



SONOMA COUNTY WATER AGENCY
AND
MENDOCINO COUNTY RUSSIAN RIVER FLOOD CONTROL & WATER CONSERVATION IMPROVEMENT DISTRICT

TECHNICAL MEMORANDUM

DATE: JUNE 25, 2024

SUBJECT: LAKE MENDOCINO STORAGE AND RUSSIAN RIVER WATER SUPPLY PLANNING FOR 2024/2025

Background

On March 21, 2022, Sonoma County Water Agency (Sonoma Water) and the Mendocino County Russian River Flood Control and Water Conservation Improvement District (Mendocino District) entered into a Memorandum of Understanding (MOU) concerning Lake Mendocino Storage Planning and Russian River Management. The MOU was developed in response to the regional drought that began in the spring of 2020 and establishes planning and management activities related to the shared water supplies in Lake Mendocino.

By May 2021, the State Water Resources Control Board (State Water Board) had issued notices of unavailable water in the upper Russian River and curtailments of all water rights occurred on August 2, 2021. The State Water Board followed up this action with the curtailments of a portion of the water rights in the lower Russian River on August 10, 2021. The arrival of an atmospheric river led to the suspension of all curtailments in the watershed on October 21, 2021. However, dry water supply conditions prevailed through much of the remainder of the wet season resulting in another year of water shortage and curtailments being issued after approval of the drought emergency regulation on June 1, 2022.

This technical memorandum is a documentation of the approach to assessing reservoir storage and water supply conditions in the upper Russian River for 2024 and 2025.

Purpose

In this technical memorandum, a methodology is documented along with the assumptions to evaluate water supply conditions that assists in allocation, planning and management of water supplies among

Lake Mendocino water uses under Sonoma Water's Permit 12947A, the Mendocino District's License 13898, and the Sonoma County Lake Mendocino Storage Reservation of 10,000-acre-feet available for post-1949 appropriative water rights along the mainstem of the Russian River.

Methodology

Sonoma Water shall utilize its Russian River reservoir/river operations model referred to as the Russian River System Model (RR ResSim) to perform updates to reservoir storage projections for Lake Mendocino on a monthly basis. RR ResSim simulates reservoir operations with a daily time step over an ensemble of hydrologic conditions. This process produces a range of storage projections that are statistically evaluated and presented based on end-of-year projected storage volumes. Additionally, to simulate the imports of Eel River water into the East Fork of the Russian River by the Potter Valley Project (PVP), a model referred to as the PVP ResSim model is used.

For each monthly projection update, the initial conditions are established by incorporating observed reservoir storage values, reservoir outflows, and PVP diversions. Starting with initial conditions, RR ResSim simulates the projection year using two hydrologic datasets: a) forecasted hydrology for the near-term conditions; and b) historical hydrology for the remainder of the year. A daily forecasted unimpaired streamflow dataset is developed by the California Nevada River Forecast Center (CNRFC) and is used for simulating the initial 30 days of the projection. The forecast dataset includes an ensemble of 42 potential future streamflows, representing a range of potential hydrologic outcomes for the next 30 days. The median ensemble member is selected to simulate the first 30 days of the projection. For the remainder of the projection RR ResSim uses a historical hydrologic dataset of unimpaired flows.

An ensemble of historical unimpaired streamflow hydrology is applied in the modeling to account for the variability and uncertainty in hydrology throughout the year. Over the projection period, multiple historical years are simulated with RR ResSim to establish the range of potential outcomes of reservoir storage in Lake Mendocino. The number of model scenarios that are simulated depends on the time of the year and the hydrologic conditions at the beginning of the projection.

For model simulations that start between June and January, all historical hydrologic years are included. The Russian River has highly variable precipitation in the early winter wet season and therefore all hydrologic years are evaluated to represent the range of potential outcomes based on the historical record.

