BUREAU OF RECLAMATION

American River Group Summary of Activities for Water Year 2023

Central California Area Office, Folsom, CA

Interior Region 10 - California-Great Basin

U.S. Department of the Interior March 2024

Mission Statements

The Department of the Interior (DOI) conserves and manages the Nation's natural resources and cultural heritage for the benefit and enjoyment of the American people, provides scientific and other information about natural resources and natural hazards to address societal challenges and create opportunities for the American people, and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities to help them prosper.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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Cover Photo: A photograph of Fall-run Chinook salmon staged at the entrance to the Nimbus Fish Ladder within Nimbus Shoals on the lower American River below Nimbus Dam. (Reclamation)

Acronyms and Abbreviations

ARG	American River Group
BiOp	Biological Opinion
CDFW	California Department of Fish & Wildlife
cfs	cubic feet per second
CNRFC	California Nevada River Forecast Center
Cramer	Cramer Fish Sciences
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CWP	cold water pool
DWR	Department of Water Resources
ESA	Endangered Species Act
FMS	Flow Management Standard
LAR	Lower American River
MRR	Minimum Release Requirement
NMFS	National Marine Fisheries Service
Reclamation	U.S. Bureau of Reclamation
RM	River Mile
ROD	Record of Decision
RPA	Reasonable and Prudent Alternative
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
USFWS	U.S. Fish & Wildlife Service
WOMT	Water Operations Management Team
WY	Water Year

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Chapter 1 – Introduction and Background

1.1 Introduction

The Water Year (WY) 2023 Summary of Activities serves to summarize biological information, and operational discussions and decisions for the lower American River (LAR). Additionally, it serves to document implementation of Alternative 1 (Preferred Alternative) as described in the Final Environmental Impact Study and as analyzed in the 2019 National Marine Fisheries Service (NMFS) Biological Opinion (BiOp) (NMFS 2019), adopted in the February 2020 Record of Decision (ROD) for the Coordinated Long-Term Operations of the Central Valley Project (CVP) and State Water Project (SWP) during WY 2023 (October 1, 2022 – September 30, 2023).

1.2 American River Geographic Orientation

The American River is located in California's Central Valley. It is the second largest tributary to the Sacramento River below Shasta Dam. The North, Middle, and South forks of the American River originate in the Sierra Nevada range and flow into Folsom Reservoir, approximately 25 miles east of the City of Sacramento, California. Folsom Dam and Reservoir, as well as Nimbus Dam and Lake Natoma are features of the CVP operated by the U.S Bureau of Reclamation (Reclamation). The LAR reach begins at Nimbus Dam, approximately river mile (RM) 23, and continues downstream until its confluence with the Sacramento River. Figure 1 illustrates the LAR and surrounding features.

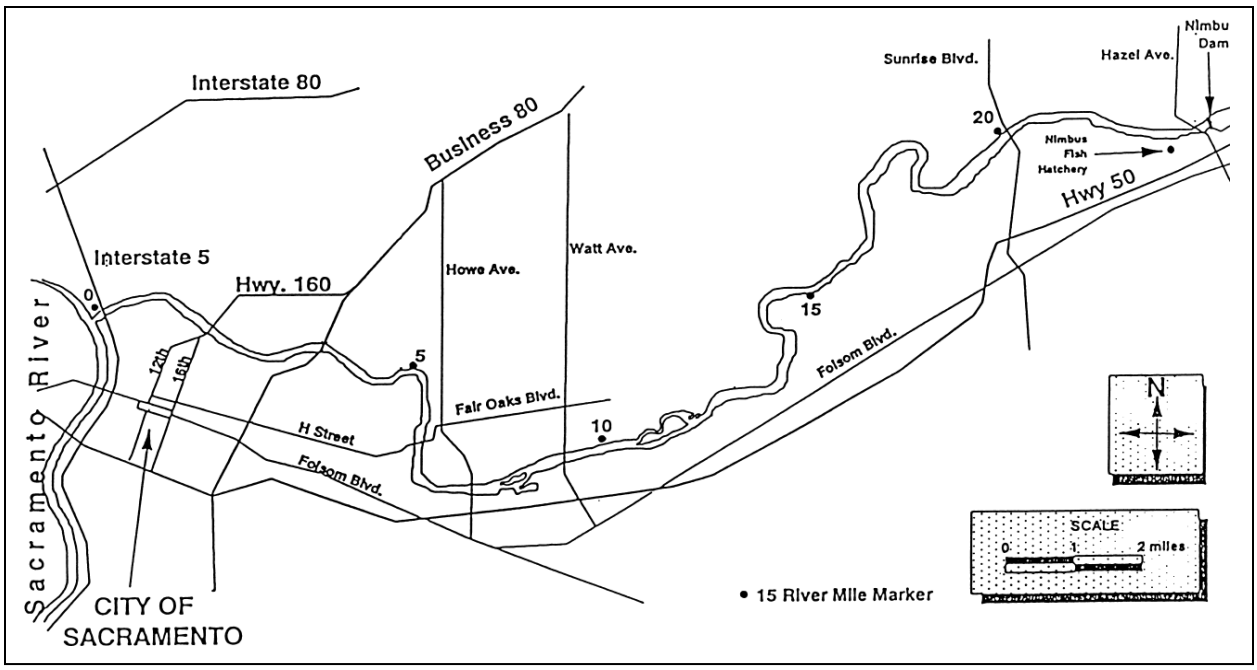

Figure 1. The Lower American River between Nimbus Dam and the Sacramento River.

Figure 1 is a map of the City of Sacramento. It depicts main roads, highways, and river mile markers at the confluence of the Sacramento and American Rivers.

1.3 Lower American River Historical Background

The LAR provides water supply for urban and agricultural uses, flood control, fish and wildlife protection, recreational opportunities, hydroelectric power generation, and contributes to water quality conditions in the Sacramento-San Joaquin Delta. Reclamation is responsible for operating the Folsom/Nimbus Dam complex to meet local and downstream water demands, regulatory requirements, and fish habitat needs. The regulating facilities of the Folsom/Nimbus Dam complex include Folsom Dam, Reservoir, and Powerplant; Nimbus Dam and Powerplant, and Lake Natoma. Releases from Folsom Dam are re-regulated approximately seven miles downstream by Nimbus Dam. Nimbus Dam creates Lake Natoma, which serves as a forebay for the diversions to the Folsom South Canal. Additional facilities at Nimbus Dam include the Nimbus Fish Hatchery, which is owned by Reclamation and operated by the California Department of Fish and Wildlife (CDFW).

Reclamation operates Folsom and Nimbus dams under a state water right permit and fish protection requirements that were adopted in 1958 as the State Water Resources Control Board (SWRCB) Decision 893 (D-893). This decision allows flows at the mouth of the American River to fall as low as 250 cubic feet per second (cfs) from January through mid-September, with a minimum of 500 cfs required between mid-September through December 31. The flow operations based on D-893 may not optimize habitat protection given current water rights and fishery conditions. Since 1958, additional SWRCB Decisions and Congressional Acts [i.e. Central Valley Project Improvement Act (CVPIA)], and Endangered Species Act (ESA)

requirements have changed the regulatory landscape for the State and Federal Water Projects, including operations on the LAR.

In 1996, Reclamation established a working group to coordinate fishery and operational requirements for the LAR, known as the American River Group (ARG). The ARG brings together stakeholders who have either a legislated or resources-specific interest in the operation of Folsom Dam and Reservoir and the LAR. Reclamation is the lead coordinator of the ARG. The formal members include agencies with trust responsibilities for fisheries resources in the LAR: Reclamation, the U.S. Fish and Wildlife Service (USFWS), NMFS, CDFW and Sacramento Water Forum (Water Forum). Members of the public and other agencies may attend ARG meetings and comment on matters under consideration by the ARG. The ARG convenes monthly or more frequently, if needed, to discuss water operations, fisheries, and other environmental factors. Reclamation considers the information provided by the ARG when making management decisions regarding temperatures and flows necessary to sustain LAR fish resources.

The Water Forum, comprised of local American River stakeholders, has successfully joined together water purveyors, environmentalists, agriculturalists, business leaders, along with city and county governments in Sacramento, El Dorado and Placer counties in an agreement to secure Sacramento region water supply through the year 2030. The Water Forum has promoted operational changes with coequal objectives: "to provide a reliable supply for planned development to the year 2030, and to preserve the Sacramento region's environmental crown jewel, the lower American River." The Water Forum, in cooperation with Reclamation, NMFS, USFWS, and CDFW, developed a draft Flow Management Standard (FMS) for the LAR to with the goal of improving the conditions of aquatic resources in the LAR. The FMS was designed to improve habitat conditions for fall-run Chinook salmon and steelhead in the LAR by enhancing minimum flows and water temperature, establishing a formal management process, and facilitating coordinated monitoring, and evaluation and reporting (Water Forum 2006).

The FMS was designed to integrate water temperature performance capability for management of the downstream habitat. The NMFS 2009 BiOp (NMFS 2009) also adopted components of the FMS temperature management process. Action II.2 of the NMFS 2009 BiOp states that "The priority for use of the lowest water temperature control shutters at Folsom Dam shall be to achieve the water temperature requirement for steelhead, and thereafter may also be used to provide cold water for fall-run Chinook salmon spawning." While NMFS's priority was temperature management for steelhead due to federal listing status, temperature management for fall-run Chinook salmon was also important. Because water temperature control operations in the LAR are affected by many factors and operational tradeoffs, ideal downstream temperature targets are sometimes infeasible (particularly with multiple years of below normal or dry water year type conditions). These factors include available cold-water resources, Nimbus Dam release schedules, annual hydrology/snowpack, Folsom power penstock shutter management flexibility, power generation, Nimbus Fish Hatchery operations and maintenance, and Delta needs.

The Folsom temperature shutters are structural devices at the Folsom Dam power unit intakes that provide downstream temperature management control. These devices help control the desired downstream temperature by selecting the elevation where water is withdrawn from the reservoir. The Folsom Shutters can be operated such that water from different reservoir

elevations is accessed and blended, providing additional temperature management control. Lastly, when temperature operations exhaust the reservoir's cold water pool (CWP) at the lowest shutter locations, Reclamation has the operational ability to release the coolest water from the river outlets at the lowest elevation outfall in Folsom Dam in effort to achieve targeted temperatures in the LAR to the extent physically controllable. Releases from the river outlets cannot be used to generate power and thus this operation is referred to as a "power bypass".

1.4 Transition to February 2020 ROD

In 2009, NOAA Fisheries issued a BiOp to Reclamation that included an RPA to address the effects of the proposed action considered in the 2009 BiOp and how that action could be implemented in a manner that would avoid the likelihood of jeopardy to listed species or adverse modification of critical habitat. On April 7, 2011, NOAA Fisheries provided an RPA amendment (NMFS 2011), which, consistent with the Delta Stewardship Council's Independent Review Panel (DSC 2010), corrected errors in the 2009 RPA and provided clarification.

On August 2, 2016, Reclamation, the federal action agency, and the California Department of Water Resources (DWR), the applicant, jointly requested the reinitiation of ESA consultation with the USFWS and NOAA Fisheries on the coordinated long-term operation of the CVP and SWP. NOAA Fisheries accepted the reinitiation request on August 17, 2016. On January 31, 2019, Reclamation transmitted their Biological Assessment (BA) to NOAA Fisheries and a revised BA (Reclamation 2019b) was submitted on October 21, 2019.

NOAA Fisheries finalized and issued its BiOp on the coordinated operations of the CVP and SWP on October 21, 2019. NOAA Fisheries concluded that Reclamation's proposed operations will not jeopardize threatened or endangered species, or destroy or adversely modify designated critical habitats.

The Bureau of Reclamation signed a ROD on February 18, 2020 to implement the preferred alternative as described in the Final EIS for the Reinitiation of Consultation on the Coordinated Long-Term Operation (ROC on LTO) of the CVP and SWP and evaluated in the 2019 USFWS and NMFS BiOps (Reclamation 2020; USFWS 2019).

1.5 2021 Re-initiation of Consultation on the Coordinated Long-Term Operations of the Central Valley Project and State Water Project

On September 30, 2021, Reclamation requested the reinitiation of Endangered Species Act (ESA) Section 7 consultation on the Coordinated Long-Term Operation of the CVP and SWP with USFWS and NMFS due to anticipated modifications to the Proposed Action that may cause effects to ESA-listed species or designated critical habitat not analyzed in the 2019 USFWS and NMFS biological opinions. USFWS and NMFS agreed reinitiated consultation was necessary on October 1, 2021. New biological opinions are expected to be completed

in 2024 with the goals of supporting species viability, protecting life history diversity, supporting operational flexibility, providing regulatory certainty, supporting science and monitoring, and creating a single, adaptable, coordinated operation for the CVP and SWP.

On February 28, 2022, Reclamation posted a Notice of Intent to Prepare an Environmental Impact Statement and held public scoping meetings on the Coordinated Long-Term Operation of the CVP and SWP (87 FR 11093).

On September 15, 2023, Reclamation released a Cooperating Agency draft EIS for a 30-day review and comment period. After the 30-day review period, Reclamation will reviews all comments provided and incorporates into the public draft EIS what is plausible.

The public draft EIS will be published in the Federal Register for public review and comment for a minimum of 45 days. During the draft EIS public review period, Reclamation will hold multiple public meetings. After the public review period closes, Reclamation will consider all substantive comments and provide responses in the final EIS.

A final EIS will then be published in the Federal Register for a minimum 30-day period in early 2024 before Reclamation makes a final decision on the proposed action. A Record of Decision can be signed following the 30 days, implementing the project. The Record of Decision will explain Reclamation's decision, describe the alternatives that were considered, and discuss mitigation and monitoring, if necessary.

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Chapter 2 – February 2020 ROD

2.1 Summary of February 2020 ROD

Implementation of the February 2020 ROD began on February 19, 2020. The February 2020 ROD for American River operations includes commitments regarding flows and water temperature objectives, with some conservation measures related to habitat restoration and hatchery management (Table 1). Reclamation proposed to adopt the minimum flow schedule or Minimum Release Requirement (MRR) and approach developed by the Water Forum in 2017-2018 (Water Forum 2017). This approach also includes implementation of redd dewatering protective adjustments that restrict changes in the MRR between December and June and, under certain conditions, a spring pulse flow. Reclamation also proposed to continue summer and fall temperature management for the LAR.

Table 1. Components of the Proposed Action related to the American River system per Table 4-7 in Chapter 4 of the 2019 Biological Assessment.

Component	Page #
Seasonal Operations	4-23
2017 Flow Management Standard Releases and "Planning Minimum"	4-23
American River Pulse Flows	4-23
Spawning and Rearing Habitat Restoration	4-23
Nimbus Hatchery Genetic Management Plans	4-23
Drought Temperature Management	4-23
Yellow-billed Cuckoo Surveys	4-23

An overview of American River operations under the February 2020 ROD specific to the 2017 FMS planning minimum and spring pulse flow is provided in Attachment A. An overview of American River operations under the February 2020 ROD specific to water temperature management is provided in Attachment B. American River operations under the 2020 ROD continue to be coordinated through the ARG.

The following non-flow components of the February 2020 ROD are not discussed in this report as they have not been standing topics of discussion at ARG meetings during WY 2023.

- Spawning and Rearing Habitat Restoration
- Hatchery Genetics Management Plans (HGMPs)
- Drought Temperature Management
- Yellow-billed Cuckoo Surveys

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Chapter 3 – ARG Discussion Topics

The following section outlines ARG discussion topics from the October 2021 through September 2022 monthly meetings. Meeting notes and supplemental ARG documents were made available to the ARG members and posted to the ARG Technical Group website[1]. The ARG distribution list is maintained by the Central California Area Office (CCAO) Resources Management Division.

3.1 Monthly Discussion Topics

- Lower American River Fisheries Monitoring
    - The status of current and future fisheries monitoring activities were provided by Reclamation, NMFS, USFWS, CDFW, Water Forum, Cramer Fish Sciences (Cramer), and Pacific States Marine Fisheries Commission (PSMFC) (see Chapter 5).
- American River System Reservoir Operations
    - Monthly reservoir operations and hydraulic forecast updates provided by Central Valley Operations (CVO), Sacramento Municipal Utility District (SMUD), and Placer County Water Agency (PCWA).
- Water Operations and Water Quality
    - Reservoir storage, CWP volume, flows measured at Fair Oaks gauge on the LAR, current temperature modeling results and water temperatures measured at Nimbus Dam, Fair Oaks gage, and Watt Ave. (see Chapter 4).
    - February 2020 ROD *2017 Flow Management Standard Releases and Folsom Planning Minimum*
        - The 2017 FMS, finalized in December 2018, was incorporated into the Proposed Action for ROC on LTO of the CVP and SWP by February 2020. It sets a minimum release requirement with flows between 500 to 2,000 cfs, varying by the time of year and hydrology. The flow schedule is intended to enhance conditions for steelhead and fall-run Chinook salmon using indices from the American and Sacramento Rivers to determine specific flows. An end-of-December storage plan is included to enhance water supply reliability and manage temperatures in the LAR. This ensures suitable temperatures for salmonids in the LAR and reliable water supply to agencies reliant on Folsom Reservoir. Additionally, there is a

[1] The ARG Technical Team webpage can be found here: https://www.usbr.gov/mp/bdo/american-river-group.html

spring pulse flow during March and April, lasting about four weeks. This complements regular releases from Folsom Dam and can be adjusted for additional requests. The spring pulse aims to initiate out-migration of juvenile salmonids before water temperatures increase later in the season.

- Temperature Management Plan
    - Reclamation will prepare a draft Temperature Management Plan by May 15 for the summer through fall water temperature management season using the best available information and decision support tools. The draft plan will contain: (1) forecasts of hydrology and storage; and (2) a modeling run or runs, using these forecasts, demonstrating what temperature compliance schedule can be attained. Reclamation will use an iterative approach, varying shutter configurations, with the objective to attain the best possible water temperature schedule for the compliance point at Watt Avenue Bridge (AWB[2]).

3.2 Other Discussion Topics

- Central Valley Project Improvement Act (CVPIA)
    - In 2023, Reclamation provided funding through the CVPIA to the Sacramento Water Forum for salmonid spawning habitat enhancement on the lower American River at Upper River Bend in Carmichael, California (see Figure 2).
    - Mobilization of construction equipment for the Upper River Bend Phase 1 project started on August 21, 2023. The construction was completed on October 30, 2023. The project is providing:
        - Approximately 5 acres of spawning habitat for adult salmon and steelhead, constructed by placing approximately 30,000 cubic yards of clean gravel to create a channel spanning riffle of appropriately sized (3/8" to 4" material).
        - Approximately 6 acres of rearing habitat, created by carving a 2,000-foot side channel into the existing gravel bar and shaping 3.7 acres of seasonal channel margin habitat along the side channel and an adjacent upstream alcove.
        - Placing about 40 large woody tree structures into the side channel to create velocity refugia and channel complexity to aid juvenile rearing.
        - Over 3 acres of enhanced riparian landscape by planting multiple native willow species, installing Carex barbarae ("basket sedge" – a culturally significant plant for regional indigenous groups) plugs, and seeding the

[2] Temperature data for the compliance point at Watt Avenue Bridge (AWB) can be found here: https://cdec.water.ca.gov/webgis/?appid=cdecstation&sta=AWB

project area with other riparian and upland native flowers and grasses after construction.

- Power Bypass proposals
    - Group discussed power bypass options to achieve cooler fall temperatures for spawning fall-run Chinook salmon (see Section 4.3).

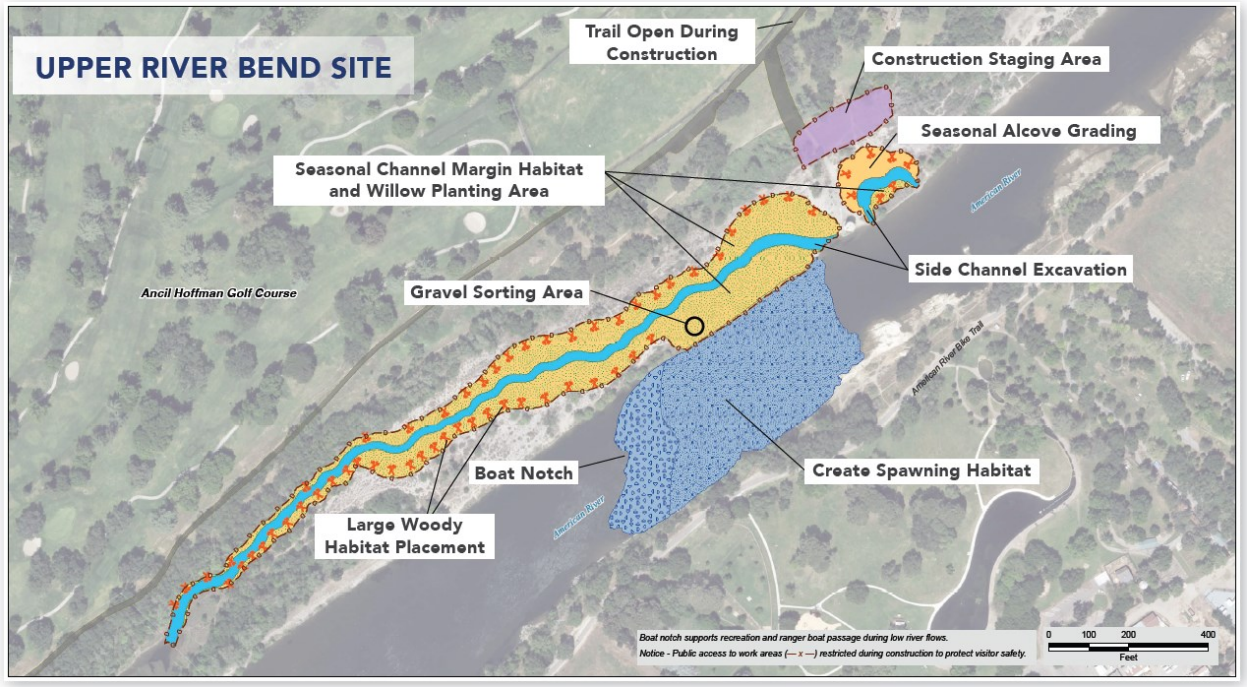

Figure 2. Upper River Bend Phase 1 project site.

Figure 2 is an aerial map of the Upper River Bend Phase 1 project site. Different project elements like the location of planned spawning habitat, side channel excavations, seasonal alcove grading and channel margin habitat and willow planting, and the placement of large woody habitat. The construction staging and gravel sorting areas are also noted on the map.

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Chapter 4 – Water Operations Summary

4.1 General Water Year Conditions and Operations

The 40-30-30 index for the Sacramento Valley was ultimately characterized as "wet" for WY 2023, based on the May 50% exceedance forecast. American River operations were dominated by flood control management operations from late December 2022 through September 2023.

4.2 Hydrologic Conditions – American River

Watershed runoff in California is typically driven by winter precipitation and spring snow-melt runoff and quantified as a late spring through summer inflow volume (April through July volume, in addition to a water year total volume). The American River watershed spring/summer forecasted inflow volume is fundamental in operational planning. This runoff forecast is updated routinely by the DWR and the National Weather Service California Nevada River Forecast Center (CNRFC), where uncertainty is represented by percent runoff exceedances. The February 2023 initial unimpaired runoff 90% exceedance (conservative) forecast volume for April – July 2023 by DWR in their Bulletin 120 was 1,115 thousand Acre-Feet (TAF)[3]. The actual full natural flow volume April –July in 2023 was 1,456 AF. The final WY 2023 total inflow to Folsom October – September was 4,324 AF.[4] Table 2 provides precipitation data and characteristics for November to May of WY 2023. Because operational planning is significantly influenced by future forecasts, these uncertainties and eventually modified decisions are translated into the performance and efficiency of the system-wide operation.

Table 2. 2023 WY Northern Sierra precipitation, American River Basin snowpack, and Sacramento Valley Index statistics by November 2022 through May 2023 (DWR Bulletin 120).

Water Year 2023	Northern Sierra 8- Station Precipitation (Cumulative inches through month)[5]	Sacramento Valley Index (40-30-30 Index 50% Exceedance; year type)[6]
November	NA	NA
December	15.83	5.45; Dry
January	17.36	6.57; Below Normal
February	4.79	7.86; Above Normal
March	17.14	8.02; Above Normal

[3] https://cdec.water.ca.gov/reportapp/javareports?name=B120.202302
[4] https://cdec.water.ca.gov/dynamicapp/QueryMonthly?&s=AMF
[5] http://cdec4gov.water.ca.gov/dynamicapp/QueryMonthly?s=8SI&end=2023-11&span=24months
[6] http://cdec4gov.water.ca.gov/reportapp/javareports?name=WSI

Water Year 2023	Northern Sierra 8- Station Precipitation (Cumulative inches through month)[5]	Sacramento Valley Index (40-30-30 Index 50% Exceedance; year type)[6]
April	1.64	9.58; Wet
May	1.90	9.35; Wet

4.3 Operations – Lower American River

Operational decisions on the LAR are balanced with local, CVP and SWP system-wide multi-purpose objectives including those that are planned and unplanned. Many factors contribute to operational actions including, but not limited to: flood protection, forecasted inflows, facility maintenance schedules, physical/mechanical facility limitations, upstream operations, minimum in-stream flow criteria, downstream Delta regulatory requirements, Delta exports, power generation, recreation, fish hatchery accommodations, water temperature management capabilities and others. In addition, uncertain, or unplanned, events may also influence real-time operation decisions (e.g. additional flow reduction for debris removal prior to fish weir and picket installation for the Nimbus Fish Hatchery). Planned operational targets are regularly updated in late winter through early summer (depending on hydrologic conditions) on Reclamation's website (http://www.usbr.gov/mp/cvo/).

Key factors that influenced WY 2023 LAR operations:

- Minimum flow rate/FMS: WY 2023 ended as a "wet" water year. Flood control releases were required.
- LAR Flow Reduction Discussions: In addition to the monthly ARG meetings, ARG calls were scheduled to discuss specifically the potential reduction of LAR flows due to current hydrologic conditions and poor outlooks. ARG members provided redd dewatering information to help understand potential redd dewatering impacts with LAR flow reductions. These discussions weighed the risk of reducing flows to increase storage and minimizing risk of redd impacts due to increased or fluctuating flows needed for flood management.
- Reservoir Storage: Reservoir storage peaked on June 7, 2023 at 917.4 TAF.
- Temperature Management Plan (TMP): Based on various iCPMM and CE-QUAL-W2 modelling runs and given the number of uncertainties with potential drought actions, inflow projections and operations forecasts, the LAR TMP goal was to target 67°F at Watt Avenue (as measured at American River Below Watt Ave Bridge - AWB gauge; see Figure 6) from June 20, 2023 until November 1, 2023 (see Attachment C). Prior to June 20th, Reclamation committed to operating to a temperature limit not to exceed 65 F at Watt Ave in absence a temperature management plan starting on May 15th.
- Dissolved Oxygen (DO) Concentrations Between Nimbus Fish Hatchery and Folsom Dam:

- On October 20, 2023, sampling efforts revealed DO levels below the critical threshold of 3.0 mg/L. This significant drop in oxygen levels prompted immediate action. In response, Reclamation tested the opening of all four river outlets on Folsom Dam at a flow of 100 cfs, which led to some improvement in DO levels downstream. On October 23rd, an aggressive approach was adopted by opening Nimbus gates 1 through 6, specifically aimed at enhancing oxygen levels in the river. A phased power bypass operation was planned for the following week, starting with 150 cfs on Monday, increasing to 300 cfs on Tuesday, and reaching 500 cfs on Wednesday. This strategy aimed to further augment the DO levels.
- The Water Forum contributed significantly by providing data loggers for DO tracking at Hazel and Watt Avenue. CDFW also played a pivotal role by measuring DO levels twice daily at the hatchery and in the river.
- The start of the power bypass operation led to a cooling of water temperatures and a noticeable increase in DO levels by a few milligrams per liter. In response to these positive changes, the USBR indicated that they are currently spilling but would consider closing gates once DO levels stabilize.
- ARG members established a comprehensive plan to address the DO issue in the lower American River. This plan included Reclamation initiating a power bypass operation and lifting and opening unit 2 bottom shutters on October 30, 2023. Concurrently, Cramer would be responsible for downloading DO logger data on the following Monday and Tuesday afternoons below Folsom Lake Crossing. CDFW would persist in monitoring DO levels at the hatchery, evaluating the need for adjustments in the fish ladder operation schedule.
- CDFW determined to delay the opening of the fish ladder to mitigate any potential impacts DO levels might have on salmon during spawning operations. The opening day on Tuesday, October 31, 2023 was moved to Friday, November 1, 2023.

- Temperature Control Device Mis-Positioning: In July and August 2023, water temperature of Folsom Dam releases were colder than anticipated. This was assumed to be due to high inflows from snowmelt. Further inquiry did not identify any issues. On August 15, 2023, investigations began that led to the discovery that the shutters on the middle gates of the temperature control device were not fully closed. Actions were immediately taken to lower the gates. This issue was likely due to debris removal action taken in May, which required the temporary lifting of the temperature control gates. However, the middle gates were not repositioned accurately. As a result, cold water pool volume was impacted, and had negative impacts for fall temperature management.
- Folsom Power Bypass[7]: On September 29, 2023, NMFS, with the support of USFWS and CDFW, transmitted a power bypass request (Request), along with water temperature modeling and Chinook egg survival results, in support of a recommendation that Reclamation implement a power bypass at Folsom Dam beginning October 30, 2023 at

[7] Although the 2023 Folsom Power Bypass occurred in WY 2024, discussions began in WY 2023; therefore, it is captured here for continuity of operations.

150 cfs, ramping up to 300 cfs on October 31, 2023 and to 500 cfs on November 1, 2023, and to continue until (a) daily average water temperature can be maintained below 56°F at both Hazel Ave. and Watt Ave. without a power bypass, or (b) reservoir conditions (due to depletion of the cold water pool or destratification) are such that the power bypass no longer provides cooler releases (see Attachment D for more details).

Updated modeling results for two scenarios were presented to ARG on September 29, 2023.

- Scenario 1:
    - 64° F temperature target at Watt Ave. on October 1
    - Roughly 61-62° F at Hazel Ave. throughout October
    - Roughly 59-60° F at Hazel Ave. on November 1
    - All shutters would be up early in October.
- Scenario 2:
    - 64° F temperature target at Watt Ave. on October 16
    - Roughly 64-65° F at Hazel Ave. until mid-October
    - Roughly 62° F at Hazel Ave. on November 1

The Request draws upon numerous Folsom power bypass and LAR temperature management discussions held at the monthly and ad hoc ARG meetings over the previous several months, as well as two supporting documents – an excel spreadsheet of Chinook egg survival modeling results and a PowerPoint of water temperature modeling results. The Request was expected to improve water temperature conditions to (a) reduce pre-spawn mortality for fall-run Chinook salmon, (b) reduce fall-run Chinook salmon egg mortality in October and much of November, (c) provide more suitable temperatures for hatchery operations, and (d) provide less stressful rearing conditions for juvenile Central Valley steelhead.

