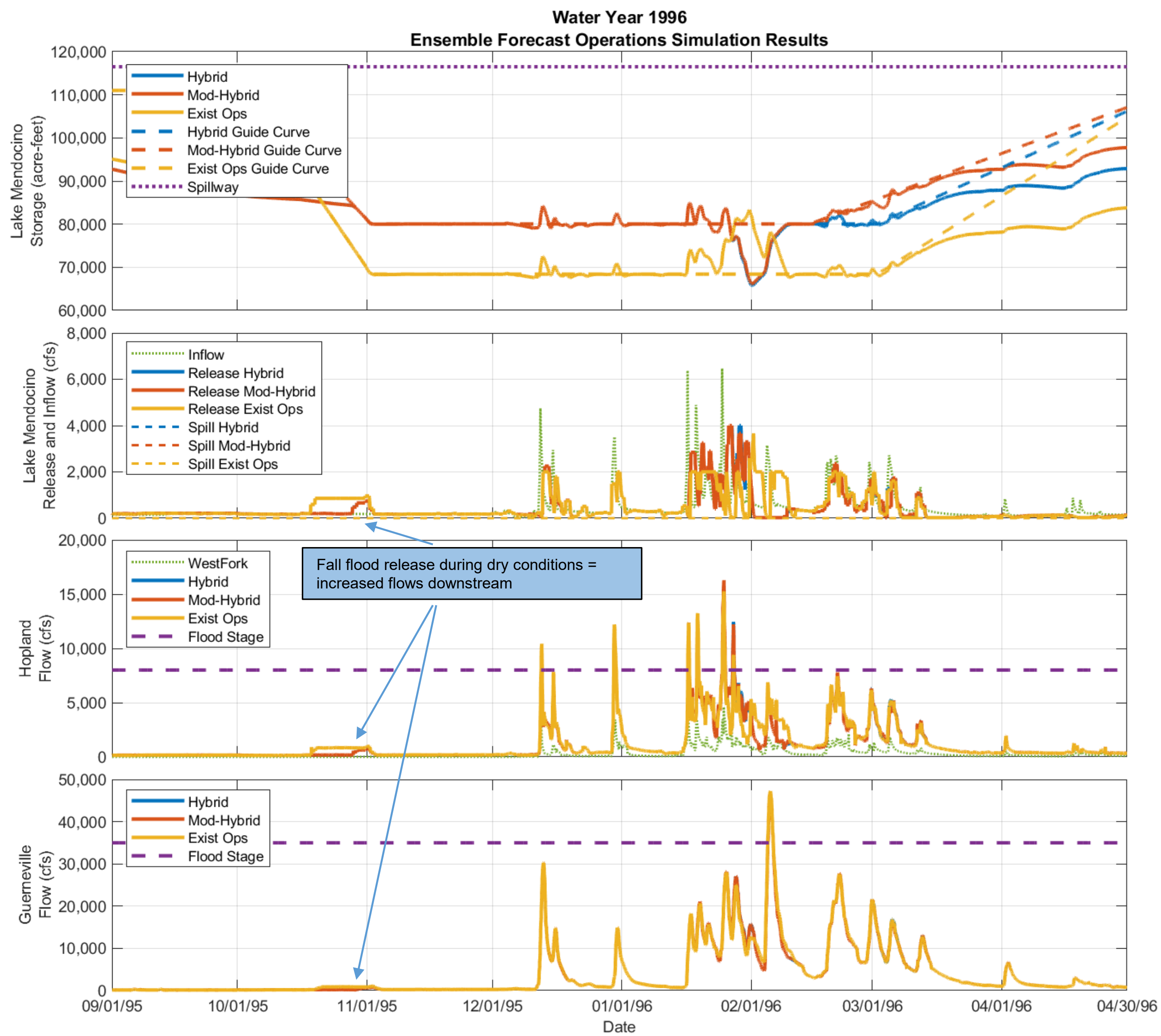


Figure D-18. Simulated comparison of fall flood releases during dry conditions, including Lake Mendocino storage, releases, and flow at Hopland and Guerneville for Water Year 1996.



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