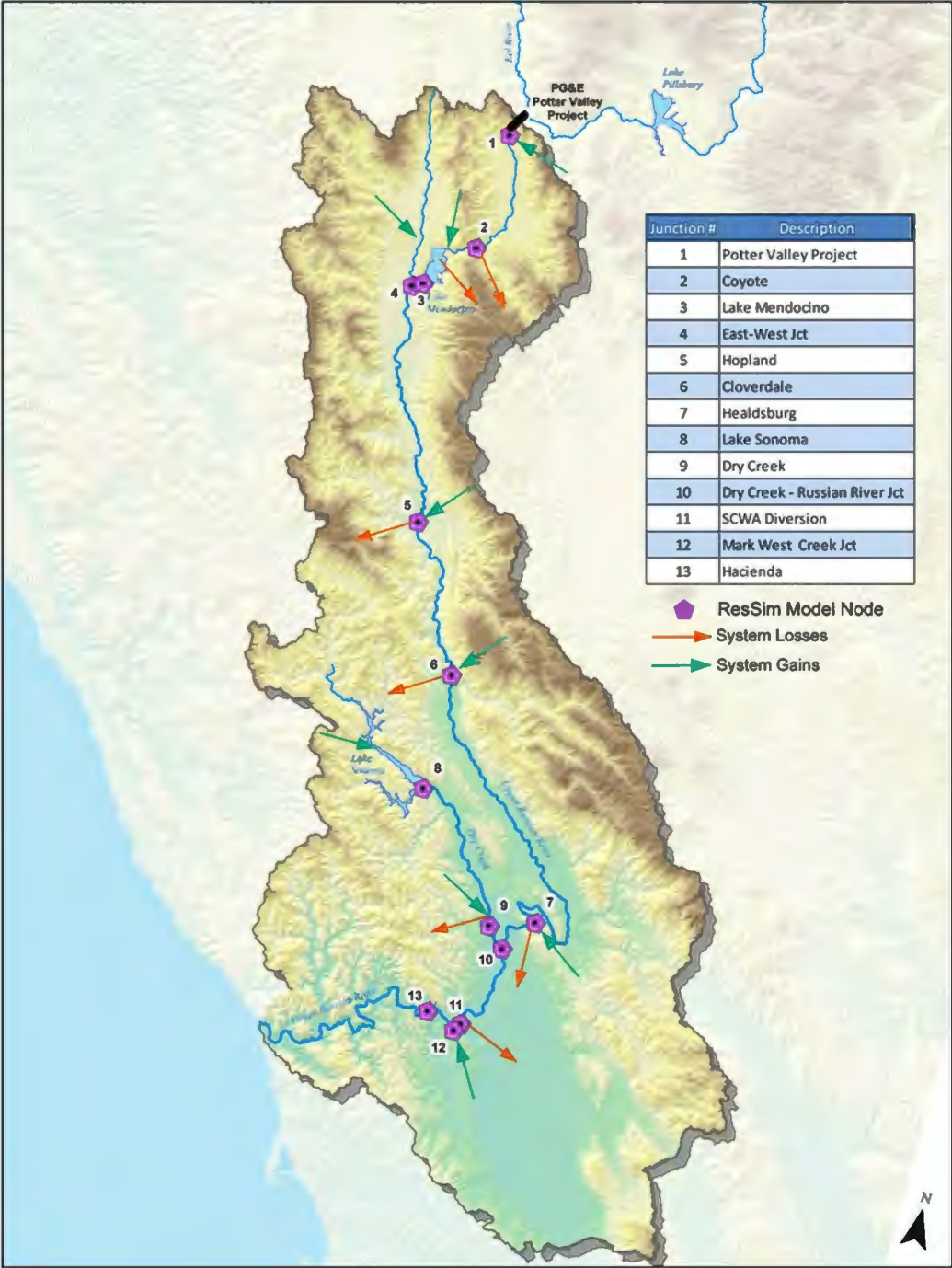
Between February and May typically most of the precipitation during the wet season has already occurred and therefore a subset of the hydrologic years is developed. The selection of hydrologic years for model simulations that begin between February and May is accomplished by analyzing observed and forecasted flows at the West Fork Russian River U.S. Army Corps of Engineers (USACE) stream gage (Russian River near Ukiah stream gage). The analysis identifies historical hydrologic years that are similar to the current forecasted stream flows. The West Fork is a mostly unimpaired tributary, so the stream gage is used as a metric for unimpaired flows in that watershed and provides a reasonable representation of the watershed state in the upper Russian River. Selection of similar historical hydrologic years is based on the CNFRC's West Fork 30-day ensemble flow forecast. The total 30-day flow volume for all the ensemble members is calculated and compared to the flow volume in historical years over the same 30-day period. Simulated historical hydrologic years with similar volumes compared to the flow forecast are selected for the model simulation.