After review, Reclamation's Regional Director approved the Request on October 11, 2023. The bypass would begin October 30, 2023 at 150 cubic feet per second (cfs), ramping up to 300 cfs on October 31, 2023 and to 500 cfs on November 1, 2023 and to continue until (a) daily average water temperature can be maintained below 56°F at Hazel Ave. and Watt Ave. Bridge (Watt Avenue) without a power bypass, or (b) reservoir conditions (due to depletion of the cold-water pool or destratification) are such that the power bypass no longer provides cooler releases. The power bypass ended when temperatures of 56° F at Watt Ave. were maintained, which occurred on December 9, 2023.

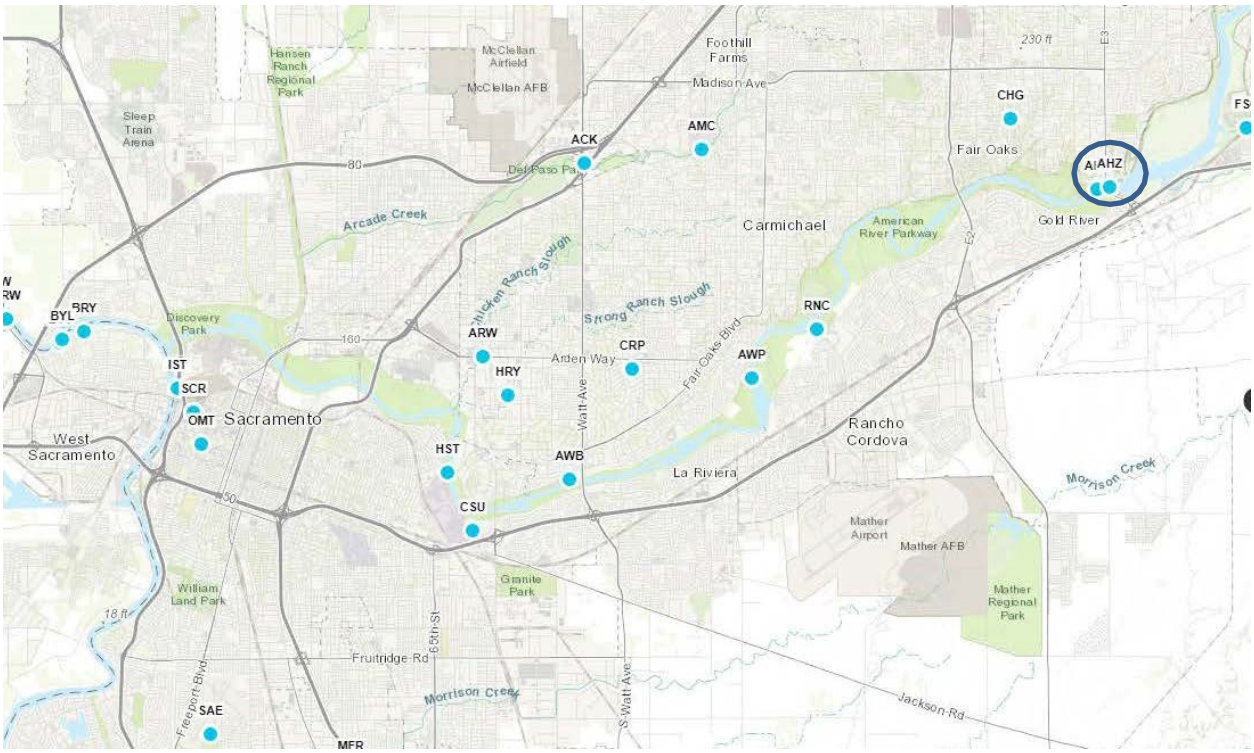

Figure 3**.** Location of water temperature monitoring station (AFO) at American River at Fair Oaks.

Figure 3 is a political map of West Sacramento. The map includes major roadways, neighborhoods, and waterways within the city. The map also includes pins for different water temperature monitoring stations within the city. The monitoring station at American River at Fair Oaks is circled.

Table 3**.** Historical Conditions (2001 – 2023) Folsom Reservoir Cold Water Pool dynamics.

Year	End of May Storage (TAF)	End of May CWP Volume < 58˚F (TAF)	All Upper Shutters Lowered by	End of Sept. Storage (TAF)	End of Sept. Volume < 60˚F (TAF)	Watt Avenue Target (˚F)
2001	696	275	30 Mar	368	30	65-71
2002	822	455	04 Mar	510	50	65-69
2003	962	640	02 Apr	658	135	65-67
2004	635	300	05 Mar	376	30	69
2005	959	705	15 Mar	652	140	65

Year	End of May Storage (TAF)	End of May CWP Volume < 58˚F (TAF)	All Upper Shutters Lowered by	End of Sept. Storage (TAF)	End of Sept. Volume < 60˚F (TAF)	Watt Avenue Target (˚F)
2006	928	670	29 Mar	639	125	65
2007	787	355	21 Mar	323	30	68
2008	617	250	None Lowered	270	25	69-70
2009	933	550	12 Mar	412	60	67
2010	905	580	14 Apr	624	130	66
2011	880 (960-July)	590	28 Mar	740	180	65
2012	926	536	29 Mar	450	60	65-66
2013	734	277	15 Apr	361	50	69
2014	548	200	None Lowered	345	35	70
2015	576	256	None Lowered	174	39	75
2016	826	421	23 Mar	306	27	68
2017	937	558	2 June	664	85	65
2018	955	622	28 Mar	467	56	66
2019	935	605	26 Mar 5 Jun (unit 1 returned to service)	714	89	65
2020	790	366	21 Apr	423	60	68
2021	361	117	None Lowered	230	34	71 (at AFO)
2022	865	461	May 6	345	45	66 (at AFO)
2023	817	630	April 25	667	85	67 (at AFO & Watt Ave)

From April through November, Reclamation collects temperature profile data in Folsom Reservoir twice a month (essentially every two weeks). For December through March,

temperature profiles are taken one time per month at all six locations. The temperature profile data are used to model reservoir and downstream temperatures throughout the temperature control season. This allows Reclamation to determine feasible temperature objectives on the LAR. The temperature model is run for every new profile to be able to either confirm that the temperature objectives are still feasible or determine that a change to the temperature plan needs to be made. The temperature compliance location is at Watt Ave. for May through October. However, the compliance location may change due to the location of redd and cold water pool availability.

4.4 WY 2023 Operations Under February 2020 ROD

4.4.1 2017 Flow Management Standard Releases and Planning Minimum

The February 2020 ROD is designed to provide minimum required flows for all steelhead life stages, as specified by the 2017 FMS Minimum Release Requirement (MRR). These MRRs are measured as total releases at Nimbus Dam. The 2017 FMS uses two hydrological indices to determine the MRR: American River Index (ARI) and Sacramento Index (SRI). The prescribed flows are minimums only, and do not preclude Reclamation from making higher releases.

Storage and flood control conditions for Folsom Lake are illustrated in Figure 7, which also includes inflow to Folsom Lake and releases at Nimbus Dam for October 2022 through October 2023. Folsom storage at the end of September was 667 TAF.

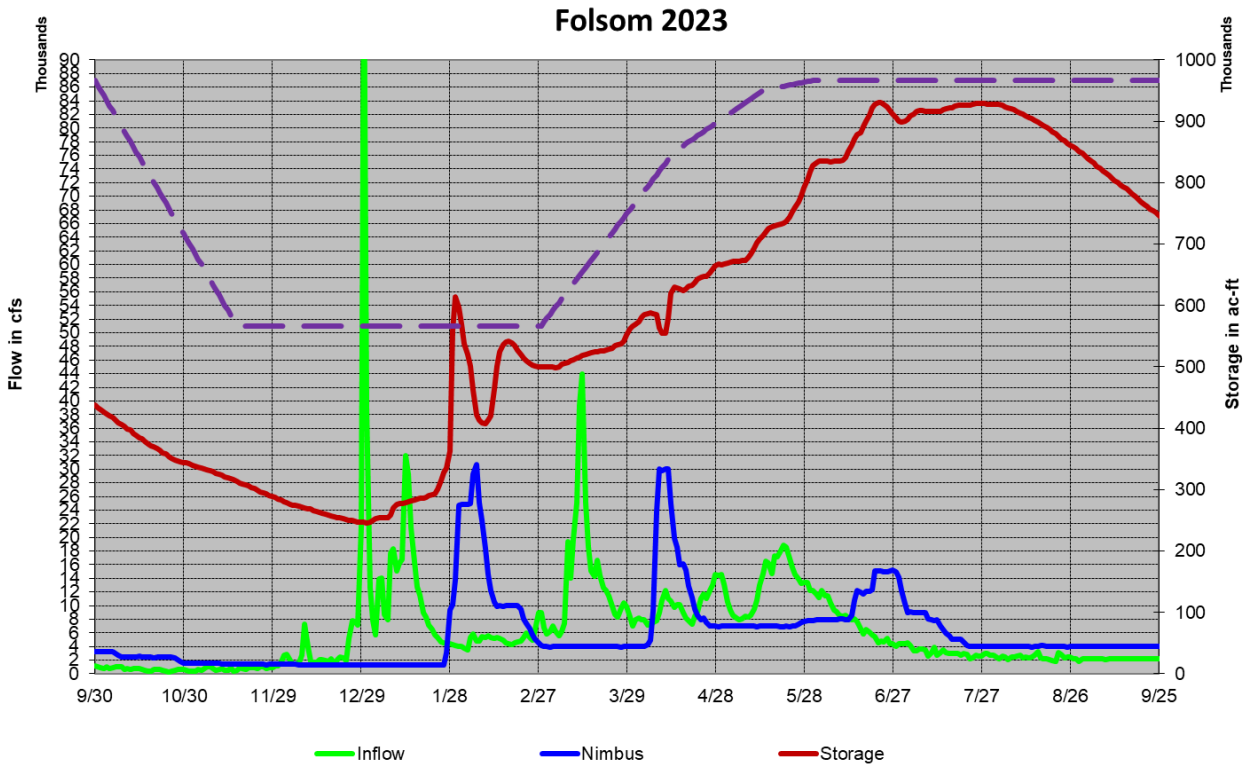

Figure 4. Summary of WY 2023 Folsom Reservoir Storage and Flow Releases from Nimbus Dam to the Lower American River.

Figure 4 is a line graph showing the inflow in thousands cubic feet per second and storage in acre-feet from September 30 2022 to September 25 2023 at Nimbus Dam. The graph shows a sharp increase of over 80 thousand cfs on December 30 2022 with increased releases from Nimbus in late January, early April, and late June, 2023.

The Nimbus Dam releases to the LAR and the prescribed MRRs for WY 2023 are shown in Figure 8.

Table 4 contains a summary of operational release changes from Nimbus Dam. Factors in making flow management adjustments included flood control, storage conservation, fall-run Chinook salmon spawning needs, Delta needs and salinity management and picket installation below Nimbus Dam.

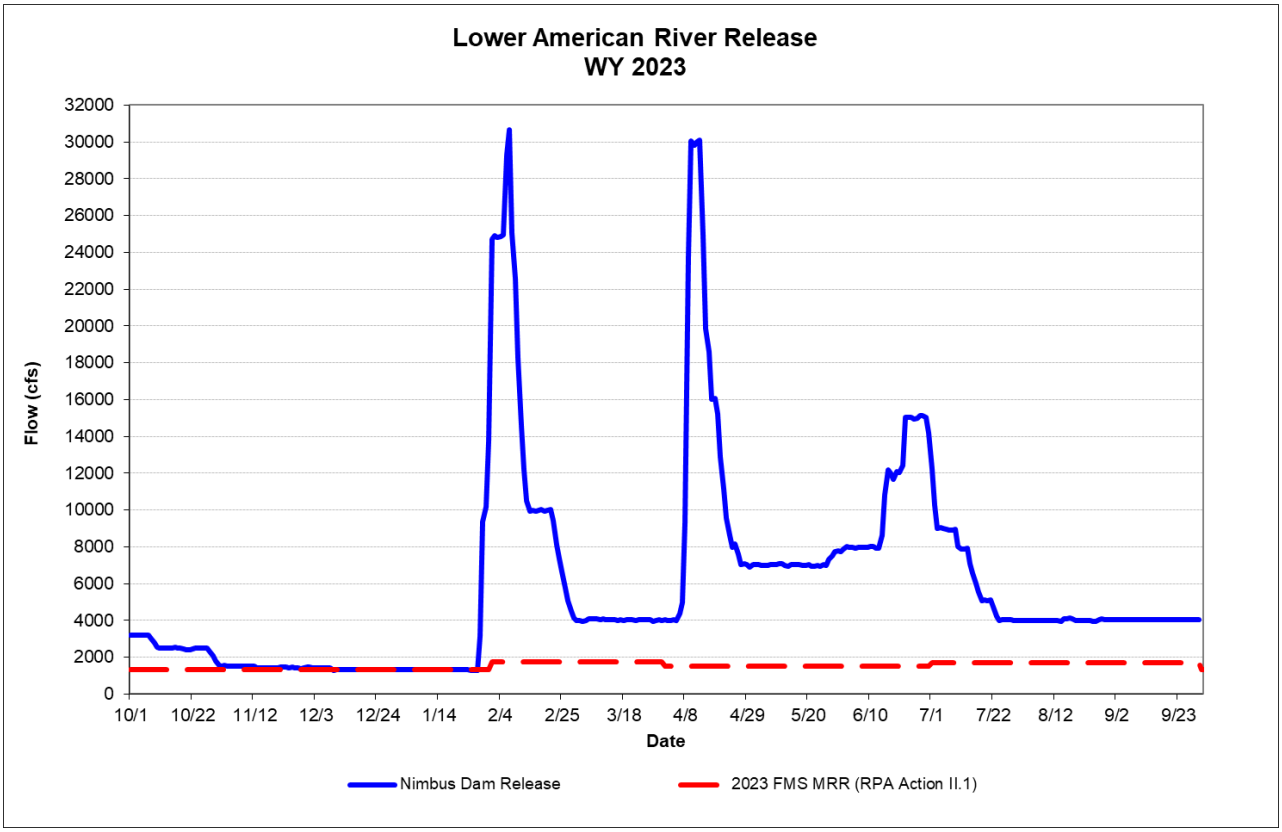

Figure 5. Summary of WY 2023 Nimbus Dam Releases to the Lower American River Releases.

Figure 5 is a line graph showing the releases from Nimbus dam in cfs and the 2023 flow management standard monthly minimum release requirements. The graph shows two large releases, nearing 30,000 cfs, in early February and mid-April with a smaller release of 15,000 cfs in late June 2023. The management standard monthly minimum release requirements are below 2000 cfs for the water year.

Table 4. Reclamation's WY 2023 Release Changes at Nimbus Dam.

Start Date	Release	To (cfs)	Comment
9/30/2022	Decrease	1,750	Conserve Storage
10/1/2022	Decrease	1,500	Conserve Storage
10/14/2022	Decrease	1,400	Conserve Storage
11/9/2022	Decrease	1,300	Conserve Storage
12/29/2022	Increase	8,000	Storage Management
12/30/2022	Increase	10,000	Storage Management
1/1/2023	Increase	25,000	Storage/Flood Management
1/7/2023	Increase	35,000	Storage/Flood Management
1/8/2023	Decrease	25,000	Storage Management

Start Date	Release	To (cfs)	Comment
1/10/2023	Decrease	20,000	Storage Management
1/11/2023	Decrease	16,000	Storage Management
1/12/2023	Decrease	13,000	Storage Management
1/13/2023	Decrease	10,000	Storage Management
1/23/2023	Decrease	7,000	Storage Management
1/26/2023	Decrease	4,700	Storage Management
1/29/2023	Decrease	4,000	Storage Management
3/7/2023	Increase	5,000	Storage Management
3/9/2023	Increase	30,000	Storage Management/Flood Control
3/15/2023	Decrease	20,000	Storage Management
3/17/2023	Decrease	16,000	Storage Management
3/20/2023	Decrease	14,000	Storage Management
3/21/2023	Decrease	12,000	Storage Management
3/22/2023	Decrease	10,000	Storage Management
3/23/2023	Decrease	9,000	Storage Management
3/24/2023	Decrease	8,000	Storage Management
3/27/2023	Decrease	7,000	Storage Management
4/27/2023	Increase	8,000	Storage Management
5/15/2023	Increase	10,000	Storage Management
5/16/2023	Increase	12,000	Storage Management
5/22/2023	Increase	15,000	Storage Management
5/31/2023	Decrease	13,000	Storage Management
6/1/2023	Decrease	11,000	Storage Management
6/2/2023	Decrease	9,000	Storage Management
6/10/2023	Decrease	8,000	Storage Management
6/14/2023	Decrease	7,000	Storage Management
6/15/2023	Decrease	6,000	Storage Management
6/17/2023	Decrease	5,000	Storage Management
6/22/2023	Decrease	4,500	Storage Management
6/23/2023	Decrease	4,000	Storage Management
9/1/2023	Decrease	3,500	Temperature Management/Storage Management
9/7/2023	Decrease	3,000	Temperature Management/Storage Management

4.4.2 Spring Pulse Flows

Spring pulse flows were not required or implemented in WY 2023 as part of the February 2020 ROD.

4.4.3 Temperature Management Plan

The Temperature Management Plan (TMP) component in the February 2020 ROD is designed to provide suitable temperatures to support over-summer rearing steelhead in the LAR from May 15 through October 31. Figure 9 is a summary of Reclamation's water temperature operations, from October 2022 through November 2023, at the Watt Ave. Bridge (~RM 9) temperature

compliance point. Each year, available water resources and conditions are assessed to develop a TMP. The iCPMM tool is used to generate temperature modeling results which are one component that guides the decision making for the TMP. Model runs incorporate the latest operation's forecast (inflow, outflow and storage) and iteratively select a temperature target based on available resources and a pre-determined habitat balance between steelhead and fall-run Chinook salmon. The selected plan is provided to ARG for comments and recommendations. After the ARG review of the TMP, Reclamation reviews the comments and determines the final plan. The plan is reviewed for potential updates every month based on the latest hydrology and CWP conditions.

Reclamation presented a finalized Temperature Management Plan (TMP) to ARG in June of 2023. Reclamation has modeled conditions using iCPMM which also support the outcome of the CE-QUAL-W2 models that were discussed with ARG stakeholders. The temperature objective in the TMP is to achieve a maximum temperature (mean daily) target at Watt Ave. of 67°F from June 20, 2023 until November 1, 2023. Between June and October, there were 2 days in September that exceeded 66°F at Watt Ave. (Sep 26: 66.2°F, and Sep 27: 66.3°F). The average for each month's temperature at Hazel are: June at 56.1°F, July at 59.1°F, August at 61.5°F, September at 64.7°F, and October at 62.8°F. The average for each month's temperature at Watt are: June at 59.7°F, July at 61.5°F, August at 63.6°F, September at 65.6°F, and October at 63.2°F.

The 2017 FMS under the February 2020 ROD includes a temperature management strategy that acknowledges resource needs for the protection of fall-run Chinook salmon spawning. The goal is to achieve cooler water temperatures in October, depending on the availability of remaining CWP resources, and continue through November until active water temperature management is no longer necessary. The onset of seasonal fall cooling in most years occurs in mid-November due to ambient air temperature cooling and decreased day length. As a result, in many years, active temperature management continues after the October 31 end date of the juvenile steelhead temperature management period. After November, cooling the river to temperatures suitable for fall-run Chinook salmon spawning is typically accomplished by raising the lower shutter and releasing water through Folsom Dam's power units. In some years, Reclamation may release water from the lower river outlet gates at a cost to power generation for additional river cooling. A summary of WY 2023 temperature shutter and power penstock blending operations, including power bypass, is provided in Table 5.

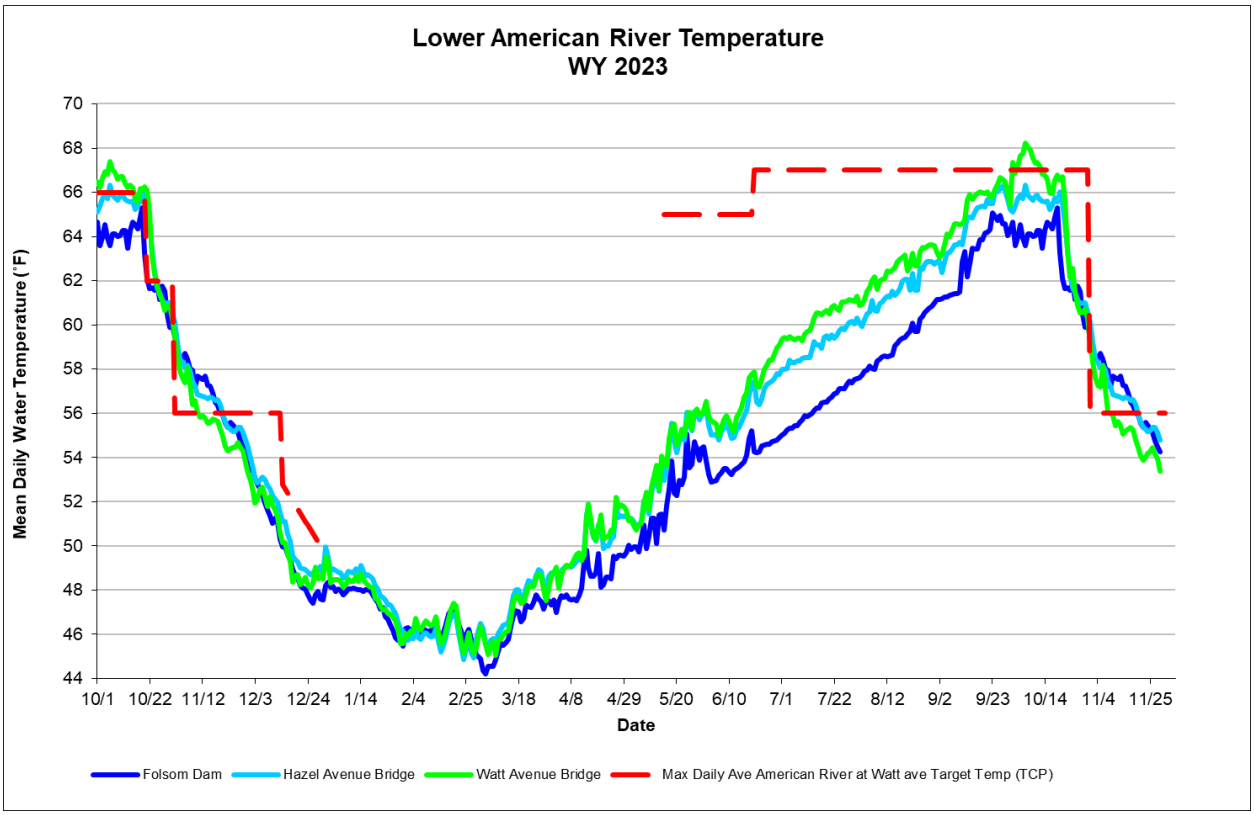

Figure 6. Summary of WY 2022 Water Temperatures in the Lower American River.

Figure 6 is a line graph showing water temperatures at the Folsom Dam and Hazel and Watt Avenue Bridges, and the max daily average American River temperature target at the Watt Avenue Bridge. The temperature at all three sites tracks with the temperature target for October – December and April – November for water year 2023. There were slight exceedances in October and November.

Table 5. List of Folsom Dam temperature shutter and power penstock blending operations taken to meet downstream temperature requirements.

Date	Operation
10/19/2022	On Wednesday, 10/19/2022, Please raise Units 1 and 2 bottom sets of shutters, this will place Units 1 and 2 into Configuration 4 (Top, Middle, and Bottom raised). Folsom shutter status after changes: Top Shutters: Unit 1, 2, and 3 - raised Middle Shutters: Units 1, 2, and 3 - raised Bottom Shutters: Units 1, 2, and 3 - raised Unit 1, Unit 2, and Unit 3 in Configuration 4 Comment: Temperature Management
10/20/2022	Please make the following power bypass releases from the lower outlet tubes: Date Time cfs 10/20/22 0800 100 10/21/22 0800 200 10/22/22 0800 300 Please maintain 300 cfs power bypass until further notice. Note: Implement Power Bypass to target 62 degree at AFO, approved by RD
10/29/2022	Please make the following power bypass releases from the lower outlet tubes: Date Time cfs 10/29/22 0800 400 10/30/22 0800 500 Please maintain 500 cfs power bypass until further notice. Note: Implement Power Bypass, approved by RD
11/21/2022	Please make the following power bypass releases from the lower outlet tubes: Date Time From (cfs) To (cfs) 11/21/22 1200 500 400 Note: Temperature Management
11/22/2022	Please make the following power bypass releases from the lower outlet tubes: Date Time From (cfs) To (cfs) 11/22/22 1200 400 200 Note: Temperature Management

Date	Operation
11/23/2022	Starting today, November 23, 2022, please cancel all bypass releases from the lower outlet tubes: Date Time From (cfs) To (cfs) 11/23/22 1200 200 0 Note: Temperature Management
2/16/2023	On Thursday, 02/16/2023, please place Units 1, 2 and 3 into Configuration 2 (Top raised, Mid and Bottom lowered) Folsom shutter status after changes: Top Shutters: Units 1, 2 and 3 - raised Middle Shutters: Units 1, 2 & 3 - lowered Bottom Shutters: Units 1, 2, & 3 - lowered Comment: Temperature Management
4/25/2023	On Tuesday, 4/25/2023, please place Units 1, 2 and 3 into Configuration 1 (Top, Mid and Bottom lowered) Folsom shutter status after changes: Top Shutters: Units 1, 2 and 3 - lowered Middle Shutters: Units 1, 2 & 3 - lowered Bottom Shutters: Units 1, 2, & 3 - lowered Comment: Temperature Management
8/25/2023	On Friday, 8/25/2023, please place Units 3 into Configuration 2 (Top raised, Mid and Bottom lowered). Please make the correction on Unit 3 by placing one stem per station to lower the middle set of shutters down to the lowest configuration. Then please raise the tops up. This will result Unit 3 into Configuration 2. Folsom shutter status after changes: Top Shutters: Units 1 - lowered, Unit 2 & 3 - raised Middle Shutters: Units 1, 2 & 3 - lowered Bottom Shutters: Units 1, 2, & 3 - lowered Comment: Temperature Management
9/11/2023	On Monday, 9/11/2023, please place Units 2 into Configuration 1 (Top, Mid and Bottom lowered) Folsom shutter status after changes: Top Shutters: Units 1, 2 - lowered and Unit 3 - raised Middle Shutters: Units 1, 2 & 3 - lowered Bottom Shutters: Units 1, 2, & 3 - lowered Comment: Temperature Management

Date	Operation
10/30/2023	On Monday,10/30/2023, please Open the Bottom set of shutters on Unit 2 (Configuration 4). Folsom shutter status after changes: Top Shutters: Unit 1, 2, & 3 – Open (raised) Middle Shutters: Units 1 – Closed (lowered) and Unit 2 & Unit 3 – Open (raised) Bottom Shutters: Units 1 -- Closed (lowered) and Unit 2 & Unit 3 - Open (raised) Comment: Temperature Management
10/30/23	Please make the following Power Bypass through the Lower River Outlet at Folsom Dam: Date Time From (cfs) To (cfs) 10/30/2023 0001 0 150 10/31/2023 0001 150 300 11/1/2023 0001 300 500 Note: Temperature Management
10/19/2022	On Wednesday, 10/19/2022, Please raise Units 1 and 2 bottom sets of shutters, this will place Units 1 and 2 into Configuration 4 (Top, Middle, and Bottom raised). Folsom shutter status after changes: Top Shutters: Unit 1, 2, and 3 - raised Middle Shutters: Units 1, 2, and 3 - raised Bottom Shutters: Units 1, 2, and 3 - raised Unit 1, Unit 2, and Unit 3 in Configuration 4 Comment: Temperature Management
10/20/2022	Please make the following power bypass releases from the lower outlet tubes: Date Time cfs 10/20/22 0800 100 10/21/22 0800 200 10/22/22 0800 300 Please maintain 300 cfs power bypass until further notice. Note: Implement Power Bypass to target 62 degree at AFO, approved by RD

Date	Operation
10/29/2022	Please make the following power bypass releases from the lower outlet tubes: Date Time cfs 10/29/22 0800 400 10/30/22 0800 500 Please maintain 500 cfs power bypass until further notice. Note: Implement Power Bypass, approved by RD
11/21/2022	Please make the following power bypass releases from the lower outlet tubes: Date Time From (cfs) To (cfs) 11/21/22 1200 500 400 Note: Temperature Management
11/22/2022	Please make the following power bypass releases from the lower outlet tubes: Date Time From (cfs) To (cfs) 11/22/22 1200 400 200 Note: Temperature Management
11/23/2022	Starting today, November 23, 2022, please cancel all bypass releases from the lower outlet tubes: Date Time From (cfs) To (cfs) 11/23/22 1200 200 0 Note: Temperature Management
2/16/2023	On Thursday, 02/16/2023, please place Units 1, 2 and 3 into Configuration 2 (Top raised, Mid and Bottom lowered) Folsom shutter status after changes: Top Shutters: Units 1, 2 and 3 - raised Middle Shutters: Units 1, 2 & 3 - lowered Bottom Shutters: Units 1, 2, & 3 - lowered Comment: Temperature Management
4/25/2023	On Tuesday, 4/25/2023, please place Units 1, 2 and 3 into Configuration 1 (Top, Mid and Bottom lowered) Folsom shutter status after changes: Top Shutters: Units 1, 2 and 3 - lowered Middle Shutters: Units 1, 2 & 3 - lowered Bottom Shutters: Units 1, 2, & 3 - lowered Comment: Temperature Management

Date	Operation
8/25/2023	On Friday, 8/25/2023, please place Units 3 into Configuration 2 (Top raised, Mid and Bottom lowered). Please make the correction on Unit 3 by placing one stem per station to lower the middle set of shutters down to the lowest configuration. Then please raise the tops up. This will result Unit 3 into Configuration 2. Folsom shutter status after changes: Top Shutters: Units 1 - lowered, Unit 2 & 3 - raised Middle Shutters: Units 1, 2 & 3 - lowered Bottom Shutters: Units 1, 2, & 3 - lowered Comment: Temperature Management
9/11/2023	On Monday, 9/11/2023, please place Units 2 into Configuration 1 (Top, Mid and Bottom lowered) Folsom shutter status after changes: Top Shutters: Units 1, 2 - lowered and Unit 3 - raised Middle Shutters: Units 1, 2 & 3 - lowered Bottom Shutters: Units 1, 2, & 3 - lowered Comment: Temperature Management

4.5 Summary of American River Operations to Meet Delta Requirements

In the spring, Nimbus Dam (as measured at the AFO[8] gauge on the LAR) releases are held steady until flows are needed to support instream demands on the mainstem Sacramento River, Delta Outflow and other requirements. CVP releases for Delta Outflow requirements are balanced between Shasta Reservoir and Folsom Reservoir. Shasta Reservoir and Folsom Reservoir are relied upon to meet in-river water temperature control requirements below Keswick Dam and Nimbus Dam later in the season, and both reservoirs need to substantially fill in the spring to fully meet these requirements. Therefore, releases must be carefully balanced to manage storage in each reservoir. An overarching goal for Reclamation when operating the CVP is to fill both reservoirs as much as possible by the end of the flood control season (end of May) while meeting all other authorized project purposes.