Model Description

The Russian River System Model was developed by Sonoma Water using the USACE Hydrologic Engineering Center (HEC) software ResSim code for use as a planning tool to simulate the water supply responses to various climatic conditions, levels of demand and operational criteria and the availability of water to meet downstream minimum instream flow requirements and demands. Based on specific demand assumptions, RR ResSim calculates the required reservoir releases from Lake Mendocino and Lake Sonoma to meet those demands and minimum instream flow requirements in Sonoma Water's water rights permits under a range of potential hydrologic conditions for USACE reservoir operations criteria. While the RR ResSim model is a watershed model, the upper Russian River component is run independently of conditions in the lower Russian River with Lake Mendocino release decisions governed by upper Russian River conditions. Lake Sonoma release decisions in the model are dependent on conditions in Dry Creek and the lower Russian River as well as the streamflow contributions from the upper Russian River.

The RR ResSim model divides the Russian River and Dry Creek with 13 primary model junctions as presented in Figure 1. The model junctions correspond with important system features such as Potter Valley Project imports, reservoir dam releases, major tributary confluences and stream gage locations. The model reaches are defined segments of the Russian River or Dry Creek between the model junctions. Within the contributing watersheds for each individual reach, there are unimpaired flows (gains) and demands (losses) associated with municipal and industrial (M&I) diversions and other distributed water demands that are accounted for.

Figure 1: Schematic for Russian River System Model



RR ResSim accounts for losses in the Russian River system attributing depletions due to diversions under Sonoma Water's water rights and all other depletions from the watershed. The model aggregates system losses by reach at each downstream junction. RR ResSim model simulates reservoir operations to meet downstream depletion requirements, the minimum instream flow requirements, and operational buffers.

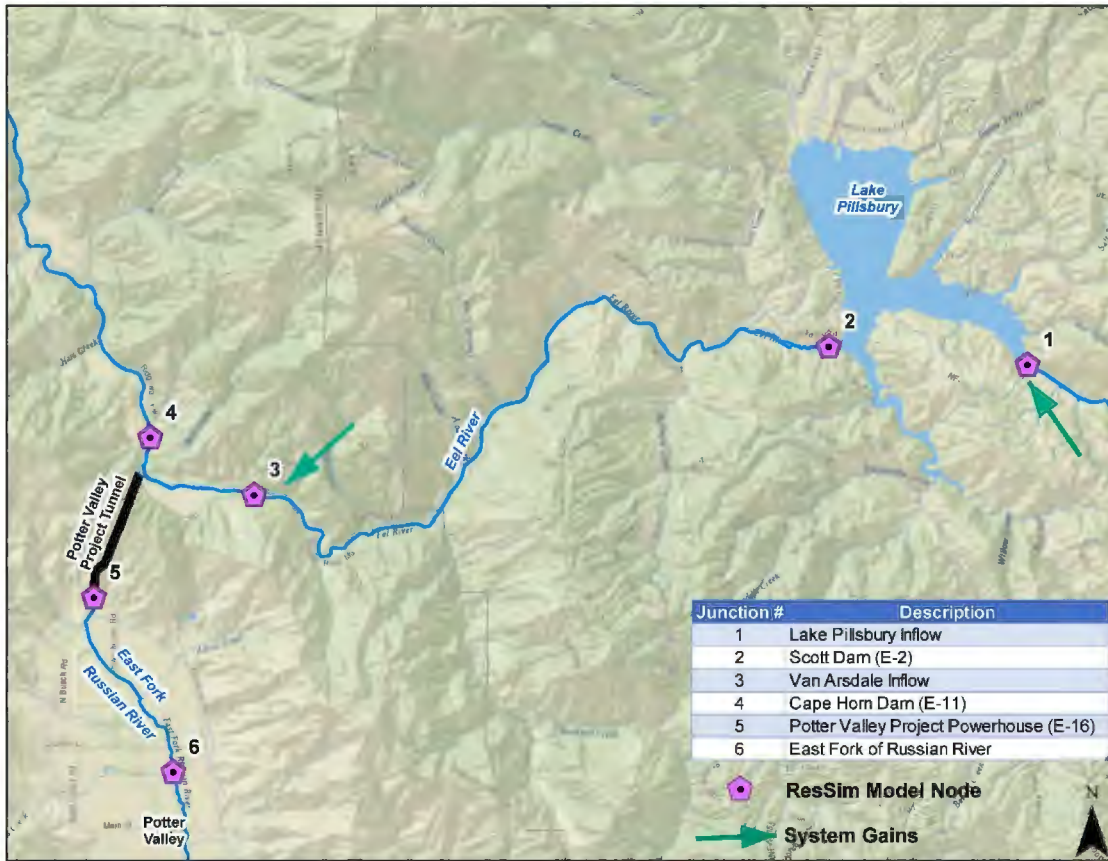
Hydrology

Unimpaired flows are the "natural" flows, unaffected by man-made influences, such as water demands, or reservoir operations. These unimpaired flows, which form the basis of the hydrology in the model, were synthetically derived by the U.S. Geological Survey using their Basin Characterization Model with historical weather, climate and hydrologic data inputs. RR ResSim incorporates 107 years of hydrologic data (WY1911 - WY2017) represented as daily unimpaired tributary flows into the Russian River and Dry Creek. As described above in the *Methodology* section, depending on the time of year and current flow forecasts, a subset of the complete hydrologic record may be used for model simulation.

Potter Valley Project Imports

Projected Eel River imports (or diversions) by Pacific Gas & Electric (PG&E) through the PVP are simulated using the PVP ResSim model. The PVP ResSim model was developed by the Water Supply Working Group as part of Congressman Jared Huffman's PVP Ad Hoc group. It was used to develop operational alternatives to PVP that met the Ad Hoc's objective of a Two-Basin solution. The model encompasses the Lake Pillsbury watershed down to the outlet of Cape Horn Dam (Van Arsdale Reservoir) along the Eel River (Figure 2). It simulates operations of Scott Dam (Lake Pillsbury) and Cape Horn Dam, as well as the inter-basin transfers of Eel River water to the East Fork Russian River for the PVP hydroelectric facility for a given set of physical and operational constraints based on the project's license from the Federal Energy Regulatory Commission (FERC) and water supply contracts with the Potter Valley Irrigation District (PVID). Similar to the RR ResSim model, it incorporates daily hydrology from WY1911 - WY2017. The hydrologic record was developed by Western Hydrologics using observed flows from gages at the reservoir outlets and the changes in storage at the reservoirs.

Figure 2: Schematic of Potter Valley Project ResSim Model



Since October 2021, PVP normal operations have been interrupted by the failure of the transformer bank at the PVP powerhouse. Without discretionary releases for power generation, the simulation of trans-basin Eel River transfers is solely dependent on minimum flow requirements for the East Fork Russian River and PVID contract deliveries. Under normal operations, additional PVP transfers are used to increase power production when Lake Pillsbury storage levels are high during the late fall through early spring. With FERC’s approval on July 29, 2022 of PG&E’s initial license surrender and decommission plan for the PVP, the operation is expected to continue without power generation discretionary releases until the project is decommissioned.

In 2023, PG&E announced that it would no longer be seasonally closing the spillway gates atop Scott Dam due to increased seismic risk that PG&E recently identified. The spillway gates were previously operated to increase the water storage capacity in Lake Pillsbury by approximately 20,000 acre-feet. The maximum storage in Lake Pillsbury without the closing of the spillway gates is 53,248 acre-feet (2023 bathymetric survey). This significant reduction in storage capacity in Lake Pillsbury prompted PG&E to submit a license amendment request to FERC on July 31, 2023, that would significantly reduce the minimum flow