The multi-year drought that had strained California's water supply has ended. In years of drought, water supply conditions put an increased demand on Shasta Reservoir and Folsom Reservoir for meeting water demands. During a drought, reservoir releases are limited to conserve storage. However, requirements must still be met for fish habitat needs and for other

[8] Temperature data for the Fair Oaks (AFO) gage can be found here: https://cdec.water.ca.gov/webgis/?appid=cdecstation&sta=AFO

downstream demands, which include seasonal water supply needs, water rights requirements, regulatory requirements and biological considerations.

WY 2023 started with the same dry conditions that had been present for the past three drought years. However, at the end of December, there was a significant change in weather patterns, marked by the arrival of an extremely powerful atmospheric river storm. This change led to a wet season filled with numerous atmospheric river storms, a deviation from the few such storms during the previous dry years. Between December 26th, 2022 and January 19th, 2023, California experienced approximately half of its typical annual rainfall.

Folsom Reservoir is one of the smallest CVP reservoirs with one of the highest refill potentials. It is also closer in proximity to the Delta, meaning reservoir releases reach the Delta faster than releases from Shasta Reservoir. In WY 2023, Folsom Reservoir was not needed to support Shasta Reservoir releases for meeting Sacramento – San Joaquin Delta demand requirements.

Chapter 5 – Lower American River Biological Monitoring

The monitoring activities described below are currently being implemented on the LAR and include actions which: represent requirements in the NMFS 2009 BiOp, NMFS 2019 BiOp, or 2020 ROD; assist Reclamation in implementing operations pursuant to the NMFS 2009 BiOp, NMFS 2019 BiOp, or 2020 ROD; provide supplemental information; or meet CVPIA specific requirements.

5.1 Monitoring Activities

5.1.1 Steelhead Spawning Surveys

Reclamation contracted with Cramer Fish Sciences to conduct bi-weekly steelhead redd surveys. Redd surveys were conducted from Nimbus Dam to Watt Ave., with the addition of surveys at Paradise Beach every other survey period, covering 18 river miles (Figure 10) (Cramer Fish Sciences 2023). Surveyed redds were recorded from a jet boat, or on foot and plotted using geographic positioning system (GPS) and biometric equipment. Surveys began on February 9, 2023 and continued through March 7, 2023. Spawning surveys could not be completed in January and mid-March through April due to high flows and sustained low visibility conditions in the Lower American River during the 2023 season.

From February 9, 2023 to March 7, 2023 a total of 32 new, clear salmonid redds were observed. When possible, redds were assigned a species based on observations of adults that could be identified to species within proximity of the redds. Of the 32 new redds, 15 were positively identified in the field as steelhead. Of the remaining redds, 17 were initially classified as "unknown" because no fish were observed on the redd. A discriminant Function Analysis (DFA) based on past data from redds of known species was used to designate 16 unknown redds as steelhead, for a total of 31 steelhead redds. One redd remained classified as "unknown" because not all data required to complete the DFA analysis could be collected due to high depth and velocity in that location.

Figure 11 shows the 2023 steelhead redd locations (following DFA) and their corresponding discovery dates by survey week. Overall, 58% of steelhead redds during the 2023 surveys were observed at gravel augmentation sites. The highest redd density (55% of all redds) occurred in the Nimbus Basin gravel augmentation project, implemented in fall 2022. The percentage of steelhead redds observed at gravel augmentation sites has ranged from 11% to 81% since 2015. Bi-weekly reports summarizing the findings of the steelhead spawning survey were sent to NMFS and survey data were also reported at the monthly ARG meeting.

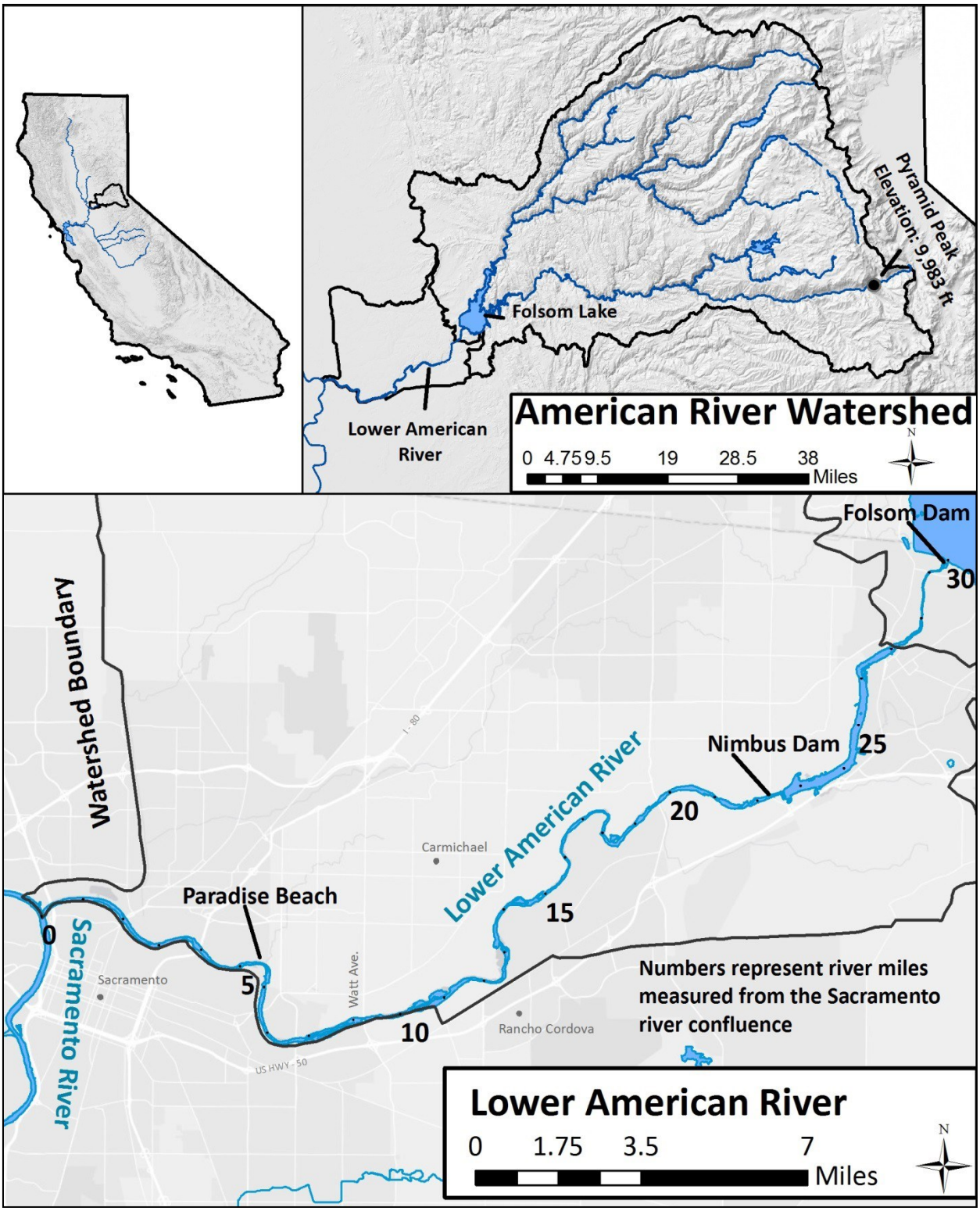

Figure 7. American River steelhead spawning survey reach.

Figure 7 is two maps. One of the American River Watershed and the other of the Lower

American River with Folsom and Nimbus dams noted with a pin.

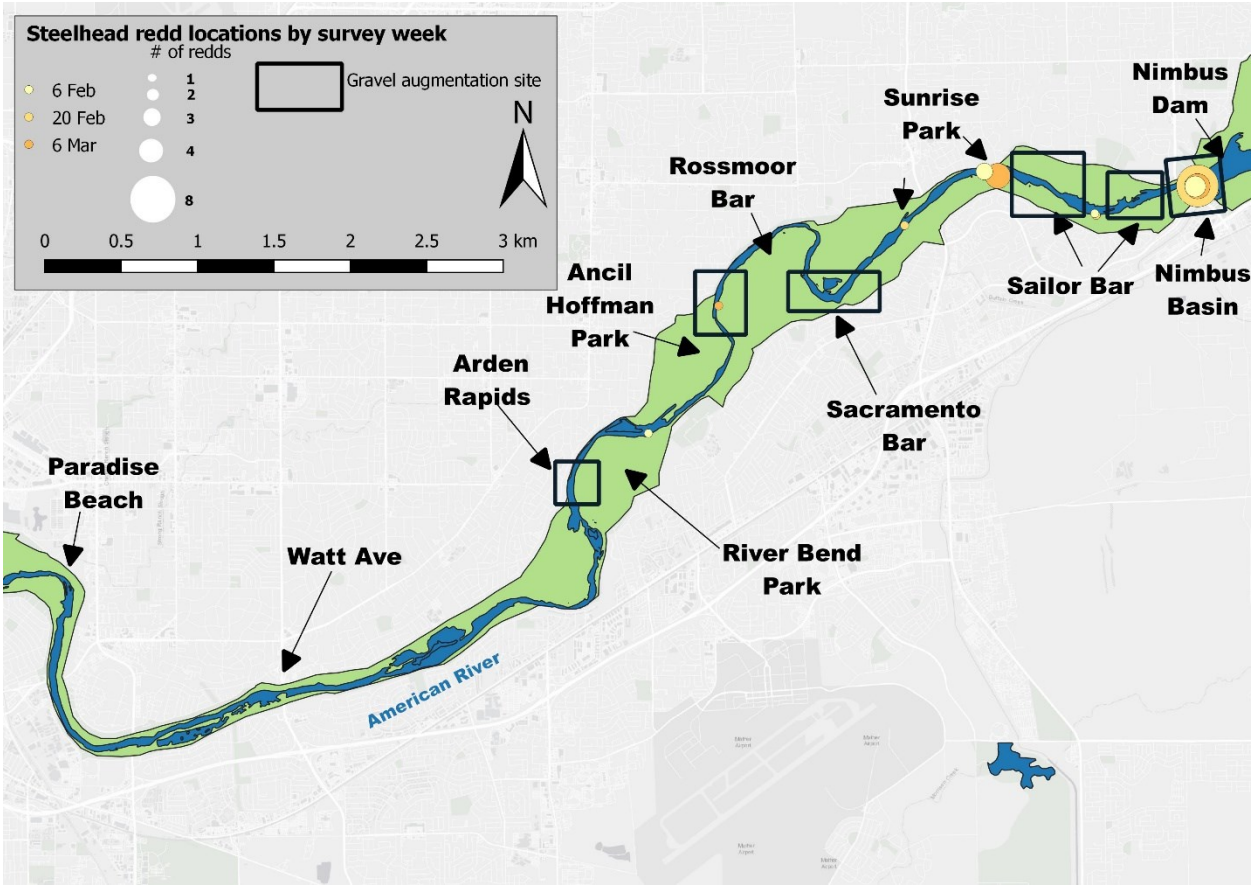

Figure 8. American River steelhead redd distribution and timing in 2023.

Figure 8 is a map of the American River. The map includes different bars, parks, dams, bridges, gravel augmentation sites and beaches along the American River. Observed Steelhead redds are marked by circles. The size of the circle indicates the number of redds observed while the color of the circle, yellow, orange, or dark orange, indicates the date of the survey the redds were observed.

5.1.2 Stranding and Isolation Pool Monitoring

Reclamation monitors flow fluctuations in the LAR to assess and minimize dewatering of salmonid redds and stranding and isolation of juvenile salmonids. Habitat evaluations have identified several locations where isolation of salmonids and other fish species have been observed in the past coinciding with the reduction or fluctuation of flows. Stranding surveys are performed throughout the river when: (1) there is a flow reduction of more than 1000 cfs, when the initial flow is greater than 2000 cfs or (2) there is a flow reduction of 250 cfs if the final flow will be below 1000 cfs. The low flow thresholds for stranding surveys are based on water's edge data collected by Cramer Fish Sciences during a flow reduction in January 2014; results from this field study indicate that substantial dewatering of the channel occurred at flows below 800 cfs and substantial redd dewatering occurred below 700 cfs (Cramer Fish Sciences 2014).

LAR stranding surveys were performed on January 18th – January 19, January 31 – February 2, March 23 – 24, April 4 – April 5, June 6, and June 19 – 20, 2023 between Nimbus Dam and Paradise Beach (Figure 12). When juvenile salmonids were observed, the approximate number of fish in the isolated pool were recorded, along with species identification, when possible. Water temperature, dissolved oxygen (DO), and turbidity were recorded in isolated pools that contained stranded juvenile salmonids. A GPS polygon outlining the stranding pool was also recorded to estimate pool area. Survey crews looked for new stranding pools and revisited previous stranding locations during each survey. All fish were captured with a beach seine or dip net. All fish captured in the isolated pools were released back into the main channel with assistance from CDFW. Occasionally some juveniles could not be captured due to dense vegetation, large cobble etc. In these cases, fish numbers were estimated visually. If the salmonids were captured with a beach seine or dip net they were identified to species. Table 6 summarizes salmonids captured. In cases where fish were observed but could not be captured, they generally could not be accurately identified to species.

Table 6**.** Summary of stranded juvenile salmonids on the Lower American River observed during stranding surveys that occurred January 31, March 23 – March 24, April 4, June 6 and June 19, 2023. No stranded salmonids were observed during the January 18 – January 19, February 1 – February 2, April 5, and June 20, 2023 stranding surveys.

Date	Location (river mile)	# of pools	Species Observed – Chinook	Species Observed – Steelhead	Species Observed – Unid. Salmonids	Rescue Conducted	Total pool area (m^2)
January 31	Riverbend Side Channel (13)	1	N/A	N/A	15	N	15
January 31	Below Riverbend/William B Pond Access (13)	1	N/A	N/A	74	N	74
January 31	Below Riverbend (12)	1	N/A	N/A	1	N	1
March 23-24	Upper Riverbend Side Channel (14)	2	N/A	N/A	31	N	31
March 23-24	River Bend Side Channel (13)	2	N/A	359	48	Y	48
March 23-24	Rossmoor Bar (17)	1	N/A	60	16	Y	16
March 23-24	Below Riverbend/William B Pond Access (13)	1	N/A	1,108	300	Y	300
March 23-24	Sacramento Bar (18)	2	N/A	1	67	N	67

Date	Location (river mile)	# of pools	Species Observed – Chinook	Species Observed – Steelhead	Species Observed – Unid. Salmonids	Rescue Conducted	Total pool area (m^2)
March 23-24	Below Upper Sunrise SC	1	2	425	148	Y	148
March 23-24	Below San Juan Rapids (18)	1	N/A	57	139	Y	139
March 23-24	El Manto to San Juan Rapids (18)	1	N/A	1	22	N	22
April 4	Sacramento Bar (18)	1	25	N/A	8	Y	8
April 4	Riverbend Side Channel (13)	1	N/A	521	67	Y	67
June 6	Upper Sailor Bar, weir to boat ramp (22)	1	N/A	N/A	6	N	6
June 6	Upper Sunrise Side Channel Island (21)	1	N/A	2	129	N	129
June 19	Upper Sunrise Side Channel Island (21)	1	N/A	67	10	Y	10
June 19	Sailor Bar Side Channel Island (22)	2	N/A	4	9	Y	9
N/A	Total	21	27	2,605	1,090	N/A	1,090

No stranded juvenile salmonids were observed during the January 18 - 19, February 1 - 2, 5 April 5, and June 20 stranding surveys. A total of 11 unique locations (21 pools) were stranded with juvenile salmonids between January 31 and June 19, covering an estimated area of 1,090 m^2 (Figure 15). Within these stranding pools, 2,702 juvenile salmonids were observed; 2,605 of these were steelhead (~96%, Table 6). Other fish species observed in stranding pools included Sacramento Pikeminnow (*Ptychocheilus grandis*), Sacramento Sucker (*Catostomus occidentalis*), Hardhead (*Mylopharodon conocephalus*), Three-Spined Stickleback (*Gasterosteus aculeatus*), Wakasagi (*Hypomesus nipponensis*), Bluegill (*Lepomis macrochirus*), sculpin (*Cottus* sp.), and Western Mosquitofish (*Gambusia affinis*). CDFW staff assisted Cramer Fish Sciences in rescuing 2,628 salmonids from these isolated pools (~97% of all salmonids observed).

One stranding pool below the upper Sunrise side channel had 425 steelhead observed and rescued. In the lower Riverbend side channel restoration area, there were a total of 880 stranded juvenile steelhead observed and rescued out of three isolated pools. A stranding pool adjacent to William B. Pond recreation area contained 1,108 juvenile steelhead that were observed and rescued; 42% of all salmonids observed in WY 2023 (Figure 12).

Juvenile salmonid stranding occurred following multiple flow reductions between January 8 and June 18; with the majority of the fish strandings occurring following a flow reduction of 20,000 cfs between March 15 – March 22.

Average temperatures in stranding pools at three locations reached levels considered stressful for juvenile salmonids. One pool containing 60 stranded steelhead was measured at 17.1°C, one pool below Sacramento Bar containing 25 juvenile Chinook Salmon was measured at 18.9°C, and two small pools on the Sailor Bar island containing a total of seven juvenile steelhead had an average temperature of 17.6 °C (Table 7). Seven of the 21 isolated pools had DO levels below 8 mg/l; with lowest reading measured at 2.3 mg/l in a small pool near Sacramento Bar (Table 7).

No additional stranding surveys were conducted after June 20, 2023.

Table 7. Summary of environmental data in the observed stranding pools containing stranded juvenile salmonids January 31, March 23 – March 24, April 4, June 6 and June 19, 2023. Numbers reported are averages across the pools observed within each location. Bolded numbers indicate stressful conditions for juvenile salmonids (USEPA 2003).

Date	Location (river mile)	# of pools	Total pool area (m^2)	Average Temp. (°C)	Average DO (mg/L)	Average Turbidity (NTU)
31 Jan	Riverbend Side Channel (13)	1	15	9.9	5.5	N/A
31 Jan	Below Riverbend/William B Pond Access (13)	1	74	7.4	6.2	N/A
31 Jan	Below Riverbend (12)	1	1	5.0	2.4	N/A
23-24 March	Upper Riverbend Side Channel (14)	2	31	N/A	N/A	N/A
23-24 March	River Bend Side Channel (13)	2	48	13.9	9.2	5.4
23-24 March	Rossmoor Bar (17)	1	16	17.1	5.0	N/A
23-24 March	Below Riverbend/William B Pond Access (13)	1	300	10.6	8.1	2.5
23-24 March	Sacramento Bar (18)	2	67	10.4	8.6	8.6
23-24 March	Below Upper Sunrise SC	1	148	9.5	11.5	5.1
23-24 March	Below San Juan Rapids (18)	1	139	12.3	9.7	2.9
23-24 March	El Manto to San Juan Rapids (18)	1	22	13.7	13.4	N/A
4 Apr	Sacramento Bar (18)	1	8	18.9	2.3	25
4 Apr	Riverbend Side Channel (13)	1	67	9.2	7.6	N/A
6 Jun	Upper Sailor Bar, weir to boat ramp (22)	1	6	13.9	9.2	2.1

6 Jun	Upper Sunrise Side Channel Island (21)	1	129	13.7	8.9	1.1
19 Jun	Upper Sunrise Side Channel Island (21)	1	10	15.5	7.2	N/A
19 Jun	Sailor Bar Side Channel Island (22)	2	9	17.6	10.0	102.1
N/A	Total	21	1,090	N/A	N/A	N/A

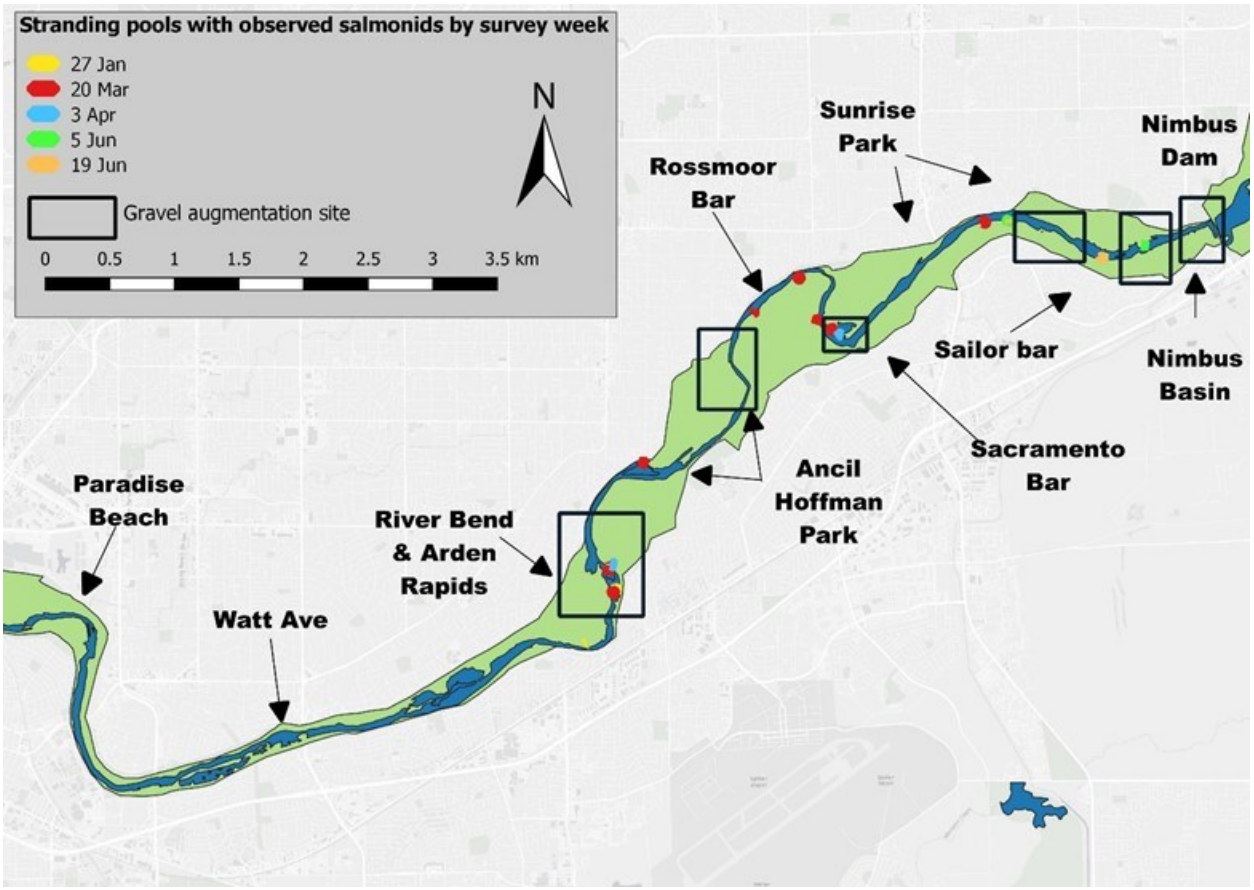

Figure 9. Locations of stranding areas with juvenile salmonids on the Lower American identified January 31, March 23 – 24, April 4, June 6, and June 19, 2023. No stranding with juvenile salmonids was observed January 18 – 19.

Figure 9 is a map of the American River. The map includes different bars, parks, dams, bridges, gravel augmentation sites and beaches along the American River. Observed stranding pools with salmonids are marked by circles. The color of the circle, yellow, red, blue, green, and orange, indicates the date the stranding pools were observed.

5.1.3 Steelhead Redd Dewatering

During stranding surveys, steelhead redds were monitored for dewatering. No steelhead redds were dewatered during WY 2023 flow reductions.

5.1.4 Rotary Screw Trap

LAR rotary screw trap (RST) operations in WY 2023 were part of a collaborative effort by the USFWS' Comprehensive Assessment and Monitoring Program (CAMP), PSMFC, and CDFW, and results are reported annually.

Sampling for the 2023 survey season began on January 25 and ended on June 28 with 104 days of sampling effort in the 155-day season. Two 8-foot diameter RSTs were deployed into the north channel of the Watt Ave. trapping site in a side-by-side configuration. Total catch for the season included 70,365 unmarked Chinook Salmon, 260 unmarked O. mykiss, and 1,693 lamprey.

Chinook catch timing and fork lengths from the Watt Ave. RSTs are summarized in Figure 14, Figure 15, and Figure 16.

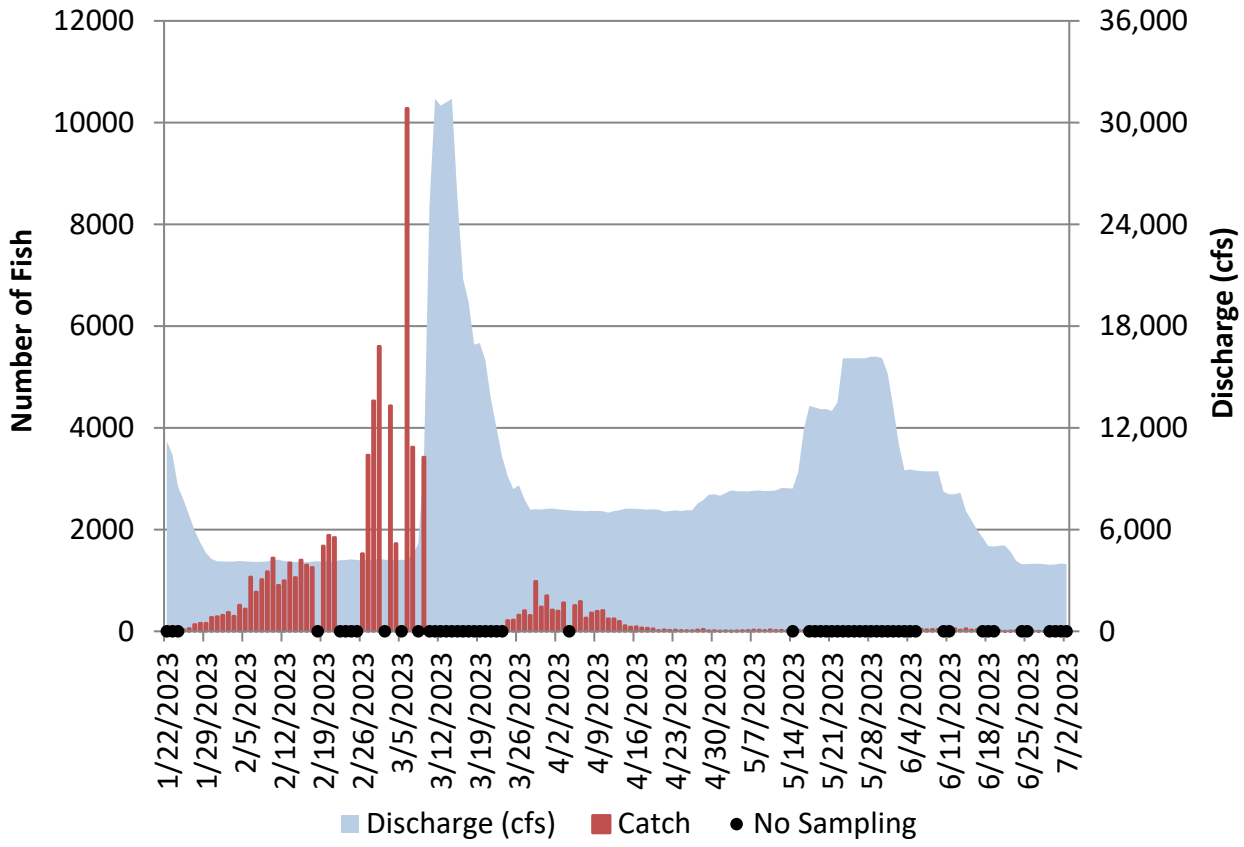

Figure 10: Daily catch of unmarked Chinook Salmon and daily average discharge at Fair Oaks during the 2023 lower American River rotary screw trap survey season.

Figure 10 is a line graph depicting the number of unmarked Chinook Salmon and discharge in cfs at Fair Oaks from January 1, 2023 to July 2, 2023. Discharge is depicted with a blue area and shows peak discharges of 11,000 cfs in January, 32,000 cfs in early March, and 16,000 cfs in late May. Catch of unmarked Chinook Salmon occurred

throughout the time period with most catch occurring late January to early March with a peak catch of over 10,000 unmarked Chinook Salmon in early March. Days with no sampling are marked by black dots.

Disclaimer: Unmarked Chinook Salmon totals and fork lengths may include fish from the Nimbus Fish Hatchery release on 2/23/23 and 5/16/23.

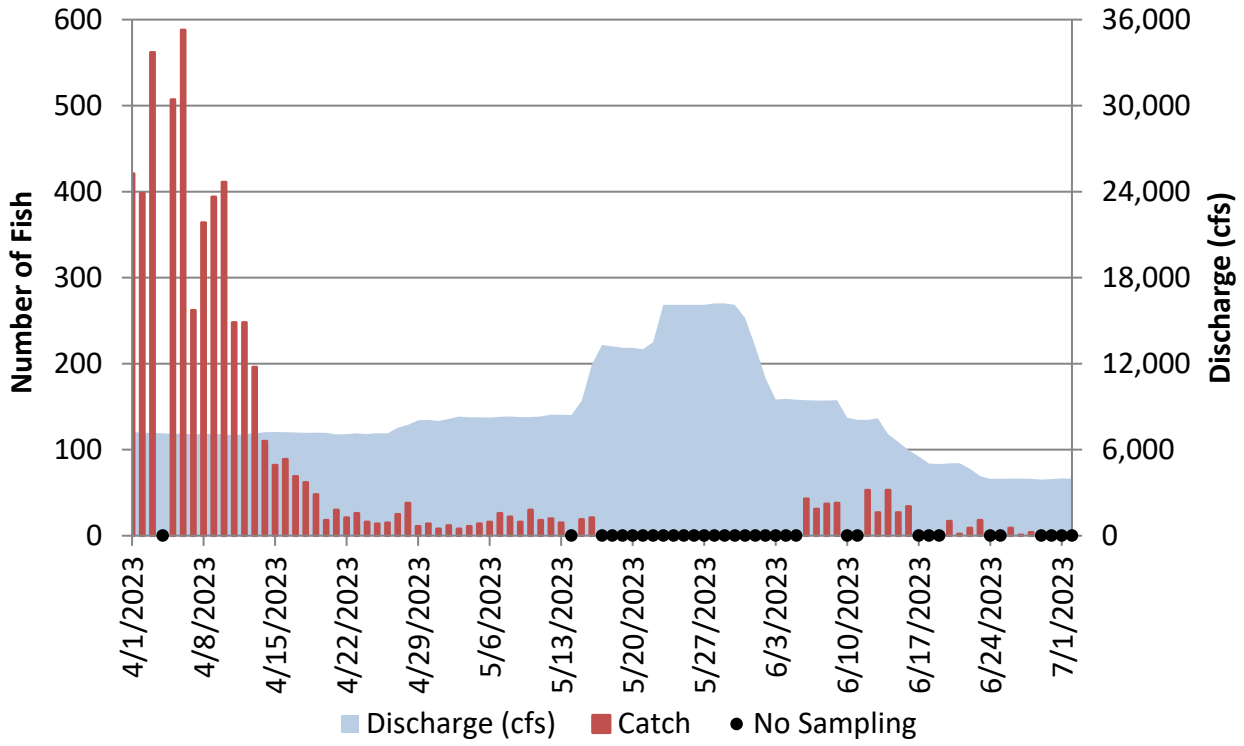

Figure 11: Daily catch of unmarked Chinook Salmon and daily average discharge at Fair Oaks from April 1st to July 2nd during the 2023 lower American River rotary screw trap survey season.

Figure 11 is a line graph depicting the number of unmarked Chinook Salmon and discharge in cfs at Fair Oaks from April 1, 2023 to July 1, 2023. Discharge is depicted with a blue area and shows peak discharge of 16,000 cfs in late May. Catch of unmarked Chinook Salmon occurred throughout the time period with most catch occurring between April 1 and May 13 with a peak catch of nearly 600 unmarked Chinook Salmon in early April. Days with no sampling are marked by black dots.

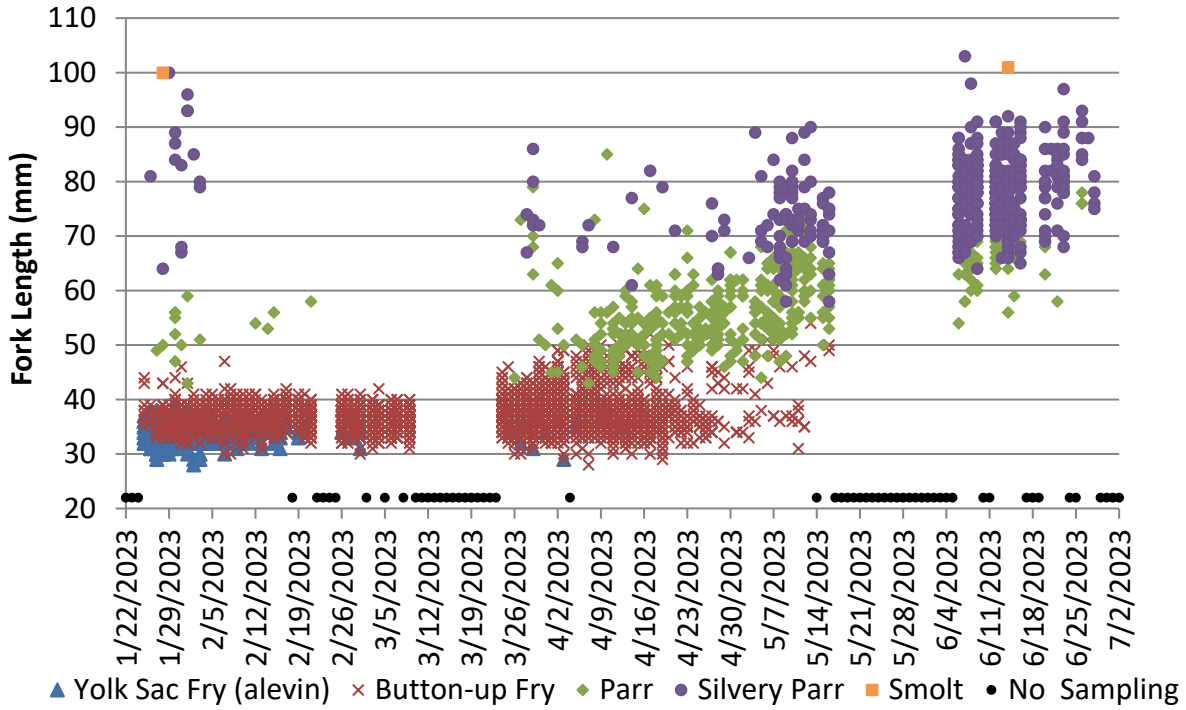

Figure 12: Daily fork length distribution by life stage of unmarked Chinook Salmon measured during the 2023 lower American River rotary screw trap survey season.

Figure 12 is a plot graph depicting fork length in millimeters for unmarked Chinook Salmon in the Yolk Sac Fry (alevin), Button-up Fry, Parr, Silvery Parr, and Smolt life stages January 1, 2023 to July 2, 2023 in the lower American River. Only two unmarked Chinook Salmon were observed in late January and mid-June to be in the Smolt life stage with a fork length over 100 millimeters. Yolk Sac Fry (alevin) were observed between late January and early April with a fork length range 27 to 38 millimeters. Button-up Fry were observed from late January to mid-May with a fork length range of 28 to 55 millimeters. Parr were observed late January to late June with a fork length range of 43 to 86 millimeters. Silvery Parr were observed late January to late June with a fork length range of 58 to 100 millimeters. Days with no sampling are marked with a black dot.

5.1.5 Chinook Escapement Surveys

CDFW conducted the Brood Year 2021 LAR Fall-Run Chinook salmon Escapement Survey over 12 survey periods from October 18, 2021, to January 5, 2022 (CDFW 2022). The 13.5-mile stretch of river from the Nimbus Dam downstream to Watt Ave., was divided into six sections and surveyed once during each survey week for salmon carcasses. The objectives of the escapement survey are to:

1. Estimate the size of the fall-run Chinook salmon escapement in the LAR;

2. Determine the ratio of adults to grilse, as well as the sex ratios of adults and grilse;

3. Determine the degree of female pre-spawn mortality; and

4. Collect coded-wire tags (CWT) to investigate the number and origin of hatchery-reared fall-run Chinook salmon using spawning habitat in the LAR.

The Brood Year 2021 LAR fall-run Chinook salmon in-river escapement estimate is 11,232. In addition to the in-river estimate, 11,075 Chinook salmon were trapped at the Nimbus Fish Hatchery for spawning purposes but were not included in the in-river escapement estimate. The carcass crew processed 16 carcasses in the rock channel entrance to the new fish ladder to the Nimbus Hatchery, 160 carcasses in Nimbus Basin, 4,347 carcasses in the area from below the old Nimbus Hatchery Weir location to El Manto Dr. access, 642 carcasses in the area extending from El Manto Dr. access to River Bend Park, and 84 carcasses in the area from River Bend Park to Watt Ave. access.

Coded wire tagged carcasses (adipose fin clipped) comprised 16% of the total carcasses observed. Adipose fins were intact for 77% of carcasses and presence or absence of an adipose fin could not be determined for 7% of carcasses due to an advanced level of decomposition. Preliminary coded wire tag data revealed that approximately 57% originated from the Nimbus Fish Hatchery, 32% were from the Mokelumne River Fish Hatchery, 2% were from the Feather River Fish Hatchery, and 2% were from the Merced River Hatchery. Coded wire tags were either not recovered or unreadable for 49 (7%) of the adipose fin-clipped carcasses processed.

After carcasses were counted and processed by CDFW, Cramer Fish Sciences collected genetic samples and otoliths from approximately 956 Chinook salmon carcasses to gather migratory information and to assess spawning success at gravel augmentation sites.

5.1.6 Other Monitoring

Additional project specific fisheries monitoring is being conducted by the Water Forum, Reclamation, and USFWS to evaluate spawning and rearing habitat restoration projects. This monitoring includes river-wide Chinook salmon redd surveys using aerial photography, ground-based redd and juvenile salmonid snorkel surveys at project sites, a genetic mark-recapture study to compare production of juveniles by female Chinook Salmon spawning at restored and unrestored locations, an otolith microchemistry study to reconstruct Chinook Salmon migration timing and compare success of different migration strategies under a range of hydrological conditions, a mark-recapture study to document fish communities and juvenile Chinook Salmon growth and residence time at restored and unrestored locations, temperature and dissolved oxygen monitoring, and comparisons of habitat availability before and after restoration implementation. A structured decision-making process is being used to determine future project types and identify monitoring needs.

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Attachment A - American River 2017 Flow Management Standard, Planning Minimum & Spring Pulse Flow Guidance Document

GUIDANCE DOCUMENT

LTO 013

American River 2017 Flow Management Standard, Planning Minimum & Spring Pulse Flow

LTO Implementation

October 7, 2021

I. Purpose

This document provides implementation guidance on the American River 2017 Modified Flow Management Standard (MFMS) approach proposed by the Water Forum in 2017 and as excerpted and summarized in the document titled "The 2017 Flow Management Standard Minimum Release Requirement" dated March 2020 (Attachment 1). Attachment 1 includes descriptions and directions for calculating the minimum reservoir releases throughout the year as proposed in the 2017 MFMS. Additional aspects to consider while implementing the attached include river temperature considerations and protocols, guidance regarding reservoir storage, and the rationale and methods for developing the standards. The scope of guidance includes the deliverables, schedule, and processes of the American River Group (ARG) Technical Team to implement the FMS as analyzed in the Proposed Action; develop and implement the Planning Minimum; and implement the Spring Pulse Flow when applicable. The primary deliverables are ARG meeting notes and handouts that include a monthly summary, and more frequent summary if needed, of the system-wide hydrologic, operational, regulatory requirement compliance, flood control, and temperature data related to the implementation and objectives of the FMS, Planning Minimum and Spring Pulse Flow and associated implementation plans. ARG feedback on these topics will be solicited, discussed and considered by Reclamation. Reclamation intends to work with the Water Forum in collaboration on determining and implementing an appropriate planning minimum and will confer with the California Department of Fish and Wildlife (CDFW), the US Fish and Wildlife Service (USFWS), and NMFS on planning minimum discussions.

II. 2017 FMS, Planning Minimum & Spring Pulse Flow

This section provides the applicable verbatim language for American River Division 2017 FMS, Planning Minimum and Spring Pulse Flow.

Erratum:

- Section: "4.10.4.1 Seasonal Operations" of the BA
    - Corrected language: Reclamation proposes to follow the 2017 Flow Management Standard, which includes a pulse flow event at some time during the period extending from March 15 to April 15 by supplementing normal operational releases from Folsom Dam under certain conditions when no such flow event has occurred between the preceding February 1 and March 15 timeframe.

III. Proposed Action:

4.10.2 American River Division

[…] Reclamation proposes to meet water rights, contracts and agreements that are both specific to the American River Division as well as those that apply to the entire CVP, including the Delta Division. For lower American River flows (below Nimbus Dam), Reclamation proposes to adopt the minimum flow schedule and approach proposed by the Water Forum in 2017 in the document titled "Lower American River – Standards for Minimum Flows" dated December 2018. Flows range from 500 to 2000 cfs based on time of year and annual hydrology. The flow schedule is intended to improve cold water pool and habitat conditions for Steelhead and Fall-Run Chinook Salmon. Specific flows are determined using an index intended to define the current and recent hydrology. Although Reclamation has assumed the index proposed by the Water Forum in 2017 for the purposes of modeling and analysis within this biological assessment, Reclamation intends to continue discussions with the Water Forum to ensure the index used for implementation is appropriate to meet the intended objectives under continuously changing hydrology.

Reclamation proposes to work together with the American River water agencies to define an appropriate amount of storage in Folsom Reservoir that represents the lower bound for typical forecasting processes at the end of calendar year (the "planning minimum"). The planning minimum brings Reclamation's forecasting process together with potential local actions that either increase Folsom storage or reduce demand out of Folsom Reservoir. The implementation of a planning minimum allows Reclamation to work with the American River Group to identify conditions when local water actions may be necessary to ensure storage is adequate for diversion from the municipal water intake at Folsom Dam and/or the extreme hydrology presents a risk that needs to be properly communicated to the public and surrounding communities. This planning minimum will be a single value (or potentially a series of values for different hydrologic year types) to be used for each year's forecasting process into the future. The objective of incorporating the planning minimum into the forecasting process is to provide releases of salmonid-suitable temperatures to the lower American River and reliable deliveries (using the existing water supply intakes and conveyance systems) to American River water agencies that are dependent on deliveries or releases from Folsom Reservoir.

This planning minimum was defined in 2019 and will be continuously evaluated between Reclamation and the Water Forum throughout implementation.

Reclamation expects infrequent scenarios where the forecasted storage may fall below the "planning minimum" due to a variety of circumstances and causes. In those instances, Reclamation and the American River water agencies will develop a list of potential off-ramp actions that may be taken to either improve forecasted storage or decrease demand on Folsom Reservoir. In its forecasting process for guiding seasonal operations, Reclamation will plan to maintain or exceed the planning minimum at the end of the calendar year. Reclamation has no legal liability should it fall below the planning minimum. When Reclamation estimates, using the forecasting process, that it would not be able to maintain Folsom Reservoir storage at or above the planning minimum for that year type (such as in extreme hydrologic conditions) or unexpected events cause the storage level to be at risk, American River water agencies would coordinate with Reclamation to identify and implement appropriate actions to improve

forecasted storage conditions, and the American River water agencies would work together to educate the public on the actions that have been agreed upon and implemented and the reasons and basis for them. If potential changes to Folsom Dam operations would have impacts on other aspects of the CVP and SWP or the entire integrated system, Reclamation will meet and discuss these potential changes and impacts with water contractors.

Reclamation will continue to work with the American River Group, a group that includes federal, state, and local agencies, water users, and NGOs, to coordinate spring pulse flow timing and communicate upcoming releases.

Reclamation would ramp down to the revised minimum flows from Folsom Reservoir as soon as possible in the fall and maintain these flows, where possible.

4.10.4.1 Seasonal Operations

In the winter and spring, flood control releases typically dominate the flow regime in the American River Division. Flood control operations occur to safely pass large storm events without exceeding the identified downstream levee capacity. This includes making dry-weather releases to ensure that the maximum storage adheres to the flood control elevation identified in the applicable Water Control Manual.

As part of implementing the 2017 Flow Management Standard, Reclamation proposes redd dewatering protective adjustments to limit potential redd dewatering due to reductions in the minimum release during the January through May period. Redd dewatering protective adjustments should limit the amount of dewatering due to a reduction of the minimum release, not the actual river release, and, as such, would not always minimize dewatering impacts to the same extent. In January and February, there is a Chinook Salmon redd dewatering protective adjustment, and in February through May there is a Steelhead redd dewatering protective adjustment.

During non-flood control operations within the fall and winter months, Reclamation proposes to operate to build storage by making minimum releases and capturing inflows, although drier conditions may also require releases for Delta requirements. To the extent possible, releases will be held relatively consistent to minimize potential redd dewatering.

Spring releases will be controlled by flood control requirements or, in drier hydrology, Delta requirements and water supply. Reclamation proposes to operate Folsom Dam in a manner designed to maximize capture of the spring runoff to fill as close to full as possible. Reclamation proposes to follow the 2017 Flow Management Standard, which includes a pulse flow event at some time during the period extending from March 15 to April 15 by supplementing normal operational releases from Folsom Dam under certain conditions when no such flow event has occurred between the preceding February 1 and March 1 timeframe. In addition to the pulse flow under the 2017 Flow Management Standard, to the extent feasible, Reclamation proposes to accommodate additional requests for spring pulse flows by re-shaping previously planned releases; however, these requests will not be accommodated in times when they may compromise temperature operations later in the year. This spring pulse flow provides a juvenile salmonid emigration cue before relatively low flow conditions and associated unsuitable thermal conditions later in the spring, and downstream in the lower Sacramento River.

Reclamation proposes to continue to make summer releases for instream temperature control, Delta outflow, and exports, typically above the planning minimum flows. By late October, it is typical for Folsom Reservoir to have depleted the cold water pool. The primary way to provide additional instream cooling is to release water from the lower outlet works. This operation bypasses the power penstocks and has a significant impact on power generation. In order to optimize power generation, Reclamation proposes to limit power bypass operations solely to respond to emergency or unexpected events or during extreme drought years when a drought emergency has been declared by the Governor of California.

Reclamation will ramp down releases in the American River below Nimbus Dam as follows in Table 4-12 below.

Table 4-12: American River Ramping Rates

Lower American River Daily Rate of Change (cfs)	Amount of decrease in 24 hrs (cfs)	Maximum change per step (cfs)
20,000 to 16,000	4,000	1,350
16,000 to 13,000	3,000	1,000
13,000 to 11,000	2,000	700
11,000 to 9,500	1,500	500
9,500 to 8,300	1,200	400
8,300 to 7,300	1,000	350
7,300 to 6,400	900	300
6,400 to 5,650	750	250
5,650 to 5,000	650	250
<5,000	500	100

Ramping rates do not apply during flood control or if needed for facility operational concerns. The working groups may also determine a need for a variance.

Appendix C –

C.7 DECISION MAKING

Nothing in this Charter modifies the rights and responsibilities of the Participants. Decisions shall be made consistent with the authorizing legislation and the regulations and policies under the federal and state Endangered Species Acts, as appropriate.

Reclamation and DWR shall retain sole discretion for:

- Water Operations of the CVP and SWP, including Allocations, under Reclamation Law and the State Water Project, as appropriate
- Agency Appropriations (budget requests, fund alignment, contracting, etc.)
- Section 7 Action Agency and Applicant (consultation)

- Coordination and cooperation with PWAs as required by Contracts and Agreements

CDFW, FWS, and NMFS shall retain sole discretion for:

- Consultation under Section 7 of the federal ESA and California Fish and Game Code, as appropriate and the associated Incidental Take Statements/Permits
- Agency Appropriations

NMFS ITS:

13.3.3.2 Take Anticipated from Flow Management

Flow fluctuations in the lower American River may result in steelhead redd dewatering and isolation. Redd dewatering can affect salmonid eggs and alevins by impairing development and causing direct mortality due to desiccation, insufficient oxygen levels, waste metabolite toxicity, and thermal stress. Flow fluctuations are also reasonably expected to result in the stranding of juvenile CCV steelhead in isolated pools where desiccation, insufficient oxygen levels, thermal stress, or predation would lead to mortality.

The flow regime of a water body is defined by its flow magnitude, timing, duration, frequency, and rate of change. Literature reviews have shown that useable habitat and fish abundance, diversity, and demographic rates can decline in response to both elevated and reduced flow magnitude. Because of the causal relationship of flow magnitude, timing, duration, frequency, and rate of change to survival within and between life stages, flow may be used as a surrogate for the amount or extent of take for listed salmonids.

The ecological surrogate to define the amount or extent of take for CCV steelhead egg-to-fry is the extent of egg habitat that is dewatered and exposed to the stressors from lower flows from January through May.

The ecological surrogate to define the amount or extent of take of CCV steelhead juvenile life stages is the ramping rate that results in isolation. Take will be exceeded if flow decreases occur at a rate greater than the ramping rates described in the proposed action, with the exception of flood control or emergency conditions.

The ecological surrogate to define the amount or extent of take of CCV steelhead egg-to-fry life stage from redd scouring is flow magnitude and rate created by releases from Nimbus Dam during egg incubation (i.e., January through May). Take will be exceeded if flows are higher than 50,000 cfs in the American River during January to May with the exception of flood control or emergency conditions.

RPM 3: Reclamation shall minimize the impact of the amount or extent of incidental take of listed species during operations of the American Division.

1. Seasonal operational decisions that affect water temperature and river flows shall be coordinated through the American River Group.

IV. DELIVERABLES

Deliverables resulting from this effort follow the coordination described in Appendix C of the Proposed Action and include regularly scheduled and ad hoc ARG meeting notes and handouts that include a summaries of the system-wide fisheries, hydrologic, operational, regulatory requirement compliance, flood control, and temperature-related data that may affect implementation of the FMS as analyzed in the Proposed Action, planning minimum and spring pulse flow. Additional items will be included as needed related to any ad hoc ARG meeting. A sample ARG monthly and ad hoc meeting agenda (BOX 1) is attached that describes the expected meeting topics and contents for the meeting notes. Section IV A and B herein describe the processes to achieve the deliverables.

V. IV. PROCESS

A. American River Group

Reclamation will convene and facilitate ARG monthly meetings and ad hoc meetings, as needed, to include:

- meeting scheduling and coordination,
- agenda development and distribution,
- coordinate preparation of monthly meeting handout materials,
- take notes, and
- posting notes and reports (including annual reports) online

Reclamation established a working group to coordinate fishery and operational requirements for the lower American River (LAR), known as the ARG, in 1996. Reclamation is the lead coordinator of the ARG, bringing together those who have either a legislated or resources-specific interest in the operation of Folsom Dam and Reservoir, and the LAR. The formal members include Reclamation which has responsibility for water operations of the Central Valley Project, the Water Forum which has interests in Folsom Reservoir water operations, and agencies with public trust responsibilities for fisheries resources in the LAR which include USFWS, NMFS, and CDFW. Members of the public and other agencies may attend ARG meetings and comment on matters under consideration by the ARG. The ARG meetings include discussion of water operations, fisheries, and other environmental concerns and to share operational and biological information with the goal of improving the technical understanding of LAR temperature needs and operational constraints and considerations. Reclamation considers the provided information when making operational and management decisions regarding temperatures and flows necessary to sustain fish resources in the LAR. In addition, temperature is a factor that may impact FMS implementation, the planning minimum and spring pulse flow. Temperature Management is acknowledged here and will be developed in a separate guidance document.

The ARG will provide input on, among other items, Reclamation's monthly forecasting and outlooks, projected end-of-year Folsom storage compared to the planning minimum, ramping rates, monthly minimum release requirements (MRR), spring pulse flow, proposed monthly

operations and potential impacts. Release discussions are expected to consider both near-term and long-term perspectives, risks, and tradeoffs. MRR provides a minimum flow value, not a maximum, and real-time conditions will dictate operations. The general steps of this process are as follows:

1. Prior to the ARG meetings, Reclamation will send to ARG a meeting agenda along with other supporting meeting materials (including temperature management updates, potential spring pulse flow and exceedance outlooks).

2. At the ARG meetings, ARG will review available hydrological and biological information along with exceedance outlooks and the details associated with the calculations of the MRR (adjusted MRR, if applicable) and potential spring pulse flow for FMS implementation.[1] ARG feedback will be solicited, discussed, and considered by Reclamation.

3. ARG Meeting notes will be generated, and a draft distributed to the ARG for review and comment before final notes are posted online along with pertinent meeting materials.

4. Reclamation, at monthly meetings, will provide updates on previous monthly FMS implementation for monthly operations (and how it relates to the planning minimum, redd dewatering[2], temperature management, ramping rates, spring pulse flows, etc.). ARG meeting notes will be made available to the Water Operations Management Team (WOMT).

B. ARG Ad-hoc meetings.

The formal members of the ARG conduct ad hoc meetings to discuss regularly occurring Folsom Reservoir operations that do not conform to the time step of the monthly ARG meeting or require discussion beyond the time allotted for the monthly ARG meeting. The purpose of these meetings is the same as the monthly ARG meetings. This information is then used to make recommendations to avoid and minimize impacts to fisheries resources based on real-time operations, consistent with Reclamation's need to balance other project purposes. Annual Folsom Reservoir operations identified in the USBR PA Section 4.10.4.1 Seasonal Operations that may require additional meetings and associated meeting timeframes include but are not limited to the following:

1. Flood Control Operations, August – May: Dry weather releases to ensure that the maximum storage adheres to the flood control elevation identified in the applicable Water Control Manual. Although, 2017 FMS redd dewatering protective

[1] Reclamation proposes to use the combined Sacramento Index (in the month of January) and American River Index (all other months) approach specified in the 2017 FMS. The Planning Minimum for WY21-WY23 is 300 TAF.
[2] Reclamation intends to implement redd dewatering protective adjustments. These adjustments are modifications to the MRRs based on hydrology and potential dewatering impacts to Chinook salmon redds in January – February and steelhead redds in February – March. These protective adjustments are built into the 2017 FMS.

adjustments would theoretically limit the amount of dewatering due to a reduction of the minimum release, the impact of flow reduction from actual river releases for flood control elevation or other purposes would not result in reduction of dewatering impacts to the same extent. These changes in releases for flood control regularly occur between monthly ARG meetings and may require discussion to develop releases strategies, to the extent possible, to releases to minimize redd dewatering, fish stranding, and other flow related fisheries impacts while meeting other Folsom Reservoir purposes.

2. Downstream Regulatory Requirements, September – June: Folsom Reservoir operations require releases for Delta regulatory requirements and other downstream needs that are above the 2017 FMS as analyzed in the Proposed Action. These changes in releases regularly occur between monthly ARG meetings and may require discussion to develop releases strategies, to the extent possible, to minimize redd dewatering, fish stranding, and other flow related fisheries impacts while meeting other Folsom Reservoir purposes.

3. Spring Pulse Planning, February – May: Spring pulses under the 2017 FMS as analyzed in the Proposed Action may require discussion and planning outside of the time allotted for monthly ARG meetings. Spring pulse planning should prioritize real-time empirical fisheries data and account for real time Folsom Reservoir operations to meet system-wide regulatory requirements to optimize benefits of spring pulse flows while also considering modeled or other information. This planning should be initiated in February and continue through May in conjunction with other potential ARG ad-hoc discussions.

4. Temperature Management, April – November: Temperature management for juvenile steelhead rearing and fall-run Chinook salmon spawning, egg incubation and fry emergence affects Folsom Reservoir release operations. Further discussion of temperature management implementation is contained in the ARG Temperature Management Guidance Document.

C. Folsom Planning Minimum

Reclamation and the Water Forum worked to develop an initial planning minimum (end of December Folsom Storage) of 300 TAF for Water Years 2021-2023 that is considered by Reclamation for monthly forecasting purposes. The Water Forum will provide input on, among other items, Reclamation's monthly forecasting and outlooks, projected end of year Folsom storage compared to the planning minimum and potential local actions that either increase forecasted Folsom storage or reduce demand out of Folsom Reservoir, if needed. Reclamation/Water Forum coordination and communication is detailed in the March 2021 MOU for Coordination of Communication and Information-Sharing Activities Related to the Lower American River Operations.

D. Change Orders

Reclamation operators coordinate the daily operation of Folsom and Nimbus Dams. Changes to releases in LAR operations require at least 48 hours prior notice to any desired releases. However, under conditions of urgent need with appropriate coordination with ARG and the fisheries agencies, Reclamation may make release changes as quickly as real-time. Reclamation intends to continue to provide change order information via email to the ARG.

E. Water Operations Management Team

After the ARG provides input on Reclamation operations under the FMS, at monthly ARG meetings or otherwise, and Reclamation has captured previous months operations, Reclamation will provide this information to WOMT and make notes and other pertinent material available from the corresponding ARG monthly meetings.

F. Updates to Guidance Document

In addition, it is expected that as this guidance is being implemented there will be necessary revisions to the document to provide further clarification and refinement. Reclamation and DWR, with technical assistance from the USFWS, NMFS, and CDFW, commit to reviewing this implementation guidance following each water year, at a minimum, to identify and incorporate any necessary revisions.

BOX 1: AMERICAN RIVER GROUP AGENDA

Date

Roster

Agency, Office, Name, Alternate(s)

Topics

1. Introductions
2. Presentation (if applicable)
3. Housekeeping
4. Fisheries Update
    a. CDFW
    b. Cramer Fish Sciences
    c. PSMFC
2. Operations Forecast
    a. SMUD
    b. PCWA
3. Central Valley Operations
    a. Operations review and outlook (storage conditions and releases)
    b. Temperature management
4. Discussion
5. Recommendation(s)
6. Decision(s)
7. Review Action Items
8. Next Meeting Scheduling

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ATTACHMENT 1

The 2017 Flow Management Standard Minimum Release Requirement

MARCH 2020 (as amended)

The 2017 Flow Management Standard Minimum Release Requirement

In response to the 2012-2016 drought, uncertainty about Reclamation operations with the implementation of the Water Fix, observations during operations for the 2007 Flow Management Standard (FMS), and NMFS's directive for improved American River water temperature management in its 2009 Biological Opinion, and 2011 amendments, for the CVP's operations, the Water Forum developed the 2017 FMS to provide improved American River water supply reliability and water temperature management for fisheries. Among the elements of the 2017 FMS was a revised approach for determining the Minimum Release Requirement (MRR) from Nimbus Dam. This document summarizes the determination of the MRR.

1 Hydrological Indices

The 2017 FMS uses two hydrological indices to determine the MRR. Those two indices are described below.

1.1 Sacramento River Index

The Sacramento River Index (SRI), published by DWR at the start of each month from December through May, is a forecast of total water year unimpaired flow volume from the Sacramento River above Bend Bridge, Feather River at Oroville, Yuba River near Smartsville, and the American River below Folsom. Forecasted 99%, 90%, 75%, 50%, 25%, and 10% exceedance probability volumes are computed for each forecast. The 2006 FMS used the 75% exceedance SRI to determine January and February minimum release requirements; the 75% exceedance SRI has been retained for use under the 2017 FMS for determining the January MRR. The SRI can be found at California Department of Water Resources 2024 Water Year Forecast as of March 1, 2024. Historical SRI values can be found in the MRR Calculator on the "Hist_SRI" worksheet.

1.2 American River Index

To determine the February through December MRRs, the Water Forum wanted to use a water supply index that was publicly available, published each year, updated monthly, and that would reflect the overall water availability of the American River watershed. After considering other available indices, the Water Forum developed the American River Index (ARI), based on the B120 unimpaired water year forecasts. Historical Bulletin 120s for the American River at Folsom can be found in the MRR Calculator on the "Hist_B120" worksheet. DWR also publishes the Bulletin 120 at California Department of Water Resources Bulletin 120 and Water Supply.

The ARI is a measure of the unimpaired inflow to Folsom Reservoir minus the amount of "spill" water that could not be captured at Folsom Reservoir (unimpaired runoff minus spill flows). The ARI is based on the median B120 forecasted unimpaired American River flow at Folsom for the water year, published on February 1, March 1, April 1, and May 1. Flood releases for the water year prior to the B120 publication are subtracted from the water year forecast; winter and spring storage is typically restricted by the flood reservation space, and any water that is released for

flood management purposes is not available for use in meeting either water supply or flow requirements.

For purposes of determining spill volume, releases from the spillway and from the river gates between October 1 and the forecast data are added up. Note that only releases from the river gates for avoiding reservoir spills, not releases used for temperature control in the fall or other discretionary releases should be considered. The CDEC timeseries for Folsom Reservoir sensor 85 (Discharge, Control Regulating) and 71 (Discharge, Spillway) are used to characterize the flood releases, when storage is within 50,000 acre-feet of the top of conservation (determined by CDEC sensor 94 – Reservoir, Top of Conservation Storage). Historical CDEC data for Folsom Reservoir storage, spillway releases, river outlet releases, and the top of conservation can be found in the MRR Calculator on the "CDEC Data" worksheet.

The MRR Calculator includes the ARI calculation on the "ARI Calculation" worksheet.