requirements of the project to the East Fork Russian River between June and October. While this license amendment request is pending, PG&E has relied on submitting annual flow variance requests to reduce summertime transfers of Eel River water with the first submittal filed on May 23, 2023. The request was approved by FERC on October 2, 2023, and remained in effect until December 20, 2023. On February 21, 2024, PG&E submitted another flow variance request to FERC. The variance request would reduce the minimum instream flow requirement on the East Fork Russian River (MF-16) from 80 cfs to either 5 or 25 cfs (~300 or ~1,500 acre-feet/month) until Lake Pillsbury storage reaches 36,000 acre-feet after October 1, 2024. For these projections, it is assumed that the variance will be approved and take effect if Lake Pillsbury water level is below the spillway starting May 15, 2024. Once the variance is in effect, MF-16 will be 25 cfs until July 1st when MF-16 becomes 5 cfs. The transition date to a lower MF-16 is discretionary based on resource agency consultations with PG&E, but for the modeling was assumed to occur on July 1st. The full historical hydrologic years in the PVP ResSim are used to determine for each simulation when the FERC temporary variance would expire and PVP operations return to the standard terms of its FERC license.

System Reach Losses and Demands

Reach losses, or depletions, in RR ResSim are categorized as either diversions under Sonoma Water's water rights or all other depletions from the watershed. System reach losses not associated with Sonoma Water diversions were estimated through an analysis of historical M&I data, streamflow gage data, unimpaired flow data, and climate data from 2002 to 2013. The depletions lump together losses from: a) evapotranspiration by riparian vegetation, b) aquifer recharge, c) agricultural diversions, and d) other M&I diversions. These reach loss patterns were adjusted for the months of July through October to match the total loss based on flow gage data observed in 2020. Reach losses between the PVP powerhouse and the USGS Russian River near Calpella stream gage (Potter Valley area) were estimated using the average total loss based on flow gage data observed in 2020 through 2022. Because the model calculates the reservoir releases necessary to meet minimum instream flow requirements, all water uses in the watershed are satisfied by simulated reservoir releases.

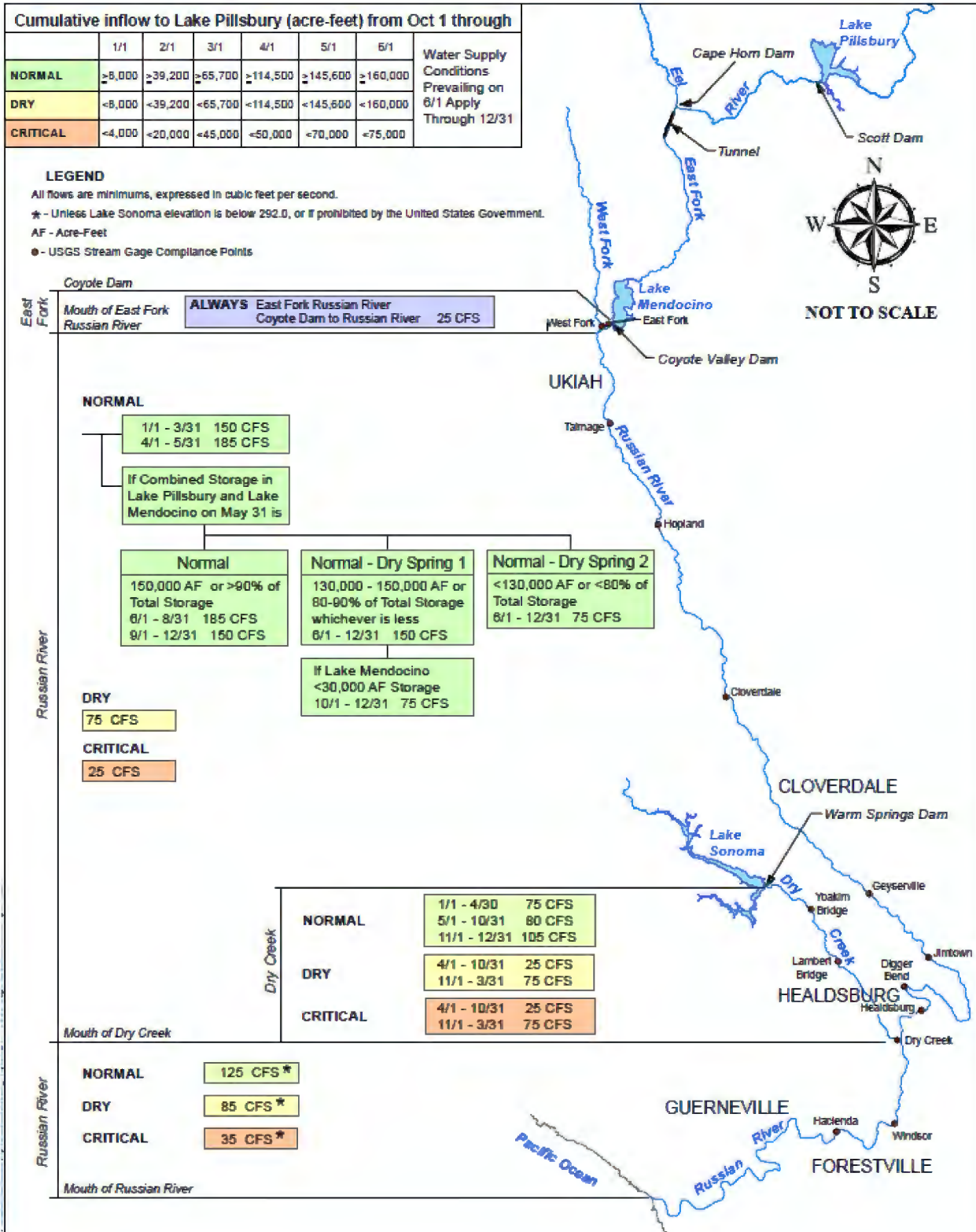
Model demands for Sonoma Water are estimated based on river diversions from 2020 that totaled approximately 55,000 acre-feet for the year.