2 Minimum Release Requirements

As indicated above, the two hydrologic indices are used to compute the MRR from Nimbus Dam. The inflection points and corresponding index values for the MRR curves were developed through iteration; while the target flows were identified based on biological effects. Each of the curves are described below.

With the release of the first Bulletin 120 in February and each subsequent update, a calculation of the MRRs through the end of December can be made. The final calculation of MRRs for the remainder of the year would be made in May. The MRR Calculator includes calculation of MRRs through the end of the year on the "MRR Forecast" worksheet, with the intent that they are used for operations planning purposes.

2.1 January

As described above, determination of the January MRR uses the 75% exceedance January 1 SRI forecast value. Figure 2-1 shows the January MRR curve.

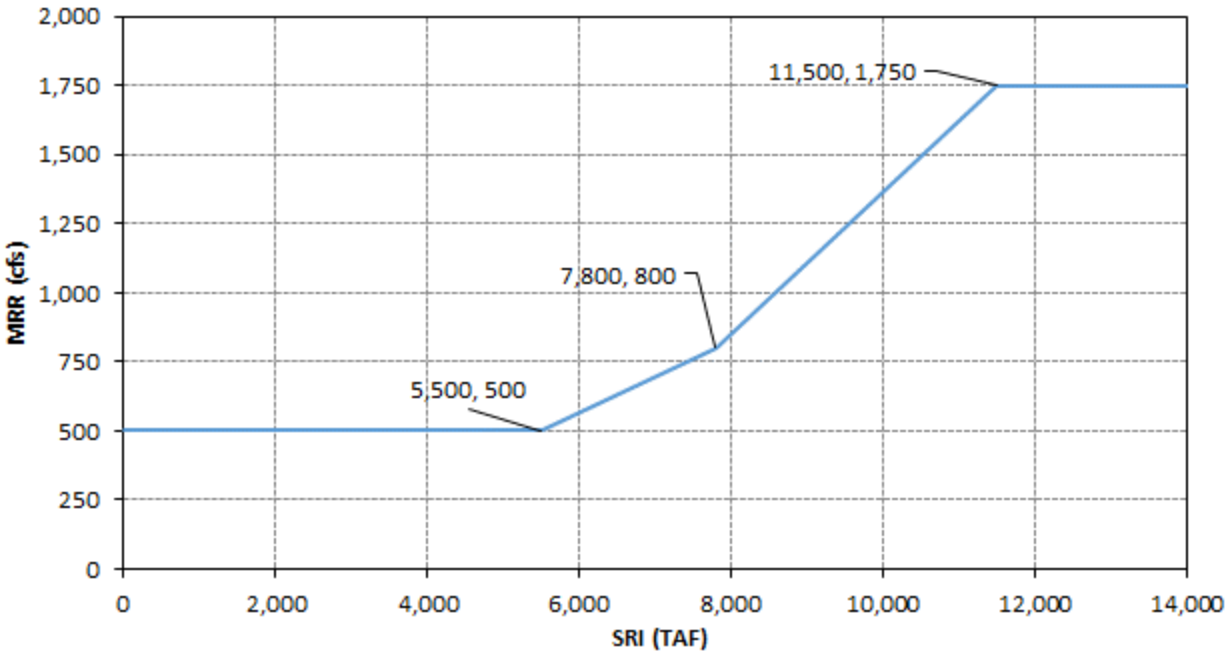

Figure 2-1. January Relationship between SRI and MRR.

Figure 2-1 is a line graph depicting MRR in cfs and SRI in TAF for January. Three inflection points, 5,500, 500; 7,800, 800; and 11,500, 1,750 where the slope of the line changes is noted.

Januarys with an SRI of less than 5.5 MAF would have an MRR of 500 cfs, and those with a SRI greater than 11.5 MAF would have an MRR of 1,750 cfs. SRIs between 5.5 MAF and 11.5 MAF would be linearly interpolated as shown in Figure 2-1.

The MRR for January can also be determined by the following formula based on the SRI:

- If SRI <= 5,500 TAF, then MRR = 500
- If 5,500 TAF < SRI <= 7,800 TAF, then MRR = 0.1304 * SRI -217
- If 7,800 TAF < SRI <= 11,500 TAF, then MRR = 0.2568 * SRI -1,203
- If SRI > 11,500 TAF, then MRR = 1,750

2.2 February through March

Calculation of the MRR for February through March uses the same relationship between ARI and MRR for both months. The MRR for this period uses the February and March B120 forecast values to determine the ARI. Figure 2-2 shows the February through March MRR curve.

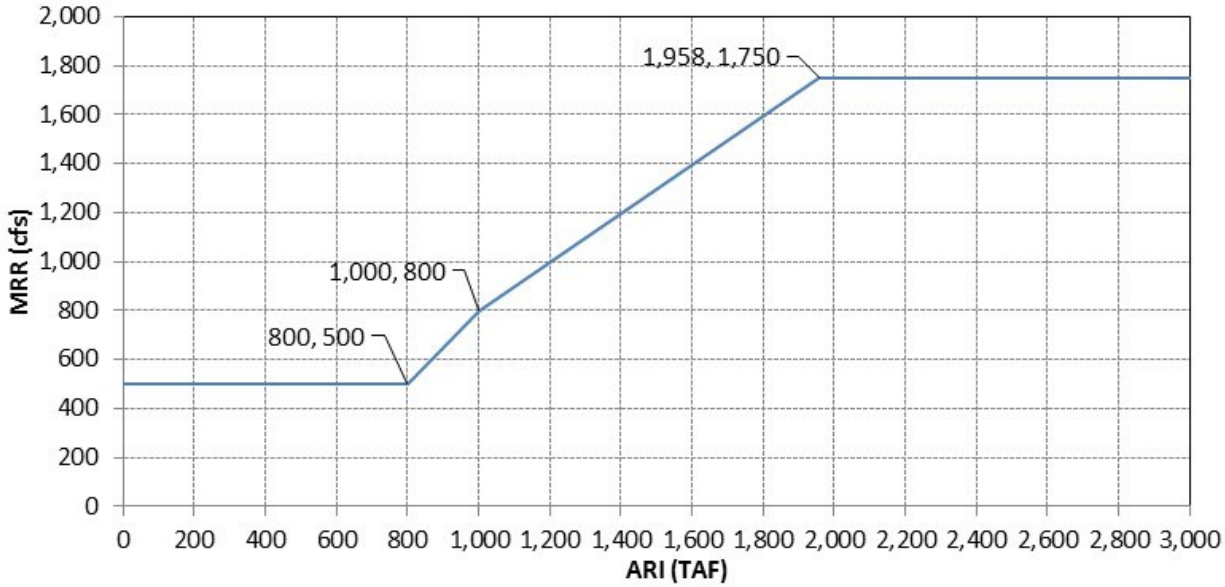

Figure 2-2. February through March Relationship Between ARI and MRR.

Figure 2-2 is a line graph depicting MRR in cfs and ARI in TAF for February to March. Three inflection points, 800, 500; 1,000, 800; and 1,958, 1,750 where the slope of the line changes is noted.

Years with a February or March ARI less than 800 TAF would have an MRR of 500 cfs, and years with a February or March ARI greater than 1,958 TAF would have an MRR of 1,750 cfs. An ARI of 1,000 TAF would correspond to 800 cfs, and MRRs for years with an ARI between 800 and 1,000 TAF, or between 1,000 and 1,958 TAF, would be linearly interpolated between points, as shown in Figure 2-2.

The MRR for February 1 through March 31 can also be determined by the following formula based on the ARI:

- If ARI <= 800 TAF, then MRR = 500
- If 800 TAF < ARI <= 1,000 TAF, then MRR = 1.500 * ARI -700
- If 1,000 TAF < ARI <= 1,958 TAF, then MRR = 0.9918 * ARI -192
- If ARI > 1,958 TAF, then MRR = 1,750

2.3 April through June

Calculation of the MRR for April through June uses the same relationship between ARI and MRR for all three months. The MRR for this period uses the April and May B120 forecast value to determine the ARI. Since the last B120 forecast is made in early May, the May B120-based ARI would also be used for June. Figure 2-3 shows the April through June MRR curve.

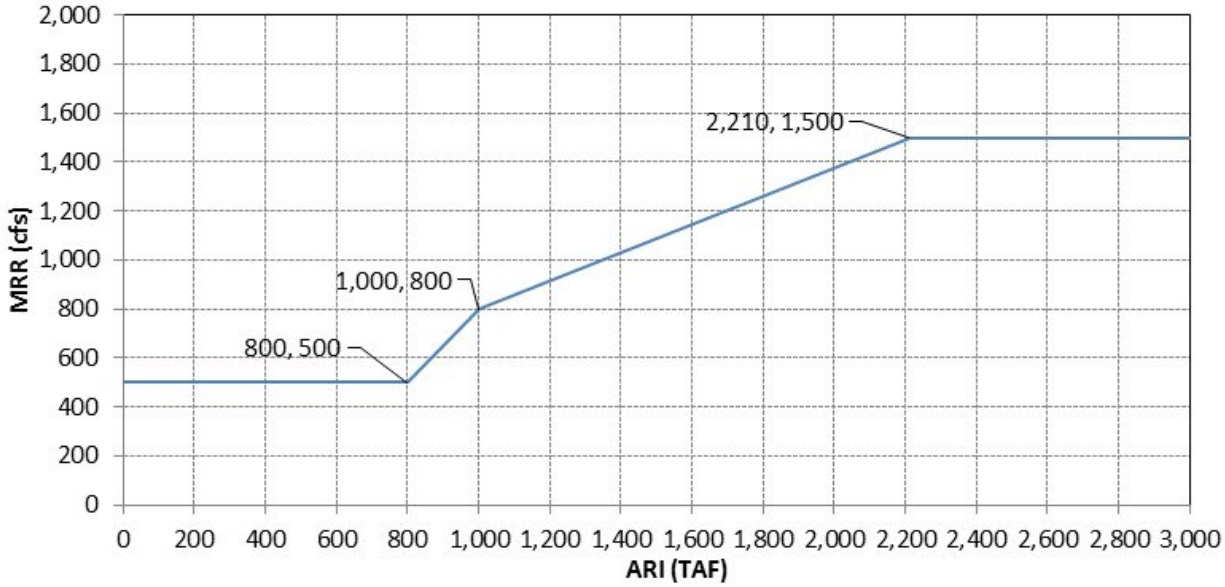

Figure 2-3. April through June Relationship Between ARI and MRR.

Figure 2-3 is a line graph depicting MRR in cfs and ARI in TAF for April to June. Three inflection points, 800, 500; 1,000, 800; and 2,210, 1,500 where the slope of the line changes is noted.

Years with an April or May ARI less than 800 TAF would have an MRR of 500 cfs, and years with an April or May ARI greater than 2,210 TAF would have an MRR of 1,500 cfs. An ARI of 1,000 TAF would correspond to 800 cfs, and MRRs for years with an ARI between 800 and 1,000 TAF, or between 1,000 and 2,210 TAF, would be linearly interpolated between points, as shown in Figure 2-3.

The MRR for April 1 through June 30 can also be determined by the following formula based on the ARI:

- If ARI <= 800 TAF, then MRR = 500
- If 800 TAF < ARI <= 1,000 TAF, then MRR = 1.500 * ARI -700
- If 1,000 TAF < ARI <= 2,210 TAF, then MRR = 0.579 * ARI + 221
- If ARI > 2,210 TAF, then MRR = 1,500

2.4 July through September

Calculation of the MRR for July through September uses the same relationship between ARI and MRR for all three months. The MRR for this period uses the ARI computed in early May (or potentially an updated ARI if the B120 is updated after the May forecast). Figure 2-4 shows the July through September MRR curve.

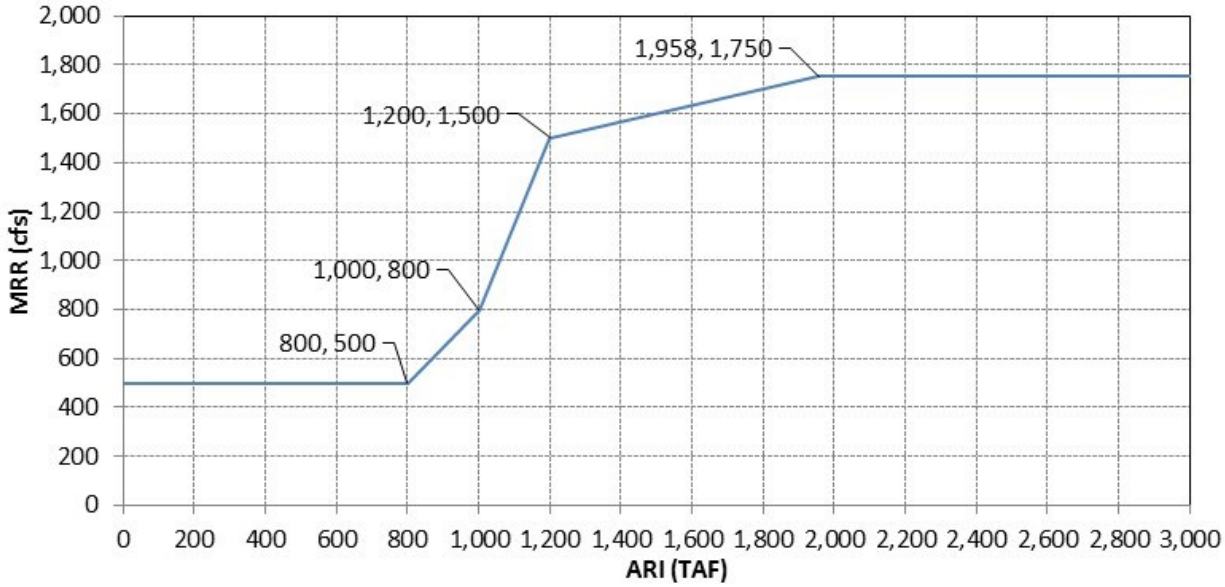

Figure 2-4. July though September Relationship Between ARI and MRR.

Figure 2-4 is a line graph depicting MRR in cfs and ARI in TAF for July to September. Four inflection points, 800, 500; 1,000, 800; 1,200, 1,500; and 1,958, 1,750 where the slope of the line changes is noted.

The MRR for July 1 through September 30 can also be determined by the following formula based on the ARI:

- If ARI <= 800 TAF, then MRR = 500
- If 800 TAF < ARI <= 1,000 TAF, then MRR = 1.500 * ARI -700
- If 1,000 TAF < ARI <= 1,200 TAF, then MRR = 3.5 * ARI -2,700
- If 1,200 TAF < ARI <= 1,958 TAF, then MRR = 0.330 * ARI + 1,104
- If ARI > 1,958 TAF, then MRR = 1,750

2.5 October

The October MRR is also based on the May ARI value (or potentially an updated ARI if the B120 is updated after the May forecast). The October ARI-MRR relationship is almost identical to the November through December relationship (see below), except the MRR is capped at 1,500 cfs rather than 2,000 cfs. Figure 2-5 shows the October ARI-MRR relationship.

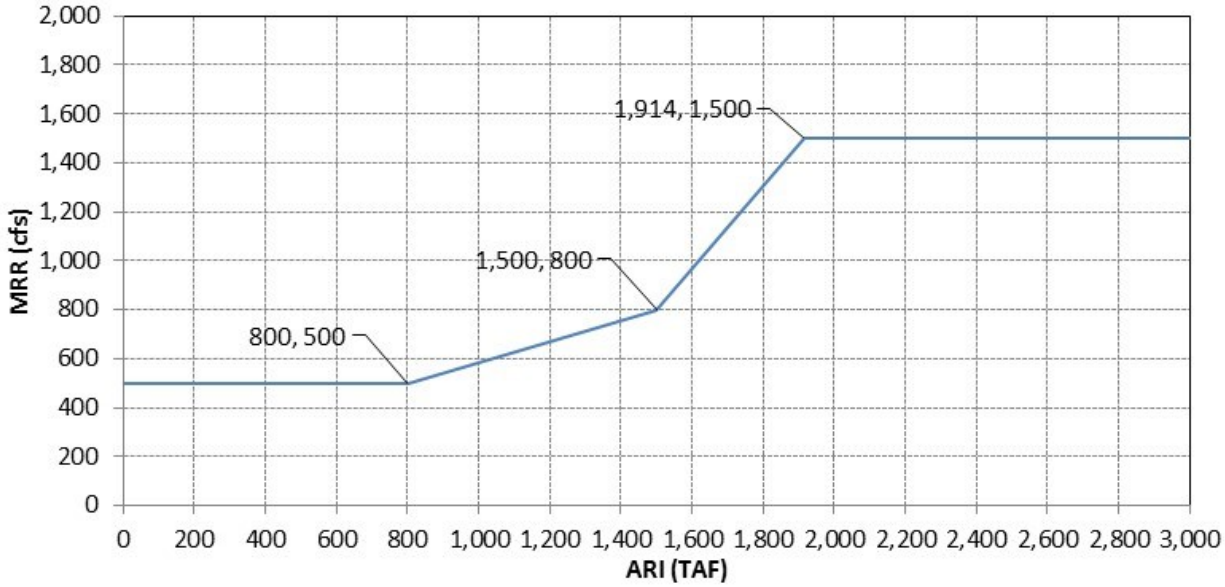

Figure 2-5. October Relationship Between ARI and MRR.

Figure 2-5 is a line graph depicting MRR in cfs and ARI in TAF for October. Three inflection points, 800, 500; 1,500, 800; and 1,914, 1,500 where the slope of the line changes is noted.

The MRR for October 1 through October 30 can also be determined by the following formula based on the ARI:

- If ARI <= 800 TAF, then MRR = 500
- If 800 TAF < ARI <= 1,500 TAF, then MRR = 0.429 * ARI +157
- If 1,500 TAF < ARI <= 1,914 TAF, then MRR = 1.690 * ARI -1,735
- If ARI > 1,705 TAF, then MRR = 1,500

2.6 November through December

Calculation of the MRR for November through December uses the same relationship between ARI and MRR for both months. The MRR for this period uses the ARI computed in early May (or potentially an updated ARI if the B120 is updated after the May forecast). Figure 2-6 shows the November through December MRR curve.

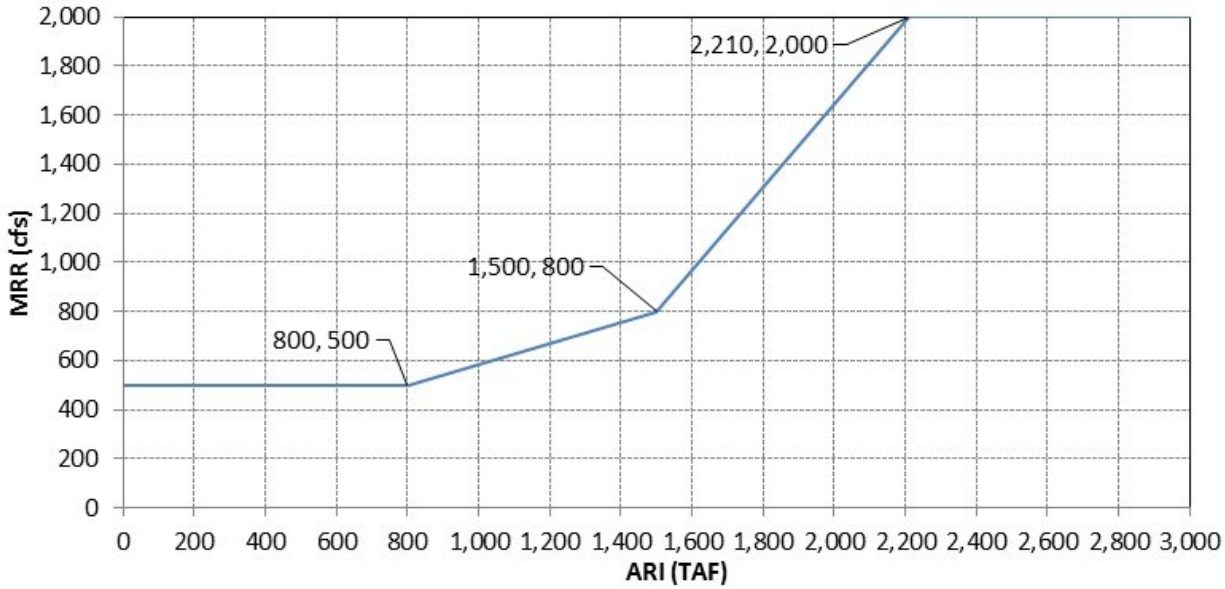

Figure 2-6. November through December Relationship Between ARI and MRR.

Figure 2-6 is a line graph depicting MRR in cfs and ARI in TAF for November. Three inflection points, 800, 500; 1,500, 800; and 2,210, 2,000 where the slope of the line changes is noted.

The MRR for November 1 through December 31 can also be determined by the following formula based on the ARI:

- If ARI <= 800 TAF, then MRR = 500
- If 800 TAF < ARI <= 1,500 TAF, then MRR = 0.429 * ARI +157
- If 1,500 TAF < ARI <= 2,210 TAF, then MRR = 1.690 * ARI -1,735
- If ARI > 2,210 TAF, then MRR = 2,000

3 Redd Dewatering Protective Adjustments

The 2017 FMS also includes Redd Dewatering Protective Adjustments (RDPA) to ensure reductions in MRR do not result in dewatering of fall-run Chinook salmon or steelhead redds. The RDPA would restrict changes in the MRR between December and June, but would not affect releases above the MRR.

3.1 Fall-Run Chinook Salmon

The fall-run Chinook salmon RDPA affect winter MRRs in two ways: there is a restriction on increases in MRR for January, and in decreases in MRR for January and February.

3.1.1 Restriction on Increasing the January MRR from the December MRR In recognition of the uncertainty of the January SRI forecast, the 2017 FMS precludes increases in MRR from December to January. Fall-run Chinook redds are constructed in October through December, and the fall-run Chinook fry emerge through February. Rather than have a condition where a January-forecasted SRI resulted in an increase in MRR, only to see a decrease in MRR with the February B120 forecast, the 2017 FMS only allows for reductions in the January MRR from the December MRR. The fall-run Chinook salmon RDPA limiting flow increases is included in the MRR calculator on the MRR Forecast worksheet as part of the January calculation.

3.1.2 Restrictions on Reductions in the January and February MRR from December MRR The fall-run Chinook salmon RDPA would restrict MRR reductions from the December MRR for January and February. If the SRI-based MRR for January, or the ARI-based MRR for February was less than 70% of the December MRR, the January or February MRR could not be less than 70% of the December MRR. If the SRI- or ARI-based MRR was higher, then it would be used. The fall-run Chinook salmon RDPA limiting flow reductions is included in the MRR calculator on the MRR Forecast worksheet as part of the January and February calculations.

3.2 Steelhead

The steelhead RDPA restrict MRR reductions from February and March, through the end of June. Table 3-1 shows the steelhead RDPA-based MRR for February through May.

Table 3-1. Steelhead RDPA-based MRR for February through May

MRR_{Jan} or MRR_{Feb} (cfs)	Steelhead RDPA-Based MRR for February-May (cfs)
≤700	500
800	520
900	580
1,000	640
1,100	710
1,200	780
1,300	840
1,400	950
1,500	1,030
1,600	1,100
1,700	1,180
1,800	1,250

The ARI- and fall-run Chinook RDPA-based MRR for February and March are compared to the steelhead RDPA-based MRR in Table 3-1, using the final, RDPA-based January or February MRR as a basis. Steelhead RDPA for January and February MRR values between those in the table would be linearly interpolated. The maximum MRR in January through May is 1,750 cfs, but 1,800 cfs is included in the table as a maximum value. If the ARI-based MRR is less than the steelhead-RDPA-based MRR, the RDPA-based MRR controls operations. Otherwise, the ARI-based MRR remains in effect. This procedure would be repeated in March, but after March,

the RDPA-based MRR determined in March would remain the minimum MRR through the end of May.

The Steelhead RDPA calculation is included in the MRR Calculator on the "MRR Forecast" worksheet as part of the February, March, April, and May calculations.

4 Spring Pulse Flow

The 2017 FMS includes a spring pulse flow intended to provide an outmigration cue for juvenile salmonid emigration before relatively low water flow and associated challenging thermal conditions occur later in the spring, and downstream in the lower Sacramento River.

The spring pulse would occur in years that the MRR for March (determined by the March Bulletin 120) was between 1,000 cfs and 1,500 cfs, and Nimbus releases had not exceeded the maximum pulse flow rate for at least two consecutive days between February 1 and March 15.

A pulse flow would occur between March 15 and April 15. The peak flow of the pulse flow would be 3 times the current MRR, but no higher than 4,000 cfs, and would last for two days. Following two days at the peak flow, Nimbus releases would be decreased at no more than 500 cfs per day and no more than 100 cfs per hour. Changes in Nimbus releases would occur at night, if possible.

In years with a pulse flow, the daily MRR for April 1 through June 30 would be reduced evenly by the volume of the pulse flow and downramp. The MRR calculator includes a calculation of maximum pulse flow as part of the March calculation.

Attachment B - American River Temperature Management Plan Guidance Document

GUIDANCE DOCUMENT

American River Temperature Management Plan

LTO Implementation

March 23, 2020

I. PURPOSE

This document provides implementation guidance on the American River Temperature Management Plan pursuant to 4.10.4.2 and 4.10.4.3 of the U.S. Bureau of Reclamation's (Reclamation) Proposed Action and NOAA's National Marine Fisheries Service's (NMFS) Biological Opinion and Incidental Take Statements (ITS). The scope of guidance includes the deliverables, schedule, and processes to develop and implement the Temperature Management Plan. The primary deliverables are American River Group (ARG) meeting notes and handouts that include a monthly summary of the hydrologic, operational, and temperature data related to Folsom cold water pool management; and draft/final Temperature Management Plans.

II. Temperature Management

This section provides the applicable verbatim language for American River Division Temperature Management

Proposed Action:

4.10.4.1 Seasonal Operations […] Reclamation proposes to continue to make summer releases for instream temperature control, Delta outflow, and exports, typically above the planning minimum flows. By late October, it is typical for Folsom Reservoir to have depleted the cold water pool. The primary way to provide additional instream cooling is to release water from the lower outlet works. This operation bypasses the power penstocks and has a significant impact on power generation. In order to optimize power generation, Reclamation proposes to limit power bypass operations solely to respond to emergency or unexpected events or during extreme drought years when a drought emergency has been declared by the Governor of California.

4.10.4.2 Temperature Management Reclamation proposes to prepare a draft Temperature Management Plan by May 15 for the summer through fall temperature management season using the best available (as determined by Reclamation) decision support tools. The information provided by the Operations Forecast will be used in the development of the Temperature Plan. The draft plan will contain: (1) forecasts of hydrology and storage; and (2) a modeling run or runs, using these forecasts, demonstrating what temperature compliance schedule can be attained. Reclamation will use an iterative approach, varying shutter configurations, with the objective to attain the best possible temperature schedule for the compliance point at Watt Ave. Bridge. The draft plan will be shared with the American River Group before finalization and may be updated monthly based on system conditions.

Reclamation proposes to manage the Folsom/Nimbus Dam complex and the water temperature control shutters at Folsom Dam to maintain a daily average water temperature of 65°F (or other temperature as determined by the temperature modeling) or lower at Watt Ave. Bridge from May

15 through October 31, to provide suitable conditions for juvenile Steelhead rearing in the lower American River. If the temperature is exceeded for 3 consecutive days, Reclamation will notify NMFS and outline steps being taken to bring the water temperature back into compliance. During the May 15 to October 31 period, if the Temperature Plan defined temperature requirement cannot be met because of limited cold water availability in Folsom Reservoir, then the target daily average water temperature at Watt Ave. may be increased incrementally (i.e., no more than 1°F every 12 hours) to as high as 68°F. The priority for use of the lowest water temperature control shutters at Folsom Dam shall be to achieve the water temperature requirement for listed species (i.e., Steelhead), and thereafter may also be used to provide cold water for Fall-Run Chinook salmon spawning.

4.10.4.3 Conservation Measures Reclamation and DWR are proposing conservation measures to avoid and minimize or compensate for CVP and SWP project effects, including take, on the species under review in this biological assessment as well as contribute to the recovery and enhancement of species and their habitats. These conservation measures include non-flow actions that benefit listed species without impacting water supply or other beneficial uses. Actions could be implemented in part or fully through agreements and cost share with the State of California and potentially under the Voluntary Agreement alternative under the State Water Resources Control Board update to the Bay-Delta Water Quality Control Plan. […]

- Drought Temperature Management: In severe or worse droughts, Reclamation proposes to evaluate and implement alternative shutter configurations at Folsom Dam to allow temperature flexibility. […]

NMFS ITS:

13.3.3 American River Division Reclamation's proposed action in the American River Division will create stressors of water temperature and flow that is reasonably expected to result in take of CCV steelhead.

Surrogates are used for this Division because, as described in the Opinion, it is not practical to accurately quantify and monitor the amount of individuals that are expected to be taken due to the co-occurrence of non-listed steelhead from the Nimbus Hatchery Program in the American River. Surrogates may also be used due to the variability in the population size at any given time of exposure to the stressors of water temperatures outside of the optimal temperature range of the species, lack of quantification for what optimal water flow are for the species in the American River, the annual variations in the timing of various parts of the species' life cycle, and variation in how individual fish use habitat within the American River. Because of the causal relationship of flow magnitude, timing, duration, frequency, and rate of change to survival within and between life stages, flow can be used as a surrogate for the amount or extent of take for salmonids.

13.3.3.1 Take Anticipated from Water Temperature Effects Suboptimal water temperatures in the American River are expected to result in reduced survival during egg-to-fry life stage and reduced growth for the juvenile rearing and smolt emigration life stages for CCV steelhead as described in the Opinion.

The ecological surrogate to define the amount or extent of take in the American River is both the magnitude and frequency of suboptimal water temperature in the reach from Nimbus Dam to Watt Ave.

The CCV steelhead egg-to-fry life stage occurs December through May, and temperatures above 54°F create suboptimal conditions for this life stage. A small proportion of CCV steelhead eggs will still be in redds during May and potentially exposed to water temperatures that will reasonably be expected to result in egg mortality. The extent of take is all redds exposed to temperatures above 54°F in the vicinity of Watt Ave. December 1 through May 31. Take of CCV steelhead during the egg-to-fry life stage during these months is expected to be minimal because of the small proportion of eggs or alevins still incubating in the month of May.

CCV steelhead juveniles can survive and grow at water temperatures of 45 to 66°F. Reduced survival is anticipated at temperatures at or above 68°F. The ecological surrogate to define the amount or extent of take of CCV steelhead juvenile life stage is daily average temperature at Watt Ave. May 15 to October 31. The anticipated level of take will be exceeded if temperatures at Watt Ave. exceed 68°F from May 15 to October 31 for more than seven consecutive days unless it is a critical year based on the Sacramento Valley index or a year following one or more critical years[11]. In critical years, and years immediately after a critical year, anticipated level of take is exceeded if temperature exceeds 68°F at Hazel Avenue.