Minimum Instream Flow Requirements

Sonoma Water's water rights permits establish the minimum instream flow requirements in the Russian River and Dry Creek based on the determination of a water supply condition. This methodology was

developed under Decision 1610. There are three main water supply conditions—Normal, Dry, and Critical—defined by Decision 1610 that are determined based on criteria for the calculated cumulative inflow into Lake Pillsbury from October 1 to the first day of each month from January to June. Decision 1610 defines cumulative inflow for Lake Pillsbury as the algebraic sum of releases from Lake Pillsbury, change in storage and lake evaporation. Decision 1610 further specifies two variations of the Normal water supply condition, commonly known as Dry Spring 1 and Dry Spring 2. These conditions provide for lower required minimum flows in the upper Russian River during times when the combined storage in Lake Pillsbury and Lake Mendocino on May 31 is unusually low. The water supply condition criteria and minimum instream flow requirements are shown in Figure 3.

Figure 3: Russian River Basin Minimum Instream Flow Requirements



On December 27, 2023, the State Water Board issued an order approving a temporary change to Sonoma Water’s water-right permits. This order replaces the hydrologic index of Decision 1610 with an index based on Lake Mendocino storage thresholds until June 28, 2024. The hydrologic index establishes the water supply condition that sets minimum instream flow requirements for the upper Russian River, lower Russian River and Dry Creek. Under the storage-threshold based hydrologic index, Lake Mendocino storage is evaluated from January 1st through June 1st. Initially, the index is evaluated solely on the first of the month. During the spring season, starting in March, a second evaluation is added on the 16th of the month. The hydrologic index establishes the water supply conditions as either *Normal*, *Dry*, or *Critical* based on the starting storage volumes for the evaluation dates as shown in Table 1.

Table 1. Lake Mendocino Storage Thresholds Hydrologic Index (December 2023 Temporary Urgency Change Order)

Storage Thresholds and Evaluation Dates for Proposed Hydrologic Index (acre-feet)

	1/1	2/1	3/1	3/16	4/1	4/16	5/1	5/16	6/1	10/1	11/1	12/1
Dry	68,400	68,400	68,400	77,000	86,000	91,000	93,000	94,000	94,000	58,000	51,000	49,000
Critical	42,000	49,000	57,000	67,000	73,000	74,000	75,000	76,000	76,000	46,000	41,000	40,000