RPM 3: Reclamation shall minimize the impact of the amount or extent of incidental take of listed species during operations of the American Division.

1. Seasonal operational decisions that affect water temperature and river flows shall be coordinated through the American River Group.

III. DELIVERABLES

Deliverables resulting from this effort follow the coordination described in Appendix C of the Proposed Action and include ARG meeting notes and handouts that include a monthly summary of the hydrologic, operational, and temperature data related to Folsom cold water pool management; and draft/final Temperature Management Plans. A sample ARG monthly meeting agenda (BOX 1) is attached that describes the expected meeting topics and contents for the meeting notes. Section IV herein describes the processes to achieve the deliverables:

IV. PROCESS

Reclamation will convene and facilitate ARG monthly meetings or more frequently, as needed, to include:

- meeting scheduling and coordination,
- agenda development and distribution,
- coordinate preparation of monthly meeting handout materials,

[11] In a critical year, or year following critical year, Reclamation will meet with NMFS, FWS, CDFW, and the SWRCB to discuss and determine the best use of the limited cold water pool for that year.

- take notes, and
- posting notes and reports (including annual reports) online

A. American River Group

Reclamation established a working group to coordinate fishery and operational requirements for the lower American River (LAR), known as the American River Group (ARG), in 1996. Reclamation is the lead coordinator of the ARG, bringing together those who have either a legislated or resources-specific interest in the operation of Folsom Dam and Reservoir, and the LAR. The formal members include agencies with responsibilities for fisheries resources in the LAR: Reclamation, the U.S. Fish and Wildlife Service (USFWS), NMFS, CDFW, and Sacramento Area Water Forum (Water Forum). Members of the public and other agencies may attend ARG meetings and comment on matters under consideration by the ARG. The ARG convenes monthly or more frequently, if needed, to discuss water operations, fisheries, and other environmental concerns and to share operational and biological information with the goal of improving the technical understanding of LAR temperature needs and operational constraints and considerations. Reclamation considers the provided information when making management decisions regarding temperatures and flows necessary to sustain fish resources in the LAR. In addition, the Flow Management Standard (FMS) and Spring pulse flow shaping are factors that may impact temperature management. FMS and Spring pulse flow shaping are acknowledged here and will be developed in separate guidance document.

The ARG will provide input on the draft Temperature Management Plan, which Reclamation will provide by May 15 of each year. Temperature Management Plans are to be developed with the best available decision making support tools, currently, currently ATSP and iCPMM models. The ARG will also provide input on monthly updates to the temperature management plan developed by Reclamation throughout the temperature management season. The general steps of this process are as follows:

1. Beginning with the May ARG meeting, Reclamation will provide the draft Temperature Management Plan (May) or updated Temperature Management Plans depending on conditions (June – October) along with other supporting monthly meeting materials.

2. At the ARG meeting, ARG will review available hydrologic and biological information along with the draft or updated Temperature Management Plans and provide feedback to Reclamation.

3. ARG Meeting notes will be generated, and a draft distributed to the ARG for review and comment before final notes are posted online along with pertinent meeting materials.

4. Reclamation will develop a Final Temperature Management Plan considering ARG feedback from the May ARG meeting or provided shortly after the meeting,

distribute to the ARG and make available to the Water Operations Management Team (WOMT).

B. Change Orders

Reclamation operators coordinate the daily operation of Folsom and Nimbus Dams. Changes to releases in LAR operations require at least 48 hours prior notice to any desired releases. However, under conditions of urgent need with appropriate coordination with ARG and the fisheries agencies, Reclamation may make release changes as quickly as real time changes. Reclamation intends to continue to provide change order information via email to the ARG.

C. Folsom Temperature Shutter Operations

Reclamation operators work with CCAO Reclamation staff to order changes in Folsom Temperature Shutter Configuration to control the blending of water of different temperatures to ensure certain temperature requirements in the LAR. Changes to the temperature shutter configuration typically require 3-5 days of planning. Temperature shutter operations will be dictated by the Temperature Management Plan and subsequent updates that have been reviewed and commented on by the ARG. In severe or worse droughts, Reclamation will evaluate and consider implementing alternative shutter configurations at Folsom Dam to allow temperature flexibility.

D. Water Operations Management Team

After the ARG provides input on the draft Temperature Management Plan, Reclamation will prepare the Final Temperature Management Plan in May and provide to WOMT and make notes available from the corresponding ARG monthly meetings (April and May). The Temperature Management Plan will be updated monthly, based on system conditions, and in this event, Reclamation will request feedback from ARG and provide any monthly plan updates to the WOMT and make notes available from the corresponding ARG meetings.

E. Updates to Guidance Document

In addition, it is expected that as this guidance is being implemented there will be necessary revisions to the document to provide further clarification and refinement. Reclamation and DWR, with technical assistance from the USFWS, NMFS, and CDFW, commit to reviewing this implementation guidance following each water year, at a minimum, to identify and incorporate any necessary revisions.

BOX 1: AMERICAN RIVER GROUP AGENDA

Date

Roster

Agency, Office, Name, Alternate(s)

Topics

1. Introductions
2. Presentation (if applicable)
3. Fisheries Update
    a. CDFW
    b. Cramer Fish Sciences
    c. PSMFC
4. Operations Forecast
    a. SMUD
    b. PCWA
    c. Central Valley Operations
5. Central Valley Operations
    a. Recap of Previous Month's Operations
    b. Temperature Management
    c. Exceedance Forecast
6. Discussion
7. Review Action Items
8. Next Meeting Scheduling

Materials

Attachment C - Water Year 2023 Temperature Management Plan for the Lower American River

Water Year 2023 Temperature Management Plan for the Lower American River

Bureau of Reclamation

June 29, 2023

The following Water Year (WY) 2023 Temperature Management Plan (TMP) for the Lower American River (LAR) has been developed according to the February 18, 2020, Record of Decision (ROD) on the Long-Term Operation of the Central Valley Project (CVP) and State Water Project (SWP). The ROD implements Alternative 1 (the Preferred Alternative) as described in the associated Environmental Impact Statement. Alternative 1 was the Proposed Action, consulted upon and analyzed in the Biological Opinions issued in October 2019 by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS).

WY 2023 began in a state of drought. The outlook changed remarkably with a series of storms beginning in December 2023 that led to a significant increase in releases for flood management from Folsom Reservoir in late December, and a "below normal" Sacramento Valley Index (SVI) Water-Year classification in January 2023. Releases dropped in early January and remained low until early March when they increased to roughly 33,000 cubic feet per second (cfs). End-of-March releases reached roughly 7,000 cfs and remained steady until the end of May, when releases reached approximately 16,000 cfs. The SVI Water-Year classification was "wet" in both April and May of 2023. Beginning May 30, releases have continued to decrease to roughly 4,000 cfs as of June 23.

On May 18, 2023, Reclamation and the American River Group (ARG) recommended to delay the release of the Draft LAR TMP until the end of June when additional modeling run results and temperature data from Reclamation would become available. This additional information allowed for a better-informed management of the temperature for the LAR. In the absence of a May 15, 2023, draft TMP for review and implementation, Reclamation committed to operating at a temperature limit not to exceed 65°F at Watt Avenue Bridge (Watt Avenue).

Exploratory modeling outputs that evaluated a range of temperature management scenarios were presented to ARG stakeholders on June 15, 2023. Key outputs included Reclamation's run using the iCPMM model (Figure 1) and Stantec's run (funded by the Water Forum) using the CE-QUAL-W2 model (Figure 2). June 2023 modeling results indicated that it is feasible for Reclamation's operations of Folsom to provide summer water temperatures between Hazel Avenue and Watt Avenue in the mid-60°F. This river reach supports year-round rearing of juvenile steelhead and fall holding and spawning of adult fall-run Chinook salmon and incubation of fall-run Chinook salmon eggs.

In the June 15 ARG meeting, the group expressed concerns about fall temperatures even with this year's robust cold-water pool, and NMFS expressed interest in considering a fall power bypass depending on updated conditions and water temperature projections later this summer. Historically, Watt Avenue water temperatures does not drop below 58°F until around the third week of November (Figure 3).An agreement was reached between Reclamation and the ARG to target warmer temperatures, between 66°F or 67°F at Watt Avenue, throughout the summer to increase the possibility of cold-water availability in the fall. On June 20, Reclamation received a message from NMFS supporting a 67°F target at Watt Avenue for the summer. This compromise would provide

better options for fall temperature management and would provide a buffer if the weather this summer trends warmer than WY 2014 weather data used in the modeling.

In conclusion, for WY 2023, Reclamation will operate to a summer temperature target of 67°F at Watt Avenue through the summer until November 1. Temperature management in the fall will be evaluated in August and September based on updated reservoir profile data. Reclamation will continue to review the hydrology and Folsom cold-water pool on a bi-weekly timeframe and update this TMP accordingly. LAR TMP updates will be shared with ARG to seek feedback from the group.

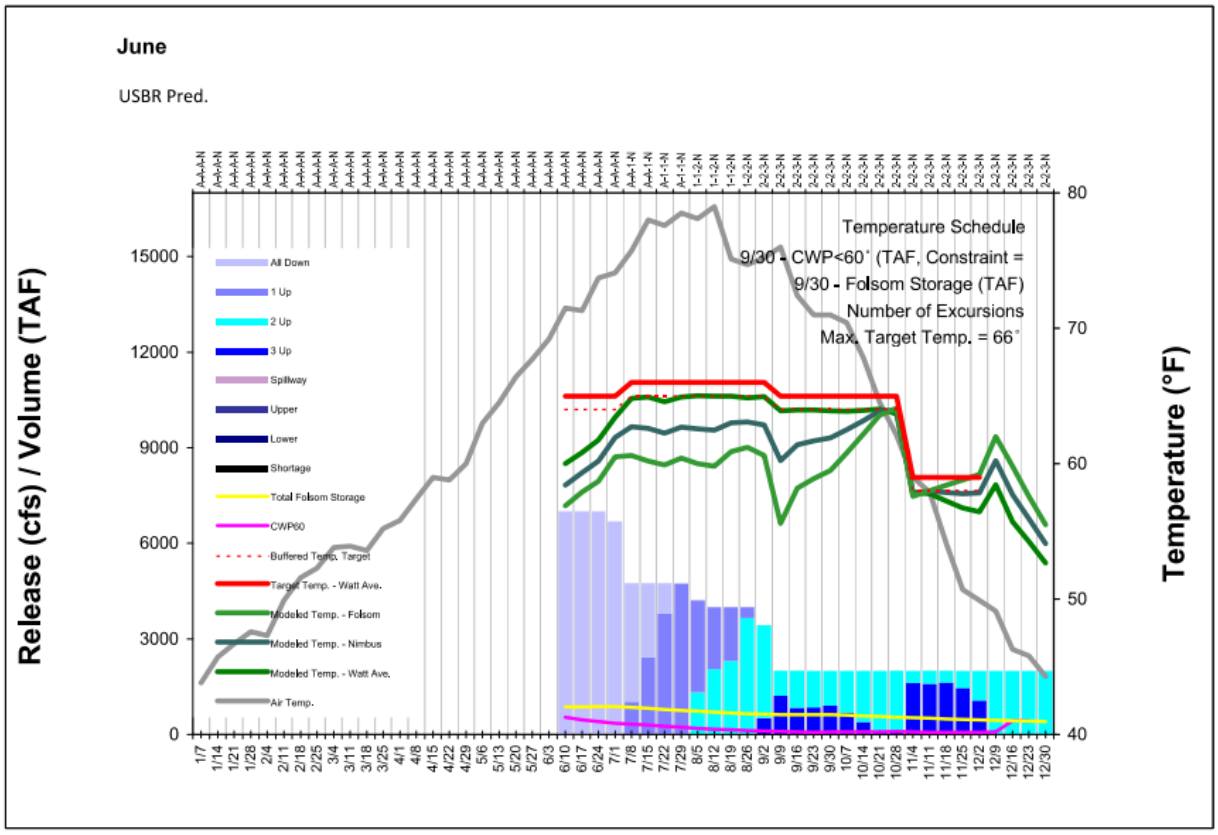

Figure 1: iCPMM run based on Schedule 22 of the Automated Temperature Schedule table.

Figure 1 is a line graph depicting the outputs of the iCPMM model run based on Schedule 22 of the automated Temperature Schedule Table. The graph shows the air temperature, modeled temperature at the Folsom and Nimbus dams and the Watt Avenue Bridge. The buffered temperature target, the target temperature at Watt Avenue Bridge, CWP60, and total Folsom Reservoir storage are also shown. Different operation configurations (all down, 1 up, 2 up, 3 up, spillway, upper, and lower) are shown in bars on the graph for early June to the end of December.

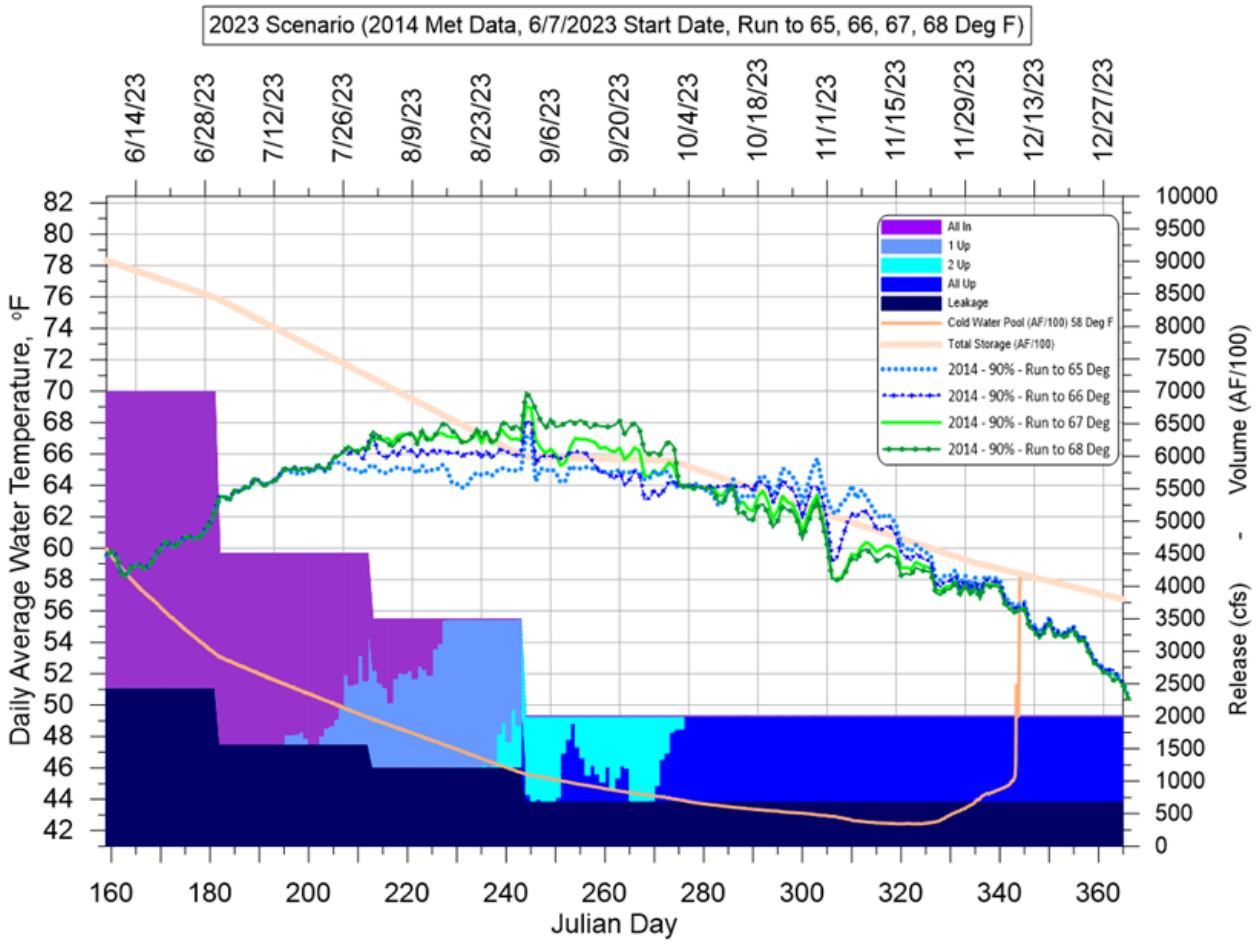

Figure 2: CE-QUAL-W2 model results targeting various summer water temperatures at Watt Avenue.

Figure 2 is a line and bar graph. It depicts CE-QUAL-W2 model results at Watt Avenue Bridge June 2023 to December 2023. Lines depict the cold water pool at 58 degrees Fahrenheit, total storage, and model runs based on 2014 Met data for 65, 66, 67, and 68 degrees Fahrenheit. Different operation configurations (all down, 1 up, 2 up, 3 up, spillway, upper, and lower) are shown in bars on the graph.

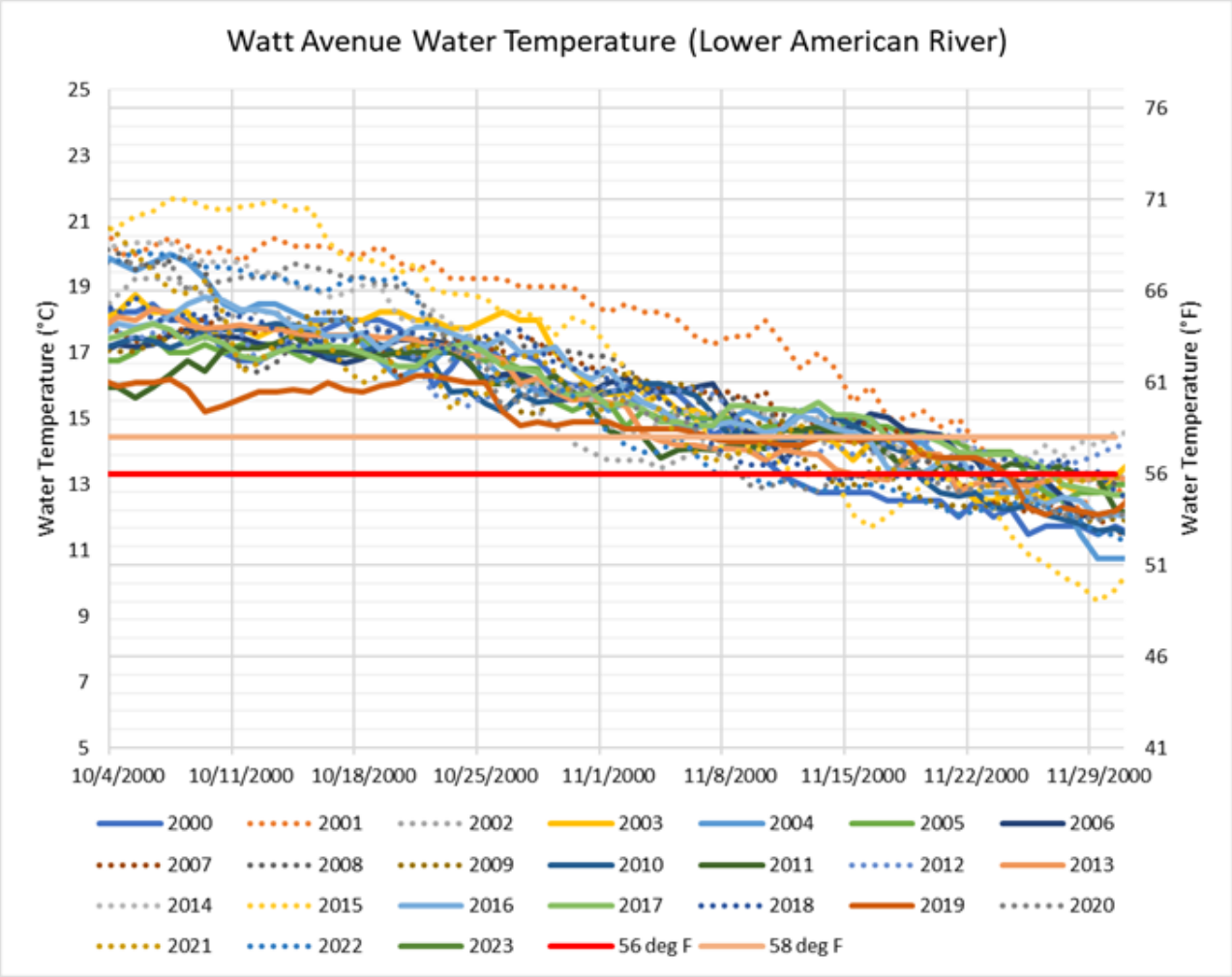

Figure 3: Historical water temperatures at Watt Avenue in October and November, with reference lines for 56°F and 58°F.

Figure 3 is a line graph. It depicts water temperature at Watt Avenue Bridge October to November for 2000 to 2023. Most years are above the 58 degrees Fahrenheit reference line until mid-November and go below the 56 degrees Fahrenheit reference line in late November.

Attachment D - Request for Power Bypass at Folsom Dam – September 29, 2023

Summary

The most recent temperature modeling and Chinook egg survival results were reviewed and discussed at the 9/28/23 ad-hoc ARG meeting. The temperature modeling shows that a 500 cfs Folsom power bypass results in cooler water temperature conditions in the Lower American River (see temperature modeling outputs in Attachments 1 and 2). Cooler water temperatures will (a) provide less stressful rearing conditions for California Central Valley steelhead juveniles, (b) improve holding conditions and reduce pre-spawn mortality for adult fall-run Chinook salmon, (c) reduce fall-run Chinook salmon egg mortality in October and much of November, and (d) improve conditions for operations at Nimbus Fish Hatchery. Details of the egg mortality modeling are provided below.

NMFS, FWS, and CDFW request that Reclamation begin a power bypass at Folsom Dam on October 30, 2023 at 150 cfs, ramping up to 300 cfs on October 31, 2023 and to 500 cfs on November 1, 2023. The fish agencies request that the 500 cfs power bypass be continued until

(a) daily average water temperature can be maintained below 56°F at both Hazel Avenue and Watt Avenue without a power bypass, or (b) reservoir conditions (due to depletion of the cold water pool or destratification) are such that the power bypass no longer provides cooler releases.

Scenarios Evaluated

The seven core scenarios evaluated were developed in coordination with the ARG at the ARG meeting on September 21, 2023, with results shared and discussed at the ad-hoc ARG meeting on September 28, 2023. All core scenario runs assumed 2014 meteorology (which does include a period of warmer air temperatures in early November) and releases from Folsom were assumed to be 2,500 cfs in October and November, and 2,000 cfs in December. Except for the explicit ramping scenario, the power bypasses in bypass scenarios were modeled as 500 cfs beginning October 30. The temperature model outputs for these seven core scenarios are provided in Attachment 1.

Also provided, for context, are results of the no bypass scenario modeled in July 2023, which allows comparison of the water temperature conditions (and associated egg survival) expected earlier this year. The temperature output of this model can be seen in the “Comparison to July Modeling” figures presented at the ad-hoc ARG meeting on September 7; full presentation included in Attachment 2.

Table 1. Evaluated Scenarios at the ARG meeting in September 2023.

Scenario	No Bypass	Bypass
67° F to Nov 1	67toNov1_NoBypass	67toNov1_Bypass

Scenario	No Bypass	Bypass
64° F on Oct 1	64onOct1_NoBypass	64onOct1_Bypass
64° F on Oct 16	64onOct16_NoBypass	64onOct16_Bypass
64° F on Oct 16, with ramped bypass	Not modeled	64onOct16_RampedBypass
For context: Corrected July scenario	JulyExpectation_NoBypass	Not modeled

The egg mortality outputs for all eight scenarios are summarized in this document; the full set of data results is available upon request.

Egg Survival Results Overview

Three different models (SALMOD, Water Forum 2020, and Martin 2016) were used to model, for each scenario, cohort-level egg survival (total survival of eggs over the entire season; Table 2) and daily-level egg survival (Table 3 and Figure 3). The estimated increase in cohort-level egg survival for the bypass vs. no bypass scenarios ranged from approximately 3% to 5%, depending on the specific scenario (Table 2). At the daily level, for early-season redds, the anticipated increase in through-season egg survival (based on SALMOD results) can be as high as 20%. For example, the pink highlighted cells in Table 3 show, for redds spawned on October 23 a through- season survival of 37% in the No Bypass scenario compared to 57% in the Bypass scenario.

These early-season benefits are especially important in supporting life history diversity by extending the window of (at least partially) successful spawning. One benefit of diversity in spawn timing is that it results in diversity of fry emergence and thus likely in outmigration timing. Notably, providing suitable conditions for some earlier spawning and egg incubation means that some part of the annual cohort of fall-run Chinook salmon will mature soon enough to migrate out to the ocean early in the spring while conditions (for example, higher flows, lower water temperatures) are more likely to support outmigration success. Fry emerging from redds spawned later may encounter less suitable conditions during their outmigration.

It is important to note these egg survival results do not account for temperature induced pre- spawn mortality of adults, pre-spawn reduction in egg viability, or delay in sexual maturation and onset of spawning, and thus underestimate total impacts to spawning success due to elevated water temperature. The thermal requirements for Chinook salmon in the Central Valley have been evaluated in a few thermal physiological studies. In a report to the California State Water Resource Control Board, Rich (1997) reported that thermal stress for migrating adult salmon had been reported at temperatures beginning at 59° F, and lethal temperatures began at 62.6° F.

Egg Survival Modeling Assumptions:

The SacPAS website includes an “Egg Growth Model” tool (Egg Growth Tool) that allows the user to apply a variety of egg mortality and emergence timing models to historical (or user-defined) water temperature and spawning data to estimate outputs such as timing to hatch, emergence, and overall egg-to-fry mortality. The survival functions available (with default parameters) are summarized in Figure 1.

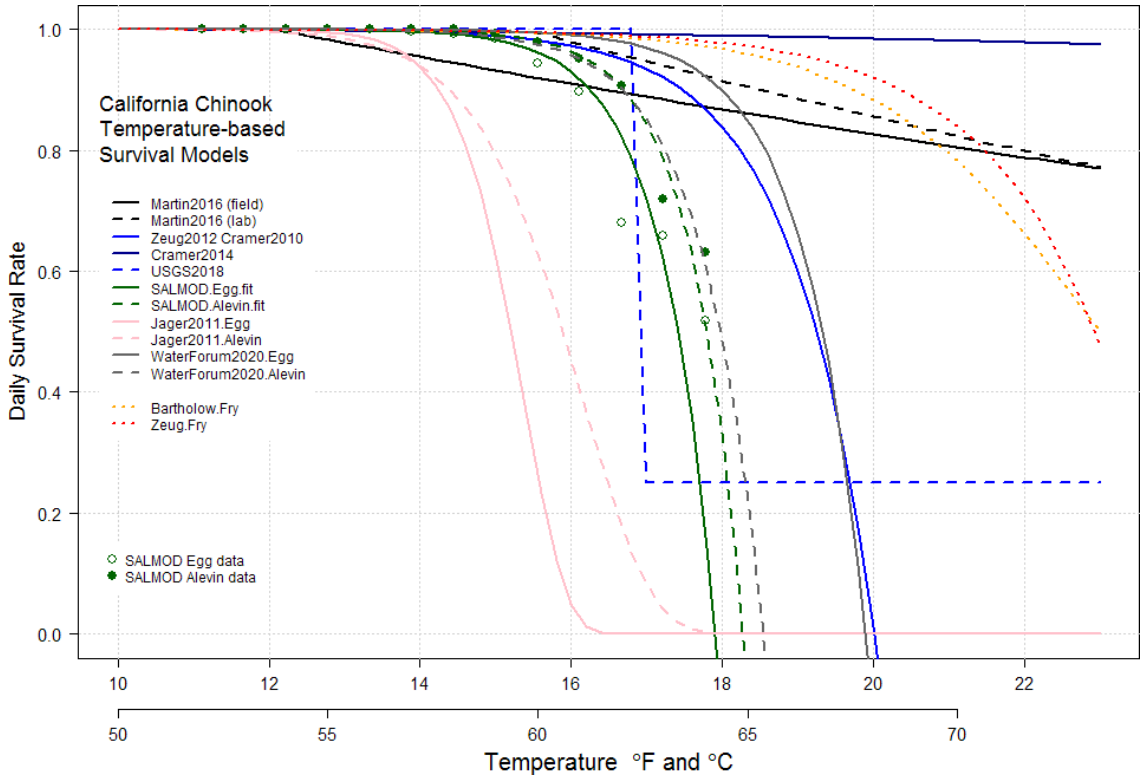

Figure 1: Temperature-dependent survival models available for use in the SacPAS Egg Growth Model tool. Each curve shows daily survival rate as a function of water temperature. Figure downloaded from http://www.cbr.washington.edu/sacramento/grow/ on September 24, 2021.

Figure 1 is a line graph. It depicts temperature-based modeled daily survival rate for the Martin 2016 field and lab, Zeug20120 Cramer2010, Cramer 2014, USGS 2018, SALMOD.Egg.fit, SALMOD.Alevin.fit, Jager2011.Egg, Jager2011.Alevin, WaterForum2020.Egg, WaterForum2020.Alevin, Bartholow.Fry, and Zeug.Fry models.

Several methods were used to estimate the expected egg-to-fry survival under the eight scenarios, as summarized in Table 1. The water temperature modeling was done by Stantec using a CE-QUAL-W2 model for Folsom, a CE-QUAL-W2 model for Lake Natoma, and regression- based estimates for water temperatures below Nimbus dam. Before being used as the water temperature inputs to the egg mortality model, the outputs from the CE-QUAL-W2 modeling were modified in two ways. First, the date range of the water temperature files was extended from the modeled end date of December 30 (Julian day 364) through the end of April (Julian day 485) to allow the estimation of egg mortality through emergence of all redds. Second, water temperatures were set to a steady 56° F once modeled water temperatures fell consistently below 56° F; this occurred:

- 67toNov1_NoBypass (Julian day 343=December 9)
- 67toNov1_Bypass (Julian day 346=December 12)
- 64onOct1_NoBypass (Julian day 344=December 10)
- 64onOct1_Bypass (Julian day 346=December 12)

- 64onOct16_NoBypass (Julian day 344=December 10)
- 64onOct16_Bypass (Julian day 346=December 12)
- 64onOct16_RampedBypass (Julian day 346=December 12)

This approach is consistent with the proposal to implement a power bypass only until a target temperature of 56°F at Hazel Avenue Bridge can be achieved and sustained without power bypass, or the power bypass no longer provides water temperature benefits. When the temperature achieved is lower than the proposed temperature, power bypass will be gradually reduced to a level that allows us to maintain temperatures at the proposed level. While actual late fall and winter water temperatures may be cooler than 56□F (which might affect emergence timing and mortality), the egg-to-fry survival estimates from the modified temperature datasets are comparable across scenarios, since all scenarios make this simplifying assumption.