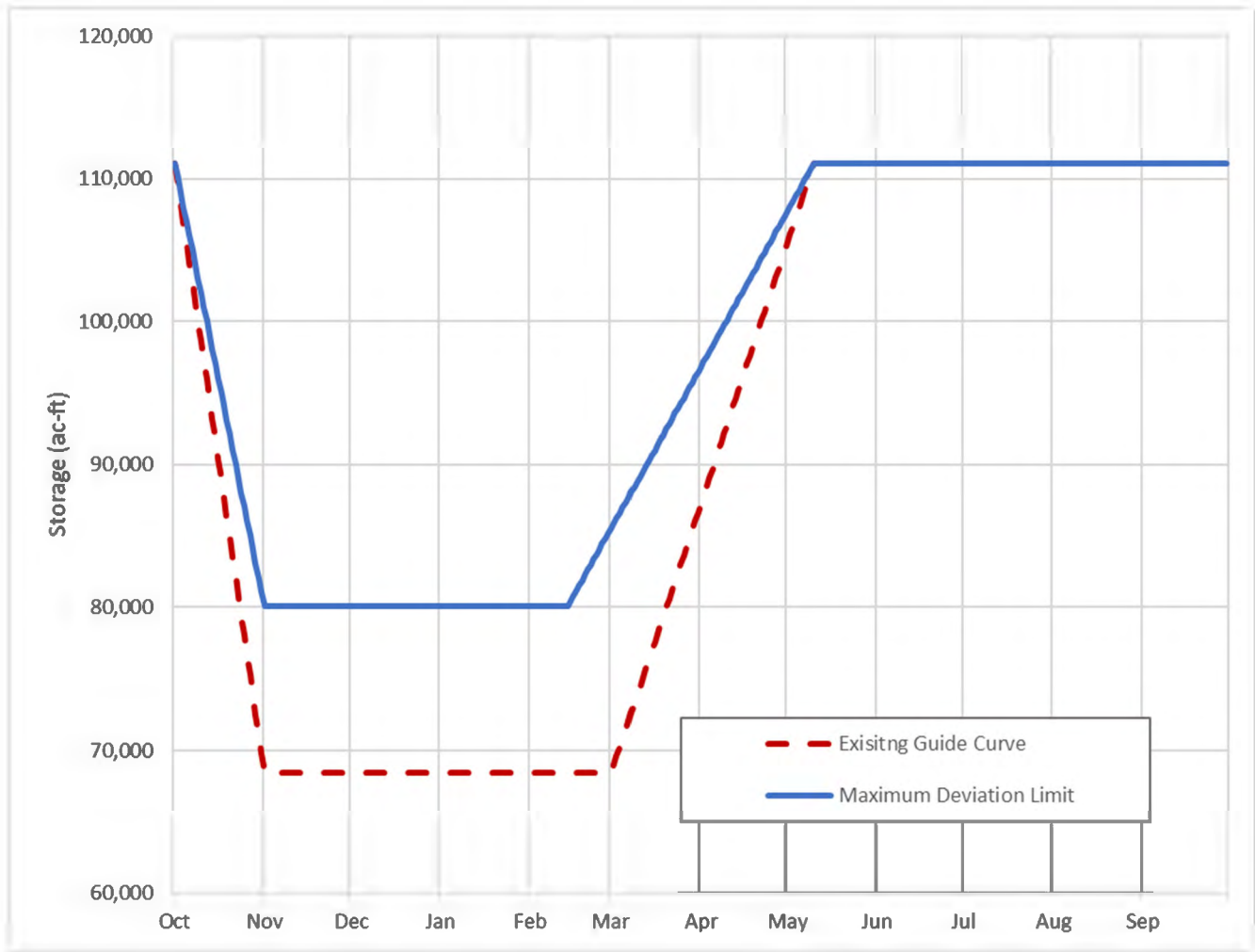
Reservoir Operations

RR ResSim simulates the operations of the reservoirs for water supply and determines transitions to flood control operations that are managed by the USACE. Sonoma Water operates the reservoir when it is below the flood control pool with operational decisions based on downstream demands and compliance with minimum instream flow requirements. The USACE makes operational decisions based on criteria in each reservoir’s Water Control Manual. For these projections, USACE flood control operations are not considered.

RR ResSim simulates operations incorporating the reservoir guide curve of the Water Control Manual that delineate the storage levels between the water supply pool and flood control pool. For Lake Mendocino, the storage guide curve varies seasonally with a low storage of 68,400 acre-feet set over the wet season from November 1 through March 1. During the dry season, the guide curve is at its highest storage of 111,000 acre-feet from May 11 through October 1. The complete guide curve is shown on Figure 4. Lake Sonoma has a static year-round storage level of 245,000 acre-feet that delineates the water supply and flood control pools.

These reservoir operations per the Water Control Manual have been modified with the implementation of the Forecast Informed Reservoir Operations (FIRO) program. The FIRO program develops tools and protocols that allow additional discretionary encroachments of the water supply pool into the flood control pool. Currently, Lake Mendocino is operating under a Planned Major Deviation (Major Deviation) of the Coyote Valley Dam/Lake Mendocino Water Control Manual that was approved by the USACE in February 2021. The Major Deviation was approved to remain in effect through Water Year (WY) 2026 at the request of the Lake Mendocino FIRO Steering Committee. The Major Deviation allows USACE flood control managers to store up to an additional 11,650 acre-feet of water in the flood control pool at their discretion during the wet season. It also initiates the progression of the seasonal increase to the summer water supply pool of 111,000 acre-feet on February 16, which is two weeks earlier than the Water Control Manual. The Major Deviation guide curve is shown in Figure 4. Current operation of Lake Sonoma is in accordance with a Minor Deviation guide curve that was first approved by the USACE in December 2022 and subsequently approved for three-year period from WY 2024 through WY 2026. Under this program, Lake Sonoma operates with a seasonal minor deviation storage curve that adds 9,500 acre-feet in the wet season (October 31 through February 15) and 19,000 acre-feet in the dry season (March 1 through October 1).

Figure 4: Lake Mendocino Storage Guide Curve



Operational Goals

The identification of operational goals is meant to establish a baseline to assess the adequacy of Lake Mendocino storage to meet projected downstream demands including minimum instream flow requirements. These downstream demands include:

- i) Diversions and rediversions by the Mendocino District under License 13898
- ii) Diversions and rediversions by Sonoma Water under Permit 12947A
- iii) Rediversions by post-1949 water-right holders in Sonoma County under the 10,000 acre-foot storage reservation

On the basis of water right priorities, diversions and rediversions under the Mendocino District's License 13898 and Sonoma Water's Permit 12947A have equal priorities. However, diversions under Sonoma Water's Permit 12947A are conditioned with a lower priority if the water is exported outside of the Russian River Valley per Term 22 of Permit 12947A. Exports under Permit 12947A are also assigned a lower priority than post-1949 water-right holders under the 10,000 acre-foot storage reservation. In Term 23 of Permit 12947A, post-1949 water-right holders access to the 10,000 acre-foot storage reservation is conditioned on the availability of water to meet minimum instream flow requirements.

While diversions by Sonoma Water with end uses within the Russian River watershed, on an annual basis, are approximately 45% of the total diversions, the RR ResSim model for simulating Lake Mendocino releases only considers minimum instream flow compliance in the upper Russian River in its release decision logic.

For these model simulations, all diversions and rediversions by Sonoma Water are assumed to be satisfied by natural flows and releases from Warm Springs Dam. Therefore, the priority of rights to Lake Mendocino storage from highest to lowest are:

- 1) Minimum instream flow requirements
- 2) Diversions and rediversions by the Mendocino District under License 13898
- 3) Rediversions by post-1949 water-right holders in Sonoma County under the 10,000 acre-foot storage reservation

Projections of Lake Mendocino storage are evaluated based on end of water year storage. The ensemble forecast approach produces a predicted range of potential end of year storage values. Median and 10th-percentile values are reviewed for assessing potential actions. If reservoir projections for October 1st are below the 58,000 ac-ft storage threshold determining *Dry* water supply conditions for the 10th-percentile scenario, Sonoma Water will notify the State Water Board of the potential risk of insufficient storage in Lake Mendocino.