The spawning data used for the egg growth model was from Brood Years 2014, 2015, and 2016. A multi-year selection is an option in the SacPAS tool that was chosen to get a more generalized spawn-timing distribution by including multiple years. The specific years of 2014, 2015, and 2016 were chosen as representative years from the recent drought period. When multiple years of spawning data are selected, the SacPAS Egg Growth Model tool implements the selection by creating a "super-cohort" time series that, for each date, has a carcass count (offset to 12 days earlier to represent the date eggs were laid in a redd) that is the sum of the carcasses observed on that date across all selected years. This summation approach results in better coverage of dates during October, when carcasses (and offset redd numbers) in any single year are relatively sparse. The summation approach does mean that the number of redds, eggs, and juveniles in the output data should be disregarded (because they are not representative of single-year abundance), but the egg-to-fry survival estimates that are the focus of this evaluation are still relevant and unaffected by the summation approach.

Next, egg-to-fry survival estimates were generated using the SacPAS Egg Growth Model tool, with inputs described in Table 1.

Table 2. Description of runs using the SacPAS Egg Growth Model tool. All options for user defined values were left at default settings except that "Smooth redd or carcass values" was selected in the "Analysis and Results Display" box; temperature data was specified "Celsius", and Celsius-based parameters were selected. Three sets of results are provided for each scenario – one for each of the temperature-dependent mortality models used.

Data	Options and Input Data
Temperature Data	Water temperature dataset for each scenario (through "Upload File" option)
Spawning Data	American River Fall Chinook carcasses in 2014, 2015, and 2016 (spawned females; smoothed)
Mortality models (temperature)	Exponential: Water Forum 2020 Exponential: SALMOD 2006, USBR 2008, HCI 1996 Linear: Martin 2016
Mortality model (density)	No density dependence
Egg Development model	Chinook linear

Results for cohort-level egg-to-fry survival from the SacPAS Egg Growth Model tool are summarized in Table 2, for all 24 runs (eight scenarios, each run using three mortality models). These results summarize egg-to-fry survival for all redds in a season, including those spawned after mid- December by which point a common temperature of 56°F is assumed for all incubating eggs.

Table 3. Cohort-level Egg-to-fry survival (%) from the SacPAS Egg Growth Model tool.

Scenarios	Bypass Status	Water Forum 2020	SALMOD 2006, USBR 2008, HCI 1996	Martin 2016
67 to Nov 1	No Bypass	87.54	72.27	7.11
67 to Nov 1	Bypass (difference from No Bypass scenario)	88.11 (+0.57)	75.51 (+3.24)	6.92 (-0.19)
64 on Oct 16	No Bypass	87.75	72.11	7.08
64 on Oct 16	Bypass (difference from No Bypass scenario)	88.26 (+0.51)	75.52 (+3.41)	6.88 (-0.2)
64 on Oct 16	Ramped Bypass (difference from No Bypass scenario)	88.50 (+0.75)	76.30 (+4.19)	7.00 (-0.08)
64 on Oct 1	No Bypass	86.85	67.92	6.74
64 on Oct 1	Bypass (difference from No Bypass scenario)	87.93 (+1.08)	72.58 (+4.66)	6.53 (-0.21)
July Expectation	No Bypass	87.45	69.80	6.65
July Expectation	Bypass: (difference from No Bypass scenario)	Not modeled	Not modeled	Not modeled

Daily-level egg-to-fry survival results (survival through emergence for eggs spawned on a particular day) are summarized in Figure 2, and Table 3. The SALMOD model appears to be the most sensitive to the temperature differences modeled; those outputs represent the greatest differential between scenarios and are the basis for the comparisons below.

- Eggs spawned during in the second half of October (orange-highlighted cells in Table 3) experience the greatest egg-to-fry survival increases between the No Bypass and Bypass scenarios, which is due to the improved conditions during November that those eggs experience.
- In the first half of November (green-highlighted cells in Table 3), egg-to-fry survival still benefits from the power bypass early in the month, but to a lesser extent. Through-season survival is comparable across scenarios by the first week of November.
- By early December (yellow-highlighted cells in Table 3), egg-to-fry survival converges at 92% across all scenarios.

- The largest differences in egg-to-fry survival are observed for early-season redds. While these early-season redds represent a small portion of overall egg production for the brood year, they are important in providing life-history diversity.
- While few eggs are spawned in the second half of October, temperatures at that time of year could also affect pre-spawn mortality and or the viability of eggs in vivo (but those impacts are not evaluated by the SacPAS egg models).

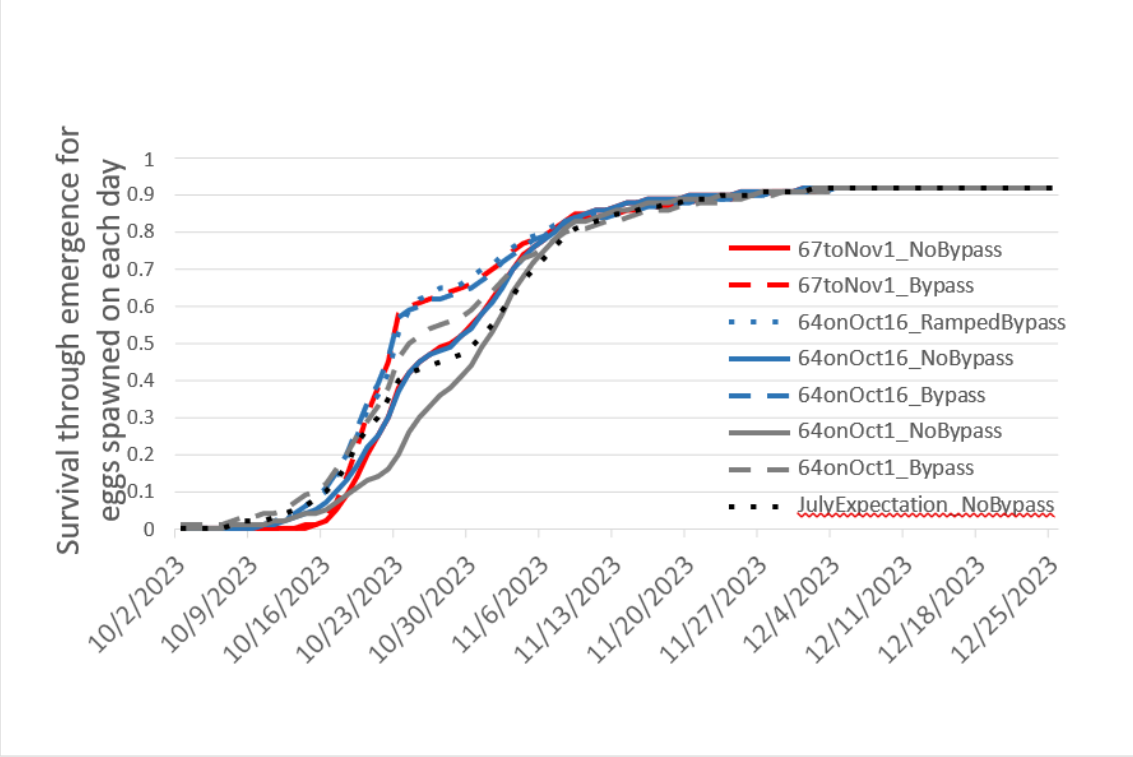

Figure 2: Estimated overall egg-to-fry survival for eggs spawned from early October to late November from the SacPAS results. These data are the same as in Table 3.

Figure 2 is a line graph. It depicts estimated survival through emergence from eggs spawned on each day for October 2023 to November for different configurations of bypass (bypass or no bypass), temperature (64 and 67 degrees Fahrenheit), and dates of passage (October 1 and 16 and November 1). The graph also depicts the expectation of survival in July with no bypass.

Table 4: Estimated overall egg-to-fry survival for eggs spawned from early October to late November from the SacPAS results. Bypass scenarios are italicized.

Date	Spawn Day	67 to Nov 1- No Bypass Survival	67 to Nov 1- Bypass Survival	64 on Oct 16 RAMPED Bypass	64 on Oct 16 No Bypass Survival	64 on Oct 16 Bypass Survival	64 on Oct 1 No Bypass Survival	64 on Oct 1 Bypass Survival	July Expectation No Bypass Survival
10/2/2023	275	0	0	0	0	0	0	0.01	0
10/3/2023	276	0	0	0	0	0	0	0.01	0
10/4/2023	277	0	0	0	0	0	0	0.01	0
10/5/2023	278	0	0	0	0	0	0	0.01	0
10/6/2023	279	0	0	0	0	0	0	0.01	0
10/7/2023	286	0	0	0	0	0	0.01	0.02	0.01
10/8/2023	287	0	0	0	0	0	0.01	0.03	0.02
10/9/2023	288	0	0	0	0	0	0.01	0.03	0.02
10/10/2023	289	0	0	0.01	0.01	0.01	0.01	0.04	0.02
10/11/2023	290	0	0	0.02	0.01	0.02	0.02	0.04	0.03
10/12/2023	291	0	0	0.02	0.02	0.03	0.02	0.05	0.04
10/13/2023	292	0	0	0.04	0.03	0.04	0.03	0.07	0.05
10/14/2023	293	0	0.01	0.06	0.04	0.06	0.04	0.09	0.06
10/15/2023	294	0.01	0.01	0.08	0.05	0.08	0.04	0.1	0.08
10/16/2023	295	0.02	0.03	0.1	0.07	0.11	0.05	0.12	0.1
10/17/2023	296	0.05	0.07	0.14	0.1	0.15	0.07	0.16	0.13
10/18/2023	297	0.09	0.14	0.19	0.13	0.2	0.09	0.2	0.17
10/19/2023	298	0.14	0.22	0.25	0.17	0.27	0.11	0.25	0.23
10/20/2023	299	0.2	0.31	0.32	0.22	0.34	0.13	0.29	0.27
10/21/2023	300	0.25	0.38	0.36	0.25	0.39	0.14	0.33	0.3
10/22/2023	301	0.3	0.45	0.42	0.3	0.46	0.16	0.38	0.35
10/23/2023	302	0.38	0.58	0.53	0.37	0.57	0.2	0.46	0.4
10/24/2023	303	0.42	0.6	0.59	0.42	0.59	0.26	0.5	0.42
10/25/2023	304	0.45	0.61	0.62	0.45	0.6	0.3	0.52	0.43
10/26/2023	305	0.47	0.62	0.63	0.47	0.62	0.33	0.54	0.44
10/27/2023	306	0.49	0.63	0.65	0.48	0.62	0.36	0.55	0.45
10/28/2023	307	0.5	0.64	0.65	0.49	0.63	0.38	0.56	0.46
10/29/2023	308	0.52	0.65	0.66	0.52	0.64	0.41	0.57	0.47
10/30/2023	309	0.55	0.66	0.68	0.54	0.65	0.44	0.59	0.49
10/31/2023	310	0.58	0.68	0.7	0.58	0.67	0.49	0.62	0.52
11/1/2023	311	0.62	0.7	0.71	0.61	0.69	0.53	0.64	0.55
11/2/2023	312	0.66	0.72	0.74	0.65	0.72	0.58	0.67	0.59
11/3/2023	313	0.7	0.75	0.76	0.7	0.74	0.64	0.7	0.63
11/4/2023	314	0.74	0.77	0.78	0.73	0.76	0.68	0.73	0.67
11/5/2023	315	0.76	0.78	0.79	0.76	0.78	0.72	0.74	0.7
11/6/2023	316	0.78	0.79	0.8	0.78	0.79	0.75	0.76	0.73
11/7/2023	317	0.81	0.81	0.82	0.8	0.81	0.78	0.78	0.76
11/8/2023	318	0.83	0.82	0.83	0.83	0.82	0.81	0.8	0.79
11/9/2023	319	0.85	0.83	0.84	0.84	0.83	0.83	0.81	0.81
11/10/2023	320	0.85	0.84	0.85	0.85	0.84	0.83	0.81	0.82

Date	Spawn Day	67 to Nov 1- No Bypass Survival	67 to Nov 1- Bypass Survival	64 on Oct 16 RAMPED Bypass	64 on Oct 16 No Bypass Survival	64 on Oct 16 Bypass Survival	64 on Oct 1 No Bypass Survival	64 on Oct 1 Bypass Survival	July Expectation No Bypass Survival
11/11/2023	321	0.86	0.84	0.85	0.86	0.84	0.84	0.82	0.83
11/12/2023	322	0.86	0.85	0.85	0.86	0.84	0.85	0.83	0.84
11/13/2023	323	0.87	0.85	0.86	0.87	0.85	0.86	0.83	0.85
11/14/2023	324	0.88	0.86	0.86	0.88	0.86	0.86	0.84	0.85
11/15/2023	325	0.88	0.86	0.87	0.88	0.86	0.87	0.85	0.86
11/16/2023	326	0.89	0.87	0.87	0.89	0.87	0.88	0.86	0.87
11/17/2023	327	0.89	0.87	0.88	0.89	0.87	0.88	0.86	0.87
11/18/2023	328	0.89	0.87	0.88	0.89	0.87	0.88	0.86	0.88
11/19/2023	329	0.89	0.88	0.88	0.89	0.88	0.89	0.87	0.88
11/20/2023	330	0.9	0.88	0.88	0.9	0.88	0.89	0.87	0.89
11/21/2203	331	0.9	0.89	0.89	0.9	0.89	0.89	0.88	0.89
11/22/2023	332	0.9	0.89	0.89	0.9	0.89	0.89	0.88	0.89
11/23/2023	333	0.9	0.89	0.89	0.9	0.89	0.9	0.88	0.9
11/24/2023	334	0.9	0.89	0.89	0.9	0.89	0.9	0.89	0.9
11/25/2023	335	0.91	0.9	0.9	0.91	0.9	0.9	0.89	0.9
11/26/2023	336	0.91	0.9	0.9	0.91	0.9	0.9	0.9	0.9
11/27/2023	337	0.91	0.9	0.9	0.91	0.9	0.91	0.9	0.91
11/28/2023	338	0.91	0.91	0.91	0.91	0.91	0.91	0.9	0.91
11/29/2023	339	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
11/30/2023	340	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
12/1/2023	341	0.92	0.91	0.91	0.92	0.91	0.91	0.91	0.91
12/2/2023	342	0.92	0.91	0.91	0.92	0.91	0.92	0.91	0.92

Attachment 1: Temperature model outputs from Stantec (Scenarios developed at the September 21, 2023 ARG meeting)

Folsom Temperature Modeling

Ad-hoc ARG Meeting

9/28/2023

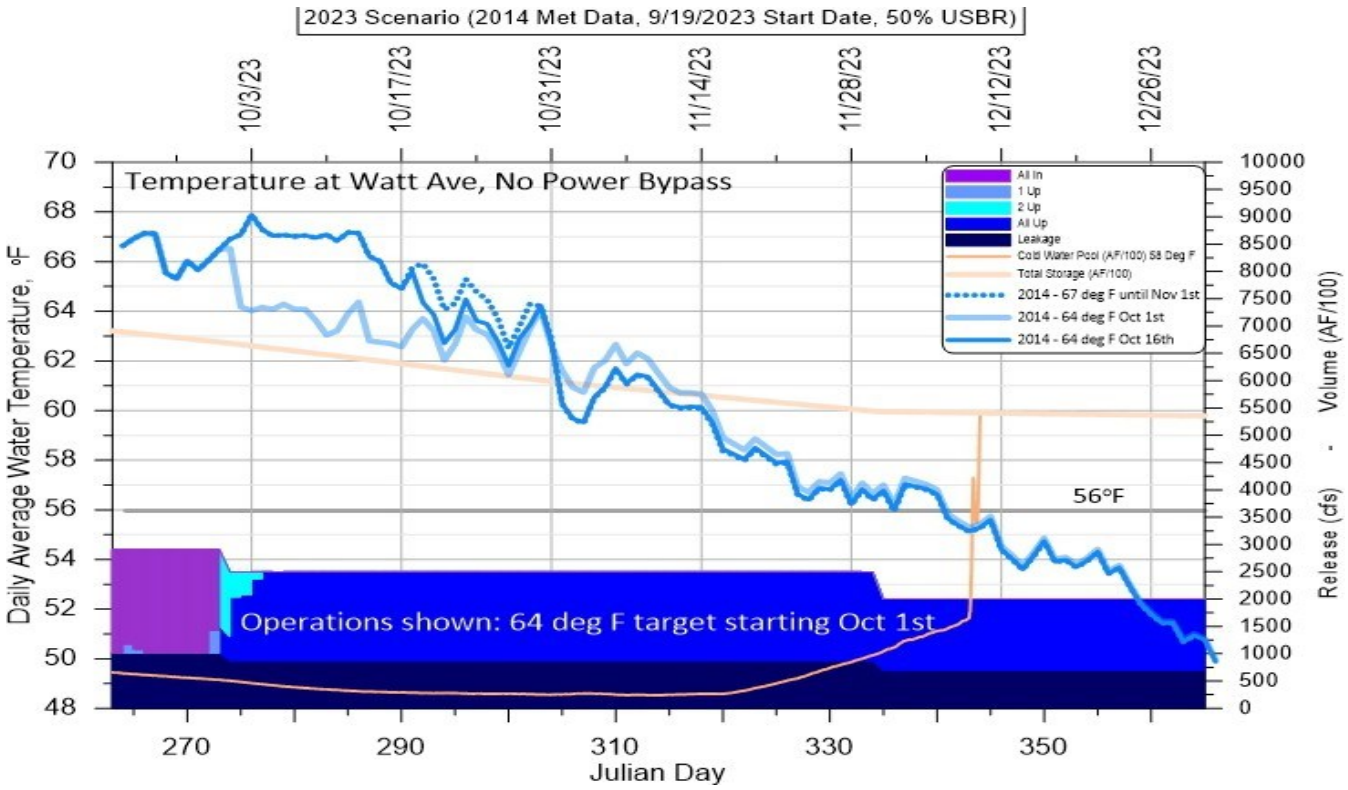

Figure 1. October Temperature Scenarios – No Bypass

Figure 1 is a line graph. It shows different October temperature scenarios at Avenue Watt Bridge Avenue with Folsom Dam with no power bypass using 2014 Met Data. The cold water pool, total storage, and 67 degrees Fahrenheit in 2014 on October 1, 16, and until November 1. The release of all in, 1 up, 2 up, and all up and release due to leakage in different color shaded areas. Under the operating conditions the graph shows meeting the 64 degree Fahrenheit target starting October 1.

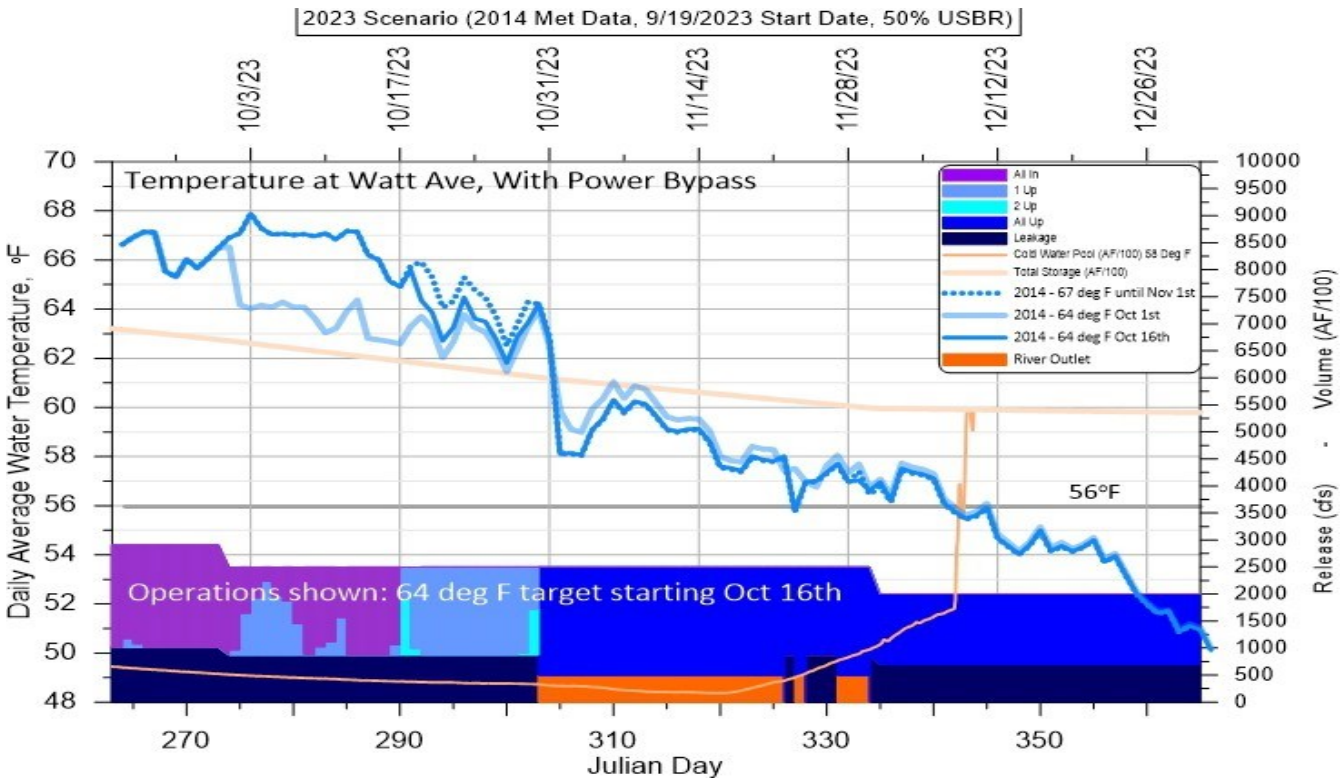

Figure 2. October Temperature Scenarios – With Bypass

Figure 2 is a line graph. It shows different October temperature scenarios at Avenue Watt Bridge Avenue with Folsom Dam with power bypass using 2014 Met Data. The cold water pool, total storage, and 67 degrees Fahrenheit in 2014 on October 1, 16, and until November 1. The release of all in, 1 up, 2 up, and all up and release due to leakage in different color shaded areas. Under the operating conditions the graph shows meeting the 64 degree Fahrenheit target starting October 16.

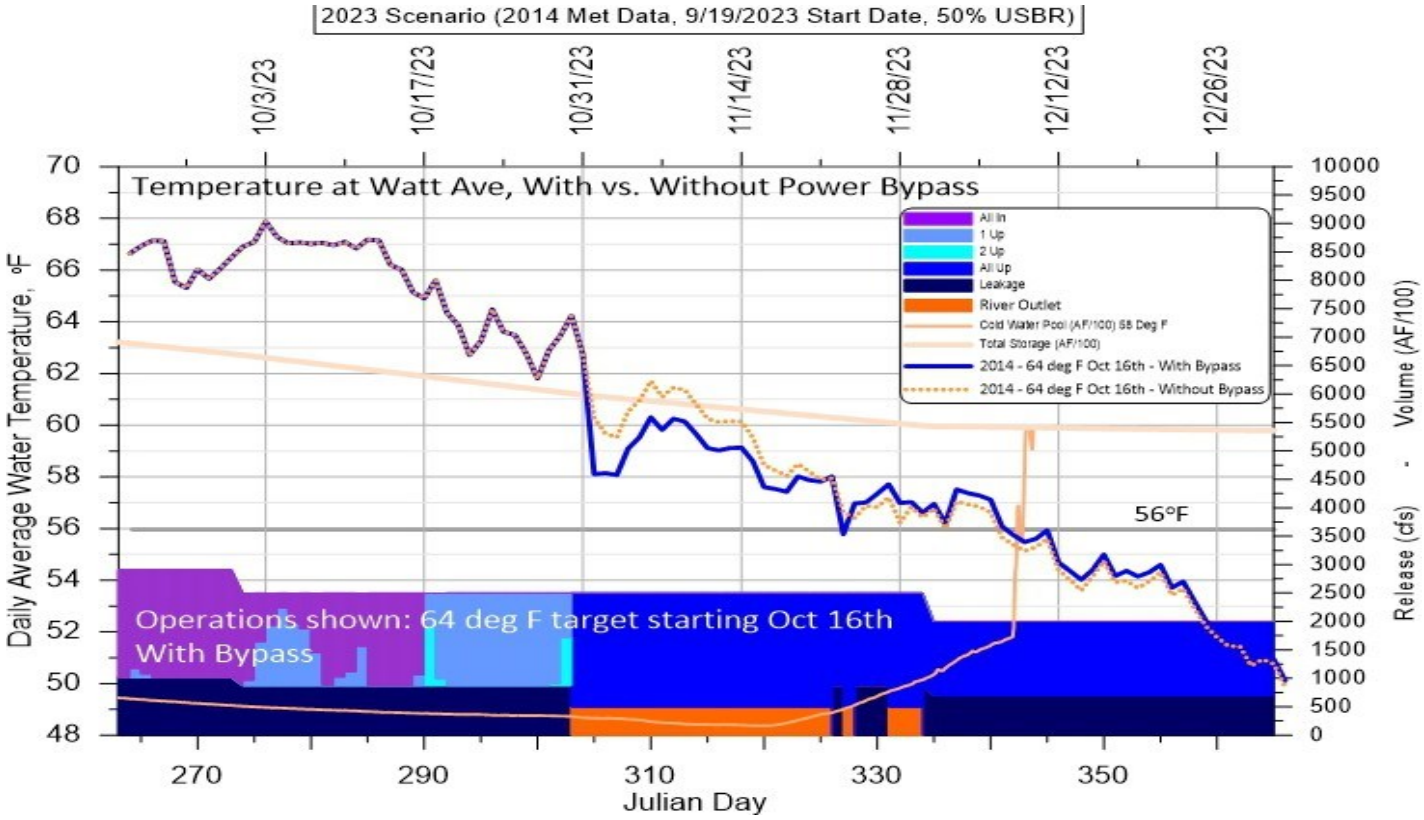

Figure 3. October temperature scenarios – With vs. Without Bypass

Figure 3 is a line graph. It shows different October temperature scenarios at Avenue Watt Bridge Avenue with Folsom Dam with and without a power bypass using 2014 Met Data. The cold water pool, total storage, and 67 degrees Fahrenheit in 2014 on October 1, 16, and until November 1. The release of all in, 1 up, 2 up, and all up and release due to leakage in different color shaded areas. Under the operating conditions the graph shows meeting the 64 degrees Fahrenheit target starting October 16 with power bypass.

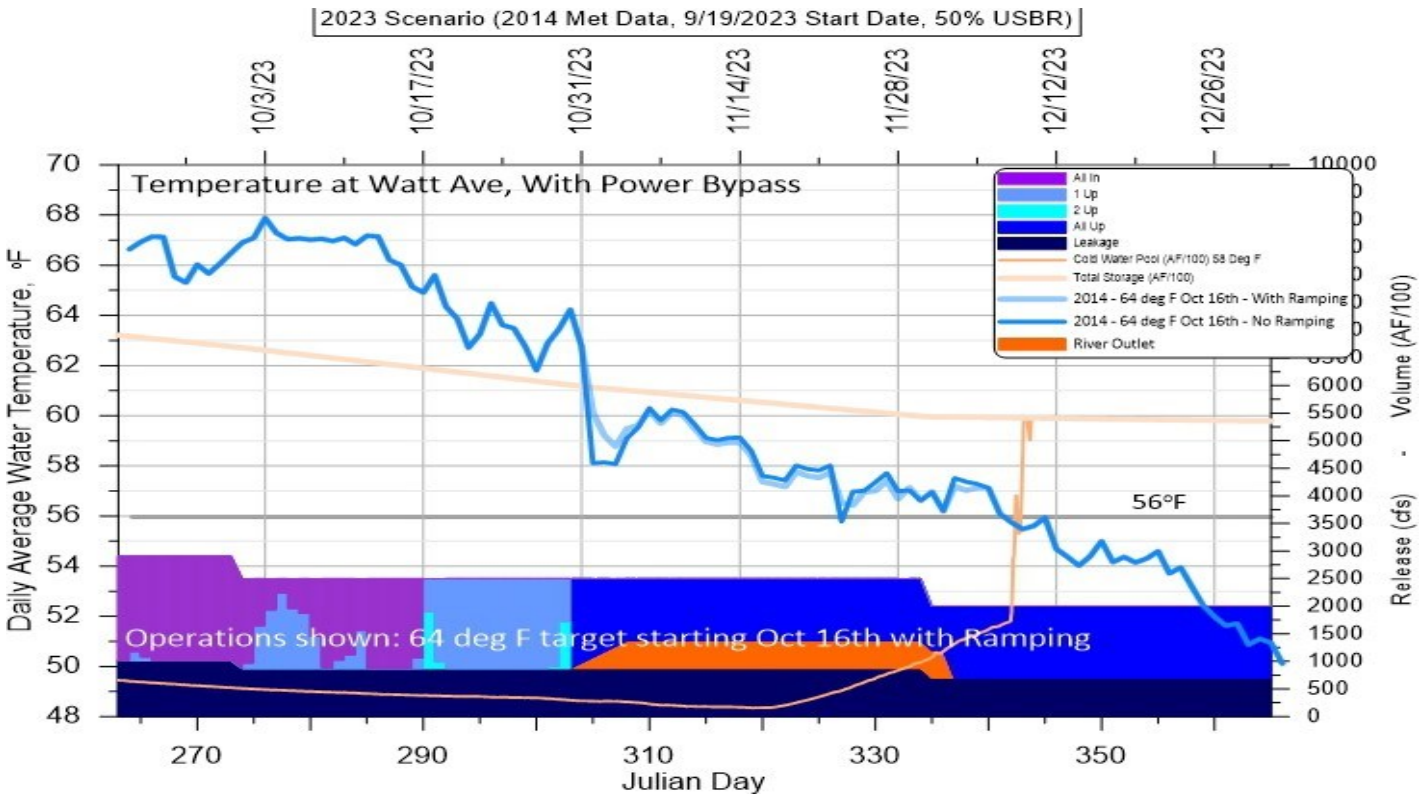

Figure 4. October temperature scenarios – Ramping vs. No Ramping Bypass

Figure 4 is a line graph. It compares different October temperature scenarios at Watt Avenue Bridge with and without ramping using 2014 Met Data. The cold water pool, total storage, and 67 degrees Fahrenheit in 2014 on October 16, with and without ramping is shown in different colored lines. The release of all in, 1 up, 2 up, and all up, release due to leakage in a bar graph, and river outlet is shown in different color shaded areas. Under the operating conditions the 64 degrees target is met starting October 16 with ramping.

Final Comments

- Changing target temperature to 64 deg F starting Oct 1st results in impacts to November temperatures (requires earlier shutter pulls), however changing target on Oct 16th has minimal impacts.
- Bypass results in a 2-degree temperature benefit at Watt Ave.
- Ramping impacts are not dramatic, might be mitigated by starting bypass flows earlier.

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Attachment 2: Temperature model outputs from Stantec (Scenarios presented at the September 7, 2023 ad-hoc ARG meeting)

Folsom Temperature Modeling

Ad-hoc ARG Meeting

9/7/2023

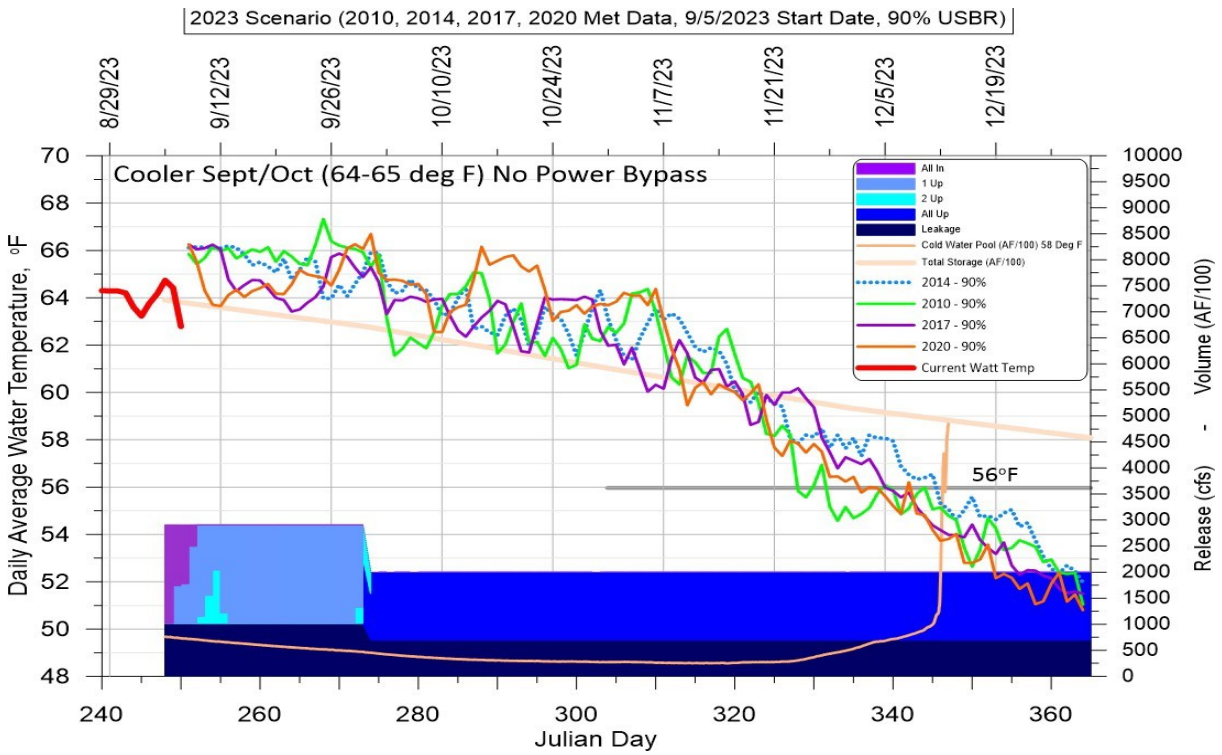

Figure 1. Various September to December temperature scenarios

Figure 1 is a line graph. It shows different temperature scenarios with a cooler September and October (64 to 65 degrees Fahrenheit) and no power bypass using 2010, 2014 2017, and 2020 Met Data. The cold water pool, total storage, current water temperature at Watt Avenue Bridge and 90% exceedances for 2010, 2014, 2017 and 2020. The release of all in, 1 up, 2 up, all up, and release due to leakage in a bar graph, and river outlet is shown in different color shaded areas.

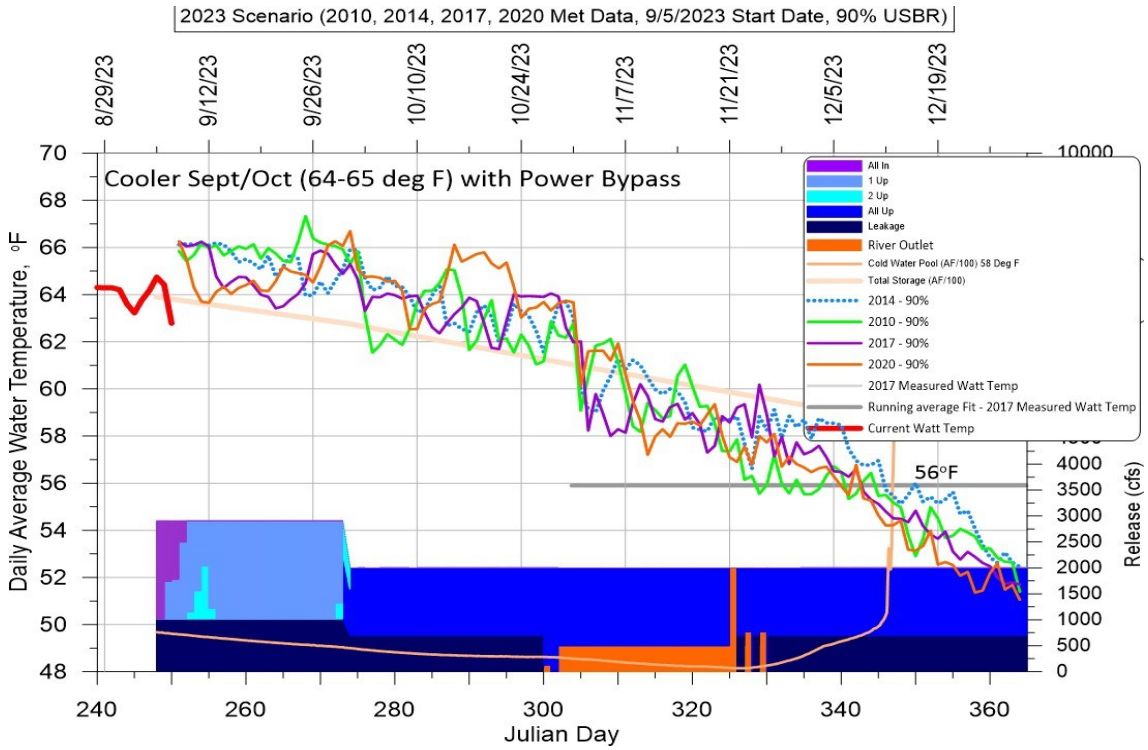

Figure 2. Various September to December temperature scenarios

Figure 2 is a line graph. It shows different temperature scenarios with a cooler September and October (64 to 65 degrees Fahrenheit) and a power bypass using 2010, 2014 2017, and 2020 Met Data. The cold water pool, total storage, current water temperature at Watt Avenue Bridge and 90% exceedances for 2010, 2014, 2017 and 2020. The release of all in, 1 up, 2 up, all up, and release due to leakage in a bar graph, and river outlet is shown in different color shaded areas.

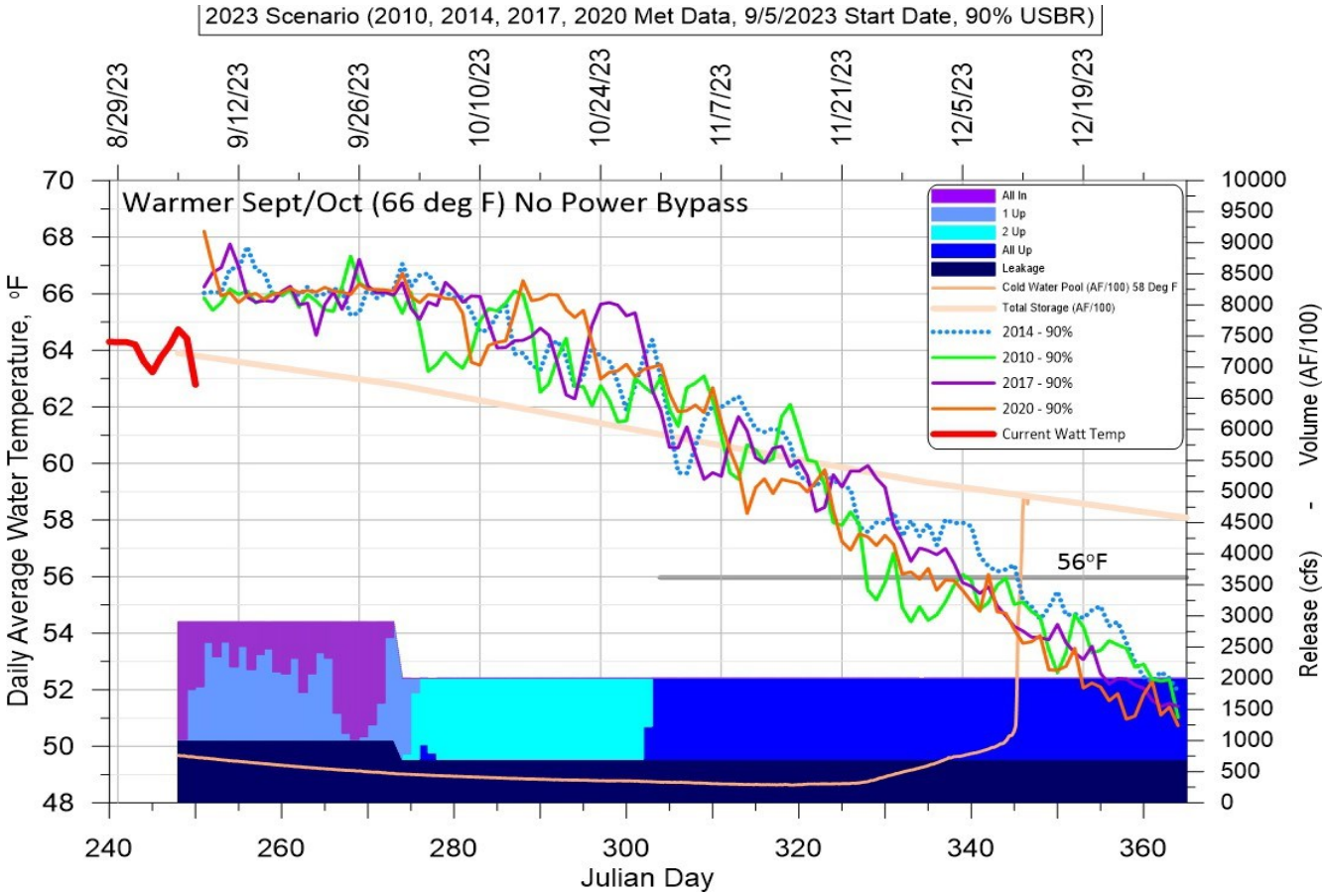

Figure 3 September to December temperature scenarios

Figure 3 is a line graph. It shows different temperature scenarios with a warmer September and October (66 degrees Fahrenheit) and no power bypass using 2010, 2014 2017, and 2020 Met Data. The cold water pool, total storage, current water temperature at Watt Avenue Bridge and 90% exceedances for 2010, 2014, 2017 and 2020. The release of all in, 1 up, 2 up, all up, and release due to leakage in a bar graph, and river outlet is shown in different color shaded areas.

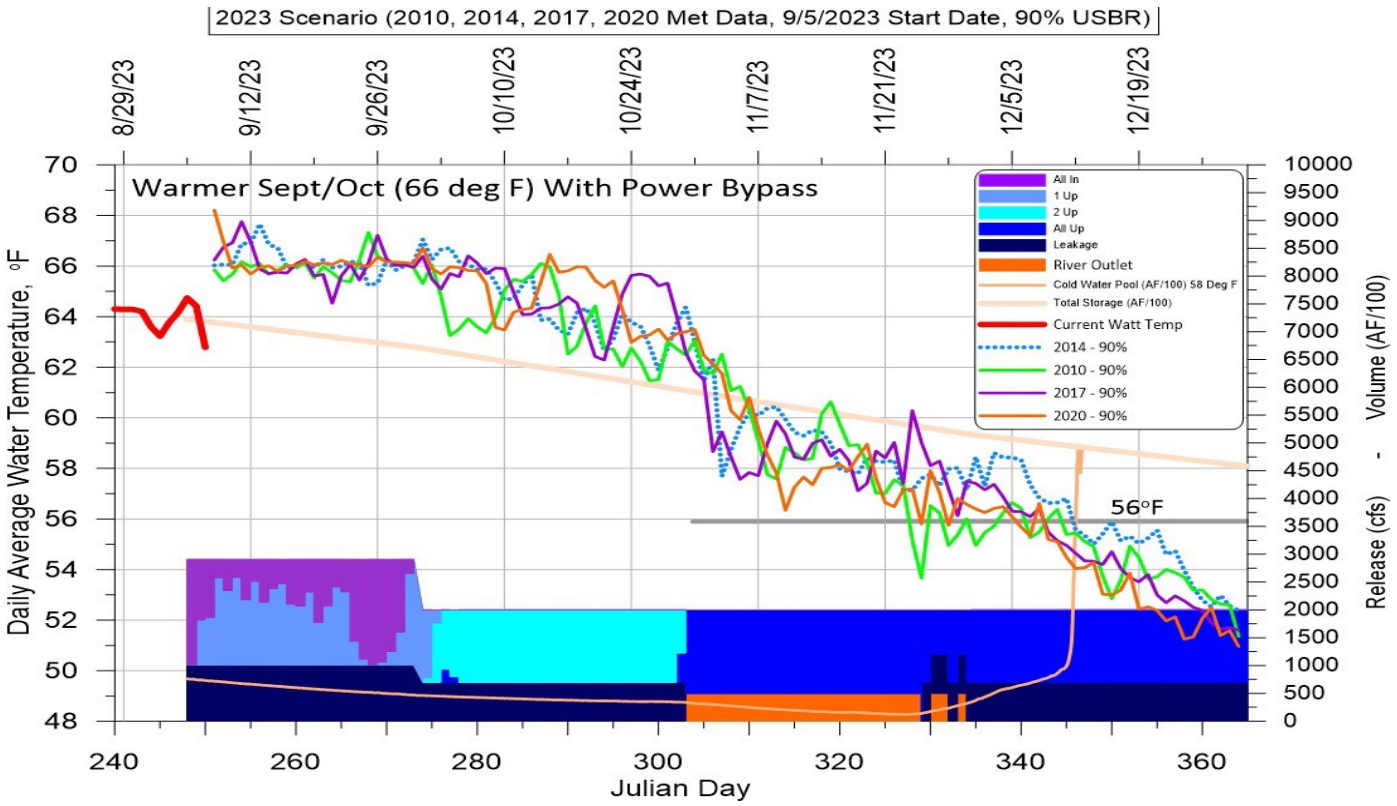

Figure 4. September to December temperature scenarios

Figure 4 is a line graph. It shows different temperature scenarios with a warmer September and October (66 degrees Fahrenheit) and a power bypass using 2010, 2014 2017, and 2020 Met Data. The cold water pool, total storage, current water temperature at Watt Avenue Bridge and 90% exceedances for 2010, 2014, 2017 and 2020. The release of all in, 1 up, 2 up, all up, and release due to leakage in a bar graph, and river outlet is shown in different color shaded areas.

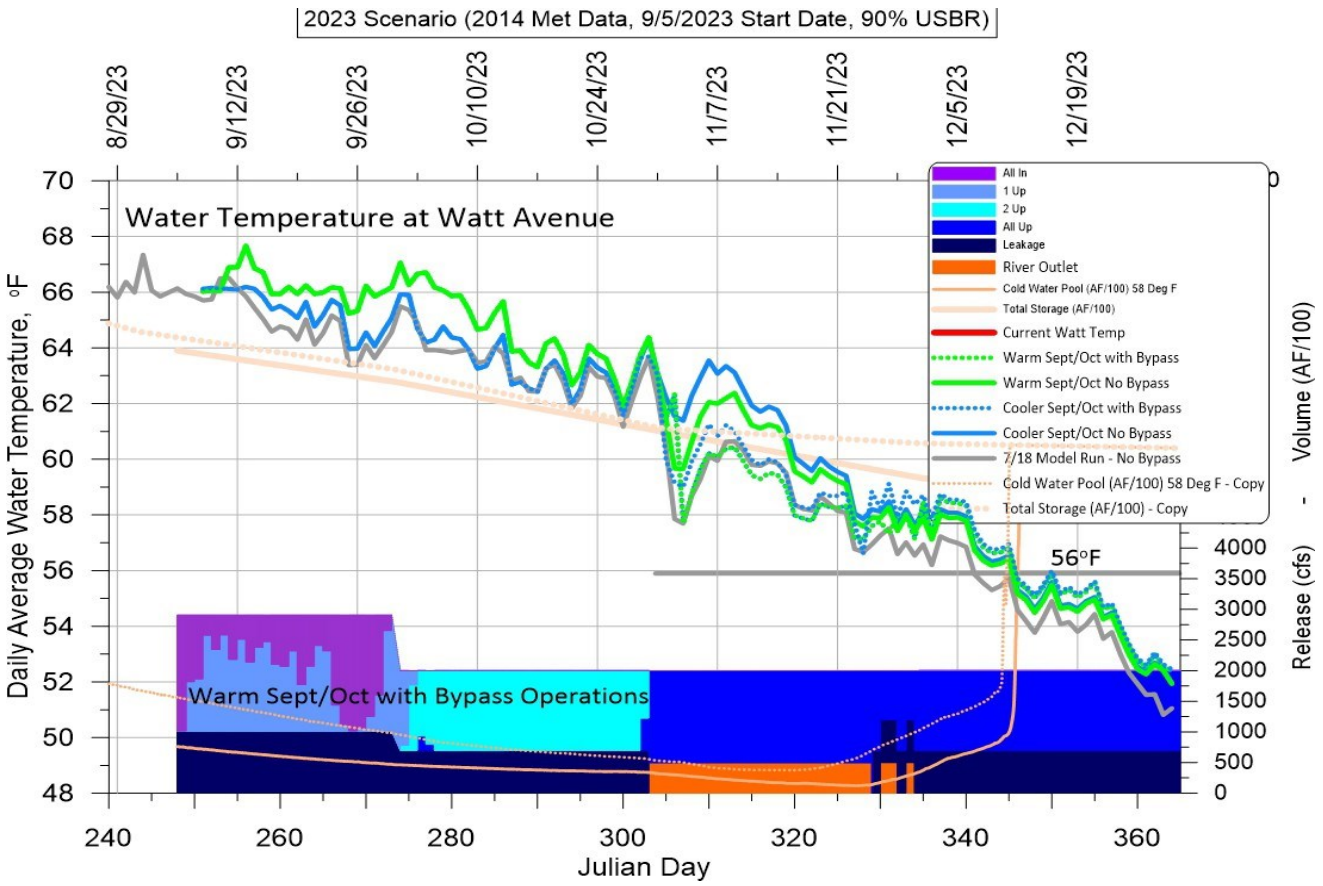

Figure 5. Cumulative September to December water temperature scenarios

Figure 5 is a line graph. It shows different temperature scenarios at Watt Avenue Bridge. using 2014 Met Data. The cold water pool, total storage, current water temperature at Watt Avenue Bridge and temperature with a warmer and cooler September and October and bypass and no bypass with different colored lines. The release of all in, 1 up, 2 up, all up, and release due to leakage in a bar graph, and river outlet is shown in different color shaded areas.

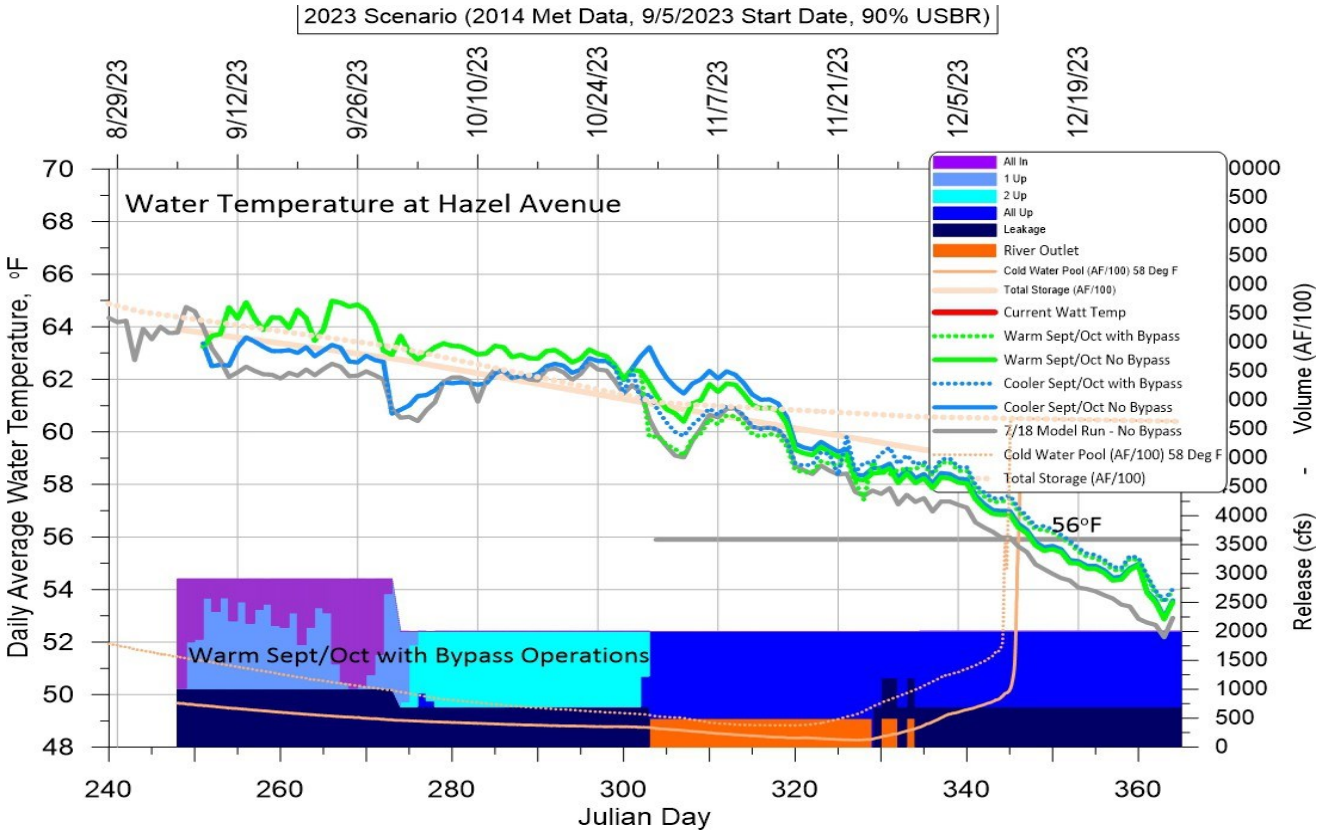

Figure 6. September to December cumulative temperature scenarios

Figure 6 is a line graph. It shows different temperature scenarios at Hazel Avenue Bridge. using 2014 Met Data. The cold water pool, total storage, current water temperature at Watt Avenue Bridge and temperature with a warmer and cooler September and October and bypass and no bypass with different colored lines. The release of all in, 1 up, 2 up, all up, and release due to leakage in a bar graph, and river outlet is shown in different color shaded areas.

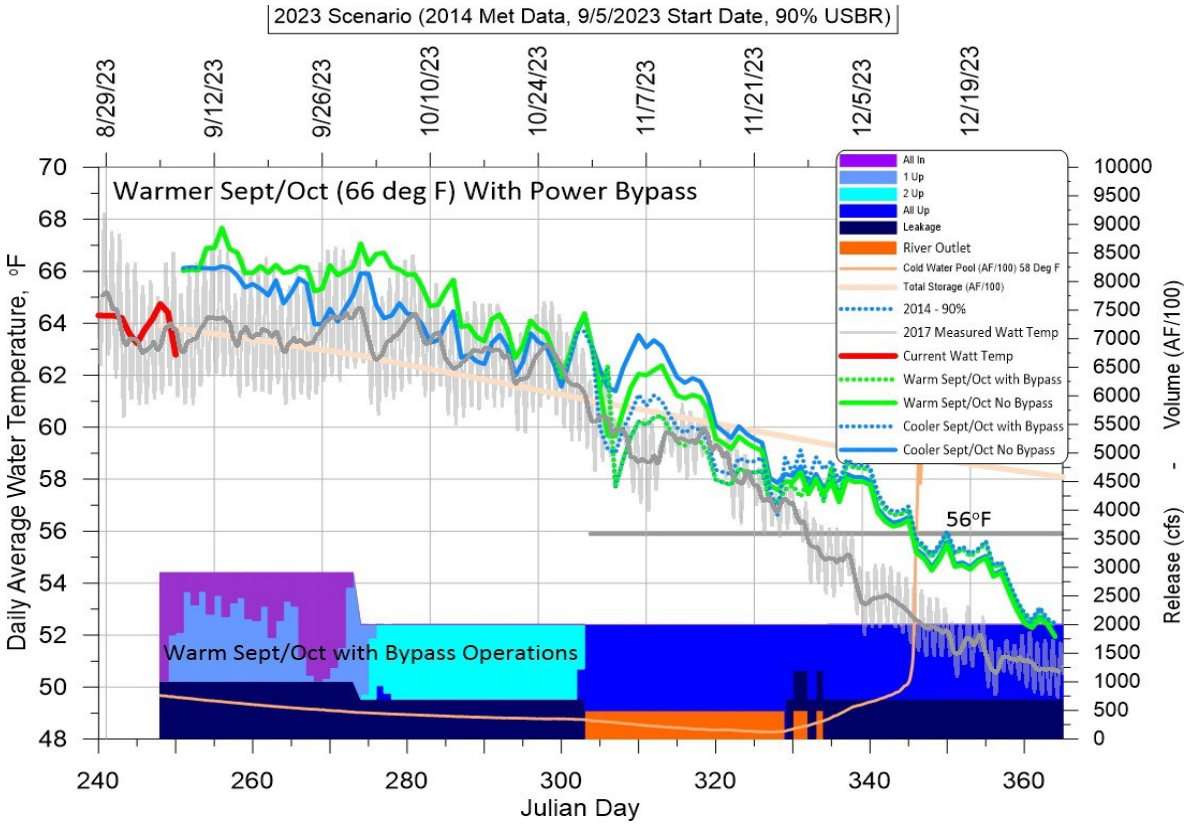

Figure 7. September to December temperature scenarios

Figure 7 is a line graph. It shows different temperature scenarios with a warmer September and October (66 degrees Fahrenheit) and a power bypass using 2010, 2014 2017, and 2020 Met Data. The cold water pool, total storage, current and measured 2017 water temperature at Watt Avenue Bridge, warmer and cooler September and October and bypass and no bypass with different colored lines. The release of all in, 1 up, 2 up, all up, and release due to leakage in a bar graph, and river outlet is shown in different color shaded areas.

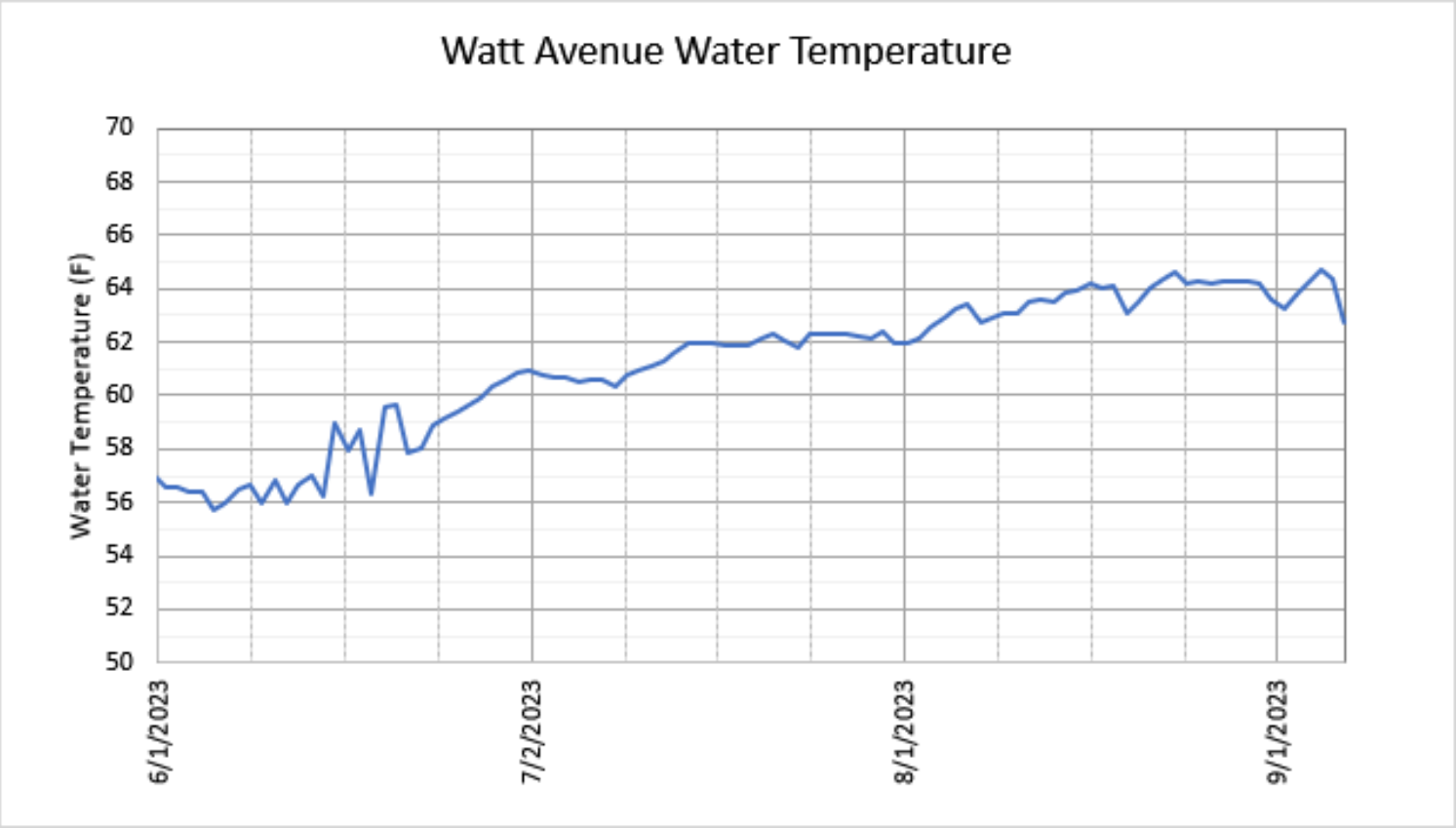

Figure 8. Watt Avenue Water Temperature.

Figure 8 is a line graph showing water temperature at Watt Avenue Bridge in degrees Fahrenheit June 1 to September 8, 2023.

Final Comments

- Shutter placement issue resulted in a cold-water pool loss of ~70 TAF (< 58 deg F) and that has significantly affected the future outlook.
- Watt Ave. water temperatures are currently 1.5-2 deg F cooler than the target (64 deg F vs. 66 deg F). Managing to 66 deg F going forward would conserve cold water and provide lower water temperatures later in the fall.
- If managing to 64 deg F in September and October there is very little chance 56 deg F can be achieved until early December, even with a power bypass.
- If managing to 66 deg F in September and October there is very little chance 56 deg F can be achieved until last week in November, even with a power bypass.
- A power bypass would partially (but not completely) mitigate for the shutter placement issue.